1

CANADIAN THESES ON MICROFICHE

I.S.B.N.

THESES CANADIENNES SUR MICROFICHE

National Library of Canada
Collections Development Branch

Canadian Theses on
Microfiche Service

Ottawa, Canada
K1A 0N4

Bibliothèque nationale du Canada
Direction du développement des collections

Service des thèses canadiennes
sur microfiche

NOTICE

The quality of this microfiche is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us a poor photocopy.

Previously copyrighted materials (journal articles, published tests, etc.) are not filmed.

Reproduction in full or in part of this film is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30. Please read the authorization forms which accompany this thesis.

THIS DISSERTATION
HAS BEEN MICROFILMED
EXACTLY AS RECEIVED

AVIS

La qualité de cette microfiche dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de mauvaise qualité.

Les documents qui font déjà l'objet d'un droit d'auteur (articles de revue, examens publiés, etc.) ne sont pas microfilmés.

La reproduction, même partielle, de ce microfilm est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30. Veuillez prendre connaissance des formules d'autorisation qui accompagnent cette thèse.

LA THÈSE A ÉTÉ
MICROFILMÉE TELLE QUE
NOUS L'AVONS REÇUE

National Library
of Canada

Canadian Theses
on Microfiche Service

Ottawa, Canada
K1A 0N4

Bibliothèque nationale
du Canada

Services des thèses canadiennes
sur microfiches

65768

0-315-17859-0

PERMISSION TO MICROFILM — AUTORISATION DE MICROFILMER

• Please print or type — Écrire en lettres moulées ou dactylographier

Full Name of Author — Nom complet de l'auteur

BORKENT, Art

Date of Birth — Date de naissance

July 1, 1953

Country of Birth — Lieu de naissance

Netherlands

Permanent Address — Résidence fixe

RR 3, Carp, Ontario, K0A 1L0

Title of Thesis — Titre de la thèse

The systematics and phylogeny of *Xestochironomus*, *Harrisus*
and *Holarctic and Neotropical Stenochironomus* (Diptera:
Chironomidae)

University — Université

Carleton

Degree for which thesis was presented — Grade pour lequel cette thèse fut présentée

Ph.D.

Year this degree conferred — Année d'obtention de ce grade

1982

Name of Supervisor — Nom du directeur de thèse

Dr. D.M. Wood (adjunct prof)

Permission is hereby granted to the NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

L'autorisation est, par la présente, accordée à la BIBLIOTHÈQUE NATIONALE DU CANADA de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur se réserve les autres droits de publication, ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans l'autorisation écrite de l'auteur.

Date

April 12/1984

Signature

A. Borkent

THE SYSTEMATICS AND PHYLOGENY OF XESTOCHIRONOMUS, HARRISIUS and
HOLARCTIC AND NEOTROPICAL STENOCHIRONOMUS (DIPTERA: CHIRONOMIDAE)

by

ART BORKENT, M.Sc.

A thesis submitted to the Faculty of
Graduate Studies and Research in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

Department of Biology
Carleton University
Ottawa, Ontario.

© September, 1982.

Thesis

Ph.D.

1982

B67

1123 5123 01 84

©1982 Art Borkent

The undersigned hereby recommend to the Faculty of
Graduate Studies and Research acceptance of this thesis, submitted by
Art Borkent, M.Sc., in partial fulfilment of the
requirements for the degree of Doctor of Philosophy.

Chairman, Department of Biology

Research Supervisor

Faculty Supervisor

External Examiner

Carleton University

September, 1982

Abstract

The Stenochironomus complex contains all those species which exhibit the highly modified, mining larval form previously recognized as typical of only the genus Stenochironomus: larvae with a dorsoventrally compressed head capsule, expanded thoracic segments and a long, flaccid abdomen. The complex contains members of Xestochironomus (New World), Harrisius (Australian Region), Stenochironomus (cosmopolitan) and two larval forms from New Zealand and Africa respectively.

This revision provides analysis of 12 species of Xestochironomus (5 new), 5 species of Harrisius, and 54 species of Neotropical and Holarctic Stenochironomus (32 new, named species, 2 new species not named, and 4 new combinations: S. innocuus (Williston), S. semifumosus (Edwards), S. longilobatus (Tokunaga) and S. gracilivalva (Kieffer)). Of these species, the pupae and fourth instar larvae are described for 2 species of Xestochironomus, Harrisius pallidus and 24 of the named species of Stenochironomus. Descriptions, diagnoses, keys and distribution maps are provided for all species in each available stage. S. taeniapennis, S. zonopterus and S. exquisitus are newly recognized as synonyms of S. hilaris.

A cladistic analysis of all these species suggests that the Stenochironomus complex is monophyletic. The African larval form is the sister group of all other members; Xestochironomus is the sister group of Harrisius, the New Zealand larval form, and Stenochironomus; and Stenochironomus is the sister group of Harrisius and the New Zealand larval form. These relationships suggest possible southern continental affinities. Stenochironomus is composed of two

monophyletic species groups, the subgenus Stenochironomus s. str. with species whose larvae mine wood and the new subgenus, Petalopholeus (type species, S. cinctus) with species whose larvae mine leaves.

Acknowledgments

This study was the result of three years of research. During that time numbers of people provided support and encouragement. Most of all I express my deep appreciation to my research supervisor, Dr. Monty Wood. He provided the freedom and financial assistance for the completion of this thesis. His combination of expertise, friendship and patience stimulated my curiosity, allowed me to investigate the intricacies of Stenochironomus systematics and markedly increased my understanding of Diptera in general.

I thank Dr. H.F. Howden for his support as my faculty supervisor and Drs. G.R. Carmody and S.B. Peck as committee members. Their criticisms and suggestions were appreciated.

This project was initiated under the direction of Dr. Don R. Oliver and I thank him for his efforts and discussions on chironomid taxonomy.

Most of my research was undertaken while in the Biosystematics Research Institute and I sincerely appreciate the support I received from the staff and for the use of various facilities.

My special thanks also goes to Dr. Don Lafontaine (of the BRI) who shared numerous discussions on the ins and outs of systematics. His clarity of thought influenced the course of this study.

I also express my thanks to members of the BRI-Wednesday-noon discussion group for stimulating discussions and arguments.

Ms. Louise Dumouche mounted most of the specimens examined for this study on microscope slides. Her cheerful enthusiasm and meticulous dissecting abilities are gratefully acknowledged.

I thank Mr. Ralph Idema for his masterful execution of many of

the illustrations and Mr. Barry Flahey for inking some of the drawings.

Dr. Douglas A. Craig allowed me to use the SEM facilities at the Dept. of Entomology, University of Alberta and I thank him for his generosity.

My appreciation also extends to all those curators who lent me specimens of Stenochironomus. The museums are listed in the section on materials and methods. In particular, Dr. N.H. Anderson (Oregon State University, Corvallis, Oregon) and Dr. J. Stark (University of Canterbury, N.Z.) made available specimens of all stages of Harrisius pallidus. Dr. A.D. Harrison (Waterloo University, Ontario) lent material of Stenochironomus and the African larval form. These specimens were critical to this study.

Ms. Colleen Jones and Pam Mitchell did a superb job typing the manuscript.

My deepest feelings are toward my wife Annette, who shared field trips, proofread much of the text and gave me the support to complete this last phase of my formal education. She gave me an abundance of friendship for which I am most grateful.

TABLE OF CONTENTS

	pg.
Introduction.	1
Materials and Methods:	
Specimens examined.	5
Collecting techniques	8
Rearing	13
Life cycle analysis	15
Preservation.	16
Dissection and examination.	17
Measurements and statistics	20
Terms for structures.	22
Illustrations	23
Criteria for species recognition.	24
Classification.	25
Description of the <u>Stenochironomus</u> complex	26
Key to genera of male adults.	31
Key to genera of female adults.	33
Key to genera of pupae.	35
Key to genera and forms of fourth instar larvae	38
African larval form.	42
<u>Xestochironomus</u> Sublette and Wirth	46
Key to male adults of <u>Xestochironomus</u>	53
Key to pupae of Nearctic <u>Xestochironomus</u> species.	56

Key to fourth instar larvae of Nearctic

<u>Xestochironomus</u> species.	56
<u>X. subletti</u> n. sp.	58
<u>X. bulbosus</u> n. sp.	62
<u>X. gilvus</u> n. sp.	65
<u>X. brunneus</u> n. sp.	67
<u>X. latilobus</u> n. sp.	71
<u>X. larval form one.</u>	74
<u>X. larval form two.</u>	75
New Zealand larval form	76
<u>Harrisius</u> Freeman	80
Key to male adults of <u>Harrisius</u>	83
<u>H. pallidus</u> Freeman	85
<u>Stenochironomus</u> Kieffer.	91
Key to adults of Nearctic <u>Stenochironomus</u>	
species	105
Key to adults of Palaearctic <u>Stenochironomus</u>	
species	112
Key to male adults of Neotropical	
<u>Stenochironomus</u> species	115
Key to pupae of Nearctic <u>Stenochironomus</u>	
species	
Preliminary key to pupae of Neotropical	
<u>Stenochironomus</u> species	125
Key to larvae of Nearctic <u>Stenochironomus</u>	
species	128
Preliminary key to fourth instar larvae of	
Neotropical <u>Stenochironomus</u> species	136

Subgenus: Stenochironomus s. str Kieffer,

new status.	140
<u>S. (S.) unictus</u> Townes.	142
<u>S. (S.) maculatus</u> n. sp.	149
<u>S. (S.) annettae</u> n. sp.	156
<u>S. (S.) crusanticus</u> n. sp.	163
<u>S. (S.) niger</u> n. sp.	169
<u>S. (S.) innocuus</u> (Williston).	176
<u>S. (S.)</u> n. sp. "Peru"	178
<u>S. (S.) bisetosus</u> n. sp.	183
<u>S. (S.) licinus</u> n. sp.	190
<u>S. (S.) fuscipatellus</u> n. sp.	193
<u>S. (S.) albipalpus</u> n. sp.	201
<u>S. (S.) hilaris</u> (Walker).	209
<u>S. (S.) macateei</u> (Malloch).	223
<u>S. (S.) recticaudatus</u> n. sp.	231
<u>S. (S.) pannus</u> n. sp.	233
<u>S. (S.) balteatus</u> n. sp.	236
<u>S. (S.) gibbus</u> (Fabricius).	240
<u>S. (S.)</u> n. sp. "Japan"	252
<u>S. (S.) satorui</u> (Tokunaga and Kuroda)	255
<u>S. (S.) colei</u> (Malloch)	260
<u>S. (S.) pulchripennis</u> (Coquillett).	268
<u>S. (S.) poecilopterus</u> (Mitchell)	275
<u>S. (S.) tectus</u> n. sp.	282
<u>Petalopholeus</u> new subgenus	287
<u>S. (P.) totifuscus</u> Sublette	289
<u>S. (P.) leptopus</u> (Kieffer).	296

<u>S. (P.) impendens</u> n. sp.	304
<u>S. (P.) townesi</u> n. sp.	307
<u>S. (P.) discus</u> n. sp.	310
<u>S. (P.) nelumbus</u> (Tokunaga and Kuroda).	313
<u>S. (P.) fascipennis</u> (Zetterstedt)	319
<u>S. (P.) larval form one</u>	326
<u>S. (P.) pupal form one</u>	329
<u>S. (P.) bacrionis</u> n. sp.	331
<u>S. (P.) pectinatus</u> n. sp.	337
<u>S. (P.) gladius</u> n. sp.	341
<u>S. (P.) fittkaui</u> n. sp.	346
<u>S. (P.) prolatus</u> n. sp.	349
<u>S. (P.) vatius</u> n. sp.	352
<u>S. (P.) albidorsalis</u> n. sp.	356
<u>S. (P.) triannulatus</u> n. sp.	360
<u>S. (P.) quadrinotatus</u> n. sp.	363
<u>S. (P.) jubatus</u> n. sp.	370
<u>S. (P.) nudipupa</u> n. sp.	374
<u>S. (P.) browni</u> Townes	379
<u>S. (P.) cinctus</u> Townes.	383
<u>S. (P.) aestivalis</u> Townes	393
Unassigned species of <u>Stenochironomus</u>	398
<u>S. hibernicus</u> (Edwards)	399
<u>S. koreanus</u> n. sp.	403
<u>S. zonarius</u> n. sp.	405
<u>S. semifumosus</u> (Edwards) n. comb.	408
<u>S. reissi</u> n. sp.	411
<u>S. aculeatus</u> n. sp.	414

<u>S. palliaculeatus</u> n. sp.	416
<u>S. varius</u> n. sp.	418
Previously unrecognized species of <u>Stenochironomus</u> from outside the Holarctic and Neotropical Regions	421
Nomen dubium.	422
Excluded species:	423
Phylogeny	426
Methods	426
Analysis	432
Cladistic Analysis of Basal Lineages Comprising the <u>Stenochironomus</u> Complex	434
Ambiguous Character States.	444
Discussion.	448
Cladistic Analysis of Species of <u>Xestochironomus</u>	449
Ambiguous Character States:	450
Discussion.	450
Cladistic Analysis of Species of <u>Stenochironomus</u>	451
Ambiguous Character States.	472
Discussion.	474
Autapomorphies of Species in the <u>Stenochironomus</u> Complex	476
Zoogeography.	479
Ecological Divergence	483
Conclusion and Suggestions For Future Research.	485
References.	488

List of Tables

	pg.
Table 1. Descriptive statistics for male adult <u>X. subletti</u> .	501
Table 2. Descriptive statistics for male adult <u>X. bulbosus</u> .	501
Table 3. Descriptive statistics for male adult <u>X. gilvus</u> .	501
Table 4. Descriptive statistics for male adult <u>X. brunneus</u> .	502
Table 5. Descriptive statistics for male adult <u>X. latilobus</u> .	502
Table 6. Descriptive statistics for male adult <u>S. unictus</u> .	502
Table 7. Descriptive statistics for male adult <u>S. maculatus</u> .	503
Table 8. Descriptive statistics for male adult <u>S. annettae</u> .	503
Table 9. Descriptive statistics for male adult <u>S. crusanticus</u>	503
Table 10. Descriptive statistics for male adult <u>S. niger</u> .	504
Table 11. Descriptive statistics for male adult <u>S. innocuus</u> .	504
Table 12. Descriptive statistics for male adult <u>S. bisetosus</u> .	504
Table 13. Descriptive statistics for male adult <u>S. licinus</u> .	505
Table 14. Descriptive statistics for male adult <u>S. fuscipatellus</u>	505
Table 15. Descriptive statistics for male adult <u>S. albipalpus</u> .	505
Table 16. Descriptive statistics for male adult <u>S. hilaris</u> .	506
Table 17. Descriptive statistics for male adult <u>S. macateei</u> .	506
Table 18. Descriptive statistics for male adult <u>S. recticaudatus</u>	506
Table 19. Descriptive statistics for male adult <u>S. pannus</u> .	507
Table 20. Descriptive statistics for male adult <u>S. balteatus</u> .	507
Table 21. Descriptive statistics for male adult <u>S. gibbus</u> .	507
Table 22. Descriptive statistics for male adult <u>S. satorui</u> .	508
Table 23. Descriptive statistics for male adult <u>S. cole</u> .	508

Table 24. Descriptive statistics for male adult	
<u>S. pulchripennis</u>	508
Table 25. Descriptive statistics for male adult.	
<u>S. poecilopterus</u>	509
Table 26. Descriptive statistics for male adult <u>S. tectus</u> . . .	509
Table 27. Descriptive statistics for male adult <u>S. totifuscus</u> . . .	509
Table 28. Descriptive statistics for male adult <u>S. leptopus</u> . . .	510
Table 29. Descriptive statistics for male adult <u>S. impendens</u> . . .	510
Table 30. Descriptive statistics for male adult <u>S. townesi</u> . . .	510
Table 31. Descriptive statistics for male adult <u>S. discus</u> . . .	511
Table 32. Descriptive statistics for male adult <u>S. nelumbus</u> . . .	511
Table 33. Descriptive statistics for male adult	
<u>S. fascipennis</u>	511
Table 34. Descriptive statistics for male adult <u>S. bacrionis</u> . . .	512
Table 35. Descriptive statistics for male adult <u>S. pectinatus</u> . . .	512
Table 36. Descriptive statistics for male adult <u>S. gladius</u> . . .	512
Table 37. Descriptive statistics for male adult <u>S. fittkaui</u> . . .	513
Table 38. Descriptive statistics for male adult <u>S. prolatus</u> . . .	513
Table 39. Descriptive statistics for male adult <u>S. vatius</u> . . .	513
Table 40. Descriptive statistics for male adult	
<u>S. albidorsalis</u>	514
Table 41. Descriptive statistics for male adult	
<u>S. triannulatus</u>	514
Table 42. Descriptive statistics for male adult	
<u>S. quadrinotatus</u>	514
Table 43. Descriptive statistics for male adult <u>S. jubatus</u> . . .	515
Table 44. Descriptive statistics for male adult <u>S. nudipupa</u> . . .	515
Table 45. Descriptive statistics for male adult <u>S. browni</u> . . .	515

Table 46.	Descriptive statistics for male adult <u>S. cinctus</u> . .	516
Table 47.	Descriptive statistics for male adult <u>S. aestivalis</u> .	516
Table 48.	Descriptive statistics for male adult <u>S. hibernicus</u> .	516
Table 49.	Descriptive statistics for male adult <u>S. koreanus</u> . .	517
Table 50.	Descriptive statistics for male adult <u>S. zonarius</u> . .	517
Table 51.	Descriptive statistics for male adult	
	<u>S. semifumosus</u>	517
Table 52.	Descriptive statistics for male adult <u>S. reissi</u> . .	518
Table 53.	Descriptive statistics for male adult <u>S. aculeatus</u> .	518
Table 54.	Descriptive statistics for male adult	
	<u>S. palliaculeatus</u>	518
Table 55.	Descriptive statistics for male adult <u>S. varius</u> . .	519
Table 56.	Descriptive statistics for female adult <u>X. subletti</u> .	519
Table 57.	Descriptive statistics for female adult <u>X. bulbosus</u> .	519
Table 58.	Descriptive statistics for female adult <u>X. brunneus</u> .	520
Table 59.	Descriptive statistics for female adult	
	<u>X. latilobus</u>	520
Table 60.	Descriptive statistics for female adult <u>H. pallidus</u> .	520
Table 61.	Descriptive statistics for female adult <u>S. unictus</u> .	521
Table 62.	Descriptive statistics for female adult	
	<u>S. maculatus</u>	521
Table 63.	Descriptive statistics for female adult <u>S. annettae</u> .	521
Table 64.	Descriptive statistics for female adult	
	<u>S. crusanticus</u>	522
Table 65.	Descriptive statistics for female adult <u>S. niger</u> . .	522
Table 66.	Descriptive statistics for female adult	
	<u>S. bisetosus</u>	522

Table 67. Descriptive statistics for female adult	
<u>S. fuscipatellus</u>	523
Table 68. Descriptive statistics for female adult	
<u>S. albipalpus</u>	523
Table 69. Descriptive statistics for female adult	<u>S. hilaris</u> . 523
Table 70. Descriptive statistics for female adult	<u>S. macateei</u> . 524
Table 71. Descriptive statistics for female adult	
<u>S. balteatus</u>	524
Table 72. Descriptive statistics for female adult	<u>S. gibbus</u> . 524
Table 73. Descriptive statistics for female adult	<u>S. satorui</u> . 525
Table 74. Descriptive statistics for female adult	<u>S. colei</u> . . 525
Table 75. Descriptive statistics for female adult	
<u>S. pulchripennis</u>	525
Table 76. Descriptive statistics for female adult	
<u>S. poecilopterus</u>	526
Table 77. Descriptive statistics for female adult	<u>S. tectus</u> . . 526
Table 78. Descriptive statistics for female adult	
<u>S. totifuscus</u>	526
Table 79. Descriptive statistics for female adult	<u>S. leptopus</u> . 527
Table 80. Descriptive statistics for female adult	<u>S. nelumbus</u> . 527
Table 81. Descriptive statistics for female adult	
<u>S. fascipennis</u>	527
Table 82. Descriptive statistics for female adult	
<u>S. quadrinotatus</u>	528
Table 83. Descriptive statistics for female adult	<u>S. jubatus</u> . 528
Table 84. Descriptive statistics for female adult	<u>S. nudipupa</u> . 528
Table 85. Descriptive statistics for female adult	<u>S. browni</u> . . 529
Table 86. Descriptive statistics for female adult	<u>S. cinctus</u> . 529

Table 87. Descriptive statistics for female adult	
<u>S. aestivalis</u>	529
Table 88. Descriptive statistics for length of pupal T II	
(in u)	530
Table 89. Descriptive statistics for pupal respiratory organ	
horn length/length of T II	531
Table 90. Descriptive statistics for pupal respiratory organ	
horn length/width	532
Table 91. Descriptive statistics for fourth instar larvae of	
African larval form.	533
Table 92. Descriptive statistics for fourth instar larvae of	
<u>X. subletti</u>	533
Table 93. Descriptive statistics for fourth instar larvae of	
<u>X. brunneus</u>	533
Table 94. Descriptive statistics for fourth instar larvae of	
<u>X. larval form one</u>	534
Table 95. Descriptive statistics for fourth instar larvae of	
<u>X. larval form two</u>	534
Table 96. Descriptive statistics for fourth instar larvae of	
New Zealand larval form	534
Table 97. Descriptive statistics for fourth instar larvae of	
<u>Harrisius pallidus</u>	535
Table 98. Descriptive statistics for fourth instar larvae of	
<u>S. unictus</u>	535
Table 99. Descriptive statistics for fourth instar larvae of	
<u>S. maculatus</u>	535
Table 100. Descriptive statistics for fourth instar larvae of	
<u>S. annettae</u>	536

Table 101. Descriptive statistics for fourth instar larvae of	
<u>S. crusanticus</u>	536
Table 102. Descriptive statistics for fourth instar larvae of	
<u>S. niger</u>	536
Table 103. Descriptive statistics for fourth instar larvae of	
<u>S. bisetosus</u>	537
Table 104. Descriptive statistics for fourth instar larvae of	
<u>S. n. sp. "Peru"</u>	537
Table 105. Descriptive statistics for fourth instar larvae of	
<u>S. fuscipatellus</u>	537
Table 106. Descriptive statistics for fourth instar larvae of	
<u>S. albipalpus</u>	538
Table 107. Descriptive statistics for fourth instar larvae of	
<u>S. hilaris</u>	538
Table 108. Descriptive statistics for fourth instar larvae of	
<u>S. macateei</u>	538
Table 109. Descriptive statistics for fourth instar larvae of	
<u>S. gibbus</u>	539
Table 110. Descriptive statistics for fourth instar larvae of	
<u>S. colei</u>	539
Table 111. Descriptive statistics for fourth instar larvae of	
<u>S. pulchripennis</u>	539
Table 112. Descriptive statistics for fourth instar larvae of	
<u>S. poecilopterus</u>	540
Table 113. Descriptive statistics for fourth instar larvae of	
<u>S. totifuscus</u>	540
Table 114. Descriptive statistics for fourth instar larvae of	
<u>S. leptopus</u>	540

Table 115. Descriptive statistics for fourth instar larvae of <u>S. nelumbus</u>	541
Table 116. Descriptive statistics for fourth instar larvae of <u>S. larval form one</u>	541
Table 117. Descriptive statistics for fourth instar larvae of <u>S. bacronis</u>	541
Table 118. Descriptive statistics for fourth instar larvae of <u>S. gladius</u>	542
Table 119. Descriptive statistics for fourth instar larvae of <u>S. quadrinotatus</u>	542
Table 120. Descriptive statistics for fourth instar larvae of <u>S. nudipupa</u>	542
Table 121. Descriptive statistics for fourth instar larvae of <u>S. cinctus</u>	543
Table 122. Descriptive statistics for fourth instar larvae of <u>S. aestivalis</u>	543
Table 123. Numbers of <u>Stenochironomus unictus</u> larvae collected from <u>Alnus</u> branches placed in Duncan Lk., Masham Twp., Quebec on 10-X-1979 . . .	543
Table 124. Numbers of <u>Stenochironomus cinctus</u> larvae and pupae collected from oak leaves in Duncan Lk., Masham Twp., Quebec	544
Table 125. Intraspecific variation of male adult <u>S. hilaris</u> . . .	545

List of Figures

pg.

Figure 1 A - L. Pigmentation of dorsum of thorax of adults:

- (A) X. brunneus; (B) X. latilobus; (C) S. maculatus;
 (D) S. annettae; (E) S. niger; (F) S. innocuus;
 (G) S. bisetosus; (H) S. licinus; (I) S.
fuscipatellus; (J) S. albipalpus; (K-L) S. hilaris. 546

Figure 2 A - L. Pigmentation of dorsum of thorax of adults:

- (A) S. pannus; (B) S. balteatus; (C) S. gibbus;
 (D) S. satorui; (E-F) S. colei; (G-H) S.
pulchripennis; (I-J) S. poecilopterus; (K) S. tectus;
 (L) S. totifuscus 548

Figure 3 A - L. Pigmentation of dorsum of thorax of adults:

- (A) S. leptopus; (B) S. impendens; (C) S. townesi;
 (D) S. discus; (E) S. fascipennis; (F) S. bacronis;
 (G) S. pectinatus; (H) S. gladius; (I) S. fittkaui;
 (J) S. triannulatus; (K) S. quadrinotatus;
 (L) S. jubatus 550

Figure 4 A - H. Pigmentation of dorsum of thorax of adults:

- (A) S. nudipupa; (B) S. browni; (C) S. cinctus;
 (D) S. aestivalis; (E) S. koreanus; (F) S. zonarius;
 (G) S. semifumosus; (H) S. aculeatus. 552

Figure 5 A - E. Pigmentation of adult thorax in lateral aspect:

- (A) X. brunneus; (B) X. latilobus; (C) S. maculatus;
 (D) S. annettae; (E) S. cruenticus 554

Figure 6 A - F. Pigmentation of adult thorax in lateral aspect:

- (A) S. niger; (B) S. innocuus; (C) S. bisetosus;
 (D) S. licinus; (E) S. fuscipatellus;

(F) S. albipalpus 556

Figure 7 A - F. Pigmentation of adult thorax in lateral aspect:

(A-B) S. hilaris; (C) S. pannus; (D) S. balteatus;

(E) S. gibbus; (F) S. satorui 558

Figure 8 A - F. Pigmentation of adult thorax in lateral aspect:

(A) S. colei; (B) S. pulchripennis; (C) S.

poecilopterus; (D) S. totifuscus; (E) S. leptopus;

(F) S. impendens. 560

Figure 9 A - F. Pigmentation of adult thorax in lateral aspect:

(A) S. townesi; (B) S. discus; (C) S. fascipennis;

(D) S. bacrionis; (E) S. pectinatus; (F) S. gladius 562

Figure 10 A - F. Pigmentation of adult thorax in lateral aspect:

(A) S. fittkaui; (B) S. albidorsalis; (C) S.

triannulatus; (D) S. quadrinotatus; (E) S. jubatus;

(F) S. nudipupa 564

Figure 11 A - F. Pigmentation of adult thorax in lateral aspect:

(A) S. browni; (B) S. cinctus; (C) S. aestivalis;

(D) S. hibernicus; (E) S. koreanus; (F) S. zonarius 566

Figure 12 A - C. Pigmentation of adult thorax in lateral aspect:

(A) S. semifumosus; (B) S. aculeatus; (C) S. varius 568

Figure 13 A - E. Shape of thorax in lateral aspect:

(A) S. prolatus; (B-E) Shape of scutum in lateral aspect:

(B) S. unictus; (C) S. cinctus; (D) S. hilaris;

(E) S. albipalpus 570

Figure 14 A - J. Pigmentation of wing:

(A) S. unictus male; (B) S. unictus female; (C) S.

maculatus; (D) S. annettae; (E) S. fuscipatellus;

(F) S. albipalpus; (G-H) S. hilaris; (I) S. pannus;

(J) S. balteatus. 572

Figure 15 A - J. Pigmentation of wing:

- (A) S. gibbus; (B) S. n. sp. "Japan" female, from Tokunaga and Kuroda (1935); (C) S. coleii; (D) S. pulchripennis; (E) S. poecilopterus; (F) S. totifuscus; (G) S. leptopus; (H) S. discus; (I) S. nelumbus female, from Tokunaga and Kuroda (1935); (J) S. fascipennis . 574

Figure 16 A - F. Pigmentation of wing:

- (A) S. pectinatus; (B) S. albidorsalis; (C) S. triannulatus; (D) S. cinctus; (E) S. jubatus; (F) S. semifumosus. 576

Figure 17 A - F. Pigmentation of male fore and hind legs:

- (A) X. subletti; (B) X. brunneus; (C) X. latilobus; (D) S. maculatus; (E) S. annettae; (F) S. crusanticus 578

Figure 18 A - F. Pigmentation of male fore and hind legs:

- (A) S. niger; (B) S. bisetosus; (D) S. licinus; (E) S. fuscipatellus; (F) S. albipalpus 580

Figure 19 A - F. Pigmentation of male fore and hind legs:

- (A-B) S. hilaris; (C) S. pannus; (D) S. balteatus; (E) S. n. sp. "Japan"; (F) S. satorui 582

Figure 20 A - F. Pigmentation of male fore and hind legs:

- (A) S. gibbus from Europe; (B) S. gibbus from Riihimaki; (C) S. gibbus from Korea; (D) S. coleii maximum pigmentation; (E-F) S. pulchripennis 584

Figure 21 A - F. Pigmentation of male fore and hind legs:

- (A-B) S. poecilopterus; (C-D) S. tectus; (E) S. totifuscus; (F) S. leptopus. 586

Figure 22 A - F. Pigmentation of male fore and hind legs:

- (A) S. impendens; (B) S. townesi; (C) S. discus;
 (D) S. nelumbus; (E) S. fascipennis; (F) S. bacrionis 588

Figure 23 A - F. Pigmentation of male fore and hind legs:

- (A) S. pectinatus; (B) S. gladius; (C) S. fittkaui;
 (D) S. albidorsalis; (E) S. triannulatus;
 (F) S. quadrinotatus 590

Figure 24 A - F. Pigmentation of male fore and hind legs:

- (A) S. browni; (B-C) S. cinctus; (D-E) S. aestivalis;
 (F) S. nudipupa 592

Figure 25 A - E. Pigmentation of male fore and hind legs:

- (A) S. jubatus; (B) S. hibernicus; (C) S. koreanus;
 (D) S. zonarius; (E) S. varius 594

Figure 26 A - J. Pigmentation of male abdomen:

- (A) X. brunneus; (B) X. latilobus; (C) S. maculatus;
 (D) S. annettae; (E) S. cruentus; (F) S. niger;
 (G) S. innocuus; (H) S. bisetosus; (I) S. totifuscus;
 (J) S. leptopus 596

Figure 27 A - J. Pigmentation of male abdomen:

- (A) S. impendens; (B) S. townesi; (C) S. discus;
 (D) S. bacrionis; (E) S. pectinatus; (F) S. fittkaui;
 (G) S. albidorsalis; (H) S. triannulatus;
quadrinotatus; (J) S. jubatus 598

Figure 28 A - G. Pigmentation of male abdomen:

- (A) S. nudipupa; (B) S. browni; (C) S. cinctus maximum
 pigmentation; (D) S. aestivalis minimum pigmentation;
 (E) S. hibernicus; (F) S. zonarius; (G) S. semifumosus 600

Figure 29 A - C. Male genitalia:

- (A) X. subletti; (B) X. brunneus; (C) H. montanus 602

Figure 30 A - C. Male genitalia:

- (A) S. unictus; (B) S. maculatus; (C) S. annettae 604

Figure 31 A - D. Male genitalia:

- (A) S. niger; (B) S. bisetosus; (C) S. albipalpus;
(D) S. hiliaris. 606

Figure 32 A - D. Male genitalia:

- (A) S. macateei; (B) S. recticaudatus; (C) S. pannus;
(D) S. gibbus 608

Figure 33 A - D. Male genitalia:

- (A) S. satorui; (B) S. poecilopterus; (C) S.
totifuscus; (D) S. leptopus 610

Figure 34 A - D. Male genitalia:

- (A) S. impendens; (B) S. discus; (C) S. nelumbus;
(D) S. fascipennis. 612

Figure 35 A - D. Male genitalia:

- (A) S. pectinatus; (B) S. gladius; (C) S. prolatus;
(D) S. vatius 614

Figure 36 A - D. Male genitalia:

- (A) S. triannulatus; (B) S. quadrinotatus;
(C) S. nudipupa; (D) S. cinctus 616

Figure 37 A - D. Male genitalia:

- (A) S. hibernicus; (B) S. koreanus; (C) S. zonarius;
(D) S. reissi. 618

Figure 38 A - B. Male genitalia:

- (A) S. aculeatus; (B) S. varius 620

Figure 39 A - N. Anal point of male adult in lateral aspect:

- (A) X. subletti; (B) X. bulbosus; (C) X. gilvus;
(D) X. brunneus; (E) X. latilobus; (F) H. montanus;

- (G) S. unictus; (H) S. maculatus; (I) S. annettae;
 (J) S. niger; (K) S. innocuus; (L) S. bisetosus;
 (M) S. licinus; (N) S. fuscipatellus. 622

Figure 40 A - N. Anal point of male adult in lateral aspect:

- (A) S. albipalpus; (B-C) S. hilaris; (D) S. macateei;
 (E) S. recticaudatus; (F) S. pannus; (G-H) S. gibbus;
 (I) S. n. sp. "Japan"; (J) S. satorui; (K) S. colei;
 (L) S. poecilopterus; (M-N) S. tectus. 624

Figure 41 A - N. Anal point of male adult in lateral aspect:

- (A) S. totifuscus; (B) S. leptopus; (C) S. impendens;
 (D) S. townesi; (E) S. discus; (F) S. nelumbus;
 (G-H) S. fascipennis; (I) S. bacronis; (J) S. pectinatus;
 (K) S. gladius; (L) S. fittkaui;
 (M) S. prolatus; (N) S. vatius. 626

Figure 42 A - N. Anal point of male adult in lateral aspect:

- (A) S. albidorsalis; (B) S. triannulatus; (C-D) S. quadrinotatus;
 (E) S. jubatus; (F) S. nudipupa;
 (G) S. browni; (H) S. cinctus; (I) S. hibernicus;
 (J) S. koreanus; (K) S. semifumosus; (L) S. reissi;
 (M) S. aculeatus; (N) S. varius. 628

Figure 43 A - L. Appendage 2 of male adult in lateral aspect:

- (A) S. unictus; (B) S. maculatus; (C) S. bisetosus;
 (D) S. annettae; (E) S. niger; (F) S. innocuus;
 (G) S. fuscipatellus; (H) S. albipalpus;
 (I) S. hilaris; (J) S. macateei; (K) S. gibbus;
 (L) S. balteatus. 630

Figure 44 A - L. Appendage 2 of male adult in lateral aspect:

- (A) S. pannus; (B-C) S. satorui; (D) S. colei;

- (E) S. pulchripennis; (F) S. poecilopterus;
 (G) S. tectus; (H) S. totifuscus; (I) S. leptopus;
 (J) S. fascipennis; (K) S. gladius;
 (L) S. quadrinotatus. 632

Figure 45 A - D. Appendage 2 of male adults in lateral aspect:

- (A) S. cinctus; (B) S. hibernicus; (C) S. varius;
 (D) S. discus 634

Figure 46 A - C. Female genitalia:

- (A) X. subletti; (B) H. pallidus; (C) H. montanus 636

Figure 47 A - D. Female genitalia:

- (A) S. unictus; (B) S. maculatus; (C) S. annettae;
 (D) S. niger. 638

Figure 48 A - D. Female genitalia:

- (A) S. bisetosus; (B) S. fuscipatellus;
 (C) S. hilaris; (D) S. macateei 640

Figure 49 A - D. Female genitalia:

- (A) S. satorui; (B) S. poecilopterus; (C)
S. totifuscus; (D) S. leptopus 642

Figure 50 A - B. Female genitalia:

- (A) S. quadrinotatus; (B) S. cinctus. 644

Figure 51 A - F. Tibial spurs of male adult:

- (A) X. subletti midleg; (B) X. subletti hindleg;
 (C) Harrisius midleg, arrow pointing to gap between spurs;
 (D) Harrisius hindleg, arrow pointing to gap between spurs;
 (E) S. hilaris midleg; (F) S. hilaris hindleg 646

Figure 52 A - C. Leg postures of male adults (positions
 determined with photographs of live individuals):

- (A) X. brunneus; (B) S. niger; (C) S. colei. Position

- of larval exuviae during pupal development (drawn from photographs): (D) S. unictus; (E) S. nudipupa (note compacted larval exuviae) 648
- Figure 53 A - C. Dorsomedial projection of pupal head capsule:
 (A) S. unictus; (B) S. cinctus; (C) S. gladius. 650
- Figure 54 A - D. Left pupal respiratory organ in lateral aspect:
 (A) S. subletti; (B) H. pallidus; (C) S. unictus;
 (D) S. bisetosus. 652
- Figure 55 A - C. Left pupal respiratory organ in lateral aspect:
 (A) S. hilaris; (B) S. poecilopterus; (C) S. cinctus
 (also showing apex of filament) 654
- Figure 56 A - F. Pupal tergites II - III:
 (A) H. pallidus; (B) X. brunneus; (C) S. unictus;
 (D) S. hilaris; (E) S. albipalpus; (F) S. gibbus. 656
- Figure 57 A - C. Pupal tergites II - III:
 (A) S. totifuscus; (B) S. quadrinotatus; (C) S. cinctus; (D) tergite IV of S. quadrinotatus 658
- Figure 58 A - D. Pupal tergites of VII - VIII:
 (A) X. brunneus; (B) S. totifuscus; (C) S. cinctus;
 (D) S. quadrinotatus. 660
- Figure 59 A - F. Pupal spurs on S VIII:
 (A-B) H. pallidus; (C) X. brunneus; (D) X. subletti;
 (E) S. unictus; (F) S. maculatus. 662
- Figure 60 A - F. Pupal spurs on S VIII:
 (A) S. bisetosus; (B) S. n. sp. "Peru"; (C) S. annettae;
 (D) S. niger; (E) S. fuscipatellus; (F) S. albipalpus 664
- Figure 61 A - F. Pupal spurs on S VIII:
 (A) S. hilaris; (B) S. macateei; (C) S. gibbus;

- (D) S. pulchripennis; (E) S. colei;
 (F) S. poecilopterus. 666

Figure 62 A - F. Pupal spurs on S VIII:

- (A) S. totifuscus; (B) S. gladius; (C) S. pupal form one
 (D) S. quadrinotatus; (E) S. nudipupa; (F) S. cinctus 668

Figure 63 A - B. Measurements and parts of larval head capsule
 of S. unictus:

- (A) dorsal; (B) ventral 670

Figure 64 A - D. Larval head capsule:

- (A) African larval form; (B) X. subletti; (C) H. pallidus;
 (D) S. maculatus. 672

Figure 65 A - C. Larval head capsule:

- (A) S. bisetosus; (B) S. hilaris; (C) S. cinctus. 674

Figure 66 A - I. SEM photomicrographs of larval head capsule
 of S. unictus:

- (A) anterolateral aspect; (B) ventral aspect of anterolateral
 portion of head capsule; (C) labrum; (D) antennal segment
 two; (E) maxilla; (F) apex of maxillary palp; (G) labio
 hypopharynx in dorsal aspect; (H) labiohypopharynx in
 ventral aspect; (I) hooks of anterior proleg 676

Figure 67 A - C. Labrum of fourth instar larva:

- (A) African larval form; (B) X. subletti; (C) New Zealand
 larval form 678

Figure 68 A - C. Labrum of fourth instar larva:

- (A) H. pallidus; (B) S. unictus; (C) S. hilaris 680

Figure 69 A - C. Labrum of fourth instar larva:

- (A) S. macateei; (B) S. poecilopterus; (C) S.
totifuscus 682

Figure 70 A - B. Labrum of fourth instar larvae:

(A) S. gladius; (B) S. cinctus. 684

Figure 71 A - D. Antenna of fourth instar larva:

(A) X. subletti; (B) H. pallidus; (C) New Zealand larval form; (D) S. unictus. 686

Figure 72 A - G. Larval mandible with attached apodemes:

(A) African larval form; (B) S. colei; (C) S. pulchripennis; (D) S. fuscipatellus; (E) New Zealand larval form; (F) S. hilaris; (G) S. albipalpus. 688

Figure 73 A - P. Larval labiohypopharynx:

(A) African larval form; (B) X. brunneus; (C) New Zealand larval form; (D) H. pallidus; (E) S. unictus; (F) S. bisetosus; (G-J) S. hilaris; (K) S. albipalpus; (L-M) S. fuscipatellus; (N-O) S. macateei; (P) S. pulchripennis. 690

Figure 74 A - G. Larval labiohypopharynx:

(A) S. totifuscus; (B) S. gladius; (C) S. quadrinotatus; (D-E) S. nudipupa; (F-G) S. cinctus. 692

Figure 75 A - F. Larval paralabial plate and hypostomium:

(A) African larval form; (B) X. subletti; (C) New Zealand larval form; (D) H. pallidus; (E) S. unictus; (F) S. bisetosus. 694

Figure 76 A - D. Larval paralabial plate and hypostomium:

(A) S. hilaris; (B) S. poecilopterus; (C) S. totifuscus; (D) S. cinctus; E-F. Larval head capsule: (E) New Zealand larval form; (F) H. pallidus. G-H. Tergite IX of larval abdomen showing procerci: (G) H. pallidus; (H) New Zealand larval form. 696

Figure 77 A - I. Larval anal papillae:

(A) X. subletti; (B) H. pallidus; (C) New Zealand
larval form; (D) S. unictus; (E) S. maculatus;
(F) S. bisetosus; (G) S. fuscipatellus; (H) S.
albipalpus; (I) S. hilaris; (J) S. colei; (K) S.
pulchripennis; (L) S. totifuscus. 698

Figure 78. Leaf mined by larvae of S. aestivalis (from
Croatan National Forest, North Carolina, 30-V-1980) 700

Figure 79. Map of North America showing localities and corres-
ponding sampling numbers for analysis of geographical
variation of leg pigmentation of male adults of S. hilaris
depicted in Figure 80 702

Figure 80. Geographical variation of extent of leg pigmentation
of male adults of S. hilaris. Locality numbers refer to
the map in Figure 79. Asterisks refer to reared samples.
For the Hubbs-Hubbs diagrams, the horizontal line depicts
range, the vertical line depicts mean, the shaded box
depicts 2 SE and the open box depicts 1.5 SD 704

Figure 81. Collecting localities for specimens of Japanese and
Korean Stenochironomus.^a 1. Kaesong; 2. South Pyongan Prov.;
3. Mt. Daisen; 4. Kyoto; 5. Chojabaru; 6. Kikuchi-suigen;
7. Miike 706

Figure 82 A - F. Distribution of:

(A) X. subletti; (B) X. brunneus; (C) S. gibbus;
(D) S. fascipennis; (E) S. hibernicus;
(F) S. maculatus (✱), S. unictus (●) 708

Figure 83 A - D. Distributions of:

(A) S. niger and S. bisetosus (✱), S. annettae (●),

S. albipalpus (■, all eastern localities);

(B) S. macateei; (C) S. fuscipatellus;

(D) S. hiliaris. 710

Figure 84 A - F. Distributions of:

(A) S. colei (★), S. pulchripennis (●); (B) S. tectus;

(C) S. poecilopterus; (D) S. totifuscus;

(E) S. cinctus; (F) S. aestivalis 712

Figure 85. Collecting localities for specimens of Neotropical

Stenochironomus. 1. Puerto Viejo; 2. El Tucuco; 3. Yacambu

National Park; 4. St. Lucia; 5. St. Vincent; 6. Tinalandia;

7. Rio Palenque; 8. 5 km N. Tena; 9. Iquitos; 10. Tingo

Maria; 11. Rio Branco; 12. Rio Cururu; 13. Lago Cabaliana;

14. Igarape Cachoeira, Rio Taruma, Rio Marauia; 15. Maloca;

16. Igarape Okueima, Rio Paru; 17. Mission Tiriyo;

18. Bompland. 714

Figure 86. Cladogram of basal lineages of the Stenochironomus

complex. See text for discussion of character states

(pg. 434). Synapomorphies 1-4 refer to adult characters, 5-20

refer to larval characters 716

Figure 87. Cladogram of Xestochironomus species. See page

449 for discussion of character states 718

Figure 88. Cladogram of the subgenus Stenochironomus. See

text for discussion of character states (pg. 451). Synapo-

morphies 25-49 refer to adult characters, 50-70 to pupal

characters and 71-91 to larval characters 720

Figure 89. Cladogram of the subgenus Petalopholeus. See

text for discussion of character states (pg. 451). Synapo-

morphies 25-49 refer to adult characters, 50-70 to pupal

characters and 71-91 to larval characters	722
Figure 90. Distribution and larval substrate of major	
lineages of the <u>Stenochironomus</u> complex	724
Figure 91. Larval habitat of species of the <u>Stenochironomus</u>	
complex superimposed on a cladogram showing their	
relationships	726

INTRODUCTION

This study is a revision of a group of chironomid midges and a discussion of their phylogenetic relationships. A total of 65 species are described and their evolutionary history analyzed. The resulting cladistic patterns are used to interpret their zoogeography and differences in habitat.

Stenochironomus is a cosmopolitan genus with 38 previously recognized species. Most of these were known only as male adults, which were characterized on the basis of their coloration and genitalic structure (Freeman, 1957, 1959, 1961; Goetghebuer, 1937; Townes, 1945). Immatures of only eight species of Stenochironomus (two Neotropical (both unnamed), three Nearctic, three Palaearctic) were previously described but the differences between these were uncertain and no keys were available (Beck and Beck, 1970; Lenz, 1954). Few studies have reported on the bionomics of any Stenochironomus species (Kalugina, 1958; Tokunaga and Kuroda, 1935, 1936). Other data are mostly anecdotal.

This study deals with a total of 55 Stenochironomus species from the Holarctic and Neotropical Regions. Descriptions of all stages for most of the Nearctic fauna (15 of 17 known species), and descriptions of the adults and some immature stages of species from the Palaearctic and Neotropical Regions, keys to all known stages, descriptions of the bionomics of some Nearctic species including the life cycle of two of these, distribution maps, and a phylogenetic analysis of the species are provided.

Nevertheless, it should be noted that many of the species,

particularly among those from tropical regions, are represented by very few specimens, suggesting that Stenochironomus is species rich and that further collecting will be amply rewarding. Immatures of many species are as yet unknown and will probably provide much phylogenetic information.

A major objective of analyzing the diversity of a group of organisms is to elucidate phylogenetic patterns. The genus Stenochironomus has proven to be quite amenable to such analysis for the following reasons.

Firstly, as holometabolous insects, species of Stenochironomus have a number of markedly different phenotypes during their life history. Each of these stages is differently adapted to its environment and each reflects different degrees of evolutionary divergence. Each stage within the genus exhibits a marked degree of interspecific difference. The species of Stenochironomus present, therefore, a great array of characters to be analyzed.

Secondly, the species of Stenochironomus exhibit some unusual features. The aquatic larvae are highly modified for a mining mode of life. Depending on the species, larvae tunnel either in dead submerged leaves or in wood and are morphologically unlike larvae of any other chironomid midge. Indeed, I know of no other Dipteran larva which is similar to that of Stenochironomus (but see below). Adult male Stenochironomus also possess unusual and characteristic features of the genitalia which are interpreted as synapomorphies. These features strongly suggest that the group is monophyletic.

Thirdly, because they were not too small, I was able to easily observe live specimens and better understand the functional

significance of some characters. An understanding of species as they interact with their environment may be important for distinguishing between homoplastic (= parallel or convergent) and homologous character states.

Finally, and as noted above, larvae are highly modified for mining in decaying submerged wood and leaves. Presence in such a specialized habitat greatly facilitates collection and study in the field. Larvae could generally be found in reasonable numbers and brought into the laboratory for rearing, thus ensuring reasonable sample size and, important for this analysis, association of different stages.

When I initiated this project I planned only on revising the genus Stenochironomus. A search for outgroup comparisons to interpret character states within the genus led me to consider and examine particularly those genera similar to, and previously thought to be closely related to, Stenochironomus. I was especially concerned with the interpretation of larval characters because, even though characters vary markedly within the genus, Stenochironomus larvae as a whole are so divergent that comparison of character states with other chironomids would be difficult. Fortunately, reared specimens of Harrisius pallidus from New Zealand became available. Even though adults lack the derived genitalia of Stenochironomus species, Harrisius pallidus did share the same derived larval habitus. This material, therefore, allowed me to interpret larval characters. Included in the material was a second larval type, different from Harrisius pallidus yet exhibiting the larval mining habitus. I describe this below as "New Zealand larval

form".

I also received material which included a larva from Africa with the typical mining habitus but with some markedly plesiomorphic features. This, too, is described, as "African larval form". Finally, Dr. and Mrs. J.E. Sublette published the results of their investigation of New Mexican chironomids (1979:109) and noted the presence of members of the genus Xestochironomus, a genus previously thought to be restricted to the West Indies and possibly related to Stenochironomus. On a field trip to the region in the spring of 1981 I discovered the previously unknown immature stages of Xestochironomus. The larvae exhibited the typical mining habitus of Stenochironomus. This material, then, became a vital data source for interpretation of larval character states within Stenochironomus and is the main reason why these genera, along with African and New Zealand larval forms, are described here in detail. Furthermore, better understanding of the other stages of these closely related species allowed a more secure interpretation of character states of pupae and adults of Stenochironomus as well. Some features seem susceptible to occasional occurrence in other chironomids and an understanding of the closest relatives of Stenochironomus allows an interpretation of such character states within the genus.

MATERIALS AND METHODS

Specimens examined. This study was based on the examination of fourth instar larvae, pupae and adults of 24 Stenochironomus species and an additional 54 species studied only in the adult stage. All 38 previously recognized species of Stenochironomus were included. The genus is poorly represented in most of the collections from which I requested loans. The majority of the specimens associated in all stages were North American species collected during the course of this study. Of these Stenochironomus species, only those from the Holarctic and Neotropical Regions are described.

I also studied material of species in two genera closely related to Stenochironomus: fourth instar larvae, pupae and adults of two species of Xestochironomus and adults only of an additional ten; fourth instar larvae, pupae and adults of Harrisius pallidus, adults only of four species of Harrisius (two undescribed).

Two larval forms, of unknown species and genera from Africa and New Zealand were also examined.

Finally, to obtain better outgroup comparisons for phylogenetic analysis and to estimate potential for parallelism of character states I examined adult, pupal and larval material of numbers of Chironominae which are noted in the section on character analysis.

I was able to examine type material of all Stenochironomus species described in this analysis unless otherwise noted. Details concerning the location and mode of preservation of type material as well as sex and details of labelling are recorded under each species.

The following is a list of abbreviations pertaining to each

collection from which I borrowed specimens, and/or to which paratype material will be deposited

- ANSP - Academy of Natural Sciences, Nineteenth
and the Parkway, Philadelphia, Pennsylvania
19103, U.S.A.
- BMNH - British Museum (Natural History), London,
England, SW7 5BD
- CAS - California Academy of Sciences,
San Francisco, California 94118, U.S.A.
- CNC - Canadian National Collection, Biosystematics
Research Institute, Research Branch, Agri-
culture Canada, Ottawa, Ontario K1A 0C6, Canada
- CUNY - Department of Entomology, Cornell University,
Ithaca, New York 14850 U.S.A.
- ELKU - Entomological Laboratory, Faculty of
Agriculture, Kyushu University, Fukuoka 812,
Japan
- HKTo - Dr. H. K. Townes, American Entomological
Institute, 5950 Warren Road, Ann Arbor,
Michigan 48105, U.S.A.
- INHS - Illinois Natural History Survey, 172
Natural Resources Building, Urbana,
Illinois 61801, U.S.A.
- INPA - Instituto de Pesquisas da Amazonia,
Manaus, Brazil.
- ITZA - Instituut voor Taxonomische Zoologie

(Zoologisch Museum), Universiteit van
Amsterdam, Plantage Middenlaan 53, Amsterdam
1004, Netherlands.

IUID - Dept. of Entomology, University of Idaho,
Moscow, Idaho 83843, U.S.A.

JESu - Dr. J.E. Sublette, University of Eastern New Mexico,
Portales, New Mexico, 88130 U.S.A.

KMWG - Kiel Museum, Kiel, West Germany.

MCZ - Museum of Comparative Zoology, Cambridge,
Massachusetts 02138, U.S.A.

OASa - Dr. O. A. Saether, Museum of Zoology;
University of Bergen, N-5014 Bergen, Norway

USNM - Systematic Entomology Laboratory, United States
Department of Agriculture, c/o United States
National Museum, NHB 168, Washington, D.C.
20560, U.S.A.

ZMLS - Department of Zoology, Zoological Museum,
Helgonavagen 3, S-223 62 Lund, Sweden

Methods

Collecting techniques. I found that I had the greatest success in obtaining both numbers of individuals and species by collecting larvae and rearing them in the laboratory to obtain pupae and adults. Larvae are concentrated in special microhabitats in aquatic environments while adults are more difficult to locate.

Stenochironomus larvae, depending on the species, are presently known as miners from three habitats in aquatic environments: dead wood; dead leaves; live floating leaves of Nelumbo (recorded only for S. nelumbus in Japan). Each of these habitats require different collecting techniques.

My experience suggests that wood mining larvae require the most skill to locate. Such larvae occur only in certain places within aquatic systems in wood in a particular state of decay. Larvae are restricted to areas of permanent water. Inundation zones or any areas above low water line yielded no Stenochironomus immatures (but see S. albipalpus as a possible exception). Secondly, wood inhabited by larvae must be securely anchored. In ponds and in small to medium-sized lakes, wood lying on the bottom and near the shore was appropriate for examination (I did not have the equipment to sample lake depths). Large lakes often exhibited too much wave action to allow wood near the shore to become stabilized. Occasionally, protected areas of these lakes provided sheltered areas in which Stenochironomus larvae were found. Stenochironomus are missing from faunal surveys of large lakes.

In slow moving streams and rivers, wood with Stenochironomus

larvae may be lying unanchored to the bottom but if so must be neither disturbed nor covered with silt (see below). For example, wood collected from San Felipe Springs at Del Rio, Texas, was lying freely on the bottom but the clear spring waters moved at a nearly constant rate and volume throughout the year. Otherwise, wood in streams and rivers must be attached to the bank or be partially buried in the bottom with part of the wood sticking up into the water column. Trees that have fallen partially into the river, dead branches of shrubs dangling in the water but still attached to their sources and dead roots on undercut banks were fruitful sources for larvae and are one of the first features I looked for. The same is true for the supports of bridges which often retain significant piles of wood.

In general, larvae were usually not located in the wood of coniferous species. However, when larvae were common in the wood of angiosperm species, I occasionally located larvae in branches of conifers.

Once a piece of wood was located I either removed it with a pair of hand pruners (for small branches) or a pair of pruning shears (for larger pieces). Large logs were dragged up on the lake shore or river bank or if not possible, were maneuvered into a position where at least the wood surface could be examined out of the water. If branches or logs were covered with silt, mud, sand, mineral deposits, or any other debris, larvae were not present. Finally, careful handling was necessary to avoid crushing larvae just beneath the wood surface.

Only a few tree species I examined had larvae under a bark

surface. Some smooth barked species, such as those of Alnus and Nemopanthus species, yielded large numbers of Stenochironomus larvae in some localities. One species, S. unictus, was collected as larvae only from under smooth bark. Alternately, thick, highly corrugated bark, such as that of Populus balsamifera, never produced larvae. I found the greatest diversity when collecting from under wood surfaces from which the bark was missing. In such instances the wood surface was firm but not hard. The surface layer should be soft enough to yield to a thumbnail to a depth of only about one mm. The underlying layer should be firm. Some woods, such as Betula, quickly become soft in water, and I rarely found Stenochironomus larvae mining such wood, even though the bark was still present and resilient. In wood both with or without bark, larvae, if present, are just underneath the surface layer. Peeling smooth bark from a branch or scraping the wood surface will, in places, reveal mined chambers and/or larvae. Chambers often exceed the total length of a mature fourth instar by two or three times and therefore, when a chamber is discovered, careful removal of the roof of the chamber will sometimes yield a complete individual although many larvae were damaged by this exploratory technique. Although third and fourth instar larvae were readily collected with the unaided eye, collection of second instars generally required dissection of the wood under a microscope. I failed to retrieve any first instar wood miners.

Larvae of those species which mine dead submerged leaves were relatively easy to collect. Mined leaves were found only in permanent waters. In lentic habitats they were on the bottom but not so as to be disturbed by wave action. In slow moving streams or

small rivers, leaves are often "compressed" against the bottom or are found in deposition areas in thick mats. Leaf packs were also found lodged against branches or protruding rocks. When leaves formed a compact mat, especially, in standing waters, only the leaves near the surface would be mined. Leaf mats in some lotic habitats had mined leaves deeper in the mat. I generally found that mined leaves were positioned so that larvae had ready access to free standing water.

Mined leaves were generally whole, firm, recently fallen and of a suitable thickness (see discussion under S. cinctus, S. aestivalis, S. totifuscus). Those of Red Maple (Acer rubrum) were the thinnest I found being mined. Leaves covered or coated with debris of any sort never contained mining larvae.

Leaves were easily checked for mining larvae. Leaves were handled at their edges, as squeezing the leaf killed the larvae underneath. Second, third and fourth instar leaf mining species of Stenochironomus form a characteristic mine with parallel frass walls (Fig. 78; see further discussion pg. 98). Leaves held up against sunlight, a bright sky or any strong light readily show these miners. Larvae can often be seen with the naked eye or hand lens, undulating or moving in the chamber.

First instar larvae formed small elongate chambers in the shape of a bent sausage, and were of variable form. Such chambers often resembled other types of leaf damage.

Third, fourth, and some second instar larvae were removed in the field, but first and most second instars required removal from their chambers under a dissecting scope with transmitted light. I preferred to remove all instars, when possible, underneath a

microscope. Once removed, second to fourth instar larvae were sluggish and easily placed in alcohol. First instar larvae, however, were very active and once disturbed from their mines were apt to wriggle rapidly away. An eyedropper easily captured such larvae for deposition into alcohol.

Tokunaga and Kuroda (1935) have provided a good review of the larval habits of S. nelumbus which mines the live, floating leaves of Nelumbo nucifera in Japan. The description of the mine construction matches that described above for miners of dead submerged leaves. Presumably, larvae of S. nelumbus could be collected in the same way as other leaf miners.

Larval exuviae were easily retrieved from vacated chambers in wood or leaves. However, just prior to pupation, the larva hooks the claws of the posterior proleg into a mass of frass and silk so that these need to be carefully detached (to ensure retrieval of the entire exuviae). The only exceptions to this are those few species of leaf miners which have a compacted larval exuviae (Fig. 52E). These exuviae seem either weakly attached or are free of any attachment.

Pupae of wood mining species were retrieved in a similar way to those of larvae. Pupae remained in the mined chamber until just before adult emergence. A smooth semicircular flap at the end of the pupal chamber, which serves as an escape hatch for the pupa, is cut by the larvae just prior to pupation. Pupal chambers may be located by searching for these flaps under a dissecting microscope. All Stenochironomus pupal chambers exhibit these terminal flaps but are very difficult to locate on a rough wood surface.

Pupae of leaf miners are easily located by using the same technique described above to collect larvae. Pupal chambers are somewhat modified by larvae just prior to pupation. The frass walls are compacted longitudinally to give a "cradle" impression (Fig. 78).

Pupal exuviae can be collected from water surfaces with nets but I obtained pupal exuviae only by rearing. Adults emerge at dusk or at night. Rapid preservation of exuviae is necessary to preserve the delicate respiratory organs (i.e. within 24 hours).

Most of my adult specimens were obtained by rearings from larvae. I attempted to sweep vegetation for adults with limited success. A search for male swarms produced only one. Three recorded observations of two species (S. hilaris and S. fuscipatellus) suggest males swarm at dusk just before dark, the edge of aquatic habitats.

Finally, I attempted to light trap with both UV and fluorescent bulbs but with limited success. On several occasions I noted a few adult S. hilaris at an incandescent light in Ottawa and made two separate, large collections of S. hilaris from below florescent lights on storefront windows, again in Ottawa.

I have never collected eggs of Stenochironomus in nature.

Rearing. Stenochironomus adults were easy to rear from larvae provided they were left in their mines. Once larvae had been removed from their chambers they would not develop further. Larvae were kept at $20 \pm 5^{\circ}\text{C}$ with an 18:6 light-dark photoperiod.

I handled wood mining larvae in a different manner than leaf miners. Wood shown by initial exploration to contain larvae was cut

into manageable portions and placed in a plastic freezer box with a snap top lid. I assumed the rest of the pieces would also contain larvae. These were placed in a cooler or bucket (sometimes with ice) to be carried back to the laboratory. Filling the containers only half full of water ensured, with movement, that the water remained well oxygenated. In the laboratory small pieces of wood were placed in 15 x 22.5 x 5 cm plastic pans half filled with water, which were then placed in screened cages with an air bubbler. The upper surface of each piece of wood remained above the water surface; 2/3 or so remained submerged. Wood mining larvae push some frass out of their air chambers; the appearance of little mounds of frass on emergent areas, indicated the presence of live larvae. Pupae which emerged from their chambers under water wriggled to the surface where the adult emerged. Adult-pupal associations were thereby ensured. Larval exuviae either remained in the chamber in the wood or dangled halfway out of the exit hole. These usually remained reasonably intact in their chambers and sometimes were not retrieved until most adults had emerged from a given piece of wood. Pupae in chambers above the waterline only partially vacated the chamber and the adult emerged while in this position. The larval exuviae could then be directly associated with the pupal exuvia. Wood collected in spring or early summer produced the largest yield of adults. Unfortunately, being the time of high water level, it was more difficult to obtain permanently submerged wood.

Adults of leaf miners were reared from larvae by placing mined leaves in a plastic freezer box with a snap top lid, in a cooler. Containers were filled nearly full with water to minimize damage or

bending to the leaf which often killed larvae. In the laboratory, leaves were cut up into portions, each with a mine, and placed in water in a 103 x 30 mm vial, if individual rearings were desired, or into plastic trays as described above for wood miners borers, for mass rearing. After adult emergence, the associated pupal exuviae were easily retrieved from the water surface and larval exuviae from the chamber in the leaf.

Kalugina (1958, 1959,) and Mitchell (1908) have recorded the oviposition of eggs by captive female Stenochironomus. Kalugina (pers. comm.) kept field collected females in small bottles with a stick support and water into which they laid their egg masses. I was unsuccessful in my attempts to induce female S. unictus, or S. hilaris to lay. One female S. colei laid an egg mass but these did not develop.

Life Cycle Analysis. I studied the life cycle of two species of Stenochironomus; a wood miner, S. unictus and a leaf miner, S. cinctus. Populations of both species were studied at Duncan Lk., Masham Twp., Quebec. S. unictus larvae commonly occurred under bark of branches of Alnus and Nemopanthus on the bottom of this lake. I cut 25-30 cm lengths of both dead and live Alnus branches, of varying diameters, tied these in bundles of four and placed them at depths of about 50-60 cm on October 20, 1979. In the early spring of 1981, I placed infested wood in a plexiglas cage, in the lake, to ensure no further invasion of larvae. Alnus branches were removed periodically and the bark removed under a dissecting scope to expose mining larvae.

Larvae of S. cinctus mine dead oak leaves in Duncan Lk.. In the fall of 1980, fallen leaves of Quercus rubra were gathered from the forest floor and were placed in a chickenwire cage, and deposited in the lake at a depth of about 50 cm. After the first evidence of emergence of adults from these leaves the following spring (presence of pupal chambers), I removed some apparently uninfested leaves from the cage and placed these in a nylon onion bag. These leaves became infested at a later date. In addition, I sampled other leaves naturally infested occurring in the lake.

Preservation. All larvae, pupae, and some adults were preserved in 70% ethanol. Some adults, when they emerged in the laboratory, were pinned and placed in a freezer where they were allowed to freeze dry for at least one month. Such material provided uncollapsed specimens. Some adults preserved in 70% ethanol were critical point dried and pinned. I preferred to critical point dry any adult material left in alcohol. Schlee's (1966) arguments for studying slide mounted chironomids are appreciated but I found some useful characters, mostly those dealing with pigmentation patterns and prunosity, to be impossible or difficult to study from such preparations. Although, pigmentation patterns may exhibit much intraspecific variation in some other chironomids, within Stenochironomus they often provide excellent characters. Long term storage in alcohol leaves material in a state very difficult to study (e.g. type material of S. nelumbus, pg. 313). Pigmentation patterns are lost and specimens become exceedingly fragile. Well mounted, pinned specimens, however, can be easily slide mounted at a later date.

The abdomens of pupal exuviae of many Stenochironomus species tended to be compressed laterally, which made them difficult to study. Specimens freshly placed in ethanol could be flattened into a dorsoventrally compressed position with a pair of needles or forceps. However, material left in ethanol for any period of time could not be manipulated in this way.

Dissection and examination. All larvae were first examined in alcohol. Shape of anal papillae was most easily viewed in this medium. Larvae were then cleared in lactic acid. The severed head was cleared and transferred to glycerine on a glass well slide and the labrum removed and placed in a drop of glycerine in one of four wells of a plastic slide (Kova Slide II, ICL Scientific, 18249 Euclid, Fountain Valley, California). The use of well slides markedly enhanced ease of observation and allowed standardized comparisons. The labrum of a Stenochironomus larva is covered with setae and spinules on the dorsal, anterior and ventral surfaces. If left on the head capsule, the labrum could be in one of many positions. When in glycerine the labrum could be moved into any position and all details examined. Because the head capsule was often somewhat torn during subsequent dissection of mouthparts it was measured for length and width and width between the anterolateral points while yet in glycerine. Measurement at this stage ensured standardization of measurement. The head capsule, thorax and abdomen were then transferred through successive baths of 2-propanol, 2-propanol layered over cedarwood oil, cedarwood oil, and finally Canada balsam. While in cedarwood oil the mandibles,

labiohypopharynx and one antenna were removed from the head capsule. The thorax and abdomen were placed under one coverslip, the head capsule under another and the disarticulated parts under a third. The Canada balsam was allowed to harden before coverslips were applied to ensure that parts were not crushed.

In addition to slide mounted material, I examined and compared a limited series of cleared head capsules of each species in glycerine to search for additional characters.

The apices of the ligular lobes, mandibles and the anterior margin of the hypostomium were sometimes quite worn but almost always in an asymmetrical way. If so, caution is necessary in some instances when interpreting keys or descriptions.

The position and shape of the larval exuviae were important characters. In some Stenochironomus species the pupal abdomen remains partially within the larval exuviae so that the larval head capsule is positioned halfway along the abdomen (Fig. 52D). Just prior to adult emergence, the pupa leaves the chamber and leaves the larval exuviae behind. Such larval exuviae are stretched out in the chamber. In other Stenochironomus species the larval exuviae is completely sloughed off by the pupa and assumes a compacted form (Fig. 52E). This character must be observed when rearing or collecting specimens.

Pupae were almost all examined under the compound scope as exuviae. However, I also examined some whole pupae under the dissecting scope. The respiratory organ was rich in characters but was difficult to study in detail. Overall structure could be observed while specimens were in alcohol under a dissecting

microscope and were most easily seen when brightly lit against a dark background. However, observation of details required examination under a compound microscope. To prevent collapse the respiratory organ with some accompanying cuticle from the thorax was placed in a 5% solution of glycerine in 70% ethanol, in an open three dram vial. Up to a week was required for the alcohol to evaporate but this could be speeded up with the use of mild heat. The respiratory organ in glycerine was then transferred to one of four wells of a plastic slide (see above for details). The rest of the pupal exuviae was transferred to 95% ethanol and permanently mounted in Euparal on a microscope slide, dorsal surface upward.

In addition, I made interspecific comparisons of pupae and pupal exuviae with specimens with the individuals resting on a thin layer of cotton wool in 70% ethanol.

Adults were examined pinned, as cleared specimens in glycerine, preserved in 70% ethanol, or site mounted as described by Saether (1969) except that specimens were cleared in cold KOH and 2-propanol was used instead of ethanol. Use of cold clearing agent seemed gentler on the specimens and there was less chance of damage. One of the inferior appendages of the male genitalia was removed and mounted laterally under a separate coverslip. Male genitalia were first mounted laterally in Canada balsam and shape of the anal point was noted. The specimen was then reoriented to a dorsoventral position. The shape of appendage 1 changes with orientation and is described here as positioned when its setae were pointing laterally. Pigmentation patterns on thorax and abdomen were recorded on standardized outline drawings before material was cleared for

placement on microscope slides.

Some adult material from outside the Holarctic region was available only as pinned specimens. Glued specimens were removed with acetone and then placed in ammonium hydroxide (see below).

Specimens perforated by a pin were softened and removed from the pin after a brief soaking in a weak solution of ammonium hydroxide. A weak solution of ammonium hydroxide was also used to restore the metallic shine to the eyes of some species.

Previous authors have used the presence and shape of the tiny spur on the foreleg tibial scale to distinguish species. I found the character to be exceedingly variable and have not used it.

Measurements and Statistics. Most measurements were taken with the aid of a Zetopan Reichert interference contrast microscope. The measuring micrometer was composed of 100 units, each equal to 9.7 μm (125 $\times$ magnification), 4.17 μm (312.5 $\times$) or 2.55 μm (600 $\times$). In recent years most chironomid taxonomists have produced a large array of measurements and ratios for each species they describe. The majority of these data remains uninterpreted and seems to be of questionable value (although an analysis of anagenesis based on these characters might be interesting). The characters which were eventually chosen for measurement for this study were initially selected on the basis of an examination of only a few individuals of each species. Only measurements and/or ratios which aided in species recognition or in phylogenetic analysis were recorded for larger series and are reported in this study. I incorporated additional measurements into the descriptions of some species to help further

differentiate between morphologically similar species. These were done for S. pulchripennis, colei, S. hilaris, albipalpus and fuscipatellus.

For all stages described I provide descriptive statistics. These are range, mean and, for samples greater than seven, the standard deviation. To study variation of extent of the pigmentation of the fore tibia of males of S. hilaris, I measured specimens with an ocular micrometer (100 divisions) mounted in a Leitz stereoscope at 32x.

The adults of some species of Stenochironomus exhibit pale annuli on otherwise dark legs. The description of how far the annulus is situated from the apex of the leg segment refers to the distance to the edge of that annulus. Measurements of larvae were taken as indicated in Fig. 63 and those of adults as in Fig. 29A, 30A, 46A, or as shown by Soponis (1977) except that I measured femora to their very apices. What are here recorded as length of wing veins M and Cu are given by Soponis (1977: fig.14a) as a-rm and a-FCu, respectively.

Ratios and some structures discussed in this study are abbreviated as follows.

L - length

W - width

Larva: anterior W - width between anterolateral points of head capsule

Ant. seg. 1 - antennal segment one

Ant. seg. 1 seta/L - distance of seta on antennal

- segment one from antennal base/total length of antennal segment one
- Para W - distance between lateral margins of of paralabial plates
- Adult: HW/WE - maximum head width/width between eyes
- Ant 13/1-12 - length of 13th flagellomere/length of combined flagellomeres 1-12
- Palp 3/4 - length of palpal segment 3/length of palpal segment 4
- Fo - foreleg
- Hd - hindleg
- Fe - femur length
- Ti - tibia length
- Tal - first tarsomere length
- WL/M - wing length/length of vein M
- Cu/M - length of vein Cu/length of vein M
- DC - dorsocentral setae
- Gc/Gs - length of gonocoxite/length of gonostylus
- App 2/1 - length of appendage 2/length of appendage 1
- Gen Fk/Cer - length of genital fork/length of cercus

Terms for structures. In general I have followed the terms used by McAlpine (1981) for adults and Teskey (1981) for larvae (Fig. 63, 66,

67). Otherwise, most characters which were of unsure homology with those of other Diptera are named with terms from Saether (1980).

Saether (1977) provided a morphological analysis of female genitalia of Chironomidae and some other Nematocera and applied names to morphological details following Smith (1969). I am unconvinced of certain homologies and have used only some of Saether's terms. In other cases, I prefer neutral, descriptive terms.

For the pupa, the terms anal lobe, genital lobe and swim paddle are applied to the apex of the abdomen (Fig. 62E). The term dorsomedial projection refers to an apodeme which extends from the dorsomedial portion of the head capsule of pupal exuviae (Fig. 53).

For the larvae, terms for the maxillary palpal sensilla follow that of Craig and Borkent (1980) (Fig. 66F). I used the term labiohypopharynx to describe the fused labium and hypopharynx. I was unsure what name to apply to the apical lobes on the labiohypopharynx but have tentatively termed them the ligular lobes. Similarly I have labelled a structure on the ventral surface of the labiohypopharynx as the M-appendage but am not confident of its homology with other chironomids.

Illustrations. Drawings were completed with the aid of a grid on a Zeiss compound microscope (those by R. Idema) or with a drawing tube mounted on a Nikon compound microscope. Photomicrographs were taken with a Reichert compound scope. SEM photomicrographs were taken with a Cambridge S150 scanning electron microscope.

Distribution maps are a compilation of all locality data for all stages and material examined.

Criteria for species recognition. Although reproductive isolation is the basic criterion for species recognition (Mayr, 1969:26), the lack of observations of adults and the failure of attempts to induce laboratory mating precluded direct use of this criterion. Instead, morphological discontinuities of any or all stages served to define species limits. In one instance, study of geographical variation patterns were used to decide that the similar but allopatric S. pulchripennis and S. colei were best not considered conspecific.

Studies by some cytogeneticists working with Nematocera (e.g. Martin, 1979; Rothfels, 1979) indicate that classical morphological techniques often lead to the inclusion of several species under one name. Intensive field and laboratory studies may allow recognition of such morphologically similar species, especially when several stages are available for study (e.g. Borkent, 1979; Lindeberg, 1967). The present study does not provide that sort of resolution, even though one species, S. hilaris, exhibits a puzzling pattern of variation suggesting the presence of more than one species. Nevertheless, recognition of morphospecies allows for the description of new forms as well as the interpretation of phylogenetic patterns and these were the major goals of this thesis.

Classification

This section treats the assemblage of species which in the larval stage exhibit a highly modified habitus, adapted to a mining mode of life. Although this peculiar larval form was previously believed to be characteristic of only the genus Stenochironomus, it is now known for the genera Harrisius (Stark, 1981) and Xestochironomus. In addition, two larval forms, one from Africa and the other from New Zealand are adapted to mining but are sufficiently different from larvae of the above three genera, that they are treated separately. The African larva seems to be the sister group to all other species with mining larvae. The New Zealand larvae are the sister group of Harrisius, also from New Zealand. Both the African and New Zealand larval forms may require new generic names when adults become associated.

All the species with such a modified larval form are here recognized as belonging to a new category called the Stenochironomus complex.

Classification of Stenochironomus, and related forms described in the following pages, generally follows an organization based on phyletic sequences (Patterson and Rosen, 1977; Nelson, 1974; Platnick, 1977). Phylogenetically older groups are described before younger ones, so that the reader is led from genera closely related to Stenochironomus through successive phylogenetic branching points within the genus. Phylogenetic methods are described in the section "Phylogeny" (pg. 426).

Description of the Stenochironomus Complex

The following is a description assuming characterization to the level of the tribe Chironomini. Only characters which are variable within the tribe and serve to distinguish members of the Stenochironomus complex from other Chironomini are included.

Adult

Coloration: variable, ranging from body completely pale to striking pigmentation patterns to completely dark brown; wings pale or with various markings.

Head: male with 13 flagellomeres, female with six flagellomeres, the basal two fused; palpus with five segments; frontal tubercles absent.

Thorax: scutum projecting well beyond level of reduced antepnotum; acrostichal setae in two rows; dorsocentral and supra-alar setae present; one species (a new species similar to S. micronyx from Africa) with katepisternal setae; calypter with fringe of setae; wing membrane with or without macrotrichia; apices of R2 and R3 close to apex of R1; fore tibia with apical scale, with or without tiny spur; fore tarsus without beard; mid and hind tibial combs, each with spur or with single spur on anterior comb; combs completely fused or closely approximated basally; pulvilli well developed; CU/M= 0.98-1.27.

Abdomen: segment VIII of male somewhat constricted basally.

Male genitalia: variable: see generic descriptions.

Female genitalia: variable: see generic descriptions; lateral protrusion of T IX with setae; postgenital plate well developed; spermathacae ovoid to nearly spherical; spermathecal ducts with loop.

Pupa

Coloration: head; variable degree of foreleg sheath but including at least base of tibia; thorax variously marked, including dark pigmentation on dorsal surface of thorax, lateral border defined by position of dorsocentral setae, reaching posteriorly to along base of wing sheath, leaving lateral region ventral to dorsocentral setae distinctly paler; margin of wing sheaths; lateral margins of abdominal segments, with some species with additional pigmentation; spur on S VIII; inner margin of swim paddle.

Head: ified; frontal tubercles and setae absent.

Thorax: respiratory organ: either a simple horn or a simple horn with anterior and posterior multifilamentous trunks arising near base, horn with spicules on surface; setae present: 2 precorneal, 4 dorsocentral; anterodorsal portion with at least some spaced, short tubercles; wing sheath margin with or without tubercle (present only

in Stenochironomus pupal form.1).

Abdomen: spicules present on T II - T VI, S III - IV, some species with spicules on T VII - VIII, S I, II, V - VIII, anal lobe, and apex of swim paddle; relative size and arrangement of spicules variable; posterior margin of T II with single row of recurved hooks, either restricted to median area or extending to lateral margin of tergite, with or without median gap of missing hooklets; conjunctive III/IV, IV/V with scattered rows of recurved spicules; pedes spurii A absent or present as fine scattered spicules and in some specimens, present along entire margin of segment IV, sometimes also present along margin of S II and III; pedes spurii B absent; lateral margin of segment V-VIII with 4, 4, 4 and 5 flattened elongate setae respectively (with some intraspecific variation); form of spur on S VIII variable; swim paddle with single row of at least 25 homogeneous setae, no additional setae present; male genital lobe not reaching, to extending beyond, apex of swim paddle.

Larva

Head capsule: dorsoventrally compressed, wedge-shaped in lateral aspect (Thienemann 1954: Fig. 62); with pair of dorsolateral stripes originating on median stripe; postoccipital carina divided into four sclerotized, pigmented portions, the entire ventral portion, two dorsolateral portions, each of which articulates with the ventral portion, and a mid-dorsal portion from which the median stripe arises; dorsal, posterolateral cuticular thickenings to which muscles

attach, allowing head to be partially drawn into thorax; the following sensilla present: S 1-10, seta submenti, campaniform organ associated with S 7,8, campaniform organ anterolateral to S 5, micropore usually present, adjacent to seta submenti; anterior coronal pore located on dorsolateral stripe; posterior coronal pore arising from dorsolateral section of postoccipital carina.

Labrum: labral sclerites not defined but dorsum with coarser shagreen; chaeta media with lateral spicule stout, swollen; S I, S II and S III of similar size; S IV laterally placed; spicules of labral lamella divided medially into two groups (except in S. nelumbus where they form a continuous row); pecten epipharyngis variable, from three stout, apically serrate spicules to row of numerous slender spicules; chaetulae lateralis grouped laterally; premandible with three or four teeth, associated premandibular brush divided into two groups of spicules.

Antenna: with five segments of usually successively decreasing length, sometimes segments three and four of similar length, or segment four longer than segment three; campaniform organ restricted to basal 1/3 of segment one; blade well developed, accessory blade minute, reduced to superficial structure; style a superficial ridge; Lauterborn sensilla reduced to pair of superficial structures.

Mandible: somewhat triangular (with nearly equal dimensions) in dorsoventral outline; articulations in a vertical plane, resulting in directly opposing mandibles; one dorsal, one apical and two or three

ventral teeth; inner surface between dorsal and ventral teeth concave; the following sensilla present: outer, basal companiform organ, two outer elongate setae, reduced to minute seta subdentalis; seta interna present or absent.

Labiohypopharynx: situated between two ridges arising ventrally from head capsule; apical ligula well developed, either a single lobe or paired lobes; dorsal shagreen present on lobe(s); labial palpus with pair of stout sensilla; pecten hypopharyngis with elongate brush-like groups of spicules; chaetae of prementum slender, forming brush on apex of weakly to strongly produced projection; M appendage elongate, parallel-sided posteriorly, variably forked or serrate apically.

Maxilla: originating posterolateral to paralabial plate and portion projecting anteriorly situated dorsal to paralabial plate, with lacinia positioned lateral to hypostomal teeth; palpus short and cylindrical with 1A, 2A, 3A, B, 1D, 2D, 1E, 2E, F and two unnamed sensilla present (observed only for S. unictus, S. hilaris); chaetae of palpiger elongate, simple, on projection; two equal, elongate setae in area of paraxial seta; lacinia with three (?) basal and three (?) apical sensilla; SM1, SM2 present, variable in position; SM3, SM4 reduced, closely approximated sensory pits posterolateral to point of ventral mandibular articulation.

Paralabial plate: located lateral to hypostoma, with weak striae or none; shape variable (see descriptions of genera and larval forms).

Hypostoma: concave, 8-12 teeth.

Thorax: segments one and two enlarged, wider than head or subsequent segments; anterior prolegs reduced to slightly bilobed, transverse projection (when extended); hooks in 7-20 transverse rows divided medially into two groups; hooks directed posteriorly, each with small serrations on posterior margin; hooks decreasing in size posteriorly.

Abdomen: elongate; procercus reduced, flush with surrounding cuticle, with filament(s) emerging directly from cuticle; posterior proleg short, hooks in one row with alternate hooks placed slightly posterior or slight anterior, hooks directed anteriorly; anal papillae directed posteriorly, simple and short to elongate, with one to three constrictions.

KEY TO GENERA OF MALE ADULTS OF THE STENOCHIRONOMUS COMPLEX

Male adults of this monophyletic group can be partially recognized by using the key by Oliver (1981). All species in the genera considered here should key to couplet 71. Some other genera, which show morphological similarities to the group of genera with mining larvae, are included in the following key.

1. Scutum projecting markedly in front of antepnotum;
one or two spurs present at apex of tibiae of mid
and hind legs; tibial combs fused or closely
approximated basally.....2

- Not as above; spurs on tibia absent or only one spine present; tibial combs closely approximated basally or widely separated.... some other Chironomini

2(1) Palpus reduced to three segments; thorax and abdomen with tufts of long setae (Africa).....
Collartiella Goetghebuer,
 see Freeman, 1957

- Palpus with five segments (basal one small); thorax and abdomen with scattered setae, not arranged in tufts.....3

3(2) Two large groups (13 each, n=1) of long setae on frons; appendage 1 with apical hook; some setae on appendage 2 scattered, long setae forked at apex (New Zealand).....Ophryophorus Freeman,
 see Freeman, 1959:427

- Setae on frons not arranged into two large groups of long setae; if such setae present, then appendage 1 cylindrical and setae on appendage 2 simple and linearly arranged on dorsal edge.....4

4. Tibial spurs completely fused (Fig. 51E, F); superior appendage cylindrical with at least one seta present on apex; appendage 2 extremely thin, elongate laterally compressed, with setae linearly arranged on dorsal edge (occasionally one or two setae are

laterally placed) (Fig. 43-45); posteroventral margin of T IX with or without stout setae (cosmopolitan)...

.....Stenochironomus Kieffer, pg. 91

- Tibial spurs not completely fused medially

(Fig. 51A-D); appendage 1 basally swollen with group of seta and an elongate apical portion, with at most, one seta placed subapically; appendage 2 sausage

shaped nearly circular in cross-section, with setae at least somewhat scattered (Fig. 29A-C); postero-

ventral margin of T IX with setae slender.....5

5(4) Wing membrane with many macrotrichia; posteromedial face of gonostylus with elongate setae (Fig. 29C)

(New Zealand, Australia, New Guinea).....

.....Harrisius Freeman, pg. 80

- Wing membrane bare of macrotrichia; posteromedial

face of gonostylus with brush like patch and with, at most, short setae (Fig. 29A, B) (New World).....

.....Xestochironomus Sublette and Wirth, pg. 46

KEY TO GENERA OF FEMALE ADULTS OF THE STENOCHIRONOMUS COMPLEX

Female adults of this group are somewhat difficult to recognize. Members of the tribe Chironomini, to which the genera described here belong, can be recognized by using the key by Oliver (1981). Some other genera, which show morphological similarities to the group of genera with mining larvae, are included in the key.

1. Antenna with six flagellomeres but basal two fused;
calypter fringed; scutum projecting markedly
in front of antepnotum; fore tibia with scale;
spur on each of both tibial combs of both mid and
hind legs or spur present only on anterior comb;
combs closely approximated basally or fused;
spermathecal duct with loop (not known for
Collartiella-Africa or for Ophryophorus-
New Zealand).....2
- Not as above; spurs on tibial combs absent or only
one spine present on anterior comb; combs closely
approximated basally or widely separated.....
.....other Chironomini
- 2(1) Palpus reduced, with only three segments; thorax and
abdomen with tufts of long setae (Africa).....
.....Collartiella Goetghebuer,
see Freeman, 1957
- Palpus with five segments (basal one small); thorax
and abdomen with scattered setae, not arranged in
tufts.....3
- 3(2) Two large groups of long setae on frons; thorax
light brown with vittae and postnotum darker (New
Zealand).....Ophryophorus. Freeman,
see Freeman, 1959:427

- Setae on frons not arranged into two large groups of long setae; if such setae present then scutum uniform dark brown.....4

4(3) Tibial spurs completely fused (Fig. 51 E, F); cleft between dorsomesal and ventrolateral lobes well developed (Fig. 46A-C) cosmopolitan.....
Stenochironomus Kieffer, pg. 91

- Tibial spurs not completely fused medially (Fig. 51A-D); cleft between dorsomesal and ventrolateral lobes shallowly or poorly developed (Fig. 47-50).....5

5(4) Wing membrane with many macrotrichia (New Zealand, Australia, New Guinea).....

.....Harrisius Freeman, pg. 80

- Wing membrane bare of macrotrichia (New World).....
Xestochironomus Sublette and Wirth, pg. 46

KEY TO GENERA OF PUPAE OF THE STENOCHIRONOMUS COMPLEX.

The following key is intended for pupae of Xestochironomus, Harrisius and Stenochironomus, assuming the pupa has been recognized as a member of the Chironominae. The key by Coffman (in press) can be used to identify pupae to that level.

8. Respiratory organ with many branches and a non-

bifurcating horn, either arising near the base of the respiratory organ or partially fused with the anterior trunk (Fig. 54A, C, D, 55A-C).....2

- Respiratory organ a simple stalk or not observable...4

2(1) No spicules present on segment VII or VIII or, if present on VIII, then restricted to anterolateral area (cosmopolitan).....Stenochironomus Kieffer
in part, pg. 91

- Spicules present on segment VII and VIII; those spicules on T VIII also present on posterior half of tergite.....3

3(2) Large tooth (teeth) on spur of S VIII elongate, slender, uniformly brown (Fig. 59C, D) (New World)....
.....Xestochironomus Sublette and Wirth, pg. 46

Large tooth on spur of S VIII basally broad, elongate, yellowish brown with apex pale (Fig. 62A)

(cosmopolitan).....Stenochironomus Kieffer (in part),
pg. 91

4(1) Swim paddle with uniform to somewhat scattered row of more than 25 setae, other setae absent; spur present on posterolateral margin of S VIII; wing sheath with or without subapical tubercle; pedes spurii B absent; lateral setae on segments V-VIII as follows: 4, 4, 4, 5 (some intraspecific variation); no cephalic tubercles; frontal setae absent; two precorneal setae

- present; median anteprenotals absent.....5
- Not as above;other Chironominae
- 5(4) Respiratory organ a simple stalk (New Zealand).....
Harrisius pallidus Freeman, pg. 85
- Respiratory organ not observable.....6
- 6(5) No spicules present on segment VII or VIII or, if
 present on T VIII, then restricted to anterolateral
 area (cosmopolitan).....
Stenochironomus Kieffer (in part), pg. 91
- Spicules present on segment VII and VIII, those on
 T VIII also present on posterior half of tergite...7
- 7(6) Large tooth on spur of S VIII basally broad, elongate,
 yellowish brown with apex pale (Fig. 62A)
 (cosmopolitan).....Stenochironomus Kieffer (in part)
 pg. 91
- Large tooth (teeth) on spur of S VIII elongate,
 slender, uniformly brown (Fig. 59A-D).....8
- 8(7) Spur with 1-3 elongate teeth, 2-6 elongate smaller
 teeth more than 1/4 length of largest tooth and
 with a few additional smaller teeth (Fig. 59C, D);
 at least some teeth not fused at their bases;
 spicules on T VIII restricted to anterolateral area
 and posterior 1/3 of tergite (New World).....

.....Xestochironomus Sublette and Wirth, pg. 46

- Spur with at most 2 small teeth closely appressed
against large tooth (Fig. 59); spicules on T VIII
restricted to anterolateral area and midlength region
of tergite (New Zealand).....Harrisius pallidus

Freeman, pg. 85

KEY TO GENERA AND FORMS OF FOURTH INSTAR LARVAE OF THE STENOCHIRONOMUS COMPLEX

The following key is intended for those larvae with a mining
adapted habitus, i.e. with a dorsoventrally compressed head capsule,
opposing mandibles, swollen thorax and an elongate narrow abdomen.

1. Ecdysial lines not present (Fig. 64B); hypostoma
with eight teeth, with lateral teeth continuous
with edge of paralabial plate (Fig. 75B); blade on
antennal segment one extending past segment three
(Fig. 71A); anal papillae markedly elongate with
four or five constrictions (Fig. 77A); head squared
in dorsal view (Fig. 64B); wood mining (New World).
.....Xestochironomus Sublette and Wirth, pg. 46
- Ecdysial lines developed (Fig. 63, 64A, C, D, 65);
hypostoma with 10-12 teeth, with lateral teeth
dorsal to plane of paralabial plate (Fig. 75A, C-F,
76A-D); blade on antennal segment one extending to
about apex of segment two (Fig. 71B-D) (not known

for African larval form); anal papillae of moderate length with 0-3 constrictions, or if markedly elongate and with more constrictions, head somewhat triangular in dorsal view (Fig. 64A); wood or leaf mining.....2

2(1) Mandible with well developed, multiple filamented seta interna (Fig. 72A); paralabial plate not fused with maxilla, with fine, multiple striae (Fig. 75A); labiohypopharynx with ligula as a single lobe (Fig. 73A); anal papillae markedly elongated, with about five constrictions; venter of head capsule with pale Y-shaped area (Fig. 64A, 75A); leaf mining (Zimbabwe).....African larval form, pg. 42

- Mandible with no seta interna (Fig. 72B-G); paralabial plate fused with maxilla, with, at most, very faint reduced striae (Fig. 75C-F, 76A-D); labiohypopharynx with ligula a single lobe or divided into two lobes (Fig. 73C-P, 74); anal papillae of moderate length with 0-3 constrictions (Fig. 77B-L); ventrum of head capsule without pale area (Fig. 63, 64B-D, 65); wood or leaf mining.....3

3(2) Anal papillae with 0-2 constrictions along length but if with two constrictions, apical portion smaller in diameter than other portions (Fig. 77D-L); lateral teeth of hypostoma dorso-

lateral to penultimate teeth, with apices just evident from ventral view (10 teeth easily counted) (Fig. 75E, F, 76A-D); pecten epipharyngis with slender spicules (Fig. 68B, C, 69, 70); chaetulae lateralis with thickened, stout spicule; wood or leaf mining (cosmopolitan).....

.....Stenochironomus Kieffer, pg. 91

(Only two of seven Palaearctic species are definitely known as larvae, namely S. gibbus and S. nelumbus, both easily separated from each other.

A preliminary key is provided for Neotropical species (pg.136). Only the Nearctic key (pg.128) probably contains the majority of species from that region.)

- Anal papillae with one constriction, moderately elongate, basal and apical portions about equal in diameter, dorsal pair with additional slight, subapical, constriction (Fig. 77B, C); lateral teeth of hypostoma dorsal to penultimate teeth with, at most, margin of lateral teeth evident from ventral view (eight teeth easily counted) (Fig. 75C, D); pecten epipharyngis with spicules with wide bases (Fig. 67C, 68A); chaetulae lateralis without thickened spicule known only from Australian Region, wood mining.....4

4. Dorsolateral stripes barely discernible (Fig. 76E);

ventral posteromedial area with longitudinal line of weakness; labrum with numerous spicules of labral lamella on two projecting lobes (Fig. 67C); mandible with three ventral teeth (Fig. 72E); lobes of labiohypopharynx joined by coloration (Fig. 73C); procerci widely separated (Fig. 76H) (New Zealand)..

.....New Zealand larval form, pg. 76

Dorsolateral stripes pale to medium brown (Fig. 76F); ventral posteromedial area with no longitudinal line of weakness (Fig. 64C); labrum with two to three spicules of labral lamella arising from cuticle (Fig. 68A); mandible with two ventral teeth (as in Fig. 72F); lobes of labiohypopharynx not joined by coloration (Fig. 73D); procerci placed more dorsally (Fig. 76G) (New Zealand).....

.....Harrisius pallidus Freeman, pg. 85

African Larval Form

Diagnosis. Dorsoventrally compressed head capsule, mandible with seta interna.

Description. Descriptive statistics: see Table 91.

Head capsule (Fig. 64A): medium brown; cuticular sculpturing not present dorsally except on labrum, fine sculpturing ventrally; dorsolateral stripe dark, originating at base of medial stripe; ecdysial lines well developed; ventral, posteromedial area with longitudinal line of marked weakness extending anteriorly, bifurcating to produce Y-shaped, pale stripe, this area with marked, posterior projection of pale cuticle; seta submenti anteroventral to paired ridges supporting labiohypopharynx (Fig. 64A); micropore not evident; posterior coronal pore canal very short, arising subapically on dorsolateral section of foramen.

Labrum (Fig. 67A): chaeta media in two groups, one lateral composed of elongate, slender, apically forked spicules and one ventral to S I, composed of shorter, simple spicules; S I pinnate; S II simple; S III simple; S I and labral lamella not on plate but with S I on weakly produced swelling; labral lamella with very short, peg-like spicules arranged on a medially divided, sclerotized bar; spicules of pecten epipharyngis arranged on apices of three elongate projections; chaetae lateralis elongate, slender, some very close

to pecten epipharyngis; premandible with three teeth, anterior tooth elongate, surpassing other teeth.

Antenna: only segment 1 available; with no cuticular weakened area close to campaniform organ.

Mandible (Fig. 72A): well developed seta interna; two ventral teeth present; posterior portion of adductor apodeme without dark pigmentation.

Labiohypopharynx (Fig. 73A): ligula not divided, rounded apically, with slight, apical indentation; shagreen on lobe very fine, not extending posteriorly as far as lateral edge of base of lobe; M appendage nearly as broad as ligula lobe, with very fine apical serrations; medial edge of labial palpus slightly developed.

Maxilla: base not fused to lateral edge of paralabial plate; SM1, SM2 lateral to paralabial plates.

Paralabial plate (Fig. 75A): not extending anteriorly as far as level of hypostomal teeth; rounded anterolaterally; anterior edge with concavity near lateral teeth of hypostoma; very fine striae present.

Hypostoma (Fig. 75A): 12 teeth, lateral most pair dorsal to penultimate teeth, and continuous with ridges supporting labiohypopharynx; apex of penultimate tooth visible from ventral aspect.

Procercus: arrangement of setae uncertain; composed of several filaments and small associated seta.

Anal papillae: exact dimensions uncertain but about as long as half total body length and with at least four constrictions; tracheation uncertain.

Distribution and bionomics: The single fourth instar larva was collected from Munwahuku stream, 36 km NNW of Salisbury, Zimbabwe, May 1963. A.D. Harrison (pers. comm.) noted that the larva was collected at Station 5 (Harrison, 1966) mining a dead submerged leaf of Syzygium cordatum (Myrtaceae) in this seasonally temporary stream. The larva constructed frass walls but other details of the mine are uncertain. Adults of two species of Stenochironomus were also reared from leaves of Syzygium cordatum: Stenochironomus polychaetus (1 male) and a new species (1 female). Phylogenetic inferences strongly suggest that this larva cannot be conspecific with the adults of either of these two Stenochironomus species.

Taxonomic discussion: Phylogenetically, this larva represents a lineage which is the sister group of all other species which have a mining adapted larval form (i.e. Xestochironomus, Harrisius pallidus, New Zealand larval form, Stenochironomus). As such it should be recognized as a separate, new genus. However, I am reticent to provide a formal name until the species has been reared. The pupa and adult male and female will provide much information for the

testing of relationships proposed in this study.

Saether (1977:167) has suggested that Collartiella Goetghebuer, a monotypic genus from Africa (Uganda, Zaire, South Africa) for which the immature stages are unknown, may be related to genera with mining adapted larvae. As such it would be possible for the larva described here to be Collartiella hirsuta Goetghebuer. However, A.D. Harrison (pers. comm.) has collected larvae of Collartiella from the Vaal River, Vereeniging, South Africa, in pupal cases of Hydropsychidae feeding on the pupae of Cheumatopsyche thomasetti and Amphipsyche scottae. He reports that "The larvae were pinkish red in colour, not clear red as in Chironomus, but their contents looked creamy as if they contained a lot of fat. The heads were not flattened as in Stenochironomus". The larva described here, therefore, cannot be referred to Collartiella.

Xestochironomus Sublette and Wirth

Xestochironomus Sublette and Wirth 1972:7. Type species Chironomus (Stenochironomus) furcata Johannsen by original designation.

Insulanus Sublette 1967:546, not Fleutiaux 1933:286. Type species Chironomus (Stenochironomus) furcata Johannsen by original designation.

Diagnosis. Male: antepnotum reduced; scutum anteriorly projecting; medial face of gonostylus with patch of spicules. Female: thorax as for male; no large groups of setae on frons; wing membrane bare of macrotrichia, tibial spurs not completely fused. Pupa: respiratory organ with many branches and a non-bifurcating horn, spicules present on T VII and VIII; spur on S VIII uniformly brown. Fourth instar larva: head capsule dorsoventrally compressed; mandible without seta interna; anal papillae markedly elongate, with 2 or more constrictions.

Description. Adults. Head: antennal hairs pale to dark brown; palpus pale to brown; eyes not metallic; frontal setae sparse; female with flagellomere six dark.

Thorax: pale to variably marked; anterior margin rounded to somewhat angled in lateral aspect.

Legs: pigmentation pale to variably darkened; tibial combs not fused,

closely approximated basally (Fig. 51A; B); in life, forelegs held almost posteriorly (Fig. 52A).

Wings: pale to entirely slightly darkened; no macrotrichia on wing membrane; halter pale to dark brown.

Male genitalia: in lateral aspect, basal 2/3 of dorsal edge of anal point slightly to markedly convex, apex gradually to abruptly bent ventrally, apex parallel-sided to bulbous in dorsal aspect; lateral margins of base of anal point weakly to moderately produced, originating apically or very near apex of T IX, widely diverging; posterior edge of T IX truncate to somewhat rounded, ventral portion with row of slender setae; dorsal patch of setae with elongate arrangement; appendage 1 elongate, base setiferous, swollen with one seta present on elongate portion; elongate portion hooked or curved; appendage 2 slender to swollen subapically, nearly circular in cross-section, with setae scattered on dorsal surface, with one apical or subapical elongate seta directed posteriorly; at least one subapical seta forked at apex; gonostylus with medial face bearing patch of spicules; gonocoxal apodeme pointed to rounded to truncated anteriorly, with slight expansion.

Female genitalia: setal patch on S VIII extending posteriorly to about level of cleft around opening of oviduct and bordered medioposteriorly by at most very weakly produced ridges; ventrolateral lobe weakly developed, cleft between dorsomesal and ventrolateral lobes of S VIII poorly developed, shallow to

semicircular ventrally; spicules of ventrolateral lobe short to long; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX short to elongate, slender to broad from dorsal aspect, tapering to ending bluntly posteriorly, straight to slightly curved.

Pupa.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: respiratory organ tripartite, an anterior and a posterior trunk, each ending in numerous filaments, and a simple median horn (Fig. 54A); horn of moderate length and thickness; horn slightly fused with anterior stalk, common base thus equal in length to about 4-5 times basal width of free portion of horn; filaments thick, unforked beyond origin on trunks near to base of respiratory organ.

Abdomen: uniformly pale brown except for narrow dark stripes on lateral margins of segments, spicules present on T II-VIII, S I-V (weakly produced, in some not apparent), S VI-VII, anal lobe, and in some specimens on S VIII; anterior spicules on T IV with single point; spicules on T VIII restricted to anterolateral area and posterior 1/3 of tergite (Fig. 58A); fine spicules (pedes spurii A) absent; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches; anterior spicules on T II, III slightly larger than posterior spicules (Fig. 56B); posterior margin of T II with row of small hooklets approximately equal in length to

spicules just anterior of row, restricted to median area of tergite, continuous medially or with median gap equal to width of, at most, 5-6 hooklets; spur of S VIII with teeth medium brown, with 1-3 large elongate teeth, 2-6 elongate smaller teeth more than $1/4$ length of largest tooth and, in some specimens, a few additional smaller teeth (Fig. 59C, D); in dorsal aspect, 2-3 teeth arranged in a row, the rest scattered; male genital lobe extending posteriorly past apex of swim paddle. Pupae of the two species for which observations are available only partially slough off the larval exuviae so that the larval head capsule is positioned about half way down the abdomen (as in Fig. 52D).

Larva

Body pale reddish-pink in live individuals; head capsule (Fig. 64B) medium to dark brown; fine cuticular sculpturing present dorsally and ventrally but reduced or absent on about posterior half of head capsule; dorsolateral stripe dark, originating on at least anterior $2/3$ of medial stripe and extending markedly anteriorly, almost merging with weak ridges extending posteriorly from dorsal mandibular articulation; ecdysial lines not present; ventral, posteromedial area with no longitudinal line of weakness or with ventrolateral margins of postoccipital carina extending slightly anteriorly before merging, producing a narrow V-shaped gap; this area with very slight posterior projection of pale cuticle or none; seta submenti lateral to paired ridges supporting labiohypopharynx; micropore present or absent (varying intraspecifically), located posterolaterally to, to

posteromedially to, seta submenti; posterior coronal pore canal very long, arising apically on dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (Fig. 67B): chaeta media in single, laterally placed group of elongate, slender, spicules with some forked apically, most laterally placed spicule blade-like, large; S I pinnate; S II simple or pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules arising from cuticle in a continuous, undivided row or divided into two groups; spicules of pecten epipharyngis simple, short, arrayed in row, grouped medially; chaetulae lateralis, elongate, grouped laterally; premandible with uncertain number of teeth.

Antenna (Fig. 71A): cuticular weakened area close to campaniform organ; antennal blade extending apically past segment three.

Mandible (as in Fig. 72E): seta interna absent; two ventral teeth present; posterior portion of adductor apodeme without dark pigmentation.

Labiohypopharynx (Fig. 73B): ligula divided into two lobes, joined by continuous pigmentation extending posteriorly past medial cleft, each squared to somewhat circular; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; M appendage narrow, apically forked; medial edge of labial palpus markedly developed.

Maxilla: not fused to lateral edge of paralabial plate; SM1, SM2 placed posterolaterally to paralabial plates (Fig. 75B).

Paralabial plate (Fig. 75B): extending anteriorly to about level of hypostomal teeth; rounded anterolaterally, anterior edge with marked concavity near lateral teeth of hypostoma; no striae present; some scattered spicules present.

Hypostoma (Fig. 75B): eight teeth, most lateral ones continuous with edge of paralabial plate.

Procerus: widely spaced, of several filaments and smaller associated seta.

Anal papillae: markedly elongate, slender, dorsal pair with two to four constrictions, ventral pair with two or three constrictions; with many tracheae.

Distribution and bionomics: Xestochironomus species are known only from the New World and have been recorded from Peru, Venezuela, the Caribbean Islands, Florida, South Carolina, Texas and New Mexico. Larvae mine wood in a similar way to those of the wood mining species of Stenochironomus (see also details under Xestochironomus subletti) and are recorded only from lotic habitats.

Taxonomic discussion: Adult Xestochironomus have been described by Sublette (1967:546) and Sublette and Wirth (1972). Seven species

have been previously recognized. These are included in the key but are not redescribed here. The generic description by Sublette and Wirth (1972) includes three character states which warrant further comment: 1) "Mesonotum not as conical and not produced as a anteriorly over head as in Stenochironomus"; I have been unable to confirm any difference between Xestochironomus and Stenochironomus. 2) "Wing with squamal fringe present but reduced". This character seems to hold only for some species where the setae that make up the fringe are reduced in size and number but I am unsure whether this character is correlated with size of the individual. However, I have not yet investigated interspecific differences; 3) "Dististyle.....with various distal modifications involving the prolongation of a tapering distal point bearing an apical seta and the development of a spiculate mesial lobe which may become long and thumblike". As I have described the genus here, this condition is now limited to a species group within Xestochironomus. In addition, this character state did not apply to all species originally included in the genus (not in X. dominicanus) by Sublette and Wirth (1972).

A larva of Xestochironomus from Peru has been described by Roback (1966:333) as Stenochironomus sp.3^r (redescribed here as Xestochironomus larval form one). The larvae collected in northeastern Brazil by Lenz (1957:180) with "abnormally long and multisegmented anal papillae" can probably be referred to a Xestochironomus species.

Available evidence suggests that the immature instars of Xestochironomus species are morphologically similar. Larvae of the three (perhaps four) available species are distinguished on the basis

of a few meristic characteristics. Pupae may also show little morphological variability as I was able to discover only one overlapping difference between the pupae of X. sublettii and X. brunneus.

KEY TO MALE ADULTS OF XESTOCHIRONOMUS

The following key is based on that by Sublette and Wirth (1972) modified to include the new species as well as the seven species known at that time.

1. Scutum uniformly pale yellow or with light brown markings restricted to lateral vittae; legs uniformly pale yellow, apex of fore femur and entire fore tibia and tarsus sometimes brownish.....2
- Scutum yellow with brown markings; legs usually with brown markings.....8
- 2(1) Male gonostylus with simple, tapering apex.....3
- Male gonostylus with apex forked or drawn out into slender distal point and with concavity near apex...7
- 3(2) Postnotum and at least some abdominal tergites with pigmentation.....4

- Postnotum and abdominal tergites with no pigmentation.....6

4(3) Anal point parallel-sided; appendage 1 with apex somewhat swollen, setae near mid-length of elongate portion (Venezuela).....bulbosus n. sp., pg. 62

- Anal point with bulbous apex; appendage 1 with apex not swollen, setae at bend of apical hook.....5

5(4) Lateral vittae light brown; nearly entire postnotum brown (Dominica).....dominicanus Sublette and Wirth, see Sublette and Wirth 1972:10

- Lateral vittae pale; postnotum with two dorsal patches of brown (Venezuela).....latilobus n. sp., pg. 71

6(3) Anal point nearly parallel-sided; appendage one with 70° bend near mid-length of elongate portion; elongate seta on appendage 2 situated subapically (Venezuela).....gilvus n. sp., pg. 65

- Anal point with markedly bulbous apex; appendage one with strong apical hook; elongate seta on appendage 2 situated apically (Fig. 29A) (New Mexico, western Texas).....sublett1 n. sp., pg. 58

7(2) Male gonostylus with apex deeply cleft into a spiculate thumblike medial lobe half as long as

tapering slender distal lobe (Dominica).....

.....luteifurcatus Sublette and Wirth,

see Sublette and Wirth 1972:14

- Male gonostylus not cleft, but with apex bearing
a slender distal point and a bluntly rounded,
spiculate, subapical medial lobe (Dominica, Jamaica).

.....hobbsi Sublette and Wirth,

see Sublette and Wirth 1972:13

8(1) Wing with light pigmentation over midportion and at
apex; halter brown; legs with prominent brown bands..

.....9

- Wing uniformly grayish or pale brownish; halter pale;

legs not banded.....10

9(8) Abdomen with prominent pattern of broad brownish
cross bands on tergites; hind tarsus uniformly pale;
male gonostylus not forked apically (Jamaica, Panama)

.....comptus Sublette and Wirth, /

see Sublette and Wirth 1972:9)

- Abdomen with narrow brownish bands on tergites;

first to third hind tarsomeres with median dark

bands; male gonostylus markedly forked apically

(Puerto Rico).....nebulosus Sublette and Wirth,

see Sublette and Wirth 1972:15

10(8) Abdomen uniformly straw yellowish (Dominica).....

-flintii Sublette and Wirth,
see Sublette and Wirth 1972:10
- Abdomen with dark crossbands on tergites.....11
- 11(10)Gonostylus forked apically; anal point parallel-
sided in dorsal aspect (Puerto Rico).....
-furcatus Sublette and Wirth,
see Sublette and Wirth 1972:12
- Gonostylus simple apically; anal point with bulbous
apex (Fig. 29B) (New Mexico).....brunneus
n. sp., pg. 67

KEY TO PUPAE OF NEARCTIC XESTOCHIRONOMUS SPECIES

1. Respiratory organ horn length/length of tergite II
= 0.57-0.74 (New Mexico)....brunneus n.sp., pg. 67
- Respiratory organ horn length/length of tergite II
= 0.33-0.64 (New Mexico, western Texas).....
-sublettii n. sp., pg. 58

KEY TO FOURTH INSTAR LARVAE OF NEARCTIC XESTOCHIRONOMUS SPECIES

A number of larvae from Florida and a single third instar from North Carolina are not included in the key because the poor condition of the material did not allow accurate measurement. These larvae may be conspecific with the species treated here or may represent new species.

1. Head capsule length = 446-533 u; distance of
antennal seta from base/length of antennal segment
one = 0.59-0.63; distance between lateral margins
of paralabial plates/head capsule anterior width =
0.67-0.72 (New Mexico).....

.....brunneus n. sp., pg. 67

- Head capsule length = 369-436 u; distance of
antennal seta from base/length of antennal segment
one = 0.46-0.58; distance between lateral margins
of paralabial plates/head capsule anterior width =
0.71-0.77 (New Mexico, western Texas).....

.....sublettii n. sp., pg. 58

Xestochironomus subletti n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype Xestochironomus subletti Borkent, Las Moras Creek, Fort Clark Springs, Texas, 1-IV-1981, A. Borkent"; allotype with associated pupal and larval exuviae, each on separate microscope slides labelled as for holotype; paratypes: 49 males, 74 females, 3 pupae, 81 pupal exuviae, 54 larvae, 6 larval exuviae, labelled as for holotype; 77 males, 41 females, 50 pupal exuviae, 4 larval exuviae, on microscope slides, labelled "Xestochironomus subletti Borkent, San Felipe Springs, Del Rio, Texas, 1-IV-1981, A. Borkent", 1 male, 1 larva, labelled "Xestochironomus subletti A Borkent, Guadalupe R. at Hwy. 90, 3 mi. W. Seguin, Texas, 1-IV-1981, A. Borkent" (CNC), 2 males on microscope slides, labelled "Xestochironomus subletti Borkent, San Felipe Spgs., Del Rio, Tex., 9-VI-60", 1 male, on a microscope slide, labelled "Guadalupe R., New Braunfeld, Tex. 10-VI-60" (JESu).

Diagnosis. Male: thorax and abdomen with no dark pigmentation; gonostylus with simple, tapering apex, anal point with markedly bulbous apex. Female: only Nearctic species with pale thorax and abdomen. Pupa: similar to that of X. brunneus, see key to pupae. Fourth instar larva: distinguished as indicated in key.

Description. Male adult. Descriptive statistics: see Table 1.

Head: antennal hairs pale brown; palpus pale.

Thorax: lacking dark pigmentation.

Legs: pigmentation poorly defined, distributed as follows (Fig. 17A): apical 0.22-0.47 of fore femur light brown, entire fore tibia and tarsus dark brown.

Wings: lacking dark pigmentation.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 29A): in lateral aspect basal 1/3 of dorsal edge of anal point straight to slightly concave, apex abruptly bent ventrally (Fig. 39A), apex markedly bulbous in dorsal aspect, lateral margins of base of anal point weakly produced, originating very near apex of T IX; slightly diverging; posterior edge of T IX markedly truncate in dorsal aspect; appendage 1 with strong apical hook, seta situated near mid-length of elongate portion; appendage 2 swollen subapically, with elongate seta situated apically, most specimens with one subapical seta forked near apex; gonostylus simple, gradually tapering apically; gonocoxal apodeme rounded anteriorly.

Female adult. As for male except as follows: descriptive statistics:

see Table 56.

Legs: pigmentation poorly defined, distributed as follows: apical 0.25-0.48 of fore femur light brown, entire fore tibia and tarsus dark brown.

Genitalia (Fig. 46A): cleft between dorsomesal and ventrolateral lobes of S VIII semicircular dorsally, slightly concave ventrally; spicules of ventrolateral lobe of S VIII short; posterior apodeme of S IX short, tapering at apex.

Pupa. As for X. brunneus; see generic description; descriptive statistics: see Tables 88-90.

Larva. Descriptive statistics: see Table 92.

Distribution and bionomics. This species has been recorded from southern New Mexico and Western Texas (Fig. 82A). Immatures were all collected from submerged, dead wood in lotic habitats. Most mining larvae were close to the surface of the wood but always under a firm layer. Some larvae were in softer (further decayed) wood sometimes deeper in the branch or log, unlike any Stenochironomus larvae I have collected. Pieces of wood containing Xestochironomus were firmly attached to the bottom of bank of the stream or river, rarely as at San Felipe Spring, Del Rio, Texas, they were lying freely on the bottom but were too heavy to be moved by currents. Larval posture, feeding behaviour, details of the pupal chamber and emergence are

similar to that described for wood mining Stenochironomus.

Derivation of specific epithet. The name subletti is proposed in honor of Dr. J.E. Sublette (Portales, New Mexico) who first discovered Xestochironomus in North America and is one of the original describers of the genus.

Xestochironomus bulbosus n. sp.

Type information: Holotype, male adult on microscope slide, labelled "Holotype Xestochironomus bulbosus Borkent, Yacambu National Park, Lara, Venezuela, 1200 m, 10-V-1981, H. Townes, malaise trap"; 1st allotype and 7 paratypes, female adults on microscope slides labelled as for holotype (CNC).

Diagnosis. Male: scutum with no dark pigmentation; postnotum and posterior margins of abdominal tergites II-IV with pigmentation; anal point parallel-sided. Female: not enough species are known to present an adequate diagnosis.

Description. Male adult. Descriptive statistics: see Table 2.

Head: lacking dark pigmentation.

Thorax: pigmentation (as in Fig. 1B; 5B) restricted to two light brown patches on postnotum.

Legs: lacking dark pigmentation; fore tarsus missing.

Wings: lacking dark pigmentation.

Abdomen: pigmentation well defined (as in Fig. 26B); present on posterior margins of T II-IV.

Genitalia: in lateral aspect basal 2/3 of dorsal edge of anal point slightly convex, apex gradually bent ventrally (Fig. 39B), apex with parallel sides from dorsal aspect, originating on apex of T IX; posterior edge of T IX rounded in dorsal aspect; appendage 1 with strong apical hook, swollen at apex, seta situated about mid-length of elongate portion on slight projection; appendage 2 swollen subapically, with elongate seta situated subapically, several subapical setae forked near apex; gonostylus simple, gradually tapering apically; gonocoxal apodeme truncated anteriorly.

Female adult. As for male except as follows: descriptive statistics: see Table 57.

Legs: pigmentation dark brown, well defined, distributed as follows: apical 0.17-0.21 of fore femur; entire fore tibia, entire fore tarsus.

Abdomen: pigmentation well defined, restricted to posterior margin of T II-IV.

Genitalia: cleft between dorsomesal and ventrolateral lobes of S VIII semicircular; spicules of ventrolateral lobe of S VIII of moderate length; posterior apodeme of S IX short, broad basally, tapering (as for X. sublettii, Fig. 46A).

Distribution. This species is known from Venezuela (Fig. 85, locality 3).

2

Taxonomic discussion. All the material was initially examined in alcohol and was subsequently mounted on microscope slides. The association of males with females (see discussion under X. latilobus) is tenuous in view of the markedly darker foreleg of the female.

Derivation of specific epithet. The name bulbosus refers to the bulbous apex of appendage 1 of the male adult.

Xestochironomus gilvus n. sp.

Type information: Holotype, male adult on microscope slide, labelled "Holotype Xestochironomus gilvus Borkent, Yacambu National Park, Lara, Venezuela, 1200 m, 10-V-1981, H. Townes, malaise trap"; 1 paratype, male adult on a microscope slide labelled as for holotype (CNC).

Diagnosis. Male: thorax and abdomen with no dark pigmentation; gonostylus with simple, tapering apex; anal point parallel-sided.

Description. Male adult. Descriptive statistics: see Table 3.

Head: lacking dark pigmentation.

Thorax: dark pigmentation absent except postnotum very pale brown.

Legs: lacking dark pigmentation.

Wings: lacking dark pigmentation.

Abdomen: lacking dark pigmentation.

Genitalia: in lateral aspect basal 2/3 of dorsal edge of anal point convex, apex gradually bent ventrally (Fig. 39C), apex with nearly parallel sides, only slight expansion, anal point originating on apex of T IX; posterior edge of T IX markedly truncate in dorsal aspect;

appendage 1 markedly elongate, with bend of about 70° at about half length of elongate portion, seta situated near bend; appendage 2, swollen subapically, with elongate seta situated subapically, several subapical setae forked near apex; gonostylus simple, gradually tapering apically; gonocoxal apodeme pointed anteriorly.

Female adults, pupae and larvae. Unknown.

Distribution. This species is known from Venezuela (Fig. 85, locality 3).

Taxonomic discussion. I initially examined the specimens in alcohol before they were dissected and mounted on slides.

Derivation of specific epithet. The name gilvus refers to the pale yellow coloration of adults of this species.

Xestochironomus brunneus n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype Xestochironomus brunneus Borkent, Pecos River, at Hwy 70, New Mexico, 4-IV-1981, A. Borkent"; allotype with associated pupal and larval exuviae, each on separate microscope slides labelled as for holotype; paratypes: 58 males, 11 females, 21 pupal exuviae, 10 larvae, 15 larval exuviae, labelled as for holotype, 3 males, 5 females, 7 pupal exuviae, labelled "Xestochironomus brunneus Borkent, Black River at Hwy 258, Eddy Co., New Mexico, 2-IV-1981, A. Borkent" (CNC), 9 males, on microscope slides, labelled "Rio Grande River, Otow. Bridge between Sante Fe and Los Alamos, N.M., 16-VII-1976, sweep net", 1 male, on a microscope slide, labelled "New Mexico, San Juan Co., San Juan River at Bridge 1 mi. W San Juan Hospital, 18-VII-1976, sweep net, Sta.F", 1 male, on a microscope slide, labelled "Xestochironomus brunneus Borkent, New Mexico, Catron Co., San Francisco River, Frisco Hot Spgs., 10-VII-1974, sweep net, Sta. H" (JESu).

Diagnosis. Male: with brown pigmentation; halter pale; abdomen with pigmentation on tergites; anal point with bulbous apex. Female: only Nearctic species with pigmentation on thorax and abdomen. Pupa: similar to that of X. subletti, see key to pupae. fourth instar larva: distinguished as indicated in key.

Description. Male adult. Descriptive statistics: see Table 4.

Head: antennal hairs dark brown; palpus pale brown.

Thorax: pigmentation pale to dark, confined to the following areas (Fig. 1A, 5A): medioanepisternum, dorsal portion of postanepisternum, portion of mesepimeron, ventral portion of katepisternum, posterior portion of lateral vittae, posterior portion of median vittae, and nearly entire postnotum.

Legs: pigmentation poorly defined, distributed as follows (Fig. 17B): apical 0.21-0.41 of fore femur, entire fore tibia and tarsus dark brown; apex of mid femur, entire mid tibia and tarsus medium brown; apical 0.14-0.54 of hind femur, and entire hind tibia and tarsus medium brown.

Wings: entire membrane somewhat smoky; halter pale.

Abdomen: pigmentation poorly to moderately defined (Fig. 26A): confined to posterior portions of T I-VI.

Genitalia (Fig. 29B): in lateral aspect basal 1/3 of dorsal edge of anal point straight to slightly concave, apex abruptly bent ventrally (Fig. 39D), apex bulbous from dorsal aspect, lateral margins of base of anal point weakly produced, originating near apex of T IX, slightly diverging; posterior edge of T IX markedly truncate

in dorsal aspect; appendage 1 with strong apical hook, seta situated near bend of hook; appendage 2 swollen subapically, with elongate seta situated apically, most specimens with one subapical seta forked near apex; gonostylus simple, gradually tapering apically; gonocoxal apodeme rounded anteriorly.

Female adult. As for male except as follows: descriptive statistics: see Table 58.

Thorax: pigmentation as for male except sometimes entire median vittae pale brown.

Abdomen: pigmentation poorly to moderately defined: confined to posterior portions of T I-IV, and in some specimens, T V.

Genitalia: cleft between dorsomesal and ventrolateral lobes of S VIII semicircular dorsally, slightly concave ventrally; spicules of ventrolateral lobe of S VIII short; posterior apodeme of S IX elongate, broad for most of length (similar to Fig. 49D).

Pupa. As for X. subletti; see generic description; descriptive statistics: see Tables 88-90.

Larva. Descriptive statistics: see Table 93.

Distribution and bionomics. This species has been recorded from New Mexico (Fig. 82B). I have examined three males from the Guadalupe

River, New Braunfels, Texas, 10-VI-1960, which are very similar to the material described here (JESu). However, they were badly damaged and I cannot be certain of their identification.

Larvae were collected from the dead, submerged, trailing roots of Tamarix on the banks of the Pecos River at Hwy. 70, New Mexico. Bionomic characteristics were similar to those recorded for Xestohironomus subletti.

Derivation of specific epithet. The name brunneus, refers to the brown markings present on the thorax and abdomen of adults of this species.

Xestochironomus latilobus n. sp.

Type information: Holotype, male adult on microscope slide, labelled "Holotype Xestochironomus latilobus Borkent, Yacambu National Park, Lara, Venezuela, 1200 m, 10-V-1981, H. Townes, malaise trap"; 1 allotype and 1 paratype, female adults on microscope slides labelled as for holotype (CNC).

Diagnosis. Male: scutum pale but postnotum and abdominal tergites II-V with dark pigmentation; gonostylus with simple, tapering apex; anal point with bulbous apex. Female: not enough Xestochironomus species are known in this stage to present an adequate diagnosis.

Description. Male adult. Descriptive statistics: see Table 5.

Head: lacking dark pigmentation.

Thorax: pigmentation (Fig. 18, 5B) restricted to two medium brown patches on postnotum.

Legs: pigmentation well defined, distributed as follows (Fig. 17C): apical 0.18 of fore femur, entire fore tibia and tarsus.

Wings: lacking dark pigmentation.

Abdomen: pigmentation well defined (Fig. 26B); present on posterior

margins of T II-V.

Genitalia: in lateral aspect basal 2/3 of dorsal edge of anal point straight, apex gradually bent ventrally (Fig. 39E), apex bulbous from dorsal aspect, originating on apex of T IX; posterior edge of T IX somewhat truncated in dorsal aspect; appendage 1 with strong apical hook, seta situated near bend of hook; appendage 2 swollen subapically, with elongate seta situated apically, several subapical setae forked near apex; gonostylus simple, gradually tapering apically; gonocoxal apodeme rounded anteriorly.

Female adult. As for male except as follows: descriptive statistics: see Table 59,

Head: palpus not present.

Legs: pigmentation well defined, distributed as follows: apical 0.85 of fore femur, entire fore tibia and tarsus.

Wing: lightly pigmented in area of r-m, fork of Cu and extreme apex of wing (similar to Fig. 15C).

Abdomen: pigmentation well defined, restricted to posterior margin of T II-IV.

Genitalia: cleft between dorsomesal and ventrolateral lobes of S VIII shallow, poorly defined; spicules of ventrolateral lobe of S

VIII long; posterior apodeme of S IX elongate, slender, tapering (similar to that shown for S. unictus).

Distribution. This species is known from Venezuela (Fig. 85, locality 3).

Taxonomic discussion. All the material of X. latilobus and X. bulbosus was retrieved from alcohol samples collected with a malaise trap. The association of males and females of each of the two species was based on correspondence of degree of pigmentation of the postnotum. It should be noted that the female of X. latilobus exhibited weak wing pigmentation and the male had unpigmented wings. In my experience this difference could be exhibited by a single species (as treated here) but in fact the males and females may be incorrectly associated.

The male genitalia of this species are very similar to those of X. dominicanus. Differences in thoracic coloration, however, suggest that they are not conspecific.

Derivation of specific epithet. The name latilobus refers to the broad (latus) anal point (lobus) of male species of this species.

Xestochironomus larval form one

Descriptive statistics: See Table 94.

Distribution and bionomics. The single fourth instar larva was collected from the Monzon River, near Tingo Maria, Peru (Fig. 85, locality 10) on 27-IX-1955. The larval gut was filled with wood particles, indicating that this larva was a wood miner.

Taxonomic discussion. Roback (1966:333) provided a brief description of this larva (as Stenochironomus sp.3).

Material examined. The single larva was borrowed from ANSP.

Xestochironomus larval form two

Descriptive statistics: see Table 95.

Distribution and bionomics. Fourth instar larvae were collected in northern Florida: Eskambia River, near Pensacola; Blue Spring Run, near Apalachicola; Waddells Mill Cr., Jackson Co.; and Withlacooche R., Suwannee Co.. One larva was collected from Georgia, 134 miles upstream from the mouth of the Savannah River at Ring Jaw Point. A single third instar came from the Wateree River, near Camden, South Carolina on 31-VIII-1958. Several larvae from Florida had wood particles in their gut, indicating a wood mining habit.

Taxonomic discussion. It is uncertain whether the larvae described here are conspecific, or if they are specifically distinct from X. subletti or X. brunneus. Differences in ant. seg 1 seta/L suggests lack of conspecificity with X. brunneus. I could discover no other characters which would suggest lack of conspecificity. However, on the basis of all the material before me, it seems that morphological differences between Xestochironomus fourth instar larvae are small, so that in fact these larvae may be that of a third undescribed species.

New Zealand larval form

Diagnosis. Dorsoventrally compressed head capsule; mandible with three (in some, an indication of a fourth) ventral teeth.

Description. Descriptive statistics: see Table 96.

Head Capsule (Fig. 76E): medium brown; fine cuticular sculpturing present dorsally and ventrally, somewhat coarser anterodorsally; dorsolateral stripes extremely pale, barely discernible, originating about half way down medial stripe; ecdysial lines weakly developed; ventral, posteromedial area with longitudinal line of weakness, with slight, posterior projection of pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx; micropore posterolateral to, to posterior to, seta submenti; posterior coronal canal very long, arising apically on dorsolateral section of foramen, directed anteriorly.

Labrum (Fig. 67C): chaeta media in single, laterally placed group of elongate, slender spicules with some forked apically, most laterally placed spicule blade-like, large; S_I pinnate, S_{II} pinnate, S_{III} simple; S_I and labral lamella on semicircular plate; labral lamella with 5-16 spicules arising from projecting pair of lobes; spicules of pecten epipharyngis simple or forked, of moderate length, arrayed in row, extending laterally, in some with medial three or four spicules stout, with wide bases; chaetae lateralis, elongate, grouped

laterally; premandible with four teeth, anterior tooth not elongate, not extending past penultimate tooth.

Antenna (Fig. 71C): cuticular weakened area close to campaniform organ; antennal blade extending apically to about apex of segment two.

Mandible (as in Fig. 72F): seta interna absent; three ventral teeth present, in some an indication of a fourth; posterior portion of adductor apodeme without dark pigmentation.

Labiohypopharynx (Fig. 73C): ligula divided into two lobes, joined by continuous pigmentation extending posteriorly past medial cleft, each transversely broadened with edges somewhat truncated; shagreen on lobes fine, extending posteriorly to lateral edge of base of lobe; M appendage a narrow, markedly sclerotized, elongate plate; medial edge of labial palpus weakly developed.

Maxilla: fused to lateral edge of paralabial plate; SM1, SM2 placed posterolaterally to paralabial plate (Fig. 75C).

Paralabial plate (Fig. 75C): extending anteriorly to about level of hypostomal teeth; fusion with maxilla resulting in bilobed margin anterolaterally; anterior edge nearly straight near lateral teeth of hypostoma; some striae present near, and perpendicular to suture of paralabial plate and maxilla; spicules arrayed in two to three rows.

Hypostoma (Fig. 75C): 12 teeth, most lateral ones continuous with ridges supporting labiohypopharynx, dorsal to penultimate teeth; apex of penultimate tooth not visible in ventral aspect.

Procercus (Fig. 76H): composed of several filaments and smaller associated seta; procerci widely spaced.

Anal papillae (Fig. 77C): somewhat elongate, with one constriction at midlength but with dorsal papillae exhibiting an additional, slight, subapical constriction; with few tracheae.

Distribution and bionomics: Larvae were collected 10 mi. NE of Kumara, New Zealand on 15-29-IV-1979. N.H. Anderson (pers. comm.) found the larvae mining dead submerged wood (probably Nothofagus). "The larvae were under about 1 mm of soft, fungal-stained wood and usually on a firm layer. They seemed to be positioned with the ventral side toward the exterior and frequently were curled in a C-shaped niche."

Taxonomic discussion. The larvae described here may be those of Ophryophorus ramiferus Freeman, a New Zealand species for which immature stages are unrecorded. The genus is monotypic and adults show some similarities to those of Xestochironomus, Harrisius and Stenochironomus: all adult characters given in "Description of Lineage of Stenochironomus Complex" are applicable to Ophryophorus. The tibial combs are fused at their bases but a partial gap is still evident.

Material examined. Six fourth instar larvae were first examined in alcohol and subsequently as slide mounted specimens from the locality given above. Some additional larvae were examined only in alcohol.

Harrisius Freeman

Harrisius Freeman, 1959:426. Type species Harrisius pallidus Freeman by original designation.

Diagnosis. Male and female: anteprenotum reduced; scutum anteriorly projecting; wing with numerous macrotrichia on membrane. Pupa: respiratory organ a simple stalk; spur present on S VIII; lateral setae on segments V-VIII: 4,4,4 and 5 respectively; cephalic tubercles absent; frontal setae absent. Fourth instar larva: head capsule dorsoventrally compressed; mandible with two ventral teeth, without seta interna; lateral tooth of hypostoma dorsal to penultimate tooth, 8 teeth thus easily counted.

Description. Adult. Head: antennal hairs pale to dark brown; palpus pale to brown; eye not metallic when reconstituted in ammonium hydroxide; frontal setae sparse; female with flagellomere six dark.

Thorax: pale to variably marked; anterior margin of scutum rounded to angular in lateral aspect (Fig. 13B, C).

Legs: pigmentation pale to apex of femur, entire tibia and tarsi of each leg darkened; tibial combs not fused, very closely approximated basally (Fig. 51C, D).

Wing: pale to somewhat darkened; macrotrichia present on wing

membrane; halter pale to dark brown.

Male genitalia (Fig. 29C): in lateral aspect basal 2/3 of dorsal edge of anal point slightly convex, apex not bent ventrally (Fig. 39F), apex parallel-sided in dorsal aspect; anal point arising from apex of T IX; posterior edge of T IX wedge-shaped with ventral row of slender setae; dorsal patch of setae with elongate arrangement; appendage 1 elongate, with setiferous swollen base and one seta present in some species on elongate portion; elongate portion hooked or curved; appendage 2 slender to swollen subapically, nearly circular in cross-section, with setae scattered on dorsal surface or restricted to dorsal surface near apex (Freeman 1959:fig.4a), with one apical elongate seta directed posteriorly or dorsally; at least one subapical seta forked at apex; medial surface of gonostylus without discrete patch of spicules; gonocoxal apodeme rounded to truncated.

Female genitalia (Fig. 46B, C): setal patch on S VIII extending posteriorly to or beyond level of cleft around opening of oviduct, sometimes bordered medioposteriorly by strong ridge; ventrolateral lobe undeveloped, very weakly developed or well developed, cleft between dorsomesal and ventrolateral lobes of S VIII poorly developed, shallow, or very narrowly U-shaped; ventrolateral lobe well developed, with long spicules or ventrolateral lobe poorly developed, with no markedly produced spicules; apodeme of S VIII straight to curved, ending at base of dorsomesal lobe or curved to fused with ridges posteromedial to setal patch; posterior apodeme of S IX short to elongate, broad in dorsal aspect.

Pupa and Larva. As described for H. pallidus, the only species of which immature stages are known.

Taxonomic discussion. Two species are presently recognized in the genus Harrisius: H. pallidus from New Zealand, and H. montanus from Australia. However, as indicated below under "material examined", more species await further collecting and description.

Two species of Harrisius have been previously recorded from Australia as Tanytarsus montanus Skuse and Tanytarsus cereolus Skuse. Freeman (1961:704) considered these to be variable forms of a single species, Harrisius montanus. For this study I had only three males and one female of H. montanus. However, I noticed some marked differences in male genitalia between a pigmented form (1 male) and a pale form (2 males). These probably represent 2 different species and are treated as such in the key to male adults provided here. Each may be referred to one of Skuse's (1889) two original descriptions. H. montanus (Skuse) was a pigmented form and H. cereolus (Skuse) a pale form. However, I have not accumulated or studied the additional material which is available in museums (see Freeman 1961:704) or confirmed identifications with type specimens. Accordingly I have not resurrected H. cereolus from synonymy. The single female of H. montanus I studied was referred to the pigmented form even though it was collected at the same place and date as a male of the pale form (Mosman, New South Wales, 9-III-1957). Finally, it should be noted that the pale form of S. montanus is very similar to S. pallidus and future research should consider the

possibility of their being conspecific (but note comments under H. pallidus).

Freeman (1959:426) noted in his generic description that the combs of the tibial spur are fused but in fact these are only closely approximated.

Material examined. I examined one male and one female of H. pallidus from New Zealand, three males and one female of H. montanus from Australia (but see above under taxonomic discussion) and two females from New Guinea, each representing a new species. All the specimens are in the BMNH. The number of specimens of immature stages examined, belonging only to H. pallidus, are recorded under that species.

KEY TO MALE ADULTS OF HARRISIUS

In the following key H. montanus is keyed out twice; see taxonomic discussion under the generic description (pg. XXX).

1. No pigmentation on scutum or abdomen; no seta on elongated portion of appendage 1; gonostylus only moderately swollen at midlength.....2
- Thorax and abdomen pigmented; seta present on elongated portion of appendage 1 (Fig. 29C); gonostylus markedly swollen at midlength (Fig. 29) (SE Australia).....montanus (Skuse), see

Freeman 1961:704

2(1) Appendage 2 with apical setae on end of rounded
apex; appendage 1 with setae distributed evenly on
medial edge of swollen base (SE Australia).....
.....montanus (Skuse), see

Freeman 1961:704

- Appendage 2 with apical setae on small protrusion;
appendage 1 with setae restricted to anteromedial
edge of swollen base (New Zealand).....pallidus

Freeman, pg. 85

Harrisius pallidus Freeman

Harrisius pallidus Freeman 1959:426. Stark 1981:66.

Diagnosis. Male: dark pigmentation absent on scutum or abdomen; appendage 1 with seta restricted to anteromedial edge of swollen base.

Description. Male adult.

Head, thorax, legs, wings and abdomen: lacking dark pigmentation.

Wing: $WL/M = 2.57$ ($n=1$).

Genitalia: appendage 1 with setae on swollen base restricted to anteromedial margin, elongate portion without seta, moderately curved; appendage 2 slender, with setae restricted to apical 1/3 and apical setae on small protrusion; gonostylus swollen subapically; $Gc/Gs = 1.19$ ($n=1$); $App\ 2/1 = 1.56$ ($n=1$).

Female adult. As for male except as follows: descriptive statistics: see Table 60.

Thorax: postnotum with pale dorsal pigmentation.

Genitalia (Fig. 46B): setal patch on S VIII extending posteriorly to

about level of cleft around opening of oviduct, bordered posteromedially by strong ridge; apodeme of S VIII somewhat curved to fuse with posteromedial ridge; posterior apodeme of S IX elongate.

Pupa. Descriptive statistics: see Tables 88-90.

Head Capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: respiratory organ simple, horn elongate (Fig. 54B).

Abdomen: pigmentation (of mature pupa) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on T II-VIII, S I-III (weakly produced), S IV in some specimens, V (weakly produced), usually also on anal lobe; anterior spicules on T IV with single point; spicules on T VIII restricted to anterolateral and median area; fine spicules (pedes spurii A) absent; T II and T III with spicules evenly spaced except for double pair of bare posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (Fig. 56A); posterior margin of T II with row of small hooklets approximately equal in length to spicules just anterior to row, restricted to medial area of tergite, continuous medially; spurs of S VIII with teeth dark brown, with one elongate tooth and 0-2 closely appressed, elongate, smaller, teeth (Fig. 59A, B); male genital lobe extending posteriorly past apex of swim paddle.

Larva. Descriptive statistics: see Table 97.

Head capsule (Fig. 64C): medium brown; very fine cuticular sculpturing present anterodorsally and ventrally; dorsolateral stripes pale to medium brown, originating about half way down medial stripe; ecdysial lines weakly developed; ventral, posteromedial area without longitudinal line of weakness, with slight, posterior projection of pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx; micropore posterolateral to, to posteromedial to, seta submenti; posterior coronal canal long, arising apically on dorsolateral section of foramen, directed anteriorly.

Labrum (Fig. 68A): chaeta media in single, laterally placed group of simple, very elongate, slender spicules with most laterally placed spicule blade-like, large; S I simple or pinnate; S II simple; S III simple; S I and labral lamella on semicircular plate; labral lamella with two to three spicules arising from cuticle, either closely approximated or somewhat separated; spicules of pecten epipharyngis simple, elongate, arrayed in row of two to three spicules, stout, with wide bases; chaetae lateralis elongate; grouped laterally; premandible with three teeth, anterior tooth not greatly elongate, extending just past apex of penultimate tooth.

Antenna (Fig. 71B): with no cuticular weakened area close to campaniform organ; antennal blade extending apically to about apex of segment two.

Mandible: seta interna absent; two ventral teeth present; posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 73D): ligula divided into two lobes, not joined by continuous pigmentation, each squared to somewhat circular; shagreen on lobes coarse, not extending posteriorly as far as lateral edge of base of lobe; M appendage narrow, somewhat sclerotized, elongate plate with apical serrations; medial edge of labial palpus weakly developed.

Maxilla: fused to lateral edge of paralabial plate; SM1, SM2 placed posterolaterally to paralabial plate (Fig. 75D).

Paralabial plate (Fig. 75D): extending anteriorly to about level of hypostoma teeth; fusion with maxilla resulting in bilobed margin anterolaterally; anterior edge nearly straight near lateral teeth of hypostoma; a few, weak striae present; spicules arrayed in a single row.

Hypostoma (Fig. 75D): 12 teeth, most lateral ones, continuous with ridges supporting labiohypopharynx, are dorsal to penultimate teeth; apex of penultimate tooth not visible from ventral aspect.

Procercus (Fig. 76G): placed more dorsally; composed of several filaments and with smaller associated seta.

Anal papillae (Fig. 77B): somewhat elongate, with one constriction at midlength but with dorsal papillae exhibiting an additional, slight, subapical constriction; with few trachae.

Distribution and bionomics. This species is broadly distributed in New Zealand. Larvae mine dead submerged wood (Anderson, pers. comm., Stark, 1981). The comments by Anderson, quoted under New Zealand larval form, also pertain to this species.

Material examined. Parts from 1 male (see below), 1 female, 2 pupae and 8 fourth instar larvae were examined. Immature stages were all from Middle Bush Stream, Cass, New Zealand.

Taxonomic discussion. The description of the male adult is partially based on that given by Freeman (1959:426). I had available only the wing, foreleg and genitalia of a single male. A single pharate female adult from Cass had very different genitalia from the female described above which was a paratype of H. pallidus from Ohakune. The ventrolateral lobe of the female from Cass was well developed, with long spicules and the cleft between the dorsomesal and ventrolateral lobes was narrowly U-shaped (Fig. 59B). These characteristics are unique within Harrisius. All other Harrisius females exhibited a very poorly developed ventrolateral lobe and a correspondingly shallow cleft between the dorsomesal and ventrolateral lobes. A pharate male adult from the same locality matched the description of the male genitalia given by Freeman (1959) from the type series. Nevertheless the material described here as

the pupa and larva of H. pallidus may in fact belong to another unnamed species.

Stark (1981), in a key to larval chironomids from New Zealand, noted that Harrisius pallidus larvae possess eight hypostomal teeth. That description differs from the one given here because the two dorsal, most lateral teeth are somewhat hidden and difficult to observe.

Stenochironomus Kieffer

Stenochironomus Kieffer 1919:44. Type species Stenochironomus fasciatus (Geoffroy) (= S. gibbus) by subsequent designation, Kieffer, 1922:56. Edwards, 1929:395. Goetghebuer, 1936:459, 1937:12. Townes, 1945:84, 1952:63. Chernovskii, 1949. Lenz, 1957:179. Preeman, 1957:409, 1961:705. Tokunaga, 1964:576.

Diagnosis. Male: antepnotum reduced, scutum anteriorly projecting; tibial spurs fused; appendage 2 elongate with setae arranged along dorsal margin. Female: reduced antepnotum; scutum anteriorly projecting; spurs tibial fused. Pupa: respiratory organ with many branches and a non-bifurcating horn; with or without spicules on abdominal T VII and VIII but, if present, spur on S VIII yellowish brown. Fourth instar larva: head capsule dorsoventrally compressed; mandible with two ventral teeth, without seta interna; lateral tooth of hypostoma dorsolateral to penultimate tooth, 10 teeth thus easily counted.

Description. Adult. Head: antennal hairs pale to dark brown; palpus pale to brown; eye metallic or non-metallic; female either with all flagellomeres dark or flagellomere six dark.

Thorax: pale to variably marked to darkly pigmented; anterior margin rounded to angular in lateral aspect.

Legs: variably pigmented; tibial combs fused (Fig. 51E, F).

Wing: pale to variably marked to entirely darkened; no macrotrichia present on membrane; halter pale to dark brown.

Male genitalia (Fig. 30-38): in lateral aspect basal 2/3 of dorsal edge of anal point slightly concave to markedly convex, apex straight to markedly bent ventrally (Fig. 39G-41), apex parallel-sided to bulbous in dorsal aspect; anal point arising subapically to apically from T IX; posterior edge of T IX wedge-shaped to markedly truncated with ventral row of slender or stout setae; dorsal patch of setae with elongate to transverse arrangement; appendage 1 short to elongate, variably sausage-shaped with setae arranged in a single longitudinal plane; appendage 2 markedly elongate, laterally compressed, with setae arranged along dorsal margin, apical seta elongate to stout, most basal setae shorter than more distal setae; medial surface of gonostylus without discrete patch of spicules; gonocoxal apodeme pointed to rounded to truncated.

Female genitalia (Fig. 47-50): setal patch on S VIII not extending posteriorly to, to extending past, level of cleft around opening of oviduct, sometimes bordered medioposteriorly by strong ridge; ventrolateral lobe weakly to well developed, variably shaped; cleft between dorsomesal and ventrolateral lobe of S VIII well developed, variably shaped; spicules on ventrolateral lobe short to long; apodeme of S VIII straight or curved, ending at base of dorsomesal lobe or curved to fuse with either ridges posteromedial of setal

patch or cleft around median oviduct; posterior apodeme of S IX short to elongate, variably shaped.

Pupa. Thorax: respiratory organ tripartite, an anterior and a posterior trunk, each ending in numerous filaments, and a simple median horn, horn partially fused to variable degree with anterior trunk in some species (Lehmann 1981 shows the respiratory organ of S. africanus as a simple horn); horn short to elongate, thin to thick; filaments thin to thick, unforked to partially to strongly forked near apex.

Abdomen: ranging from uniformly yellowish brown to pale brown, lateral margins of segments with narrow dark stripes; some species with additional markings; spicules present on T II-VI, S III, IV, in some species on T VII-VIII, S I, S II, S V-VII, anal lobe, and apex of swim paddle; anterior spicules on T IV with single to multiple pointed; spicules on T VIII, when present, restricted to either anterolateral area or to about posterior 2/3 of tergite; pedes spurii A present or absent, in some species, spicules present along entire margin of S IV, and in others, present also along margin of S II and III; T II, III with spicules evenly spaced except for double pair of bare posterior patches or with rounded, bare patches amidst spicules; anterior spicules on T II, III equal in size to, or markedly larger than, posterior spicules; posterior margin of T II with row of moderate-sized to large hooklets longer than spicules just anterior to row, restricted to median area to extending to lateral margins of tergite, continuous medially or divided into two groups of hooklets;

spur of VIII yellowish brown to dark brown, with teeth varying in arrangement, form and number; male genital lobe not reaching, to extending beyond, apex of swim paddle.

Larva. Body medium red in live individuals; head capsule light yellowish brown to dark brown, fine to coarse sculpturing present or absent; dorsolateral stripe light to dark, originating at base of dorsomedian stripe or on at least anterior 2/3 of dorsomedian stripe and extending anteriorly to level of about 0.6 of total head capsule length; ecdysial lines weakly to markedly produced; ventral, posteromedial area with or without longitudinal line of weakness and with moderate to marked posterior projection of pale cuticle; seta submenti positioned lateral or posterolateral to paired ridges supporting labiohypopharynx; micropore present or absent (intraspecifically variable), located anterolateral to, to posteromedial to, seta submenti; posterior coronal canal short to long, arising subapically or apically on dorsolateral section of postoccipital carina, directed anteromedially to anterolaterally.

Labrum: chaeta media in single, laterally-placed, group of elongate, slender spicules, some spicules forked apically, most laterally placed spicule blade-like, large; each of S I, S II and S III simple or pinnate; S I and labral lamellae on semicircular or elongate plate; labral lamella with 2 to numerous spicules, either arising from cuticle in a continuous, non-divided row, or divided into two groups, either arising directly from the cuticle or from projecting pair of lobes; spicules of pecten epipharyngis simple or forked,

elongate to peg-like, arrayed in a row, grouped medially or extending laterally; chaetae lateralis, grouped laterally, elongate except for one markedly stouter spicule; premandible with three or four teeth.

Antenna: with no cuticular weakened area close to campaniform organ; antennal blade extending apically to about apex of segment two (Fig. 71D).

Mandible: seta interna absent; two ventral teeth present; posterior portion of adductor apodeme with or without dark pigmentation.

Labiohypopharynx: ligula undivided or divided into two lobes, joined or not joined by continuous pigmentation, each lobe transversely broadened with edges somewhat truncated to elongate; shagreen on lobes very fine to scale-like, extending or not extending posteriorly as far as lateral edge of base of lobe; M appendage a narrow, weakly to markedly sclerotized, elongate plate with apical serrations on three to four stalks; medial edge of labial palpus weakly to moderately developed.

Maxilla: fused to lateral edge of paralabial plate; SM1, SM2 placed posterolateral to paralabial plate.

Paralabial plate: extending anteriorly to, to projecting markedly anterior to, level of hypostoma teeth; fusion with maxilla resulting in an anterolaterally bilobed or truncated margin; anterior edge

nearly straight near lateral teeth of hypostoma; a few, weak striae absent or present near hypostoma; spicules absent or present in a scattered, single row.

Hypostoma: 12 teeth, most lateral pairs, continuous with ridges supporting labiohypopharynx, are dorsal to penultimate teeth; apex of penultimate tooth visible in ventral aspect.

Procercus: placed more dorsally; composed of one to several filaments, with or without smaller associated seta.

Anal papillae: short to somewhat elongate, with 0-2 constrictions; with few tracheae.

Distribution and bionomics. The genus Stenochironomus is cosmopolitan, except that no species have been recorded above, north or south of treeline or from New Zealand.

Depending on the species, larvae mine either dead submerged wood, dead submerged leaves or the floating live leaves of Nelumbo. First instar larvae are free living and search out a suitable substrate, in which they construct a mine. The three food types are correlated with differences in behaviour. Further details are described in the section on collection techniques (pg. 8).

Wood mining Stenochironomus larvae may be found in permanent lotic or lentic habitats and occupy only wood which is firmly anchored and not susceptible to movement. In addition, larvae are almost always found in wood which exhibits a relatively clean

surface; deposits of any sort inhibit the presence of Stenochironomus larvae. Larvae generally only mine wood of angiosperm species. Finally, larvae occupy only wood which is of firm constitution.

Stenochironomus larvae mine wood in a characteristic fashion. Chambers are parallel to the wood surface and are straight in longitudinal section. Therefore, chambers run parallel to the grain in small branches; in large logs they may run perpendicular to the grain. The chamber of a 4th instar larvae may be 2-3 times the length of the larva. The chambers are generally about one millimeter deep, under a layer of firm wood or thin bark and above a firmer layer. The chambers have small straight slits in the covering layer, presumably to allow circulation of water through the chambers. By partially opening chambers I was able to observe larvae undulating their abdomens. Some of these slits also serve as exit holes for frass. Lateral extensions of the chamber are also packed with frass, leaving a relatively narrow passage for the larva to move in. The diameter of the open area of the chamber is generally about twice the diameter of the larval body.

Wood mining larvae generally are in a narrowly U-shaped posture with the posterior prolegs positioned just posterolateral to the head capsule. This position allows the larva to push the head forward, anchored by the posterior prolegs. Larvae extend their anterior prolegs to wedge their thoraces into the thin gap between the upper and lower surfaces of the chamber to anchor themselves, to allow forward and backward probing by the head capsule. Larvae generally feed with their ventral surface toward the outer surface of the wood. This may allow larvae to best exploit the presumably nutrient rich

cambium layer when mining wood with a bark layer.

Leaf mining larvae occupying dead submerged leaves are known from permanent lotic and lentic habitats, depending on the species. The leaves occupied by larvae must be immovable, either resting on the bottom in lentic habitats and slow moving streams or wedged into leaf packets in faster moving lotic habitats. Only certain leaves are occupied by Stenochironomus larvae. Leaves must be free of detritus and be exposed to open water. Silt, heavy algal growth on the leaf, or being buried under a heavy layer of leaves precludes the leaf from being inhabited. In addition, leaves must be of a certain thickness and constitution. Leaves which are too thin do not contain leaf miners.

Leaf miners form characteristic patterns in the leaves. Larvae build two elongate, parallel, frass "walls", bound by silk, which form a channel about twice the diameter of the larval body. These are composed of frass and silk. Larvae mine between the upper and lower epidermal layers of the leaf. Feeding posture is similar to that of wood miners but larvae seem indifferent to a particular upright or upside down position. Feeding takes place in the open area beyond the end of the frass "walls". Leaf miners feed in a similar way to the wood miners (see above). Larvae are in a narrowly U-shaped posture with the thorax wedged between the leaf surfaces, close to the edge of the chamber margin, to allow probing with the head capsule.

The frass walls in the chamber may function for at least two purposes. Periodically, or when oxygen levels are reduced, larvae assume an elongate posture in the frass tube, expand their thoraces

dorsoventrally to wedge themselves between the upper and lower layers of the chamber and rapidly undulate their abdomens, presumably to drive water through the tube and thus increase oxygen concentrations. Secondly, larvae, as they mature, expand the distance between the upper and lower epidermal layers of the leaf, resulting in a blistering of the upper epidermal layer. However, as described below, larvae require contact with an upper and lower surface to move along the frass tube and to feed. The frass walls function to keep the epidermal layers separated at a particular distance to allow larval locomotion and feeding.

Tokunaga and Kuroda (1935) have recorded the mining habits of S. nelumbus in the floating leaves of Nelumbo. It is the only known Stenochironomus species to mine live plant tissues. The mode of feeding is similar to that of species which mine dead leaves, in that two frass walls are constructed. Larvae mine only the upper mesenchyme, just below the upper epidermal layer of the leaf. Direction of the mine generally extends outward from the centre of the leaf. Tokunaga and Kuroda (1935:fig. 15) show a larva feeding while in an elongate posture, unlike other Stenochironomus larvae.

Movement of larval mouthparts were observed for S. unictus fourth instar larvae placed under a coverslip in a well slide with chips of wood. Mandibles abducted synchronously to a position where the inner face of each mandible were parallel. The head capsule was then pushed forward to grab at the wood surface. Simultaneously the labiohypopharynx was withdrawn and the labrum extended. The labral armature spread out in an extended fashion. As the mandibles adducted or the labiohypopharynx moved anteriorly and the labrum

posteriorly. After a wood chip is in the oral cavity it moves very rapidly down the crop to a region in the gut just posterior to the anterior prolegs. All wood miners had small pieces of wood in their guts and the combined action of these mouthparts presumably aid in ensuring that only small pieces are ingested. Of all mining larvae observed, the gut was always packed with food material. Larvae secrete silk but I am unsure how, or if, this relates to feeding. Silk is used by leaf miners in building the frass walls and by all larvae in preparation for pupation.

Larval locomotion of both wood and leaf miners is characterized by two types of movement. When a larva was disturbed from a normally U-shaped posture it would either straighten out by withdrawing the anterior half of its body leaving its posterior prolegs in position or by withdrawing the head a short distance and then withdrawing the posterior prolegs. If found in an elongate position or if such a position was assumed, the larva moved forward by alternate movements of head and thorax. The thorax was dorsoventrally expanded with the anterior prolegs extended so that the thorax became wedged between the upper and lower layers of the chamber. The head was then extended and the mouthparts placed in contact with the substrate in front of the body. The thorax was then compressed dorsoventrally and the head capsule moved ventrally so the body moved forward. At this new position the thorax was expanded and the sequence of movements repeated. Larvae can move backward by repeatedly grabbing with posterior prolegs and alternately straightening and convoluting the abdomen.

Pupation and pupal chamber characteristics were similar for wood

and leaf miners. The larva, before pupation, constructed a special pupal "cradle" by compacting the frass walls (for leaf miners) or lining the chamber with frass and silk (for wood miners). At the end of the pupal "cradle" a semicircular flap was cut into the dorsal wall of the chamber through which the pupa emerged. Prior to pupation the posterior prolegs of the larva were attached to a mass of silk and frass at the posterior end of the chamber. The position of the larval exuviae in relation to the pupa differed among species and is a characteristic of phylogenetic importance. The pupae of some species retained the larval head capsule at the level of the pupal abdomen, while the rest sloughed it off completely. The shape of the larval exuviae after being sloughed off also differed between species (Fig. 52D, E).

Shortly before adult emergence, the pupa emerged from the pupal chamber via the semicircular flap at the end of the chamber. The pupa then swam to the surface and the adult emerged. During emergence the terminal pupal tergites of some species emerged through the surface film and appeared to aid in stabilizing the pupa at the surface. This characteristic was correlated with the absence of spicules on tergites 7-8. Laboratory rearings suggested that adults emerged at or near dusk.

I have few observations of adult behaviour. Male swarming has been recorded for three species: S. hilaris, S. fuscipatellus and S. gibbus. Otherwise I have observed only a few adults in nature, collected by sweeping and at lights. At Duncan Lake, Quebec, north of Ottawa, I made a concerted effort to make observations of adults. Three species occur in the lake: S. cinctus, S. unictus and S.

hilaris; and the first two were collected as larvae in large numbers and appeared to be common in the lake. However, in spite of many hours of observation throughout the period from the beginning of June to the end of August, 1979, I collected or observed only 1 ♂ of S. cinctus, 5 ♂, 3 ♀ S. unictus, and 7 ♂, 10 ♀ S. hilaris.

In contrast to this, many adults have been observed in the laboratory as a result of rearing. One characteristic of importance concerns the posture of the forelegs of both male and female adults. Adults of all Stenochironomus species, with the exception of one lineage (see pg. 453), hold their forelegs pointing somewhat backwards, at greater than a 90° angle from the body axis when at rest (Fig. 52C). Stoffer (1979) has suggested that foreleg posturing in chironomids is a diversion to potential predators. However, my observations of Stenochironomus adults suggest to me that such posturing is a means of detecting disturbance.

I have only one observation of the eggs of a Stenochironomus species (S. colei), which coincides with those recorded for S. gibbus by Kalugina (1958). Eggs are laid in a sticky, spherical mass which is differentiated into an inner core of dense matrix containing the eggs and an outer transparent layer which was extremely sticky. S. colei and S. gibbus are closely related phylogenetically (see Fig. 88), so that I cannot appraise how widespread this type of egg mass may be in the genus. Mitchell (1908) described the egg mass of S. poecilopterus, also closely related to colei and gibbus, but failed to mention a differentiated outer and inner layer. She did state that the matrix contained "myriads of short lines directed toward the center of the mass". Tokunaga and Kuroda (1935) noted that the eggs

of S. nelumbus were in "gelatinous egg cords".

I studied the life cycle of two species of Stenochironomus in the Ottawa area and these showed markedly different strategies. S. unictus, a wood miner, had a one year cycle consisting of overwintering third and fourth instar larvae, a scattered adult emergence throughout spring and summer months, egg laying during this period and a subsequent maturing of larvae to the third or fourth instar by winter (see pg. 147).

The life cycle of S. cinctus, a leaf miner, was composed of an overwintering first instar larval stage in dead submerged leaves, a subsequent development of adult stages early in the summer months and a number of complete cycles during the season. August populations either remained as first instar larvae in submerged leaves or completed development to the adult stage (see pg. 389).

Tokunaga and Kuroda (1936) suggested that S. nelumbus may have 7-8 generations a year.

Taxonomic discussion. The genus Stenochironomus contains 38 previously recognized species. This study indicates the presence of 92 species (including species from Oriental and Afrotropical regions), a number reflecting some changes in taxonomic status and the description of new species.

Some confusion has surrounded the name of the type species of Stenochironomus and its correct subsequent designation. Kieffer (1919:44) in erecting the new genus Stenochironomus included two named species: flexilis Linnaeus and pulchripennis Coquillett. Kieffer (1922:56) subsequently designated Stenochironomus fasciatus

(Geoffroy) as type species, which he considered to be the correct name for Chironomus flexilis (of authors, not Linnaeus). Tipula fasciata Geoffroy (1785) is a junior homonym of Tipula fasciata Scopoli (1763) and Tipula fasciata Linnaeus (1767) and the first available name for this species is Stenochironomus gibbus (Fabricius). The type of Stenochironomus is therefore S. gibbus. This was correctly recognized by Goetghebuer (1937:12). Freeman (1957) and Freeman and Cranston (1980) incorrectly believed Goetghebuer (1937) to be the original designator. Townes (1945:84) designated S. pulchripennis as the type of Stenochironomus but this designation is superceded by the designation of Kieffer (1922). Cole (1969) and Sublette and Sublette (1965, 1973) incorrectly recognized Townes' designation.

KEY TO ADULTS OF NEARCTIC STENOCHIRONOMUS SPECIES

1. Wing with a distinct, transverse, medial band,
always discrete from more basal and more apical
pale membrane (Fig. 14D-H, 15C-E); femur and tibia
of at least fore and hind legs partially to
completely pigmented2
- Wing without discrete medial band; legs with or
without pigmentation.....9
- 2(1) Wing with apical band extending into cells R3 and
CuA1 (Fig. 14E-H); appendage 2 of male with apical
seta shorter and basally thicker than subapical seta.
(Fig. 14G-I); apex of anal point either parallel-
sided or bulbous from dorsal view (Fig. 31C, D).....3
- Wing with apical band not extending into cells R3
or CuA1 (Fig. 14D, 15C-E); appendage 2 of male with
apical seta either shorter and basally thicker
(Fig. 43D) or nearly as long and basally as thick
as subapical seta (Fig. 44E-G); apex of anal point
parallel-sided from dorsal view (Fig. 30C, 33B).....5
- 3(2) Lateral vittae of thorax with dark pigmentation
restricted to posterior portion and filling width
of vitta (Fig. 1J, 6F); anterior point of scutum
angled (Fig. 13E); male with pale palpus and apex
of gonostylus rounded (Fig. 31C) (eastern Nearctic)..

.....albipalpus n. sp., pg. 201

- Lateral vittae of thorax with no dark pigmentation or with pigmentation restricted to inner margin of vitta (Fig. 1I, K, L, 6E, 7A, B); anterior point of scutum rounded (Fig. 13D); male with dark palpus; apex of gonostylus rounded to tapering (Fig. 31D)...4

4(3) Pigmentation of legs light to dark brown; male with basal 0.12 to entire fore tibia pigmented (Fig. 19A, B), of female basal 0.18 to entire fore tibia; Gc/Gs of male 0.82-0.98; female with inner half of lateral apodeme of S IX not markedly swollen (Fig. 48C) (Nearctic exclusive of Pacific States).....hilaris (Walker), pg. 209

- Pigmentation of legs light brown; male with basal 0.16-0.26 of fore tibia pigmented, of female basal 0.16-0.26 of fore tibia (Fig. 18E); Gc/Gs of male 0.70-0.84; some females with inner half of lateral apodeme of S IX swollen (Fig. 48B) (western Nearctic).....fuscipectus n. sp., pg. 193

5(2) Hind femur with pigmentation restricted to apical 0.13-0.73 of femur length.....6

- Entire hind femur pigmented but some specimens with a subapical pale annulus.....8

6(5) Halter brown; some pleural sclerites pigmented

(Fig. 50); T I-IV with some discrete pigmentation (Fig. 26D); male with appendage 1 elongate (Fig. 30C); appendage 2 with apical seta shorter and basally thicker than subapical seta (Fig. 43D); female with ventrolateral lobe markedly developed (Fig. 47C) (Del Rio, Texas).....
.....annettae n. sp., pg. 156

- Halter pale; no pleural sclerites pigmented; no abdominal tergites pigmented; male with superior appendage 1 very reduced (Fig. 33B), appendage 2 with apical seta as long and basally as thick as subapical seta (Fig. 44D-G); female with ventrolateral lobe not markedly developed (Fig. 49B).....7

7(6) No pigmentation on wing between C and M basal to area of r-m (Fig. 15C); male with apical 0.13-0.18 of hind femur pigmented (Fig. 20D); female with apical 0.13-0.22; male with length of Cu/M = 0.98-1.05 and Hd Tal/Ti = 0.74-0.80; female with wing length/length of M = 2.23-2.36, M with 13-40 setae, Hd Tal/Ti = 0.72-0.77, and palp segments 3/4 = 1.07-1.27 (western Nearctic).....colei (Malloch),
pg. 260

- Male with pigmentation on wing between C and M restricted to area anterior to arculus (Fig. 15D); female with area between C and M veins pigmented (Fig. 15D); male with apical 0.23-0.28 (Fig. 20E, F),

female with apical 0.19-0.69 of hind femur pigmented;
 male with length of Cu/M = 1.02-1.11 and Hd Tal/Ti
 = 0.78-0.88; female with wing length/length of M =
 2.34-2.51; M with 2-9 setae, Hi Tal/Ti = 0.77-0.83
 and palp segment 3/4 = 1.28-1.46 (eastern Nearctic)..
pulchripennis (Coquillett), pg. 268

8(5) Male with entire fore femur pigmented and with
 extreme base and subapical annulus pale (Fig. 21A,
 B); Ant. 13/1-12 = 1.93-2.48; female with subapical
 annulus 0.05-0.14 of total fore femur length (eastern
 Nearctic, Colorado).....poecilopterus
 (Mitchell), pg. 275

- Male with apical 0.15-0.23 of fore femur pigmented
 (Fig. 21C, D); Ant. 13/1-12 = 1.43-1.79; female with
 subapical annulus 0.20-0.50 of total fore femur
 length (eastern Nearctic).....tectus n. sp., pg. 282

9(1) Thorax, legs and abdomen without cuticular
 pigmentation.....10

- Thorax and legs with some pigmentation abdomen
 with or without pigmentation.....11

10(9) Wing without pigmentation; palpus pale; male antenna
 with all hairs pale; anal point of male with dorsal
 edge straight in lateral aspect (Fig. 40D) and with
 parallel sided apex in dorsal aspect (Fig. 32A);

female with spicules on ventrolateral lobe weakly developed and not on a pronounced swelling (Fig. 48D) (eastern Nearctic).....macateel (Malloch), pg. 223

Male with area of wing membrane around CuA2 pigmented (Fig. 14A); female with entire wing membrane pigmented (Fig. 14B); palpus dark; male antennae with apical 0.30-0.40 of antenna with dark hairs; male with apex of anal point with abrupt ventral bend from lateral aspect (Fig. 39G) and with swollen apex from dorsal aspect (Fig. 30A); female with spicules on ventrolateral lobe well developed and on a pronounced swelling (Fig. 47A) (eastern Nearctic).....unictus Townes, pg. 142

11(9) Median vittae tan to pale; palpus pale; eye markedly metallic when alive or in alcohol.....12

Median vittae either entirely dark, with discrete pigmentation on part of the vitta or pale; palpus dark; eyes not metallic, or if metallic (when alive or in alcohol), palpus dark and all of thorax at least somewhat darkened.....13

12(11) Postnotum in lateral view with pigmentation not reaching anteroventral edge (Fig. 11B); entire fore tibia pigmented, or rarely with a paler annulus at midlength extending 0.00-0.30 of total tibia length (Fig. 24B, C); male with

pigmentation on T II extending 0.16-0.33 from its posterior edge (Fig. 28C); female with pigmentation on T II extending 0.28-0.45 from its posterior edge; male with Tal/Ti of foreleg 1.28-1.43 female palp 3/4 = 1.21-1.50 (eastern Nearctic).....cinctus Townes, pg. 383

Postnotum in lateral view with pigmentation reaching anteroventral edge (Fig. 11C); entire fore tibia pigmented but with paler annulus at midlength extending 0.22-0.45 of total tibia length (Fig. 24D, E); male with pigmentation on T II extending 0.28-0.58 from its posterior edge (Fig. 28D); female with pigmentation on T II extending 0.44-0.72 from its posterior edge; male with Tal/Ti of foreleg 1.38-1.53 female palp 3/4 = 1.42-1.70 (eastern Nearctic).....aestivalis Townes, pg. 393

13(11)Wing with only area around r-m and fork of Cu pigmented (Fig. 15F); male with only extreme posterior margins of T II-IV pigmented (Fig. 26I); female with no discrete abdominal pigmentation; male with basal 0.57-0.68 of antenna with dark hairs (Arizona, California).....totifuscus

Sublette, pg. 289

Wing with all of membrane at least somewhat pigmented (Fig. 14C); male and female with more

extensive pigmentation of abdominal tergites
(Fig. 26C, F, H, 28B); male with all antennal
setae dark.....14

14(13)Ant. 13/1-12 > 1.00 and thorax nearly completed
dark brown; eye metallic when live or in alcohol;
T I without discrete pigmentation; male appendage 1
relatively short (as in Fig. 36D) (Florida).....

browni Townes, pg. 379

- Ant. 13/1-12 < 1.00, if more than 1.00 then thorax
with only vittae and postnotum pigmented; eye not
metallic; T I with discrete pigmentation; male
appendage 1 relatively long (Fig. 30B, 31A, B)....15

15(14)Scutum shiny dark brown-black; halter brown;
anal point of male broad (Fig. 31A); female with
setae on S VIII bordered posteriorly by markedly
produced ridge (Fig. 47D) (Arizona).....
.....niger n. sp., pg. 169

- Scutum with various markings, surface dull; halter
pale; anal point of male narrow (Fig. 30B, 31B)
female with setae on S VIII at most bordered
posteromedially by weak ridge (Fig. 47B, 48A).....16

16(15)Postnotum completely pigmented (Fig. 1G), male Ant.
13/1-12 = 0.65-0.71; male appendage 2 with two
apical setae, equally long and equally thick at

- base (Fig. 43C); female with apodemes of S VIII directed transversely (Fig. 48A) (Arizona).....
bisetosus n. sp., pg. 183
- Postnotum with at most posterior 3/4 pigmented (Fig. 1C); male Ant. 13/1-12 = 1.53-1.83; male appendage 2 with apical seta shorter and basally thicker than subapical seta (Fig. 43B); female with apodemes of S VIII directed posteromedially (Fig. 47B) (western Texas, New Mexico).....
maculatus n. sp., pg. 149

KEY TO ADULTS OF PALAEARCTIC STENOCHIRONOMUS SPECIES

1. Wing without pigmentation.....2
 - Wing with some pigmentation (Fig.).....4
- 2(1) Body very dark: thorax and abdomen almost completely dark brown (female unknown) (Europe).....hibernicus
 (Edwards), pg. 399
 - Body generally pale, at most, with dark pigmentation on lateral vittae and postnotum.....3
- 3(2) Fore tibia entirely medium brown (Fig. 25C); postnotum and lateral vitta with dark pigmentation (Fig. 4E, 11D); anal point of male bent ventrally in lateral aspect (Fig. 42J) (Korea).....koreanus
 n. sp., pg. 403

- Fore tibia pale; thorax entirely pale; anal point of male straight in lateral aspect (Fig. 40E) (Korea).....
.....recticaudatus n. sp., pg. 231

- 4(1)Wing with apical band extensive, including cells R3 and CuA1 (Fig. 15I, J).....5
- Wing with apical band restricted to extreme apex, not extending into cells R3 or CuA1 (Fig. 14I, J, 15A, B)..
.....6

- 5(4)Apex of anal point bulbous in dorsal aspect; appendage 1 very short and squat (Fig. 34D); fore tibia with some paler portions (Fig. 22E) (Europe)....
.....fascipennis (Zetterstedt), pg. 319
- Apex of anal point parallel-sided in dorsal aspect; appendage 1 more elongate (Fig. 34C); fore tibia completely pigmented (Fig. 22D) (Japan).....
.....nelumbus (Tokunaga and Kuroda), pg. 313

- 6(4)Small, posterior, oval markings present on median vitta (Fig. 20, 7F); postnotum with marking extending to anterior margin; male appendage 2 with apical seta elongate, but basally thicker than subapical seta (Fig. 44B, C); female with flagellomeres brown 1-6 (Japan).....satorui (Tokunaga and Kuroda), pg. 255
- No markings present on median vitta; postnotum with markings not extending to anterior margin (Fig. 2A,

7C); male appendage 2 with apical seta either elongate or short and stout; female with only flagellomere 6 pigmented (not known for pannus, n. sp. "Japan").....7

- 7(6) Postnotum with markings not extending to posterior margin (Fig. 2A, 7C); fore femur with only apical 0.18-0.19 distinctly pigmented (Fig. 19C); male Ant. 13/1-12 = 0.98-1.00 (female unknown) (Japan).....
pannus n. sp., pg. 233
- Postnotum with markings extending to posterior margin (Fig. 2B, C, 7D, E) (not known for n. sp. "Japan"); fore femur with at least apical 0.43 pigmented but poorly defined (Fig. 19D, E, 20A-C); male Ant. 13/1-12 = 1.86-2.35.....8

- 8(7) Male appendage 2 with stout apical seta (Fig. 43K, L).
9
- Male appendage 2 with elongate apical seta (as in Fig. 44B) (Japan).....n. sp. "Japan", pg. 252

- 9(8) Foreleg Tal/Ti = 1.32-1.38; mid and hind femora with dark band at midlength, resulting in a pale subapical, poorly defined annulus (Fig. 19D) (Japan).....
balteatus n. sp., pg. 236
- Foreleg Tal/Ti = 1.20-1.33; mid and hind femora with neither dark band at midlength nor pale subapical

annulus: apical 0.23 to entire hind femur with dark
pigmentation (Fig. 20A-C) (Europe, Korea).....gibbus
(Fabricius), pg. 240

KEY TO MALE ADULTS OF NEOTROPICAL STENOCHIRONOMUS SPECIES

1. Thorax, wing, legs and abdominal tergites without
dark markings or, at most, wing membrane uniformly
light brown and apex of fore femur and all of fore
tibia and tarsus darkened.....2
- Thorax, wings, legs or abdominal tergites (or
several of these) with distinct dark bands or
patches.....5
- 2(1) Anal point broad at base and with dorsal crest
extending laterally along length (Fig. 35C, D).....3
- Anal point narrow at base, either with expanded
apex or narrow posteriorly but not with dorsal
crest (Fig. 37D, 38B).....4
- 3(2) Thorax anteriorly elongate (Fig. 13A); portion of
setal patch of T IX on posteriorly projecting lobe
(Fig. 35C, 41M) (northern Brazil)...prolatus n. sp.,
pg. 349
- Thorax not anteriorly elongate (as in Fig. 13C);
setal patch of T IX arranged on flattened area
(Fig. 35D, 41N) (northern Brazil).... vatus n. sp.,

pg. 352

- 4(2) Apex of T IX markedly wedge-shaped in dorsal aspect (as in Fig. 38A); apical seta on ~~appendage~~ 2 elongate, about as long as subapical seta (northern Brazil).....palliaculeatus n. sp., pg. 416
- Apex of T IX truncated in dorsal aspect (Fig. 37D); apical seta on appendage 2 stout, shorter than subapical seta (northern Brazil).....reissi n. sp., pg. 411

- 5(1) Fore femur with three discrete areas of pigmentation (Fig. 23E); very lateral and posterior margins of T II-IV with pigmentation (Fig. 27H) (northern Brazil).....triannulatus n. sp., pg. 360
- Fore femur with, at most, two areas of pigmentation; abdomen variably pigmented but not as above.....6

- 6(5) Anal point broad at base and with dorsal crest extending laterally along length (Fig. 31A, 35A-D).....7
- Anal point narrow at base, either with or without expanded apex but not with dorsal crest (as in Fig. 33D, 34A, B, 36B; C, 37C).....13

- 7(6) Lateral vitta completely pigmented (Fig. 1E, F, 6A, B); halter dark brown; eye not metallic when live

- or in alcohol.....8
- Lateral vitta, at most, only partially pigmented
(as in Fig. 3A-D, G-L) halter pale; eye not metallic
or markedly shiny metallic when alive or in alcohol.
.....9
- 8(7) Ant 13/1-12 > 1.00; entire scutum dark brown (as in
Fig. 1E, 5E) (Ecuador east of Andes).....
.....crusanticus n. sp., pg. 163
- Ant 13/1-12 > 1.00; only portion of scutum dark
brown (Fig. 1F, 6B) (St. Vincent).....innocuus
(Williston), pg. 176
- 9(7) Appendage 1 extending beyond apex of gonocoxite
(App 2/1 = 1.94-2.70) (Fig. 35A, B).....10
- Appendage 1 extending, at most, to level of apex of
gonocoxite (App 2/1 = 2.96-4.05).....12
- 10(9) Apex of anal point bulbosus (northern Brazil,
Ecuador east of Andes).....bacrionis n. sp., pg. 331
- Apex of anal point tapering (Fig. 35A, B).....11
- 11(10) Hd Fe/T1 = 1.01-1.04; appendage 1 with 10-14
setae; anal point relatively broad (Fig. 35A)
(northern Brazil).....pectinatus n. sp., pg. 337
- Hd Fe/T1 = 1.08-1.091; appendage 1 with 4-9
setae; anal point relatively slender (Fig. 35B)

- (Costa Rica).....gladius n. sp., pg. 341
- 12(9) Mid and hind legs with pigmentation (Fig. 23C);
 apical seta on appendage stout (northern Brazil)..
fittkaui n. sp., pg. 346
- Mid and hind legs pale; apical seta on appendage
 2 elongate, about as long as subapical seta
 (northern Brazil).....albidorsalis n. sp., pg. 356
- 13(6) Lateral vittae connected medially with dark
 pigmentation (Fig. 4F, G, 11E, 12A).....14
- Lateral vittae with or without pigmentation but
 not connected medially with darker pigmentation...15
- 14(13) Lateral vitta with two areas of dark pigmentation
 (Fig. 4G, 12A); nearly entire postnotum pigmented;
 posterior portion of abdominal T IV pigmented
 (Fig. 28G) (northern Argentina).....semifumosus
 (Edwards), pg. 408
- Lateral vitta with only anterior portion pigmented
 (Fig. 4F, 11E); dorsal portion of postnotum
 pigmented; abdominal T IV pale (Fig. 28F) (northern
 Brazil).....zonarius n. sp., pg. 405
- 15(13) Lateral vitta with two dark patches, one situated
 anteriorly of the other (Fig. 3K, L, 10D, E).....16
- Lateral vitta with one dark patch or pigmentation

absent.....17

16(15)Ant 13/1-12 = 2.03-2.15; palp 3/4 = 1.89-2.00; fore femur and tibia with dorsal and ventral rows of setae markedly more elongate than those of mid and hind legs; apex of anal point expanded in dorsal aspect (as in Fig. 37C) (northern Brazil).....
.....jubatus n. sp., pg. 370

- Ant 13/1-12 = 1.15-1.80; palp 3/4 = 1.23-1.44; fore femur and tibia with setae of similar length to those of mid and hind legs; apex of anal point slightly bulbous in dorsal aspect (Fig. 36B) (Costa Rica).....quadrinotatus n. sp., pg. 363

17(15)Nearly entire thorax completely brown; abdomen pale (Venezuela).....varius n. sp., pg. 418

- Thorax mostly pale, with or without pattern of markings; abdomen pale or with pattern of marking.....18

18(17)Lateral vitta with pigmentation along lateral margin which extends to anterior point of scutum (Fig. 3A, 8E) (West Indies, Ecuador west of Andes).....leptopus (Kieffer), pg. 296

- Lateral vittae with or without dark pigmentation but thorax never with pigmentation extending anterior of lateral vitta.....19

19(18) Lateral vitta with one dark patch along anterior margin, which is somewhat circular in outline (Fig. 3B, 4H, 8F, 12B); mid and hind legs pale....20

- Lateral vitta with pigmentation restricted to stripe along lateral margin or lacking dark pigmentation (Fig. 3C, D, 4A, 9A, B, 10F); mid and hind legs with or without pigmentation.....21

20(19) Abdomen with dark pigmentation (Fig. 27A); posterior setae of setal patch on T IX on posteriorly projecting lobe (Fig. 34A, 41C) (northern Brazil).....impedens n. sp., pg. XXX

- Abdomen lacking dark pigmentation; setal patch on T IX arranged on flattened area (Fig. 38A, 42M) (northern Brazil).....aculeatus n. sp., pg. 414

21(19) Lateral vitta with dark stripe along lateral margin (Fig. 3D, 9B); T IX markedly broad (Fig. 34B) (Venezuela).....discus n. sp., pg. 310

- Lateral with lacking dark pigmentation; tergite not broad (Fig. 36C).....22

22(21) T I with dark pigmentation (Fig. 27B) (Venezuela)....

.....townesi n. sp., pg. 307

- T I lacking dark pigmentation.....23

- 23(22) Dark pigmentation present on posterior margins of
 at least T II-IV (Fig. 28A); apical seta on
 appendage 2 stout, shorter than subapical seta
 (Fig. 45D) (Costa Rica).....nudipupa n. sp., pg. 374
- Abdomen lacking dark pigmentation; apical seta on
 appendage 2 elongate, about as long as subapical
 seta (similar to Fig. 440) (Peru).....
n. sp. "Peru", pg. 178

KEY TO PUPAE OF NEARCTIC STENOCHIRONOMUS SPECIES

Two species are not known as pupae. Based on phylogenetic placement, S. browni from Florida should key out to the second half of couplet 2 and S. tectus from the eastern Nearctic Region to the second half of couplet 10.

1. T II with posterior row of hooklets restricted
 to medial portion of T II (Fig. 57A-C); T VII,
 T VIII with at least some spicules (Fig. 58B-D);
 subgenus Petalopholeus.....2
- T II with posterior row of hooklets extending to
 lateral margins of tergite (Fig. 56C-F); T VII,
 T VIII with no spicules; subgenus Stenochironomus
3

2(1) T II with posterior row of hooklets with median gap of missing hooklets (Fig. 57A); T VIII with strong spicules restricted to posterior 2/3 (Fig. 58B); male genital lobe extending posteriorly past apex of swim paddle; spur on S VIII with one elongate, large tooth and several markedly smaller teeth, in some with an additional tooth, about 1/2 size of large tooth (Fig. 62A) (Arizona, California)..

.....totifuscus Sublette, pg. 289

- T II with posterior row of hooklets complete without median gap (Fig. 57C); T VIII with spicules restricted to anterolateral margin (Fig. 58C); male genital lobe not extending posteriorly past apex of swim paddle spur on S VIII with 1-3 short, basally broad teeth and, in some specimens, a few smaller teeth (Fig. 62F) (eastern Nearctic).....cinctus

Townes, pg. 383, aestivalis Townes, pg. 393

3(1) T II with posterior row of hooklets with median gap of missing hooklets, width of gap equal to at least width of 4-5 hooklets (Fig. 56C); largest teeth on spur of S VIII elongate or sometime 1-2 deltoid teeth are largest (Fig. 59E, F, 60A, C, D).....4

- T II with posterior row of hooklets without median gap or, if present, width of gap no more than width of 2-3 hooklets (Fig. 56D-F); largest teeth on spur of S VIII composed of 1-6 deltoid teeth of similar

- size and shape (Fig. 60E, F, 61A-F).....8
- 4(3) Teeth on spur of S VIII dark brown (Fig. 59E, F);
 numerous spicules on anal lobe.....5
- Teeth on spur of S VIII yellowish brown (Fig. 60A,
 C, D); a few spicules on anal lobe or none.....6
- 5(4) Length of T II 0.71-1.08 mm (eastern Nearctic).....
unictus Townes, pg. 142
- Length of T II 0.52-0.85 mm (western Texas, Arizona)
maculatus n. sp., pg. 149
- 6(4) Horn of respiratory organ short, stout, not
 extending beyond apices of filaments (Fig. 54D),
 horn length/length of T II = 0.32-0.42; in dorsal
 aspect teeth on spur of S VIII arranged in straight
 row (Fig. 60A) (Arizona)...bisetosus n. sp., pg. 183
- Horn of respiratory organ elongate, of moderate
 thickness, extending to about level of apices of
 filaments (as in Fig. 54C), horn length/length of
 T II = 0.66-0.96; in dorsal aspect teeth on spur of
 S VIII arranged in an evenly curved row, some
 specimens with additional small, ventral teeth
 (Fig. 60C, D).....7
- 7(6) Respiratory organ horn length/length of T II =
 0.66-0.84 (Arizona).....niger n. sp., pg. 169

- Respiratory organ horn length/length of T II =
0.85-0.96 (Del Rio, Texas).....annettae n. sp.,
pg. 156

8(3) Respiratory organ with horn mostly fused with
anterior trunk, with free portion small (Fig. 55A);
with or without clear, anteriorly bilobed area on
posterior margin of S II and S III.....9

- Horn of respiratory organ arising near base,
elongate thin, extending beyond multiforked portion
of anterior trunk (Fig. 55B); S II and S III
uniformly yellowish brown.....10

9(8) T II with posterior row of hooklets with or without
median gap (Fig. 56E) (eastern nearctic).....
.....albipalpus n. sp., pg. 201

- T II with posterior row of hooklets without median
gap (Fig. 56D) (but see taxonomic discussion under
S. hilaris for an exception from Georgia).....
.....hilaris (Walker) (Nearctic exclusive of
Pacific states), pg. 209, fuscipatellus n. sp.,
(western Nearctic), pg. 193

10(8) Spur on S VIII with 1-2 deltoid lateral teeth and
2-5 sharply pointed, smaller median teeth, each more
than 1/4 length of largest tooth (Fig. 61B);
terminal filaments of respiratory organ stout

(greater than 4 u in diameter), forking near apices (as in Fig. 55C) (eastern Nearctic).....

macateei (Malloch), pg. 223

Spur on S VIII with 2-6 deltoid to elongate lateral teeth of similar size or with most lateral teeth smaller than those in midregion of spur, and with 1-3 elongate, smaller, medial teeth (Fig. 61D-F); terminal filaments of respiratory organ thin (less than 4 u in diameter), forking subapically

(Fig. 55B).....poecilopterus, (Mitchell)

(eastern Nearctic, Colorado, pg. 275

pulchripennis (Coquillett) (eastern Nearctic,

pg. 268

colei (Malloch) (western Nearctic, pg. 260

PRELIMINARY KEY TO PUPAE OF NEOTROPICAL STENOCHIRONOMUS SPECIES

The following key contains only a fraction of the species present in the Neotropical Region. I have attempted to include as many morphological details in the final couplets as possible to maximize the possibility of correct identification. Specimens which do not key out could possibly be further resolved through examination of phylogenetically important characters (see pg.).

1. T II with posterior row of hooklets extending to lateral margins of tergite (Fig. 56C-F); T VII,

- T VIII with no spicules; subgenus Stenochironomus
2
- T II with posterior row of hooklets restricted to
 medial portion of T II (Fig. 57A-C); T VII, T VIII
 with at least some spicules; subgenus
Petalopholeus.....3
- 2(1) Spur on S VIII with 6-10 deltoid, lateral teeth
 of similar size (Fig. 60B) (Peru east of Andes).....
n. sp. "Peru", pg. 178
- Spur on S VIII with one large deltoid tooth and
 2-4 elongate, medial teeth (as in Fig. 60D)
 (Ecuador east of Andes).....crusanticus n. sp.
 pg. 163
- 3(1). Anterior margin of wing pad with small tubercle
 or projection near base; outer tooth on spur of
 S VIII markedly elongate (Fig. 62C).....4
- Anterior margin of wing pad smooth, lacking any
 modification; outer tooth on spur of S VIII not
 markedly elongate (Fig. 62A, B, D, E).....5
- 4(3) Apex of swim paddle with spicules (northern
 Brazil).....pupal form one, pg. 329
- Apex of swim paddles with no spicules (northern
 Brazil, Ecuador east of Andes).....bacrionis
 n. sp., pg. 331

- 5(3) Spicules on T VIII present along posterior margin of tergite (as in Fig. 58B) (West Indies, Ecuador west of Andes).....leptopus (Kieffer), pg. 296
- Spicules on T VIII restricted to anterolateral area of tergite (Fig. 58C, D).....6
- 6(5) Head capsule with dorsomedial projection only somewhat elongate (as in Fig. 53B).....7
- Head capsule with dorsomedial projection markedly elongate (as in Fig. 53C).....8
- 7(6) Hooklets along posterior margin of T II very large (Fig. 57B); male genital lobe extending posteriorly past apex of swim paddle (Costa Rica).....quadrinotatus n. sp., pg. 363
- Hooklets along posterior margin of T II of moderate size (as in Fig. 57C); male genital lobe at most just reaching level of apex of swim paddles.....nudipupa n. sp., pg. 374
- 8(6) Spur of S VIII with one elongate tooth and one elongate smaller tooth (northern Brazil).....vatus n. sp., pg. 352
- Spur of S VIII with 1-4 elongate tooth and 0-5 elongate smaller teeth.....9

- 9(8) Total length of T II = 543 u (n=1) (northern Brazil).....albidorsalis n. sp., pg. 356
- Total length of T II = 427-466 u (n=3) (Costa Rica).....gladius n. sp., pg. 341

KEY TO LARVAE OF NEARCTIC STENOCHIRONOMUS SPECIES

The following key is intended for fourth instar larvae only, even though the limited material available suggests that the non-meristic characters and ratios given also apply to at least some third instar larvae. Fourth instar larvae can be recognized as such by characteristics given in the key.

It should also be noted that most Nearctic Stenochironomus species are restricted to either eastern or western North America. Keeping in mind that our understanding of the distribution of some species is probably incomplete, locality data can be helpful in reducing the number of choices in the following key.

Two species are not known as larvae. Based on phylogenetic placement, S. browni from Florida should key out to couplet 3 and S. tectus from the eastern Nearctic should key out to at least couplet 10.

1. Head capsule squat and narrowed anteriorly (Fig. 65C), with head length/maximal width = 0.87-1.04 and anterior width/maximal width =

0.51-0.68 dorsolateral stripes originating near base of dorsomedian stripe; posterior coronal pore canals arising subapically on posterolateral section of postoccipital carina, directed anterolaterally; fused maxilla and paralabial plate anterolaterally truncate (Fig. 76C, D); subgenus Petalopholeus; mining dead submerged leaves.....2

- Head capsule elongate and somewhat squared anteriorly (Fig. 64D, 65A, B), with head length/maximal width = 1.00-1.25 and anterior width/maximal width = 0.65-0.89; dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; posterior coronal pore canals arising apically on posterolateral section of postoccipital carina, directed anteriorly or anteromedially; fused maxilla and paralabial plate anterolaterally bilobed (Fig. 75E, F, 76A, B); subgenus Stenochironomus; mining dead submerged wood.....5

- 2(1) Head capsule length less than 301 u; thoracic imaginal discs not evident in undissected individuals.....2nd and 3rd instar larvae
- Head capsule length 320-485 u; thoracic imaginal discs evident or not in undissected individuals; fourth instar larvae.....3

- 3(2) Pecten epipharyngis with elongate spicules, most spicules separate basally, not arranged on a sclerotized bar; labral lamella with comb-like arrangement of spicules (Fig. 69C); fused parafacial plate and maxilla projecting markedly anterior to hypostomal teeth, lateral edge with a slight, basal cuticular thickening (Fig. 76C).
(Arizona, California) totifuscus

Sublette, pg. 289

- Spicules of pecten epipharyngis peg-like, all arranged on a sclerotized bar; labral lamellae composed of 2-6 spicules, forming two groups, each composed of basally fused spicules (Fig. 70B); fused parafacial plate and maxilla projecting to or just anterior to level of hypostomal teeth, lateral edge with marked cuticular thickening (Fig. 76D).....4

- 4(3) Head capsule length 388-395 u; in lentic habitats (eastern Nearctic)..... cinctus Townes, pg. 383

- Head capsule 388-553 u; in lotic habitats (eastern Nearctic)..... aestivalis Townes, pg. 393

- 5(1) Head capsule length less than 533 u; thoracic imaginal discs not evident in undissected individuals; (third instar larvae rarely collected in series without some fourth instars being

encountered).....2nd or 3rd instar larvae

Head capsule length 533-970 u, except for S.

macateei with a head capsule length of 407-640 u;

thoracic imaginal discs present or not evident in
undissected individuals: fourth instar larvae.....6

6(5) Head capsule anterior width/maximum width =
0.68-0.89; ventromedial area of postoccipital
carina with or without line of weakness; head
capsule length 514-970 u; micropore, when present,
located lateral to, to posterior to seta submenti;
labral lamella with many spicules on two projecting
lobes (Fig. 68B); labrum with S III pinnate; one
eastern Nearctic species, four from
southwestern U.S.A.....7

Head capsule anterior width/maximum width = 0.61-
0.74, ventromedial area of postoccipital carina
with line of weakness; head capsule length 407-
640 u; micropore, when present, located postero-
lateral to, to anterolateral to seta submenti;
labral lamella with up to about 11 spicules,
arranged into groups, although sometimes fused
basally, never on projecting lobes (Fig. 68C);
labrum with S III simple or pinnate.....11

7(5) Posteroventral median area of head capsule with
longitudinal line of weakness (Fig. 63B); procercus

- with only a single filament.....8
- Posteroventral median area of head capsule with no longitudinal line of weakness (Fig. 65A); procercus with many filaments.....9
- 8(7) Venter of head capsule with characteristic pattern of pigmentation (Fig. 64D); anal papillae relatively short (Fig. 77E); distance between lateral margins of paralabial plates/head capsule anterior width = 0.68-0.75; head capsule length 514-660 u (western Texas, New Mexico).....
.....maculatus n. sp., pg. 149
- Venter of head capsule without patterned pigmentation; anal papillae more elongate (Fig. 77D); distance between lateral margins of paralabial plates/head capsule anterior width = 0.53-0.67; head capsule length 650-970 u (eastern Nearctic).....unictus Townes, pg. 142
- 9(7) Seta submenti located posterolateral to ridges supporting labiohypopharynx (Fig. 65A); posteroventral medial area of head capsule with stripe long, pointed anteriorly (Fig. 65A) (Arizona).....
.....bisetosus n. sp., pg. 183
- seta submenti located lateral to ridges supporting labiohypopharynx (as in Fig. 65B); posteroventral medial area of head capsule with stripe about 1/2

- to 3/4 of that shown in Fig. 65A, blunt or jagged anteriorly.....10
- 10(9) Head capsule length 592-718 u; distance of antennal seta from base/length of antennal segment one = 0.67-0.70 (Del Rio, Texas).....annettae n. sp., pg. 156
- Head capsule length 708-757 u; distance of antennal seta from base/length of antennal segment one = 0.75-0.77 (Arizona).....niger n. sp., pg. 169
- 11(6) Mandibular adductor apodeme with posterior dark pigmentation (Fig. 72B, C); ligula with very fine shagreen, extending posteriorly to or nearly to lateral edge of base of lobe, defined posteriorly, in most specimens, by a discrete border (Fig. 73P); paralabial plate wider than portion of maxilla (Fig. 76B).....12
- Mandibular adductor apodeme with no marked posterior dark pigmentation (Fig. 72F, G); ligula lobe with very fine to scale-like shagreen, not extending posteriorly as far as lateral edge of base of lobe, or rarely, extending to lateral edge, not defined or defined posteriorly by a discrete border (Fig. 73G-O); paralabial plate and portion of maxilla fused with of approximately equal width (Fig. 76A).....14

- 12(10) Anal papillae without constriction (Fig. 77J).....
colei (western Nearctic, pg. 260)
 - Anal papillae with single constriction (Fig. 77K)...
13

- 13(12) Head capsule length 534-698 u; distance of
 antennal seta from base/length of antennal segment
 one = 0.63-0.72 (eastern Nearctic, Colorado).....
poecilopterus (Mitchell), pg. 275
 - Head capsule length 592-776 u; distance of antennal
 seta from base/length of antennal segment one =
 0.68-0.82 (eastern Nearctic).....pulchripennis
 (Coquillett), pg. 268

- 14(11) Anal papillae without constriction (Fig. 77H);
 ligula lobe somewhat circular, with coarse
 shagreen; cleft between ligular lobes with margins
 diverging at midlength and rounded posteriorly
 (Fig. 73K); outer margin of mandible with marked
 concavity (Fig. 72G) (eastern Nearctic).....
albipalpus n. sp., pg. 201
 - Anal papillae with no or one constriction
 (Fig. 77I, K); ligular lobe squared to somewhat
 circular, with shagreen fine (sometimes coarse in
 specimens from western Nearctic Region); cleft
 between ligular lobes very narrow and nearly

parallel-sided, to V-shaped (Fig. 73G-J); outer
margin of mandible with slight concavity (Fig. 72F).
.....15

- 15(14) Anal papillae without constriction; ligular lobe
with scale-like shagreen (Fig. 73L, M) (western
Nearctic).....fuscipatellus n. sp., pg. 193
- Anal papillae with one constriction or none; ligular
lobe with fine to coarse shagreen (Fig. 73 G-J,
N, O).....16

- 16(15) Spicules of pecten epipharyngis in a short,
medially-placed row but grouped medially
(Fig. 69A); head capsule length 407-640 u;
ligular lobes joined or not joined by coloration
(Fig. 73N, O); distance of antennal seta from
base/length of antennal segment one = 0.48-0.71
(eastern Nearctic).....macateei (Malloch), pg. 223
- Spicules of pecten epipharyngis in a longer row,
extending laterally to bases of chaetulae laterales
(Fig. 68C); head capsule length 533-756 u; ligula
lobes joined by coloration (Fig. 73G-J); distance
of antennal seta from base length of antennal
segment one = 0.69-0.83 (Nearctic exclusive of
Pacific States).....hilaris (Walker), pg. 209

PRELIMINARY KEY TO FOURTH INSTAR LARVAE OF NEOTROPICAL

STENOCHIRONOMUS SPECIES

The following is a preliminary key to known Neotropical larvae. I have attempted to include detailed species characteristics in the final couplets to maximize the possibilities for correct identification. However, the larvae I have before me undoubtedly represent a small fraction of Neotropical diversity. Fresh material which does not key out here could be further resolved to at least species group by examining phylogenetically important characters.

Fourth instar larvae can be recognized by a head capsule length of at least 320 μ and/or the presence of thoracic imaginal discs which can be seen in undissected individuals.

1. Head capsule pale yellowish brown, somewhat triangular (Fig. 65C); dorsolateral stripes originating near base of dorsomedian stripe; posterior coronal pore canal arising subapically on posterolateral section of postoccipital carina directed anterolaterally; labral lamella with spicules not on projecting lobes; fused maxilla and paralabial plate truncate anterolaterally (Fig. 76C, D); anal papillae with one constriction at midlength, with portions of about equal diameter; (Fig. 77L); subgenus Petalopholeus; mining dead submerged leaves.....3

- Head capsule medium brown, somewhat squared (Fig. 65A); dorsolateral stripes originating on apical half of dorsomedian stripe; posterior coronal pore canal arising apically on posterolateral section of postoccipital carina, directed anteriorly; labral lamella with numerous spicules on paired, projected lobes (as in Fig. 68B); fused maxilla and paralabial plate anterolaterally bilobed (as in Fig. 75E); anal papillae with one or two constrictions, portions decreasing in size distally; mining dead submerged wood.....2

- 2(1) Anal papillae with two constrictions, situated on basal stalk (Iquitos, Peru).....n. sp. "Peru"

pg. 178

- Anal papillae with one constriction, arising directly from cuticle (eastern Ecuador).....
.....crusanticus n. sp., pg. 163

- 3(1) Pecten epipharyngis with elongate spicules, most spicules fused basally, not arranged on a sclerotized bar (as in Fig. 69C); labral lamella with comb-like arrangement of spicules; lateral edge of paralabial plate with cuticular thickening restricted to posterior half (Fig. 76C) (West Indies, Ecuador).....leptopus (Kieffer), pg. 296
Spicules of pecten epipharyngis peg-like and

- arranged on sclerotized bar (Fig. 70A, B); labral lamella with groups of short, basally fused spicules; lateral edge of paralabial plate with marked thickening (Fig. 76D).....4
- 4(3) Procercus composed of single filament, associated seta about equal in length to filament (Tingo Maria, Peru).....larval form one, pg. 326
- Procercus composed of several filaments, associated seta shorter than filament.....5
- 5(4) Paralabial plate with concavity near to hypostoma (similar to Fig. 75A) (eastern Ecuador, northern Brazil).....bacrionis n. sp., pg. 331
- Paralabial plate straight, or with slight curve near to hypostoma (as in Fig. 76D).....6
- 6(5) Anterior width/width = 0.52-0.65; labral lamella with 2-6 basally fused spicules, separated by a median gap into two groups.....7
- Anterior width/width = 0.64-0.70; labral lamella with 7 or more short, basally fused spicules, separated into two or more groups (Costa Rica).....gladius n. sp., pg. 341
- 7(6) Head capsule length = 427-533 u; 11-16 hooks in each posterior proleg (Costa Rica).....quadrinotatus

n. sp., pg. 363

- Head capsule length = 340-388 u; 9-10 hooks in each
posterior proleg (Costa Rica).....nudipupa

n. sp., pg. 374

Subgenus Stenochironomus s. str. Kieffer, new status

Type species: Stenochironomus fasciatus (Geoffroy) (= S. gibbus) by subsequent designation, Kieffer, 1922:56.

Diagnosis. Adults cannot be presently diagnosed. Pupa: T II with posterior row of hooklets extending to lateral margin of tergite. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe.

Description. Adult male and female. No distinguishing features are recognized.

Pupa. No spicules present on T VII or T VIII; T II with posterior row of hooklets extending to lateral margin of tergite.

Fourth instar larva. Head capsule elongate and somewhat squared anteriorly, with head length/maximal width: 1.00-1.25 and anterior width/maximal width = 0.65-0.89; dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; posterior coronal pore canals arising apically on posterolateral section of postoccipital carina; fused maxilla and paralabial plate anterolaterally bilobed.

Taxonomic discussion. This newly recognized taxon can be presently recognized only in the larval and pupal stages. The subgenus Stenochironomus contains all those species whose larvae mine wood and

forms the sister group to the only other subgenus, Petalopholeus.

Stenochironomus (Stenochironomus) unictus Townes

Stenochironomus unictus Townes, 1945:89. Holotype male adult, pinned, genitalia on a microscope slide, labelled "Atsion, N.J., VI.3, 1939, H.K. Townes", "Gen. No. 40", "Holotype Stenochironomus unictus H.K. Townes", "Type No. 40" (HKTo). Townes, 1952:65.

Diagnosis. Male: wing pale except for pigmented Cu2. Female: wing darkly pigmented; thorax without dark markings. Pupa: only eastern Nearctic species of Stenochironomus with row of hooklets on posterior margin of T II extending to lateral margin of tergite, but with median gap of missing hooklets; spurs of S VIII with dark brown teeth, one elongate tooth and 2-3 smaller ones. Fourth instar larva: only eastern Nearctic species with pigmentation of ligula restricted to lobes; procercus with a single filament.

Description. Male adult. Descriptive statistics: see Table 6.

Head: apical 0.30-0.40 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation: posterior half of postnotum slightly darkened in some specimens otherwise, dark pigmentation lacking; acrostichal seta extending to or nearly, sometimes continuing around anal under anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: lacking dark pigmentation except on fifth tarsomeres of all legs; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: pigmentation restricted to narrow band covering Cu₂; rarely (n=2) some infuscation, especially along M and Cu₁ and membrane distal to fork of Cu and posterior to R₄ + 5 but ending subapically (Fig. 14A); halter pale.

Abdomen: lacking dark pigmentation; genitalia pale with only some cuticular thickenings, anal point dark.

Genitalia (Fig. 30A): in lateral aspect basal 2/3 of anal point very high and dorsal edge straight, apex abruptly bent ventrally (Fig. 39G), apex swollen in dorsal aspect; lateral margins of base of anal point strongly produced, continuous with ridges bordering dorsal setal patch of T IX which meet posteriorly with the medioposterior edge of T IX; posterior edge of T IX truncate to rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae in longitudinally elongate, semi-circular to oval arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae restricted to apical 3/4; apex of appendage 2 slightly to moderately bent dorsally with apical seta shorter and basally thicker than subapical seta (Fig. 43A); gonostylus of nearly constant diameter to slightly swollen subapically, apex tapering; gonocoxal apodeme truncated to pointed anteriorly, with slight expansion.

Female adult. Descriptive statistics: see Table 61. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 3-4 rows; scutellar setae in 3-4 rows.

Wing: pigmentation: present on all of wing membrane but lightened on apical 1/4 of wing (Fig. 14B).

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 47A): setal patch on S VIII not extending posteriorly to cleft around opening of oviduct, bordered posteromedially by pronounced ridge; ventrolateral lobe markedly developed; cleft between dorsomesal and ventrolateral lobe of S VIII very narrowly U-shaped; spicules of ventrolateral lobe of S VIII long, on projecting medial swelling; apodeme of S VIII straight, ending on dorsomesal lobes; posterior apodeme of S IX well developed, tapering posteriorly, straight to slightly curved; spermatheca small.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (Fig. 53A).

Thorax: horn of respiratory organ partially fused with anterior stalk near base, length of fused portion approximately equal to width

of free portion (Fig. 54C), of moderate length and thickness; terminal filaments of respiratory organ stout, >4 μ in diameter, apices non-forked, with short tubercles scattered along length.

Abdomen: pigmentation (of exuviae) nearly uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VI, S II-V (weakly produced), S I in some specimens (weakly produced), and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV, some specimens with a few spicules on lateral margin of S III; T II and T III with rounded bare patches among spicules, or spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (Fig. 56C); T II with posterior row of large hooklets extending to lateral margin of tergite, divided medially into two groups (Fig. 56C); spur on S VIII with teeth dark brown, apex of large tooth pale, with one large elongate tooth and 0-2 deltoid to elongate smaller teeth, each more than $1/4$ length of largest tooth (Fig. 59E); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobes extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (Fig. 52D).

Larva. Descriptive statistics: see Table 98.

Head capsule (Fig. 63A, B): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe, ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterolateral or posterior to seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteriorly.

Labrum (Fig. 68B): S I pinnate; S II pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 73E): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (Fig. 75E): apically bilobed with paralabial and maxillary portions of approximately equal width,

projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with one filament, without small associated seta.

- Anal papillae (Fig. 77D): relatively short, with one constriction at midlength, basal portion equal to or wider than apical portion.

Distribution and bionomics: S. unictus is distributed in the eastern Nearctic Region, from southern Quebec to Florida (Fig. 82F). The only locality where I collected larvae in abundance was at Duncan Lake, Masham Twp., Quebec. Otherwise, larvae of S. unictus represented a small fraction of the total number of Stenochironomus I collected from a given locality.

Larvae mine under the bark layer of wood in streams, small rivers and lakes. I collected immature stages from Alnus, Nemopanthus and occasionally Betula.

I studied the life cycle of S. unictus at Duncan Lake, Masham Twp., Quebec. Table 123 indicates the numbers of larvae collected from Alnus branches I placed in the lake in the fall of 1979. Sampling in the spring of 1980 showed that no larvae had yet invaded the wood. By 18-X-1980, however, the branches contained a large number of larvae but no evidence of old mines; no adult had emerged from these. Sampling on May 9 and 16, 1981 showed that most larvae were in the fourth instar and a few were third instars. Some branches were protected from further invasion by being placed in a plexiglas cage; the remainder were left on the lake bottom. Adult

emergence was completed by 13-VI-1981 from the branches placed in the cage but larvae continued to appear in branches left on the bottom. Nearly all larvae had emerged, as evidenced by the numerous empty mines with pupal emergence "flaps" cut into the bark (see pg. XXX).

These data suggest that most S. unictus have a one year life cycle in Duncan Lake with a small percentage of the population not emerging till the second season after invasion of wood by first instar larvae.

Taxonomic discussion. Townes (1945:fig.100) illustrated the anal point of S. unictus as parallel sided from a dorsal aspect but all specimens examined, including the type, show an apically swollen anal point (Fig.).

Material examined. I examined larvae, pupae and adults from Duncan Lake (Masham Twp.); University of Montreal Biology Field Station, near St. Hippolyte, Quebec, and the Yamaska R. at West Brome, Quebec. With the exception of the holotype, all southern localities represent pupal or larval material; some of these are from Keowee Res., Seneca, and Upper Three Run, Aitken Co., South Carolina; Green River, nr Paradise, Kentucky; Black Creek, Walton Co., Florida.

Derivation of specific epithet. The name unictus apparently refers to the unique male used for the original description.

Stenochironomus (Stenochironomus) maculatus n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype Stenochironomus maculatus Borkent, Black River at Hwy 258, Eddy Co., New Mexico, 2-IV-1981, A. Borkent", allotype with associated pupal and larval exuviae, each on separate microscope slides, labelled as for holotype; paratypes 9 males, 6 females, 1 pupa, 13 pupal exuviae, and 6 larvae labelled as for holotype; 15 males, 44 females, 63 pupal exuviae, 25 larvae and 4 larval exuviae labelled "Stenochironomus maculatus Borkent, Las Moras Creek, Fort Clark Springs, Texas, 1-IV-1981, A. Borkent" (CNC).

Diagnosis. Male: only Nearctic species with all of wing membrane a light smokey gray; halter pale; lateral and median vittae with pigmentation; pigmentation on abdomen restricted to posterior margins of T 1-IV. Female: as for male except abdominal pigmentation absent or restricted to posterior margin of T I-III. Pupa: only western Nearctic species of Stenochironomus with row of hooklets on posterior margin of T II extending to lateral margins of tergite but with median gap of missing hooklets; spurs of S VIII with dark brown teeth, one elongate tooth and 2-3 smaller ones. Fourth instar larva: ventrum of head capsule with characteristic pattern of pigmentation; procercus with a single filament.

Description. Male adult. Descriptive statistics: see Table 7.

Head: all antennal hairs dark; palpus dark; labellum with dark markings; eye not metallic.

Thorax: dark pigmentation confined to the following areas (Fig. 1C, 5C): posterodorsal edge of mesepimeron, ventral portion of katepisternum (pale brown), entire to about posterior 3/4 of lateral vitta, posterior portion of median vitta, posterior 3/4 of postnotum (in some specimens anterior 1/4 of postnotum a lighter brown); acrostichal setae extending to, to around and under anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: all legs light to medium brown, basal 1/3 of fore femur lightened (Fig. 17D); in life, forelegs held posterolaterally (as in Fig.).

Wing: pigmentation light smoky gray on entire membrane (Fig. 14C); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 26C): posterior margins of T I, T II, T III, T IV, and weakly on T V; genitalia brown.

Genitalia (Fig. 30B): in lateral aspect basal 2/3 of dorsal edge of anal point straight to slightly concave, apex abruptly bent ventrally

(Fig. 39H), apex slightly bulbous to nearly parallel-sided in dorsal aspect; lateral margins of base of anal point moderately produced, almost continuous with ridge bordering dorsal setal patch of T IX; posterior edge of T IX wedge-shaped to rounded, with ventral row of stout setae; dorsal patch of setae in circular to semicircular arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae distributed along most of length; apex of appendage 2 bent dorsally and with apical seta shorter and basally thicker than subapical seta (Fig. 43B); gonostylus of nearly constant diameter, apex tapering; gonocoxal apodeme truncated anteriorly, with expansion.

Female adult. Descriptive statistics: see Table 62. Similar to male except as follows:

Head: flagellomere six dark, 1-5 light brown.

Thorax: dorsocentral setae in 2-3 rows; scutellar setae in 2-3 rows.

Abdomen: pigmentation absent to light brown, poorly defined: dark pigmentation absent on tergites or restricted to posterior margins of T I, T II, and T III and posterior portion of S VIII; ridge of ventrolateral lobe of S VIII darkly pigmented.

Genitalia (Fig. 47B): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, rarely bordered posteromedially by weak ridge; ventrolateral lobe markedly

developed; cleft between dorsomesal and ventrolateral lobes of S VIII narrowly U-shaped; ventral surface of dorsomesal lobe with inner ridge; spicules of ventrolateral lobe long, on projecting medial swelling of ventrolateral lobe; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX very thin, straight; spermatheca small.

Pupa. Descriptive statistics: see Tables 88-90

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ partially fused with anterior stalk near base, length of fused portion approximately equal to width of free portion (as in Fig. 54C), of moderate length and thickness; terminal filaments of respiratory organ stout, >4 μ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) nearly uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VI, S II-IV (weakly produced), S I in some specimens (weakly produced), and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than to moderately larger than posterior spicules (as in Fig. 56C); T II with posterior row of large hooklets extending to lateral margin of

tergite, divided medially into two groups (Fig. 56C); spur on S VIII with teeth dark brown, apex of large tooth pale, with one large elongate tooth and 1-4 deltoid to elongate smaller teeth, each more than $1/4$ length of largest tooth (Fig. 59F); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 99.

Head capsule (Fig. 64D): medium to dark brown; cuticular surface sculpturing coarser ventrally than dorsally; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore located lateral to, to posterior, to seta submenti or absent; posterior coronal pore canal short, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (similar to Fig. 68B): S I pinnate; S II pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pecten epipharyngis simple, arrayed in row, extending

laterally, some with medial spicules stout.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (as in Fig. 73E): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, not extending, to extending posteriorly, to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 75E): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with one filament and small associated seta.

Anal papillae (Fig. 77E): relatively short, with one constriction at midlength, basal portion equal to or wider than apical portion.

Distribution and bionomics. S. maculatus is known from southeastern New Mexico and western Texas (Fig. 82F). At Las Moras Creek, larvae were in wood lying on the bottom of this gently flowing stream which has its origin as a spring. At Black River, larvae mined wood which was firmly attached to the bank. This river valley is heavily inundated during summer rains.

Derivation of specific epithet. The name maculatus (spot) refers to the blotchy larval head capsule.

Stenochironomus (Stenochironomus) annettae n. sp.

Type information: Holotype, male adult with associated pupal exuviae, each on separate microscope slides, labelled "Holotype *Stenochironomus annettae* Borkent, San Felipe Springs, Del Rio, Texas, I-IV-1981, A. Borkent"; allotype with associated pupal exuvia, each on separate microscope slides, labelled as for holotype; paratypes 10 males, 1 female, 13 pupal exuviae, and 3 larval exuviae, labelled as for holotype (CNC).

Diagnosis. Male: wing with medial band, apical band not extending into cells R3 or CuA1; halter brown; hind femur with pigmentation on apical 0.67-0.73; abdomen as in Fig. 26D. Female: as for male except for abdomen which also has pigmentation on T I-IV; ridge of ventrolateral lobe markedly produced. Pupa: only Nearctic species with horn of respiratory organ arising from near base; respiratory organ horn length/length of T II = 0.85-0.96; T II with posterior row of hooklets extending to lateral margins of tergite but with a median gap of missing hooklets, teeth on spur of S VIII yellowish brown. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; labral lamella with spicules on two projecting lobes; seta submenti located lateral to ridges supporting labiohypopharynx; antennal seta from base/length of antennal segment one = 0.67-0.70, procercus with many filaments.

Description. Male Adult. Descriptive statistics: see Table 8.

Head: all antennal hairs dark; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 1D, 5D): dorsal portion of medioanepisternum, portion of postanepisternum, dorsal portion of mesepimeron, dorsal portion of metepisternum, metanotum, nearly entire lateral vitta except for pale semi-circular area on postero-medial edge, posterior portion of median vittae, and nearly entire postnotum except for pale portion at anterolateral edge; acrostichal setae extending to, or nearly to, anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum somewhat angular in lateral aspect (Fig. 13C).

Legs: dark pigmentation moderately discrete, distributed as follows (Fig. 17E): apical 0.61-0.67 of fore femur (poorly defined), apical 0.25-0.30 of fore tibia, fore tarsus (very lightly infuscated), apical 0.41-0.46 of mid femur, basal 0.20-0.30 of mid tibia. mid fifth tarsomere, apical 0.67-0.73 of hind femur (poorly defined), entire hind tibia, and hind fifth tarsomere; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band light brown, extending into cell CuA1; apical pigmentation restricted to very narrow border, not including cells R3 or CuA1 (Fig. 14D); halter dark brown.

Abdomen: pigmentation discrete, distributed as follows (Fig. 26D):

almost entire T I, extreme lateral and posterior margins of T II, extreme lateral, anterior and posterior margins of T III, extreme lateral margin and anterior and posterior margins of T IV; T VIII somewhat infuscated; genitalia brown.

Genitalia (Fig. 30C): in lateral aspect basal 2/3 of anal point moderately high, dorsal edge convex, apex bent ventrally (Fig. 39I), sides gradually expanding from base to apex in dorsal aspect; lateral margins of base of anal point moderately produced, almost continuous with ridge bordering dorsal setal patch of T IX; posterior edge of T IX truncated to rounded in dorsal aspect, with ventral row of stout setae; dorsal patch of setae in longitudinally elongate to semi-circular arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, most with setae restricted to apical and basal portions and midlength free of setae; apex of appendage 2 moderately bent dorsally and with apical seta shorter and basally thicker than subapical seta (Fig. 43D); gonostylus of nearly constant diameter, apex tapering; gonocoxal apodeme truncated to pointed anteriorly, with expansion.

Female Adult. Descriptive statistics: see Table 63. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: coloration as for male except as follows: lateral vitta completely pigmented, median vitta more extensively pigmented;

dorsocentral setae in 1-2 rows; anterior edge of scutum rounded to angular in lateral aspect).

Legs: dark pigmentation poorly defined, distributed as follows: apical 0.26-0.33 of fore femur, (apical 0.67 lightly pigmented), apical 0.23-0.25 of fore tibia, fore tarsus lightly infuscated, apical 0.23-0.25 of mid femur, basal 0.20 of mid tibia, (extreme apex somewhat infuscated), mid fifth tarsomere, apical 0.64-0.73 of hind femur with blotches of pigmentation. entire hind tibia (except 0.34-0.36 of midregion, and hind fifth tarsomere.

Abdomen: pigmentation discrete, distributed as follows: antero-lateral portions of T I,; anterior and lateral margins of T II,; anterior portion of T III, anterior portion of T IV, S VIII somewhat pigmented; ridge of ventrolateral lobe of S VIII darkly pigmented.

Genitalia (Fig. 47C): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered posteriorly by strong ridge which fuses with apodeme of S VIII; ventrolateral lobe markedly developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped dorsally, very narrowly U-shaped ventrally; spicules of ventrolateral lobe long, on markedly-produced, raised dorsoventral ridge; apodeme of S VIII straight, ending anterior to base of dorsomesal lobe; posterior apodeme of S IX well developed, tapering posteriorly, slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ originating near base (as in Fig. 54C), of moderate length and thickness; terminal filaments of respiratory organ slender, $<4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) nearly uniformly pale brown, lateral margin with narrow dark stripe in some specimens, posterior margin of T VII and anterior margin of T VIII; spicules present on the following: T II-VI, S I-III (weakly produced), S IV in some specimens (weakly produced), and sometimes a few on anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with rounded bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (as in Fig. 56C); T II with posterior row of large hooklets extending to lateral margin, divided medially into two groups (Fig. 56C); spur on S VIII with teeth yellowish brown; with 1-2 large deltoid to elongate teeth and 2-4 deltoid to elongate smaller teeth which are more than $1/4$ the length of the largest tooth (Fig. 60C); from a dorsal aspect, teeth arranged in an evenly curved row, some specimens

with additional ventral teeth; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 100.

Head capsule (similar to Fig. 64C): medium to dark brown; cuticular surface sculpturing coarser ventrally than dorsally; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with no longitudinal line of weakness, seta submenti lateral to paired ridges supporting labiohypopharynx, micropore lateral or posterolateral to seta submenti; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 68B): S I pinnate; S II pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pect~~er~~ epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

3

with additional ventral teeth; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 100.

Head capsule (similar to Fig. 64C): medium to dark brown; cuticular surface sculpturing coarser ventrally than dorsally; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with no longitudinal line of weakness, seta submenti lateral to paired ridges supporting labiohypopharynx, micropore lateral or posterolateral to seta submenti; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 68B): S I pinnate; S II pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pectus epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (as in Fig. 73E): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 75E): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77F): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. S. annettae was collected as larvae from wood in San Felipe Springs at Del Rio, Texas (Fig. 83A). The pieces of wood were all lying on the bottom where the substrate was sandy and rocky under the bridge where the highway crosses the stream.

Derivation of specific epithet. This colorful and pretty species is named for my wife Annette, who shared in all the field trips and many of the tasks of this study.

Stenochironomus (Stenochironomus) crusanticus n. sp.

Type information: Holotype, male adult with associated pupal exuviae, each on separate microscope slides, reared from larva, labelled "Holotype *Stenochironomus crusanticus* Borkent, 5 km N. Tena, Ecuador, 13-II-1982, A. Borkent"; allotype with associated pupal and larval exuviae, each on separate microscope slides labelled as for holotype: paratypes 2 pupae on microscope slides, labelled as for holotype (CNC).

Diagnosis. Male: all of thorax dorsal to anapleural suture dark brown; anal point markedly bent in lateral aspect. Female: pigmentation as for male; ventrolateral lobe markedly developed. Pupa: only Neotropical species with T II with posterior row of hooklets extending to lateral margins of tergite; spur on S VIII with one lateral deltoid tooth and 2-4 elongate medial tooth. Fourth instar larva: only Neotropical species with dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; seta submenti located lateral to ridges supporting labiohypopharynx.

Description. Male adult: Descriptive statistics: see Table 9.

Head: dorsum of head capsule dark; all antennal hairs dark; palpus light brown; labellum with dark markings; eyes not metallic.

Thorax: dark pigmentation restricted to following areas (Fig. 5E); all of thorax dorsal to level of anapleural suture, including

mesepimeron and metepisternum; acrostichal setae extending nearly to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: dark pigmentation poorly defined, distribution as follows (Fig. 17F): apical 0.15 of fore femur, entire fore tibia, all of fore tarsomeres, apical 0.44 of hind femur, entire hind tibia, hind tarsomeres light brown; in life, forelegs held anterolaterally with occasional, momentary movement to a posterolateral position (Fig. 52B).

Wing: entire membrane medium brown (as in Fig. 14C); halter dark brown.

Abdomen: pigmentation dark brown, distributed as follows (Fig. 26E): entire T I-VI; anterior portion of T VII; genitalia dark brown.

Genitalia: similar to that of S. niger (as in Fig. 31A, 39J) except for the following: appendage 1 of nearly constant diameter, with setae distributed along entire length; apical seta of appendage 2 elongate nearly the length as the subapical seta.

Female adult. Descriptive statistics: see Table 64. Similar to male except as follows:

Head: all flagellomeres with dark pigmentation but lighter on

flagellomeres 1-2.

Legs: dark pigmentation moderately well defined, distributed as follows: apical 0.73 of fore femur, entire fore tibia, all of fore tarsomeres, apical 0.38 of mid femur mid brown; entire mid tibia mid brown, mid tarsomeres light brown, apical 0.48 of hind femur, entire hind tibia, hind tarsomeres light brown.

Abdomen: all of abdomen dark brown except T IX and genitalia plate.

Genitalia: similar to that of S. niger (as in Fig. 47D) except for the following: setal patch on S VIII extending posteriorly past level of cleft around opening of oviduct; spicules of ventrolateral lobe of moderate length.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory arising directly from base, of moderate length and thickness; terminal filaments of respiratory organ slender, <4 u in diameter, apices non-forked, smooth (similar to Fig. 54C).

Abdomen: pigmentation (of exuviae) nearly uniformed pale brown, lateral margin with narrow dark stripe; spicules present on T II-VI and on S II-IV (weakly produced), but not on anal lobe; anterior

spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with rounded bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (as in Fig. 56C); T II with posterior row of large hooklets extending to lateral margin of tergite, divided medially into two groups (as in Fig. 56C); spur on S VIII with teeth yellowish brown, with one large deltoid tooth and 2-4 elongate, medial teeth, each more than 1/4 length of largest tooth (as in Fig. 60D); from a dorsal aspect, teeth arranged in an evenly curved row, some specimens with additional, small ventral teeth; male genital lobe extending posteriorly past apex of swim paddle.

Larva. Descriptive statistics: see Table 101.

Head capsule: medium brown; cuticular surface sculpturing similar dorsally and ventrally; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe (as in Fig. 63A, B); ventral, posteromedial area with very weak longitudinal line of weakness, and short stripe (as in Fig. 65B) with slight, posterior projection of pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore absent; posterior coronal pore canal elongate, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially (as in Fig. 64C).

Labrum (similar to Fig. 68B): S I pinnate; S II pinnate; S III

pinnate; S I and labral lamella on semicircular plate; labral lamella with 8 spicules, arising from projecting pair of lobes; spicules of pecten epipharyngis simple (except for one spicule which was bifurcate, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (as in (Fig. 73F): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very narrow, nearly parallel-sided.

Fused maxilla and paralabial plate (as in Fig. 75E): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae: one constriction at midlength, similar to Fig. 77F but basal portion markedly wider than apical portion.

Distribution and bionomics. I found larvae of this species in a large stream, 5 km N. Tena, Ecuador, (Fig. 85, locality 8) mining wood which was either attached to the bank or firmly lodged on the

bottom.

Derivation of specific epithet. The name crusanticus (leg, foremost) refers to the way adults of this and a few other species hold their forelegs (see Fig.52B).

Stenochironomus niger n. sp.

Type information: Holotype, male adult with associated pupal exuviae, each on separate microscope slides, reared from larva, labelled "Holotype *Stenochironomus niger* Borkent, Oak Creek Canyon, Sedona, Arizona, 15-IV-1981, A. Borkent"; allotype with associated pupal exuviae, each on separate microscope slides labelled as for holotype; paratypes, female adult with associated pupal exuvia, 4 larval exuviae each on separate microscope slides, labelled as for holotype (CNC).

Diagnosis. Male: entire thorax and at least abdominal segments I-IV dark brown; anal point markedly bent in lateral aspect. Female: pigmentation as for male; ventrolateral lobe markedly developed. Pupa: only Nearctic species with horn of respiratory organ arising from near base; respiratory organ horn length/length of T II = 0.66-0.84; T II with posterior row of hooklets extending to lateral margins of tergite but with a median gap of missing hooklets; teeth on spur of S VIII yellowish brown. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe, labral lamella with spicules on two projecting lobes; seta submenti located lateral to ridges supporting labiohypopharynx; antennal seta from base/length of antennal segment one = 0.75-0.77, procercus with many filaments.

Description. Male adult. Descriptive statistics: see Table 10.

Head: dorsum of head capsule dark; all antennal hairs dark; palpus dark; labellum with dark markings; eye not metallic.

Thorax: completely pigmented, dark brown, except for areas of membrane (Fig. 1E, 6A); katepisternum somewhat paler; acrostichal setae extending nearly to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: all legs pale brown with medium brown pigmentation poorly defined, distributed as follows (Fig. 18A): apical 0.66 of fore femur, entire fore tibia, all of fore tarsomeres, apical 0.52 of mid femur, entire mid tibia, apical 0.69 of hind femur, entire hind tibia; in life, forelegs held anterolaterally with occasional, momentary movement to a posterolateral position (as in Fig. 52B).

Wing: entire membrane medium brown, area between C and R somewhat darkened (similar to Fig. 14C); halter dark brown.

Abdomen: pigmentation dark brown, distributed as follows (Fig. 26F): entire T I-IV, T V, T VI somewhat infuscated; T VII-IX darker; genitalia dark brown.

Genitalia (Fig. 31A): in lateral aspect basal 2/3 of anal point very high and dorsal edge markedly thickened, basal portion markedly convex, apex straight (Fig. 39J), dorsum of anal point with marked lateral expansion in dorsal aspect, tapering posteriorly; base of

anal point stoutly attached, lateral margins nearly continuous with ridges bordering dorsal setal patch of T IX; posterior edge of T IX truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in longitudinally elongate arrangement; appendage 1 markedly elongate, thick, tapering from near base, setae restricted to basal half; apex of appendage 2 slightly bent dorsally and with apical seta shorter and basally thicker than subapical seta (Fig. 43E); gonostylus swollen at midlength, apex tapering; gonocoxal apodeme truncated anteriorly, with expansion.

Female adult. Descriptive statistics: see Table 65. Similar to male except as follows:

Head: flagellomere six dark with light pigmentation on flagellomeres 1-5.

Thorax: dorsocentral setae in 2-3 rows; scutellar setae in 2 rows.

Legs: dark pigmentation poorly defined: base of fore femur medium yellow, apical 0.36 dark; fore tibia and fore tarsus dark; mid femur medium yellow, extreme apex somewhat darkened; mid tibia dark; mid tarsus medium yellow; hind femur medium yellow with very apex somewhat darkened; hind tibia dark; hind tarsus medium yellow.

Abdomen: all of abdomen dark brown with cerci, all sternites, except S VIII, and segment 9 a lighter shade of pigmentation.

Genitalia (Fig. 47D): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered posteromedially by markedly developed ridge which almost merges laterally with apodeme of S VIII; ventrolateral lobe markedly developed; cleft between dorsomesal and ventrolateral lobes of S VIII very narrowly U-shaped; spicules of ventrolateral lobe long, markedly produced, darkly pigmented, on raised dorsoventral ridge; apodeme of S VIII straight, ending at extreme base of dorsomesal lobe; posterior apodeme of S IX well developed, tapering posteriorly from dorsal aspect, moderately curved, pincers-like.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ partially fused with anterior stalk near base, length of fused portion approximately equal to width of free portion (as in Fig. 54C), of moderate length and thickness; terminal filaments of respiratory organ slender, $<4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) nearly uniformly pale brown, lateral margin with narrow dark stripe; spicules present on T II-VI and on S I-V (weakly produced), but not on anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S III, IV; T II and T III with rounded bare patches among spicules in addition to double pair of bare,

posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (Fig. 56C); T II with posterior row of large hooklets extending to lateral margin of tergite, divided medially into two groups (Fig. 56C); spur on S VIII with teeth yellowish brown, with one large deltoid to somewhat elongate tooth and 2-5 elongate, smaller teeth, each more than $1/4$ length of largest tooth (Fig. 60D); from a dorsal aspect, teeth arranged in an evenly curved row, some specimens with additional, small ventral teeth; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: uncertain in relation to pupa but larval exuviae in elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 102.

Head capsule: medium to dark brown; cuticular surface sculpturing coarser ventrally than dorsally; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe (as in Fig. 63A); ventral, posteromedial area with no longitudinal line of weakness, and short stripe (as in Fig. 64C) with slight, posterior projection of pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx (as in Fig. 64C), micropore located lateral or posterolateral to seta submenti; posterior coronal pore canal short, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially (as in Fig. 65A).

Labrum (similar to 68B): S I pinnate; S II pinnate; S III pinnate; S

I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (as in Fig. 73F): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 75F): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77F): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. I found larvae of this species at only one locality, Oak Creek Canyon, near Sedona, Arizona (Fig. 83A), mining wood which was firmly attached to the bank. I found appropriate wood to be rather scarce in this rushing stream, which

explains the low number of specimens reared.

Derivation of specific epithet. The name niger (black) refers to the dark appearance of adults of this species.

Stenochironomus (Stenochironomus) innocuus (Williston) n. comb.

Chironomus innocuus Williston, 1896:274. Lectotype, here designated, male adult, on microscope slide labelled "St. Vincent, W.I. [West Indies], H.H. Smith", "W. Indies 1907-66.", "Cotype" label added "Lectotype of Stenochironomus innocuus (Williston) designated by A. Borkent 1981"; paralectotypes 1 male on microscope slide, 4 males pinned, labelled as for holotype, some with an additional label "1000 feet" (BMNH). Johannsen, 1905:235.

Diagnosis. Male: scutellum pale; halter brown; dorsum of anal point with marked lateral expansion in dorsal aspect.

Description. Male Adult. Descriptive statistics : see Table 11.

Head: antennal hairs dark; palpus dark brown; labellum with dark markings; eyes not metallic (when reconstituted in ammonium hydroxide).

Thorax: pigmentation confined to the following areas (Fig. 1F, 6B): dorsal portion of medioanepisternum, mesepimeron and metepisternum, anterior portion to entire median vitta, entire lateral vittae with pigmentation extending in anterior portin to median vitta and lateral margin of scutum and extending posteriorly to postalar callus, posterior portion of postnotum; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum somewhat angular in lateral

aspect (as in Fig. 13C).

Legs: pigmentation distributed as follows (Fig. 18B): entire fore tibia, with a lightened area in midregion.

Wing: entire membrane a light smokey brown (Fig. 14C); halter dark brown.

Abdomen: pigmentation distributed as follows (Fig. 26G): all of T I-VI; genitalia dark brown.

Genitalia: similar to S. niger (Fig. 31A) except dorsal margin of anal point more convex in lateral aspect (Fig. 39K) and setae distributed along entire length of appendage 1.

Female adult, pupa and larva. Unknown.

Distribution. This species is known only from St. Vincent (Fig. 85, locality 5).

Taxonomic discussion. All specimens were first examined as pinned specimens.

Derivation of specific epithet. The name innocuus (harmless) probably refers to the (assumed) non-biting nature of this and most other species of Chironomidae.

Stenochironomus (Stenochironomus) n. sp. "Peru".

Diagnosis. Male: only Neotropical species with anterior margin of gonocoxal apodeme bilobed. Pupa: only Neotropical species with 6-10 deltoid teeth of similar size on spur of S VIII. Larva: anal papillae situated on short stalk, with two constrictions, portions decreasing in size distally.

Description. Male adult.

Head: Ant 13/1-12 about 2.2.

Thorax: pigmentation restricted to anterior portion of pleural region; dorsocentral setae in 1 row; scutellar setae in 2 rows.

Legs: anterior portion of fore femur and entire fore tibia with dark pigmentation.

Wing: lacking discrete dark pigmentation.

Abdomen: lacking dark pigmentation.

Genitalia: apex of anal point somewhat bulbous in dorsal aspect (similar to Fig. 30B); lateral margins of base of anal point weakly produced, originating subapically on T IX, slightly diverging; posterior edge of T IX wedge-shaped in dorsal aspect, with ventral row of stout setae; dorsal patch of setae in semicircular

arrangement; appendage 1 elongate, thick, somewhat tapering from base (as in Fig. 32B), with setae distributed along entire length; appendage 2 with apical seta elongate and basally more thick than subapical seta; gonostylus of nearly constant diameter, apex tapering; gonocoxal apodeme truncated anteriorly, with two anterolateral lobes (as in Fig. 31B).

Pupa. Descriptive statistics: see Tables 88-89.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ originating near base (as in Fig. 54C), of moderate length and thickness; terminal filaments of respiratory organ stout, $>4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly yellowish brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VI, S II-VI (weakly produced), and anal lobe (weakly produced); anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S II-IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III equal in size to posterior spicules; T II with posterior row of large hooklets extending to lateral margin of tergite, divided medially into two groups (Fig. 56C); spur on S VIII with teeth yellowish brown, with 6-10 deltoid, lateral teeth of similar size and 1-2 deltoid to elongate smaller medial teeth (Fig. 60B); from a

dorsal aspect, teeth arranged in a slightly curved row; male genital lobe extending posteriorly past apex of swim paddle.

Larva. Descriptive statistics: see Table 104.

Head capsule: medium brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe (as in Fig. 63A); ventral, posteromedial area with faint longitudinal line of weakness, with moderate posterior projection; seta submenti posterolateral to paired ridges supporting labiohypopharynx, micropore lateral or posterolateral to seta submenti; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially (as in Fig. 64C).

Labrum (as in Fig. 73E): S I pinnate; S II pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pecten epipharyngis not observable; premandible with 4 teeth.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (as in Fig. 73E): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very

narrow, nearly parallel-sided to V-shaped; M appendage narrow, markedly sclerotized, elongate plate.

Fused maxilla and paralabial plate (as in Fig. 75E): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae: with two constrictions, basal portion largest, situated on short stalk.

Distribution and bionomics. Two fourth instar larvae were collected from the Amazon River, near Iquitos, Peru, on 15-X-1955 and another from the Nanay River, near Iquitos on 14-X-1955 (Fig. 85, locality 9). Two pupae from near Iquitos, were collected 12-X-1955. The specimens were obtained from cages containing rocks and wood and all three larvae had wood particles in their guts.

Taxonomic discussion. Roback (1966: 333) has provided a previous description of these forms (as Stenochironomus sp.1). Contrary to his description of the larvae, the paralabial plates exhibit fine striations just lateral to the hypostomal teeth and some scattered spicules.

One of the pupae contained a pharate male adult which is described above. Roback (1966: fig. 22) provides an illustration of

the genitalia. The thorax is partially crushed but some dark pigmentation is evident on the pleural region.

Although it is not absolutely certain that the pupae and larvae are correctly associated here, congruent synapomorphies of both larvae and pupae with S. bisetosus suggest that they are indeed conspecific.

I have preferred not to name this species until complete adults become available.

The specimens are deposited in the INHS.

Stenochironomus (Stenochironomus) bisetosus n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype *Stenochironomus bisetosus* Borkent, Oak Creek Canyon, Sedona, Arizona, 15-IV-1981, A. Borkent"; allotype with associated pupal and larval exuviae, each on separate microscope slides labelled as for holotype; paratypes 5 males, 26 females, 6 pupae, 19 pupal exuviae, 19 larvae and 5 larval exuviae, labelled as for holotype (CNC).

Diagnosis. Male: only Nearctic Species with extreme apex of anal point bent upwards in lateral aspect, otherwise recognizable by the following combination - wing light brown; halter pale; lateral and median vittae with dark pigmentation; entire postnotum pigmented; abdomen with pigmentation on each segment. Female: apodemes of S VIII transverse, otherwise recognizable combination given for male. Pupa: only species with respiratory organ horn short, stout, not extending beyond multiforked portion, only Nearctic species with teeth of spur on S VIII arranged in a straight row. Fourth instar larva: only Nearctic species with seta submenti located posterolateral to ridges supporting labiohypopharynx.

Description. Male adult. Descriptive statistics: see Table 12.

Head: dorsum of head capsule dark; all antennal hairs dark; palpus dark; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 1G, 6C): dorsal portion of medioanepisternum, postanepisternum, mesepimeron, and area ventral to posterior spiracle medium brown; katepisternum, and mid and hind coxae light brown; dorsum of thorax light brown, median and lateral vittae, and dorsal portion of postalar callus, darker; scutellum light brown; entire postnotum medium brown; acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: pigmentation (Fig. 18C): all segments medium brown with the following dark brown: entire fore femur except with extreme base lightened, entire fore tibia and tarsus, and mid and hind tibia; in life, forelegs held posterolaterally (as in Fig.).

Wing: all of wing light brown (as in Fig. 14C); halter pale.

Abdomen: pigmentation poorly defined, light brown with medium brown markings, distributed as follows (Fig. 26H): all of T I (medial area light brown); lateral and posterior borders of T II, lateral and posterior borders of T III (with two pale spots 1/3 of total tergite length from anterior margin); anterior and posterior border of T IV, and posterior border to entire T V; T VI-VIII variably mottled; genitalia brown.

Genitalia (Fig. 31B): in lateral aspect basal 2/3 of anal point very

high and dorsal edge convex to straight, apex evenly bent ventrally except extreme apex slightly bent dorsally (Fig. 39L); apex parallel-sided to very slightly bulbous in dorsal aspect; lateral margins of base of anal point weakly produced, originating subapically on T IX, slightly diverging; posterior edge of T IX wedge-shaped in dorsal aspect, with ventral row of slender setae; T IX with sharp subapical constriction; dorsal patch of setae in semicircular arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae restricted to apical half; appendage 2 straight to slightly curved with 2 apical setae about equally long and thick at base; a third, subapical seta present close to apex (Fig. 43C); gonostylus of nearly constant diameter, apex tapering; gonocoxal apodeme truncated anteriorly, with two anterolateral lobes.

Female adult. Descriptive statistics: see Table 66. Similar to male except as follows:

Head: all flagellomeres dark; head capsule somewhat darkened.

Thorax: dorsocentral setae in 3-4 rows; scutellar setae in 3-4 rows.

Abdomen: pigmentation distributed as follows: T I and T III medium brown, T III with a pair of clear spots 1/4 length of tergite from anterior edge; lateral margins of T II and T IV-VIII variably infuscated with brown; T IX darkened; cercus pale; sternites paler brown than tergites.

Genitalia (Fig. 48A): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered medioposteriorly by weak to moderately developed ridge which almost merges laterally with apodeme of S VIII; ventrolateral lobe markedly developed; cleft between dorsomesal and ventrolateral lobes of S VIII narrowed dorsally, broadly U-shaped ventrally; spicules of ventrolateral lobe long, on projecting medial swelling; apodeme of S VIII curved, ending at side of cleft around opening of oviduct at transverse angle; posterior apodeme of S IX well developed, tapering posteriorly, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ partially fused with anterior stalk, length of fused portion more than twice width of free portion (Fig. 54D), short, of moderate thickness; terminal filaments of respiratory organ slender, $<4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) nearly uniformly pale brown, lateral margin with narrow dark stripe; spicules present on T I-VI and on S I-V (weakly produced), sometimes a few on anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with

poorly defined bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III moderately larger than posterior spicules (as in Fig. 56F); T II with posterior row of large hooklets extending to lateral margin of tergite, divided medially into two groups (as in Fig. 56C); spur on S VIII with teeth yellowish brown, with one or two smaller, deltoid to slightly elongate, lateral teeth and 2-5 elongate medial teeth larger or equal in length to lateral teeth (Fig. 60A); from a dorsal aspect, teeth arranged in a straight row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 103.

Head capsule (Fig. 65A): medium to dark brown; cuticular surface sculpturing much coarser ventrally than dorsally; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with no longitudinal line of weakness, and long stripe with markedly broad posterior projection of pale cuticle; seta submenti posterolateral to paired ridges supporting labiohypopharynx, micropore lateral to, to posterior to, seta submenti, or absent; posterior coronal pore canal short, arising from apex of dorsolateral section of postoccipital

carina, directed anteromedially.

Labrum (similar to Fig. 68B): S I pinnate; S II pinnate; S III pinnate; S I and labral lamella on semicircular plate; labral lamella with numerous spicules, arising from projecting pair of lobes; spicules of pecten epipharyngis simple, arrayed in row, extending laterally, some with medial spicules bifurcating.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 73F): ligular lobes not joined to joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe transversely broadened with edges somewhat truncated; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (Fig. 75F): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 77F): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. See discussion under S. niger, all of which applies to S. bisetosus. Adults of S. bisetosus were markedly more active than any other species I observed.

Derivation of epithet. The name bisetosus refers to the two elongate setae present on the apex of appendage 2 of the male adult.

Stenochironomus (Stenochironomus) licinus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus licinus* Borkent, Missao Cururu, Rio Cururu, Brazil, 20-I-1961, Leg. E.J. Fittkau"; paratype 1 male adult labelled as for holotype (INPA).

Diagnosis. Male: extreme apex of anal point bent upwards in lateral aspect; very posterior margin of T I-IV with light pigmentation.

Description. Male adult. Descriptive statistics: see Table 13.

Head: antennal hairs missing; palpus and labellum pale; eye not metallic in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 1H, 6D): posterodorsal edge of mesepimeron, anterior portion of lateral vitta, extending laterally to parapsidal suture, posterior portion of postnotum; acrostichal setae extending to around and under anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 1-2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: light pigmentation poorly defined, distributed as follows (Fig. 18D): apical portion of fore femur, entire fore tibia with midregion lightened.

Wing: lacking dark pigmentation; halter pale.

Abdomen: light pigmentation, distributed as follows: very posterior margin of T I-IV; genitalia brown.

Genitalia: in lateral aspect basal 2/3 of anal point very high and dorsal edge straight, apex abruptly bent ventrally except extreme apex slightly bent dorsally (Fig. 39M); apex parallel-sided in dorsal aspect; lateral margin of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX wedge-shaped in dorsal aspect with ventral row of slender setae; T IX with sharp subapical constriction (as in Fig. 31B); dorsal patch of setae in elongate arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae restricted to apical half (as in Fig. 31B); appendage 2 slightly curved with apical seta as long and basally as thick as subapical seta (similar to Fig. 43C); subapical seta close to apex; gonostylus somewhat swollen at midlength, apex tapering; gonocoxal apodeme truncated anteriorly, with slightly developed, two anterolateral lobes (as in Fig. 31B).

Female adult, pupa and larva. Unknown.

Distribution. This species is known only from northern Brazil (Fig. 85, locality 12).

Taxonomic discussion. Both specimens were first examined in alcohol

and were subsequently mounted on microscope slides.

Derivation of specific epithet. The name licinus (bent° upward) refers to the upward curve of the very apex of the anal point in male adults of this species.

Stenochironomus (Stenochironomus) fuscipatellus n. sp.

Type description: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype Stenochironomus fuscipatellus Borkent, Silver Lake, 8 km S. Hope, B.C., 27-VII-1980, A. Borkent"; allotype, with associated pupal and larval exuviae, each on separate microscope slides, labelled as holotype; paratypes 19 males, 24 females, 47 pupal exuviae, 7 larvae and 4 larval exuviae, labelled as for holotype (CNC); additional paratypes, 30 males, 8 females, 35 pupal exuviae, 5 larvae from Wahtum Lake, Hood River Co., Oregon, 28-VI-1981; 1 female from Mesachie Lake, B.C., 8-VI-1979 (CNC); 2 females from 0.5 mi.E. of Lower Sardine Lake, Sierra Co., California, 17-VII-1967 (Grodhaus); 2 males from Lake Tahoe, California, 19-VII-? and 10-VII-?, respectively (MCZ).

Stenochironomus taeniapennis: Townes, 1945:90 (in part), 1952:66 (in part).

Diagnosis. Male: wing with median band at most extending into very base of CuA1; apical band extending into cells R3 and CuA1; palpus dark brown; basal 0.16-0.26 of fore femur pigmented; Gc/Gs = 0.70-0.84. Female: wing as for male; basal 0.16-0.26 of fore tibia pigmented; lateral vitta with pigmentation along inner margin; lateral apodeme of S IX somewhat swollen. Pupa: horn of respiratory organ fused for most of its length with anterior stalk; T II with posterior row of hooklets without median gap; spurs on S VIII with

yellowish brown teeth; with 2-4 deltoid, lateral teeth of similar size and shape and a few smaller medial teeth (pupae cannot be distinguished from all specimens of S. albipalpus or S. hilaris, except by distribution). Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; labral lamella with 3-7 spicules arising from cuticle, divided into two groups; mandibular adductor apodeme without dark pigmentation; cleft between ligular lobes very narrow and nearly parallel-sided, to V-shaped; ligular lobes with scale-like shagreen.

Description. Male Adult. Descriptive statistics: see Table 14.

Head: apical 0.31-0.40 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 11, 6E); posterodorsal edge of mesepimeron, all of lateral vitta very light tan, sometimes with darker marking along inner margin, and posterior 0.6 of postnotum; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 3-4 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: pigmentation light brown, poorly defined, distributed as follows (Fig. 18E): apical 0.14-0.21 of fore femur, basal 0.16-0.26 of fore tibia, fore fifth tarsomere, apical 0.11-0.25 of mid femur, basal 0.00-0.12 of mid tibia, mid fifth tarsomere, apical 0.10-0.26

of hind femur, very light pigmentation at extreme base and apex of hind tibia, and hind fifth tarsomere; in life, forelegs held posterolaterally (as in Fig.).

Wing: medial band present but pigmentation of membrane extending anteriorly only to r-m, discontinuous between M and Cu1, at most extending into extreme base of CuA1; apical band extensive, including cell CuA1; area between C and M pale (Fig. 14E); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark.

Genitalia (as in Fig. 31D): in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight, apex abruptly bent ventrally (Fig. 39N), apex bulbous in dorsal aspect, lateral margins of base of anal point moderately to strongly produced, originating subapically on T IX, widely diverging; posterior edge of T IX truncate in dorsal aspect with ventral row of stout setae; dorsal patch of setae with transverse to circular arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter, and basally thicker than subapical seta (Fig. 43G); gonostylus somewhat swollen subapically, apex rounded to tapering; gonocoxal apodeme pointed anteriorly, with slight expansion.

Female Adult: Descriptive statistics: see Table 67. Similar to male except as follows:

Head: flagellomere, six dark.

Thorax: pigmentation confined to the following areas: posterodorsal edge of mesepimeron, all of lateral vitta very light tan with darker marking along inner margin, and posterior 0.6 of postnotum.

Legs: pigmentation pale, poorly defined, distributed as follows: apical 0.17-0.25 of fore femur, basal 0.16-0.26 of fore tibia, in some specimens extreme apex of fore tibia, fore fifth tarsomere, apical 0.11-0.24 of mid femur, basal 0.00-0.16 of mid tibia, mid fifth tarsomere, apical 0.05-0.24 of hind femur, basal 0.16-0.26 and apical 0.00-0.29 of hind tibia, and hind fifth tarsomere.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 48B): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, rarely bordered posteromedially by very weak ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped; spicules of ventrolateral lobe of moderate length, on small, raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; some specimens with inner half of lateral apodeme of S IX markedly swollen; posterior apodeme of S IX well developed, broad in dorsal aspect, tapering posteriorly, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Thorax: horn of respiratory organ fused for most of its length with ventral region of anterior stalk, free portion of horn short, thin (as in Fig. 55A); terminal filaments of respiratory organ slender, $<4\mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly yellowish brown, lateral margin with narrow dark stripe and posterior margins of S II, III and S IV in some specimens with transparent, anteriorly bilobed area; spicules present on the following: T II-VI, S II-IV (weakly produced), S V in some specimens (weakly produced), and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S II-IV; T II and T III with rounded bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (Fig. 56D); T II with posterior row of large hooklets extending to lateral margin of tergite, continuous across middle (as in Fig. 56D); spur on δ VIII with teeth yellowish brown, with 2-4 deltoid, lateral teeth of similar size and shape and 4-5 sharply pointed to blunt, deltoid to elongate, smaller medial teeth (Fig. 60E); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 105.

Head capsule (as in Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore anterolateral to, to posterolateral to, seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 68C): S I pinnate; S II pinnate; S III simple; S I and labral lamella on semicircular plate; labral lamella with 3-7 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 73L, M): ligular lobes joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes scale-like, not extending posteriorly as far as lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between

lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76A): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 77G): without constriction.

Distribution and bionomics. S. fuscipatellus is distributed from extreme southern B.C. to California (Fig. 83C). I have examined a female adult from Granite Lake, Bonner Co., Idaho, 9-VI-1971 (IUID) which may belong to this species by virtue of its pale pigmentation but the genitalia was too poorly mounted to confirm the identification.

I have observed immature stages of this species from two localities. At Silver Lake, B.C. larvae were found under a wood layer in branches of Acer macrophyllum and Alnus rubra. At Wahtum Lake, Ore. larvae were collected similarly from unidentified logs and also from under the bark of branches of Alnus.

Adults from other localities were all collected near lakes, so the few data suggest that this species is restricted to lake habitats.

A swarm of male adult S. fuscipatellus was observed at Silver Lake, B.C. on 27-VII-1980. The adults were at a height of about 4 m

just above the apex of a branch of a sapling reaching toward the lake and located near the shore.

The infested wood collected at Silver Lake, B.C. on 27-VII-1980 and at Wahtum Lake, Oregon on 28-VI-1981 produced adults irregularly over a long emergence period. These data are consistent with overwintering as mature larvae.

Taxonomic discussion. This species is morphologically similar to S. hilaris. The two species are allopatric for most of their ranges, with sympatry only at Mesachie Lake, B.C. This sympatry and differences in Gc/Gs of the male adult (with slight overlap in ranges), the shape of the lateral apodeme of S IX of some female adults and shagreen on the larval ligular lobes suggest to me that they are reproductively isolated. It should be noted that a somewhat scale-like shagreen on the apex of the larval ligular lobes also occurred to a slight degree among some British Columbia and Yukon samples of S. hilaris. The distinction between these two species therefore warrants further investigation.

Derivation of specific epithet. The name fuscipatellus refers to the pigmentation on the legs of adults of this species, being restricted to the apex of the femora and base of the tibiae.

Stenochironomus (Stenochironomus) albipalpus n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype Stenochironomus albipalpus Borkent, 3 mi. S. Rockville, Maryland, 21-III-1980, D.M. Wood"; allotype with associated pupal and larval exuviae, each on separate microscope slides, labelled as for holotype; paratypes 19 males, 6 females, 25 pupal exuviae, 11 larvae and 1 larval exuviae, labelled as for holotype (CNC); additional paratypes, adults, on microscope slides, 2 males, 2 females from Fall Church, Virginia, collected 4-VII-1950, 8-VI-1952, 8-VII-1950 and 4-VII-1950 respectively; 1 male from Dyke Marsh, Alexandria, Virginia, 14-VI-1951; 1 male from Alexandria, Virginia, 14-VI-1951; 1 female from Plummers Is., Maryland, 17-VI-1906 (USNM); 1 male, 1 female from Philadelphia, Pennsylvania, 26-VIII-? (MCZ).

Stenochironomus taeniapennis: Townes, 1945:90 (in part), 1952:66 (in part).

Diagnosis. Male: wing with median band at most extending into very base of CuA1; apical wing band extending into cells R3 and CuA1; palpus pale. Female: wing as for male; lateral vitta with dark broad pigmentation on posterior portion. Pupa: horn of respiratory organ fused for most of its length with anterior stalk; T II with posterior row of hooklets with or without median gap; spur on S VIII with yellowish brown teeth, with 2-3 deltoid; lateral teeth of similar

size and shape and a few smaller medial teeth (pupae cannot be distinguished from all specimens of S. hilaris and may be separated from S. fuscipatellus only on the basis of distribution). Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe, labral lamella with 3-7 spicules arising from cuticle, divided into two groups; cleft between ligular lobes with margins diverging at mid-length, rounded posteriorly; ligular lobes with coarse shagreen.

Description. Male Adult. Descriptive statistics: see Table 15.

Head: apical 0.42-0.52 of antenna with dark hairs; palpus pale; labellum pale; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 1J, 6F): posterodorsal edge of epimeron (in some specimens), all of lateral vitta very light tan with semicircular dark area in posterior portion and posterior 0.6 of postnotum; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (Fig. 13E).

Legs: dark pigmentation discrete, distributed as follows (Fig. 18F): apical 0.22-0.26 of fore femur, basal 0.25-0.39 of fore tibia, fore fifth tarsomere, apical 0.28-0.35 of mid femur, basal 0.23-0.35 of mid tibia, mid fifth tarsomere, apical 0.28-0.34 of hind femur, basal 0.37-0.52 and apical 0.25-0.33 of hind tibia, and hind fifth

tarsomere; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present, at most extending into extreme base of CuA1; apical band extensive, including cell CuA1; area between C and M dark only near r-m (Fig. 14F); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark.

Genitalia (Fig. 31C): in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight, apex abruptly bent ventrally (Fig. 40A), apex bulbous in dorsal aspect; lateral margins of base of anal point moderately to strongly produced, originating subapically on T IX, moderately to widely diverging; posterior edge of T IX truncated in dorsal aspect with ventral row of stout setae; most specimens with dorsal patch of setae in transverse arrangement, a few with semi-circular arrangement; appendage 1 somewhat shortened, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter and basally more thick than subapical seta (Fig. 43H); gonostylus somewhat swollen subapically, apex rounded; gonocoxal apodeme truncated to pointed anteriorly, with slight expansion.

Female Adult. Descriptive statistics: see Table 68. Similar to male except as follows:

Head: flagellomere six dark; palpus dark brown; labellum with dark markings.

Thorax: pigmentation: present on posterodorsal edge of mesepimeron, otherwise as for male; scutellar setae in 2-3 rows.

Legs: dark pigment discrete, distributed as follows: apical 0.85-0.92 of fore femur, basal 0.20-0.38 of fore tibia, fore fifth tarsomere, apical 0.71-0.79 of mid femur, basal 0.22-0.30 of mid tibia, mid fifth tarsomere, apical 0.69-0.86 of hind femur, entire hind tibia, and hind fifth tarsomere.

Wing: pigmentation: medial band present, at most extending into extreme base of CuA1; apical band extensive, including cell CuA1 and, in most specimens, extending basally between M1 and CuA1 to approach or join medial band; area between C and R dark.

Abdomen: lacking dark pigmentation.

Genitalia (similar to Fig. 48C): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, rarely bordered posteromedially by very weak ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped; spicules on ventrolateral lobe of moderate length, on small, raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, broad from dorsal aspect, straight.

Pupa. Descriptive statistics: see Tables 88-90.

Thorax: horn of respiratory organ fused for most of its length with ventral region of anterior stalk, free portion of horn short, thin (Fig. 55A); terminal filaments of respiratory organ slender, $<4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly yellowish brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VI, S II-IV (weakly produced), and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S II-IV; T II and T III with rounded bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (Fig. 56E); T II with posterior row of large hooklets extending to lateral margin of tergite, continuous medially or with median gap equal to width of no more than 7 hooklets (Fig. 56E); spur on S VIII with teeth yellowish brown, with 2-3 deltoid, lateral teeth of similar size and shape and 1-4 sharply pointed to blunt, deltoid to elongate, smaller medial teeth (Fig. 60F); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobes extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 106.

Head capsule (as in Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore anterolateral to, to posterolateral to, seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 68C): S I simple or pinnate; S II simple; S III simple; S I and labral lamella on semicircular plate; labral lamella with numerous 2-5 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation; outer margin with marked concavity (Fig. 72G).

Labiohypopharynx (Fig. 73K): ligular lobes not joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes coarse, not extending posteriorly as far as lateral edge of base of lobe; each lobe somewhat circular; cleft between lobes with

margins diverging at mid-length, rounded posteriorly.

Fused maxilla and paralabial plate (as in Fig. 76A): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 77H): without constriction.

Distribution and bionomics. S. albipalpus is known only from a restricted range on the eastern seaboard of northern USA (Fig. 83A).

Larvae of this species were collected at only one locality: 3 mi. S. of Rockville, Maryland, in a shallow (<20 cm deep), seepage area located in Cabin John Regional Park about 1 km along a gravel road, heading north of Tuckerman Lane. Larvae were under a wood layer in unidentified branches and small logs. The seepage area lacked standing water on 30-VI-1981 but it was uncertain whether larvae were present at that time. The uniquely modified outer concavity of the larval mandible, the unique ligular lobes (important in feeding) and short, unconstricted anal papillae (unique in the eastern Nearctic) suggest that larvae are adapted to different conditions than those of other Stenochironomus species.

Infested wood brought into the laboratory (collected on 21-III-1980) produced adults during April and May. The last adult emerged on 20-V-1980. This suggests overwintering as mature larvae.

Derivation of specific epithet. The name albipalpus refers to the pale palp of male adults, a unique feature among those Stenochironomus species with both a medial and apical wing band.

Stenochironomus (Stenochironomus) hilaris (Walker)

Chironomus hilaris Walker, 1848:17. Lectotype, here designated, male adult, pinned, labelled "Chironomus hilaris Walker (Type)", "Type", "Identified as the type by E.A. Waterhouse Chironomus hilaris Walk." label added "Lectotype of Stenochironomus hilaris (Walker) designated by A. Borkent, 1981" (BMNH).

Chironomus (Stenochironomus) hilaris: Johannsen, 1938:28.

Stenochironomus hilaris: Townes, 1945:90, 1952:66. Beck and Beck, 1970:33. Gillespie, 1974:238.

Chironomus taeniapennis Coquillett, 1901:607. Holotype, female adult, pinned, labelled "Andover [Massachusetts] June 14, 1868", "Type No. 5485 U.S.N.M.", "Chironomus taeniapennis Coq." (USNM); paratype, female adult, pinned, labelled "Del.W.Gap, NJ [Delaware Water Gap, New Jersey], July 11", "90", "Paratype No.", "Type 7434", "C.W. Johnson Collection", "C. taeniapennis" (MCZ). Johannsen, 1905:203 (adult). Malloch, 1915b:430 (adult). NEW SYNONYMY.

Chironomus (Stenochironomus) taeniapennis: Johannsen, 1938:28.

Stenochironomus taeniapennis: Townes, 1945:90 (in part), 1952:66 (in part).

Chironomus nephopterus Mitchell, 1908:7. Holotype, male adult,

pinned, labelled "CabnJn Md [Cabin John, near Rockville, Maryland]",
 "T", "Type No. ~~11022~~ U.S.N.M.", "Chironomus nephopterus Mitchell"
 (USNM). Johannsen, 1907:280. Malloch, 1915b:429.

Chironomus nephopterus [sic]: Johannsen, 1908:280, 1926: 276.

Stenochironomus nephopterus: Townes, 1945:90.

Chironomus zonopterus Mitchell, 1908:12. Holotype, male adult,
 pinned, labelled "Clementon NJ [New Jersey] 6.3.97", "Type No.
 11025", "Chironomus zonopterus Mitchell" (USNM); paratype, male
 adult, pinned, labelled "Can", "Paratype No. 11025 U.S.N.M." (USNM).
 NEW SYNONYMY.

Stenochironomus zonopterus: Townes 1945:91

Chironomus exquisitus Mitchell, 1908:11. Holotype, male adult,
 pinned, labelled "CabnJn Md [Cabin John, near Rockville, Maryland]",
 "June 10", "Type No. 11141 U.S.N.M.", "Chironomus exquisitus
 Mitchell" (USNM). NEW SYNONYMY.

Chironomus (Stenochironomus) exquisitus: Johannsen, 1938:28.

Stenochironomus exquisitus: Townes, 1945:91, 1952:66. Not
 Johannsen, 1938:29.

Diagnosis. Male: wing with median band at most extending into very

base of CuA1; apical wing band extending into cells R3 and CuA1; palpus dark brown; basal 0.12 to entire fore tibia pigmented; Gc/Gs = 0.82-0.98. Female: wing as for male; basal 0.18 to entire fore tibia pigmented; lateral vitta with no markings or with pigmentation along inner margin; lateral apodeme of S IX not markedly swollen. Pupa: horn of respiratory organ fused for most of its length with anterior stalk; T II with posterior row of hooklets without median gap; spur on S VIII with yellowish brown teeth, with 2-4 deltoid, lateral teeth of similar size and shape and a few smaller medial teeth, (pupae cannot be distinguished from all S. albipalpus, and are separated from S. fuscipatellus only on the basis of distribution). Fourth instar larva: dorsolateral stripes originating on the anterior 2/3 of dorsomedian stripe; labral lamella with 3-7 spicules arising from cuticle, divided into two groups, mandibular adductor apodeme without dark pigmentation; cleft between ligular lobes very narrow and with nearly parallel to V-shaped sides, ligular lobes with fine to coarse shagreen.

Description. Male Adult. Descriptive statistics: see Table 16.

Head: apical 0.34-0.63 of antenna with dark hairs; palpus dark brown, labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 1K, L, 7A, B): posterodorsal edge of epimeron, all of lateral vitta very light tan with darker marking absent to restricted to inner margin of lateral vitta, from posterior margin of postnotum extending 0.4-1.0

to anterior margin; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13D).

Legs: dark pigmentation poorly defined to discrete, distributed as follows (Fig. 19A, B): apical 0.14-0.70 of fore femur, basal 0.12 and apical 0.08 to entire fore tibia, (intermediate specimens with base and apex dark, midregion pale); fore fifth tarsomere, apical 0.14-0.88 of mid femur, basal 0.12-0.38 of mid tibia, mid fifth tarsomere, apical 0.09-0.84 of hind femur, basal 0.03 and apical 0.08 to entire hind tibia (intermediate specimens with base and apex dark, midregion pale); when hind tibia dark only at base and apex, fore tibia never completely dark, hind fifth tarsomere; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present, at most extending into extreme base of CuA1; apical band extensive, including cells R3 and CuA1; area between C and M pigmented or pale (Fig. 14G, H); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark.

Genitalia (Fig. 31D): in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight, apex abruptly bent ventrally (Fig. 40B, C), apex bulbous to parallel-sided in dorsal aspect; lateral margins of base of anal point moderately to strongly produced, originating subapically on T IX, moderately to widely diverging;

posterior edge of T IX truncated in dorsal aspect with ventral row of stout setae; most specimens with dorsal patch of setae in circular to semi-circular arrangement, a few specimens with transverse arrangement; appendage 1 elongate, thick, of nearly constant diameter to tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter and basally more thick than subapical seta (Fig. 43I); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme truncated to pointed anteriorly, with slight expansion.

Female Adult. Descriptive statistics: see Table 69. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 1-3 rows; scutellar setae in 2-3 rows.

Legs: dark pigmentation poorly defined to discrete, distributed as follows: apical 0.15-0.92 of fore femur, entire fore tibia except in some specimens basal 0.18 and apex unpigmented, (intermediate specimens with base and apex dark, midregion pale), fore fifth tarsomere, apical 0.16-0.91 of mid femur, basal 0.18-0.34 of mid tibia, mid fifth tarsomere, apical 0.22-0.91 of hind femur, basal 0.09 and apical 0.10 to entire hind tibia (intermediate specimens with base and apex dark, midregion pale; when hind tibia dark only at base and apex, fore tibia never completely dark) and hind fifth tarsomere.

Wings: area between C and M pigmented rarely pale; intermediate specimens darker between C and R than between R and M.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 48C): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct; rarely bordered posteromedially by weak ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped; spicules of ventrolateral lobe of moderate length, on small, raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, broad in dorsal aspect, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial pigmentation short (as in Fig. 53A).

Thorax: horn of respiratory organ fused for most of its length with ventral region of anterior stalk, free portion of horn short, thin (Fig. 55A), terminal filaments of respiratory organ slender, $<4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly yellowish brown, lateral margin with narrow dark stripe and, in some specimens, with at least posterior margin of S II and III and, rarely, S I and IV, with transparent anteriorly bilobed area; spicules present on the

following: T II-VI, S II-IV (weakly produced), S V in some specimens (weakly produced), and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S II-IV, reduced in some specimens on S IV; T II and T III with rounded bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (Fig. 56D); T II with posterior row of large hooklets extending to lateral margin of tergite continuous across middle (Fig. 56D); spur on S VIII with teeth yellowish brown, with 2-4 deltoid, lateral teeth of similar size and shape and 3-7 sharply pointed to blunt, deltoid to elongate, smaller medial teeth (Fig. 61A); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 107.

Head capsule (Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges

supporting labiohypopharynx, micropore anterolateral to, to posterolateral to, seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (Fig. 68C): S I pinnate; S II pinnate; S III simple; S I and labral lamella on semicircular plate; labral lamella with 3-9 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (Fig. 72F).

Labiohypopharynx (Fig. 73G-J): ligular lobes joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes very fine to coarse, in some specimens restricted to apex of lobes; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (Fig. 76A): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 771): without constriction, or with one constriction at mid-length, basal portion wider than apical portion.

Distribution and bionomics. S. hilaris is broadly distributed in the Nearctic Region, from the Yukon Territory to Florida (Fig. 83D). The species has not been recorded from the western U.S.A., where the closely related S. fuscipatellus occurs.

Larvae of S. hilaris occur in a variety of aquatic situations, in both small and large, lotic to lentic habitats. Larvae mine under both bark and wood layers and were found in Populus tremuloides, Alnus, Acer and Myrica. They undoubtedly occur in other species as well. However, in some localities, larvae occurred preferentially in certain types of wood. For example, at Duncan Lake, Masham Twp., Quebec, S. hilaris larvae were common in aspen logs from which the bark was absent and the wood surface was darkly stained. Larvae were found only rarely in Alnus or Nemopanthus where S. unictus occurred in abundance. In contrast, I found S. hilaris abundant in Alnus at localities in the Gaspé Peninsula of Quebec. It is uncertain whether such preferences reflect subtle changes in the habitats or the interspecific partitioning of resources.

I have available two records of male adult swarms. L. LeSage (pers. comm.) observed a swarm on the bank of the Ottawa River at Ottawa, Ontario in the late evening of 12-VIII-1979, when visibility was low. The swarm was oval, about 1.5 m from the ground, situated beside a tree trunk. P. Mason (pers. comm.) collected a swarm of S. hilaris 1/4 mi. upstream from the Queen Elizabeth Power Station, Saskatoon, Saskatchewan on 27-VII-1976 but further details are

uncertain.

Spring and early summer collections yielded numbers of third and fourth instar larvae. Infested wood brought into the laboratory at that time large numbers of adults. This suggests overwintering as mature larvae.

Taxonomic discussion. In his description of S. taeniapennis, Coquillett (1901) stated that the "apical half of the femora, bases of front and middle tibiae and nearly the whole of the hind ones brown". The type fits this description but the single paratype does not. The apical 0.88 of the fore femur, entire fore tibia and entire hind tibia are brown. Both midlegs, one wing, and the apex of the other are missing. Phenotypically, this individual is typical of S. hilaris sensu Townes (1945).

The lectotype of S. hilaris is somewhat damaged. All right legs, fore, mid and hind tarsomeres, hind tibia and abdomen are missing. Palpus, wing and leg coloration, however, indicate that the concept of S. hilaris as used here and by Townes (1945) complies with the type.

There is no indication of the type locality of S. hilaris. However, the completely pigmented fore tibia is otherwise present only in S. hilaris from the eastern Nearctic (see below), so it seems likely that the lectotype was collected in this region.

In both the holotype and paratype of S. zonopterus the genitalia are missing.

Townes (1945:fig. 103) illustrated the male genitalia of S. hilaris (as S. taeniapennis) in which the apical seta on appendage 2

was slender. All S. hilaris I observed exhibited a stout apical seta.

Townes (1945:91) suggested that S. taeniapennis (here = S. hilaris) may be conspecific with the Palaearctic S. fascipennis but noted that he had examined no specimens of the latter species. This study indicates discrete differences between S. hilaris and S. fascipennis and that they are not closely related phylogenetically. The record of fascipennis from New England by Johnson (1925) probably refers to specimens of S. hilaris.

Beck and Beck (1970:33) described the larva and pupa of S. hilaris but neither stage can be recognized by the characters provided.

Saether (1977:167) noted that the spermathecal ducts of the female adult of S. hilaris (as S. taeniapennis) may be looped. No other specimens I examined showed this condition (nor any other numbers of the Stenochironomus complex) so that that condition is probably an artifact of preparation.

The consideration of S. hilaris and S. taeniapennis as conspecific requires comment. Townes (1945) suggested that S. hilaris and S. taeniapennis could be distinguished on the basis of wing and leg coloration. His key provides the following differences:

"Apical part of fore tibia brown, usually" (always in the female) the entire tibia brown; basal part of wing of male dusky between veins C and R.....
.....S. hilaris (Walker)

- Apical part of fore tibia whitish; basal part of wing of male hyaline between veins C and R.....

.....S. taeniapennis (Coquillett)"

My study of adults of these two forms indicates that degree of pigmentation of wings and legs are correlated, as suggested by the above cited couplet. Specimens with darker legs have darker and more extensive coloration of the wing. I was unable to confirm, however, that degree of pigmentation could be used to recognize individuals of S. hilaris and S. taeniapennis. When all material was examined, the variation was continuous from one form to the other. To further investigate the problem I analyzed the extent of pigmentation of the fore tibia of males (Fig. 80). Results show that all samples from the western Nearctic (localities 1-8) exhibited partially pigmented fore tibiae and all samples from South Carolina, Georgia, Florida, Alabama and Louisiana (locality 30) exhibited a completely dark fore tibia. In the northeastern USA and eastern Canada marked variation occurred. In some samples, extent of pigmentation was markedly variable, ranging from that characterized by Townes as typical of S. taeniapennis to that typical of S. hilaris (e.g. localities 11,13,15,19,21,23). However, other localities yielded samples which were discretely different in leg coloration (localities 13,20,26,27). At some localities, therefore, this evidence suggests the presence of only one species, while at other localities, the presence of two species is suggested.

To further test the possibility of two species being present in my samples, I divided all male adults into three groups (see Table 125). Group A corresponds to Townes (1945) concept of S. hilaris and group C to that of S. taeniapennis. Group B contained intermediate individuals. I examined each group for any further differences.

Four characters were found to differ significantly between groups A and C. All show overlap in range. Group B shows significant differences from Group A (and no differences from C) in thorax length and Hd Fe/Ti and significant differences from group C (and no difference from A) in Fo Fe/Ti. Therefore two characters suggest that intermediate individuals (group B) belong to S. taeniapennis (group C) and one character suggests they belong to S. hilaris sensu Townes (group A). For the fourth character, Hd T_{ad}/Ti, group B was intermediate but unfortunately, the sample size was small. In addition, I examined fourth instar larval and pupal exuviae of reared material of S. hilaris and could detect no differences between the immature stages of reared individuals of either color form.

Finally, it should be noted that Townes (1945:90) suggested S. hilaris (dark form) "is most often collected around lakes, while the closely related S. taeniapennis is most common around streams and rivers". My rearings did not confirm this ecological distinction.

In conclusion, previous hypotheses that degree of pigmentation serve to indicate the presence of two forms is true only at certain localities in the eastern Nearctic. Some statistical differences do not provide evidence of different species because as such differences be used to group intermediates. I therefore conclude that only one species should be recognized for the present. Future work is needed, however, to further resolve the intraspecific variation of S. hilaris.

One male pupa from Oconee River, Athens, Georgia, 22-VIII-1978 exhibits some differences from all other pupae examined: the row of hooklets on the posterior margin of T II showed a median gap equal to

the width of 17 hooklets; the spur on S VIII was reduced to two basally broad teeth. The pharate adult present was in a somewhat deteriorated condition but clearly exhibited a wing and leg pigmentation pattern typical of S. hilaris for that region. The genitalia was also similar to that of S. hilaris except that the terminal seta on appendage 2 seemed proportionally somewhat more elongate. These differences may indicate the presence of another, unnamed species.

The number of setae on male adult wing vein M are recorded only here and for S. albipalpus and S. fuscipatellus. Differences provide additional evidence that these three morphologically similar species are not conspecific forms.

Material examined. I examined numerous specimens of larvae, pupae and adults from many localities (see Fig. 79 for list of reared material) and habitats. Some of the more disjunct localities not given in Figure 79 are listed as follows: Show Low Lake, Arizona; Pecos, New Mexico; Palmetto State Park, near Luling, Texas; Chappedeela Creek, 48 km from Lake Pontchartrain, Louisiana; Morrison Field, West Palm Beach, Florida; Mesachie Lake, B.C.

Derivation of specific epithet. The name hilaris, meaning gay or cheerful, apparently refers to the aesthetically pleasing appearance of adults of this species (as for most Stenochironomus!).

Stenochironomus (Stenochironomus) macateei (Malloch)

Chironomus macateei Malloch, 1915a:45. Holotype male adult, pinned, labelled "Plummers I Md [Plummers Island, Maryland] 10-VIII-12", "WL McAtee Collector", "Type", "Chironomus macateei Malloch (Type)" (USNM); paratype, male adult on a microscope slide, labelled "Plummers I Md 17.VIII.12", "WLMcAtee Collector", "Chironomus pallidus", "Paratype Chironomus macateei o Malloch", "Chironomus macateei Malloch (Paratype)" and added label with "Stenochironomus macateei (Malloch) Paratype, Plummers I. Md. 17-VIII-1912, W.L. McAtee, Ill.Nat.Hist.Surv." (INHS); paratype, female adult, on microscope slide, labelled "Plummers I Md June 28, 14", "WL McAtee Collector", "Paratype Chironomus macateei + Malloch" and added label with "Stenochironomus macateei (Malloch) Paratype, Plummers I. Md., 28-VI-1914, W.L. McAtee" (INHS).

Chironomus (Stenochironomus) macateei: Johannsen, 1942:72 (adult).

Stenochironomus macateei: Townes, 1945:89, 1952:65. Sublette, 1964:137. Not Sublette, 1957:388.

Diagnosis. Male: only Nearctic species without dark pigmentation; in lateral aspect anal point straight. Female: only Nearctic species without dark pigmentation. Pupa: horn of respiratory organ arising near base; terminal filaments of respiratory organ $> 4 \mu$ in diameter, with forked apices; T II with posterior row of hooklets without median gap or gap equal to no more than width of 3-4 hooklets; spurs

on S VIII with yellowish brown teeth; with one or two deltoid, lateral teeth and a few smaller median teeth. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe, labral lamella with 5-11 spicules, arising from cuticle, arranged into two groups; mandibular apodeme with dark pigmentation; distance of antennal seta from base/length of antennal segment one = 0.48-0.71, anal papillae constricted.

Description. Male adult. Descriptive statistics: see Table 17.

Head: lacking dark pigmentation; eye not metallic.

Thorax: lacking dark pigmentation; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation absent except for all fifth tarsomeres which, in some specimens, are pale brown; in life, forelegs held posterolaterally (as in Fig. 52C).

Abdomen: lacking dark pigmentation; anal point light brown.

Genitalia (Fig. 32A): in lateral aspect, anal point straight (Fig. 40D), apex parallel-sided or very slightly swollen in dorsal aspect;

lateral margins of base of anal point weakly produced, originating subapically on T IX, moderately diverging to nearly parallel; posterior edge of T IX rounded to pointed in dorsal aspect with ventral row of stout setae; dorsal patch of setae in circular to semi-circular arrangement; appendage 1 elongate, thick, tapering apically from midlength, with setae distributed along entire length to restricted to apical 3/4; apex of appendage 2 slightly to moderately bent dorsally with apical seta shorter and basally thicker than subapical seta (Fig. 43J); gonostylus of nearly constant diameter, apex tapering; gonocoxal apodeme pointed anteriorly, with slight expansion.

Female adult. Descriptive statistics: see Table 70. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 2-3 rows; scutellar setae in 2-3 rows.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 48D): setal patch on S VIII not extending posteriorly to level of cleft around opening of oviduct, bordered posteromedially by weak ridge; ventrolateral lobe very weakly developed; cleft between dorsomesal and ventrolateral lobes of S VIII rounded dorsally, broadly U-shaped ventrally; spicules of ventrolateral lobe of moderate length, sometimes on slight projection; apodeme of S VIII

straight, ending at dorsomesal lobe; posterior apodeme of S IX well developed, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head Capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ originating near base (as in Fig. 55B) to partially fused with anterior stalk near base, length of fused portion approximately equal to width of free portion, elongate, thin; terminal filaments of respiratory organ stout, >4 μ in diameter, apices forked, smooth.

Abdomen: pigmentation (of exuviae) nearly uniformly pale brown, lateral margin with narrow dark stripe and anterior margin of S VIII; spicules present on the following: T II-VI, S II-V (weakly produced), S I in some specimens (weakly produced); and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III moderately larger than posterior spicules (as in Fig. 56F); T II with posterior row of large hooklets extending to lateral margin of tergite, continuous medially or with median gap equal to width of no more than 3-4 hooklets (as in Fig. 56D); spur on S VIII with teeth yellowish brown, with 1-2 deltoid, lateral teeth and 2-5 sharply pointed, deltoid to elongate, smaller median teeth each more than $1/4$

length of largest tooth. (Fig. 61B); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 108.

Head capsule (as in Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore anterolateral to posterolateral to seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (Fig. 69A): S I pinnate; S II simple or pinnate; S III simple or pinnate; S I and labral lamella on semicircular plate; labral lamella with 5-11 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis short, simple, arrayed in row, grouped medially.

- ✓ Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 73N, O): ligular lobes not joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76A): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77F): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. S. macateei is broadly distributed in the eastern Nearctic Region, from southern Manitoba and Quebec to Florida and Texas (Fig. 83B).

Larvae of S. macateei were collected from a number of localities; most of these were eutrophic rivers or streams. Exceptions were at Fort Clark Springs, Texas where the stream was pure spring water and at Otter Lk., 5 mi. W. Jordan, N.Y. which was a eutrophic, shallow lake. At all but one locality, I collected S.

macateei larvae with larvae of other species. At the South Nation R., nr ^{Casselman} ~~Castelman~~, Ont., 28-VI-1979 I collected a sample of larvae containing only S. macateei and subsequent rearing of adults confirmed the presence of only this species. The South Nation R. is markedly polluted and my field experience suggests that larvae of S. macateei can ~~not occur~~ in eutrophic situations where other Stenochironomus species are either reduced in number or absent. Associated with some of these habitats, I noted that larvae were sometimes in wood upon which a mat of algae grew, an unusual occurrence for Stenochironomus wood miners in general.

Spring and early summer collections yielded numbers of third and fourth instar larvae. Infested wood brought into the laboratory at that time resulted in a large number of adults. This suggests overwintering as mature larvae.

Taxonomic discussion. The type material of this species requires comment. Malloch (1915a) recorded the type locality as "Plummers Island, Md. August 10-17, 1912 (W.L. McAtee)" and an allotype from "Maryland, near Plummers Island, July 4, 1914". The holotype of S. macateei is known and the date of collection is August 10, 1912. This suggests that Malloch had other specimens of macateei before him which are paratypes. One of these, a male from the type locality, bears the date 17-VIII-1912 and a label "Chironomus pallidus" which Malloch noted was present on one of the specimens. In addition, a female from the type locality, dated 28-VI-1914 is labelled a paratype but it is uncertain if this specimen is in fact a paratype. I was unable to locate the allotype.

The holotype is missing the apex of the abdomen. The two paratypes were first examined as pinned specimens and then dissected onto microscope slides.

The record of S. macateei by Rochon (1977) from Lac Triton (University of Montreal Biology Field Station near St. Hippolyte, Quebec) actually refers to specimens of S. unictus.

Material examined. I examined larvae, pupae and adults from the following localities: South Nation R., Ont; Assiniboine R., Man.; Otter Lk., 5 mi. N. Jordan, N.Y.; Brazos R., Guadalupe R. and Fort Clark Springs, Texas. A few pupae from Athens, Georgia and Florida were studied.

Derivation of specific epithet. This species was named in honor of W.L. McAtee.

Stenochironomus (Stenochironomus) recticaudatus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus recticaudatus* Borkent, Nordkorea, No. 181, Prov. South Pyongan, Bongwa-ri, 16-17.8.1971, leg. Papp & Horvatovich" (INPA).

Diagnosis. Male: dark pigmentation entirely absent except on tarsomeres 3-5 of all legs; anal point straight in lateral aspect, with base strongly produced in dorsal aspect.

Description. Male adult. Descriptive statistics: see Table 18.

Head: dark pigmentation absent but palpus unknown; eye iridescence unknown.

Thorax: without obvious discrete pigmentation; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 1 row; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: pigmentation light brown, restricted to third to fifth tarsomeres of all legs.

Wing: lacking dark pigmentation; halter pale.

Abdomen: pigmentation: genitalia somewhat pigmented but degree

uncertain.

Genitalia (Fig. 32B): in lateral aspect anal point straight (Fig. 40E), apex slightly bulbous in dorsal aspect; lateral margins of base of anal point strongly produced, originating subapically on T IX, strongly diverging; posterior edge of T IX truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in transverse arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter and basally thicker than subapical seta (as in Fig. 43L); gonostylus of nearly constant diameter, apex tapering; gonocoxal apodeme projected but, rounded anteriorly, with no expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from North Korea (Fig. 81, locality 2).

Taxonomic discussion. The single available specimen was examined only as a microscope slide preparation. The specimen had not, however, been cleared so that description of pigmentation is probably accurate.

Derivation of specific epithet. The name recticaudatus (straight, tail) refers to the straight anal point of the male adult (in lateral aspect).

Stenochironomus (Stenochironomus) pannus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus pannus* Borkent, male, Kumamoto Pref, Kikuchi-suigen, Japan, 2-VII-1976, M. Yamamoto"; paratype male labelled as for holotype (ELKU).

Diagnosis. Male: wing with a faint median band and an apical band not extending into cells R3 and CuA1; median vitta and pleural region without dark pigmentation; apical 0.18-0.19 of fore femur; and basal 0.22-0.26 and apical 0.13-0.21 of hind femur, darkly pigmented; postnotum with markings not reaching posterior margin; appendage 1 elongate.

Description. Male adult. Descriptive statistics: see Table 19.

Head: apical 0.42-0.44 of antennae with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic (when reconstituted in ammonium hydroxide).

Thorax: pigmentation confined to the following areas (Fig. 2A, 7C): posterodorsal edge of mesepimeron, posterior portion of lateral vitta, median marking on postnotum not reaching either anterior or posterior edge; acrostichal setae extending over and under anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation discrete, distributed as follows (Fig. 19C): apical 0.18-0.19 of fore femur, basal 0.27-0.28 and apical 0.10-0.11 of fore tibia, fore fifth tarsomere, apical 0.22-0.24 of mid femur, basal 0.14-0.18 of mid tibia, mid fifth tarsomere, apical 0.24-0.26 of hind femur, basal 0.22-0.26 and apical 0.13-0.21 of hind femur, hind fifth tarsomere.

Wing: pigmentation faint: medial band present, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and R pale (Fig. 14I); halter pale.

Abdomen: pigmentation: genitalia brown.

Genitalia (Fig. 32C): in lateral aspect basal $\frac{2}{3}$ of dorsal edge of anal point concave, apex abruptly bent ventrally (Fig. 40F), apex bulbous in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX somewhat wedge shaped to rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae in semicircular arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter and basally thicker than subapical seta (Fig. 44A); gonostylus of nearly constant diameter to slightly swollen subapically, apex tapering; gonocoxal apodeme pointed to truncated anteriorly, with expansion.

Female adult, pupa and larva: Unknown.

Distribution. S. pannus is known from Japan (Fig. 81, locality 6).

Taxonomic discussion. The specimens were first examined as pinned specimens and were subsequently mounted on microscope slides.

Derivation of specific epithet. The name pannus (patch) refers to the pigmentation which does not extend to the posterior margin of the postnotum.

Stenochironomus (Stenochironomus) balteatus n. sp.

Type information: Holotype male adult, on microscope slide, labelled "Holotype, *Stenochironomus balteatus* Borkent male, Miyazaki Pref., Miike, Kyushu, Japan, 28-V-1977, M. Yamamoto"; allotype on microscope slide, labelled as for holotype; paratypes on microscope slides, two female adults labelled as for holotype and one male from Oita Pref., Chojabaru, Kyushu, Japan, 8-VII-1977, (ELKU).

Diagnosis. Male: wing with median band and apical band not extending into cells R3 and CuA1; median vitta and pleural region without dark pigmentation; postnotum with markings reaching posterior margin; mid and hind femora with dark band at midlength, resulting in a subapical poorly-defined annulus; with stout apical seta on appendage 2. Female: coloration as for male.

Description. Male adult. Descriptive statistics: see Table 20.

Head: apical 0.51 of antenna with dark hairs; palpus dark brown, labellum with dark markings; eye not metallic (when reconstituted in ammonium hydroxide).

Thorax: pigmentation confined to the following areas (Fig. 2B, 7D): posterodorsal edge of mesepimeron, stripe down middle of lateral vitta, posterior 0.3-0.6 of postnotum; acrostichal setae extending to, or nearly to, anterior point of scutum; dorsoventral setae in 2 rows; scutellar setae in 3-4 rows; anterior edge of scutum rounded in

lateral aspect (Fig. 13B).

Legs: dark pigmentation poorly defined, distributed as follows (Fig. 19D): apical 0.65-0.66 of fore femur, basal 0.54 of fore tibia, fore fifth tarsomere, apical 0.72 of mid femur (except pale subapical annulus 0.21-0.28 femur length, situated 0.28-0.34 from apex), basal 0.46-0.47 of mid tibia, mid fifth tarsomere, apical 0.69-0.73 of hind femur (except pale subapical annulus with length 0.22-0.27 of femur length, situated 0.24-0.28 from apex), hind fifth tarsomere, entire hind tibia.

Wing: medial band present, extending into cell CuA1; apical band markedly restricted, not including cells R3 or CuA1; area between C and R faintly pigmented area anterior to stem vein more darkly pigmented (Fig. 14J); halter pale.

Abdomen: pigmentation: genitalia brown.

Genitalia: (similar to Fig. 32C); in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight, apex abruptly bent ventrally (as in Fig. 40C), apex parallel-sided to slightly bulbous in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX, widely diverging; posterior edge of T IX truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in semicircular arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally.

with apical seta shorter and basally thicker than subapical seta (Fig. 43L); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme, truncated anteriorly, with moderate expansion.

Female adult: Descriptive statistics: see Table 71. Similar to male except as follows:

Head: flagellomere six dark.

Legs: dark pigmentation poorly defined, distributed as follows: all of fore femur light brown with apical 0.71-0.74 more darkly pigmented, basal 0.50-0.55 of fore tibia, fore fifth tarsomere, all of mid femur light brown with apical 0.68-0.72 more darkly pigmented (including a subapical or apical, paler annulus 0.12-0.43 of total femur length, situated 0.00-0.31 from apex), basal 0.42-0.48 of mid tibia, mid fifth tarsomere, all of hind femur light brown with apical 0.69-0.75 more darkly pigmented (including a subapical or apical paler annulus 0.19-0.60 of total femur length, situated 0.00-0.26 from apex basal 0.63 to entire hind tibia), and hind fifth tarsomere.

Wing: as for male but posterior, basal extension of medial band more extensive, extending to vannal fold.

Abdomen: lacking dark pigmentation.

Genitalia (similar to Fig. 49A): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of

oviduct, bordered posteromedially by moderately produced ridge; ventrolateral lobes of S VIII moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII U-shaped, more constricted ventrally; spicules of ventrolateral lobes of moderate length, on small, raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, broad in dorsal aspect, straight to slightly curved.

Pupa and larva. Unknown.

Distribution. This species is recorded from Japan (Fig. 81, localities 5, 7).

Taxonomic discussion. The specimens were first examined as pinned specimens and were subsequently mounted on microscope slides.

Derivation of specific epithet. The name balteatus (belted) refers to the banded appearance of the mid and hind femora of adults of this species.

Stenochironomus (Stenochironomus) gibbus (Fabricius)

Tipula fasciata Fourcroy 1785:512, not Tipula fasciata Scopoli 1763:321; not Tipula fasciata Linnaeus 1767:973. Type not designated, presumed lost. No locality given.

Stenochironomus fasciatus: Kieffer, 1922:56, 1924:31.

Endochironomus (Stenochironomus) fasciatus: Goetghebuer, 1928:35.

Tipula gibba Fabricius, 1794:245. Holotype, male adult destroyed, only pin with name label available (KMWG), type locality Halle, East Germany collected by J.G. Hubner (not seen).

Chironomus gibbus: Fabricius, 1805:41. Panzer, 1813:20. Meigen, 1818:23, 1850:3504, 1855:4840. Gimmerthal, 1845:306. Walker, 1856:163. Macquart, 1834:52. Zetterstedt, 1850:3504.

Chironomus (Stenochironomus) gibbus: Edwards, 1929:395.

Stenochironomus gibbus: Kruseman, 1933:136. Goetghebuer, 1937:12. Lenz, 1957:180. Kalugina, 1958:21, 1959. Rodova, 1971:131. Pinder, 1978:140.

Stenochironomus bitensis Kieffer, 1924:31. Type not designated, presumed lost. No locality given. Not Tokunaga and Kuroda, 1935:1 (= S. n.sp. "Japan").

Endochironomus (Stenochironomus) bitensis: Goetghebuer, 1928:35.

Stenochironomus gibbus bitensis: Goetghebuer, 1937:13.

Stenochironomus occultus Kieffer, 1924:30. Type not designated, presumed lost, from Bitche, France.

Endochironomus (Stenochironomus) occultus: Goetghebuer, 1928:35.

Stenochironomus gibbus occultus: Goetghebuer, 1937:13.

Chironomus flexilis: of authors, not Linnaeus. Meigen, 1830: pl. 6, Fig. 1a, 1b. Schiner, 1864:599. Wulp, 1877:264.

Tendipes flexilis (not Linnaeus): Wahlgren, 1922:84.

Diagnosis. Male: wing with median band an apical band not extending into cells R3 and CuA1; median vitta and pleural region without dark pigmentation; apical 0.43-0.69 of fore femur darkened; no dark band at midlength of mid and hind femora; with stout apical seta on appendage 2. Female: coloration as in male except that apical 0.76 to entire fore femur with dark pigmentation. Pupa: not distinguishable from those of S. pulchripennis, S. colei or S. poecilopterus, see S. colei. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; spicules of pecten epipharyngis forked apically; anal papillae without

constriction.

Description. Male adult. Descriptive statistics: see Table 21.

Head: apical 0.35-0.41 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Figs. 2C, 7E): posterodorsal edge of mesepimeron, usually with medial stripe on lateral vitta extending, in some specimens, to postalar callus, and posterior 0.6 of postnotum; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation poorly defined to moderately discrete, distributed as follows (Fig. 20A-C): apical 0.43-0.69 of fore femur, basal 0.00-0.34 of fore tibia, fore fifth tarsomere, apical 0.47 to entire mid femur, basal 0.12-0.30 of mid femur, mid fifth tarsomere, apical 0.56 to entire hind femur, basal 0.60 to entire hind tibia, and hind fifth tarsomere.

Wings: medial band present, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and M pale or with light pigmentation (Fig. 15A and as in Fig 14J); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark.

specimen described here. These include the following: T/II with posterior row hooklets with median gap (but not so shown in his figure), spicules on tergites with a few rounded areas free of spines and pedes spurii A absent. Lenz (1957) also noted that the male genital lobes extend exactly to the level of swim paddle apex. I have been unable to confirm this observation, as the specimen examined was a female, but all other closely related species exhibit the condition of the genital lobes extending past the apex of the swim paddles (see phylogenetic discussion, pg. 465). These differences probably reflect either intraspecific variation or inaccurate observation but the possibility of specific differences should be considered by future researchers.

The inclusion here of the one available European larva requires comment. Lenz (1957) and Kalugina (1958) have described reared material of S. gibbus, Chernovskii (1949) and Pinder and Reiss (in press) have provided figures of unidentified Stenochironomus larvae, Meschkat (1936) briefly described a larval form and Romaniszyn (1958) gave a brief description of a larva he referred to as S. gibbus. All six of these descriptions match the single larva described here and it seems likely that it is the larva of S. gibbus.

The two other larval forms previously described cannot be confidently associated with a named adult (see pg. 323). The larvae of S. gibbus can be distinguished from these other two forms by the lack of a constriction on the anal papillae. The apically forking spicules of the pecten epipharyngis are also probably characteristic of S. gibbus. Otherwise I cannot confidently indicate differences between the larvae of S. gibbus and the form described as S.

tarsomere.

Wings: pigmentation: as for male except area between C and M darkened in all specimens.

Abdomen: lacking dark pigmentation.

Genitalia: (similar to Fig. 49B); setal patch of S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered posteromedially by ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII rounded; spicules of ventrolateral lobe of S VIII of moderate length, on small, raised dorsoventral ridge; posterior apodeme of S IX well developed, broad in dorsal aspect, straight to slightly curved.

Pupa. Descriptive statistics: see Table 88.

Head-capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ partially fused with anterior stalk near base, length of fused portion approximately equal to width of free portion (as in Fig. 55B), elongate, thin; terminal filaments of respiratory organ slender, $< 4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) not available; spicules present.

on the following: T II-VI, S I-V (weakly produced), and anal lobe; anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S III, IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III moderately larger than posterior spicules (Fig. 56F); T II with posterior row of large hooklets extending to lateral margin of tergite, continuous across middle (Fig. 56F); spur on S VIII with teeth of uncertain coloration with 5 deltoid, lateral teeth of similar size and shape and 2 sharply pointed to blunt, deltoid to elongate, smaller medial teeth (Fig. 61C); in dorsal aspect, teeth arranged in an evenly curved row; male genital lobe at most just reaching level of apex of swim paddle (from Lenz 1957).

Larva. Descriptive statistics: see Table 109.

Head capsule (similar to Fig. 65B): medium brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe and stripe markedly broad; ventral, posteromedial area with no longitudinal line of weakness, with no posterior projection of pale cuticle; position of seta submenti uncertain, micropore posterolateral to seta submenti; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum: S I pinnate; S II pinnate; S III simple; S I and labral lamella on semicircular plate (as in Fig. 68C); labral lamella with 6 spicules, elongate, arising from cuticle but basally fused, divided into two groups (as in Fig. 68C); spicules of pecten epipharyngis apically forked, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme with faint pigmentation.

Labiohypopharynx (similar to Fig. 73E): ligular lobes joined by faint coloration; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided.

Fused maxilla and paralabial plate (as in Fig. 76A): apically bilobed with paralabial and maxillary portions of approximately equal width, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77J): without constriction.

Distribution and bionomics. S. gibbus is broadly distributed in the Palaearctic Region from England to Korea (Fig. 82, 81, locality 1). However, as noted below, several species may be included under this name. Fittkau and Reiss (1967) recorded this species from southern

Europe (Spain, Italy). Albu (1963) recorded S. gibbus from Romania.

Kalugina (1958) observed that the larvae from which she reared S. gibbus adults were common in dead submerged wood. She also noted that some larvae were recovered from plant material other than wood. In light of the discreteness of wood-boring and leaf-mining which I note for the New World species for which data are available, it is possible that the two larval habits recorded by Kalugina reflect the presence of two species. However, Meschkat (1936) described larvae which are here interpreted as probably S. gibbus, that were mining the dead stems of Phragmites, so S. gibbus may indeed be ecologically plastic.

The single fourth instar larva studied here came from submerged wood (P.S. Cranston, pers. comm.).

Shilova (1976) has described the swarming behaviour of male S. gibbus. Swarms were dense, vertically elongate, about 1 m in height and about 1-1.5 m above the surface.

Taxonomic discussion. It is possible that the adults described here as a single species actually represent two or more species. The material at hand exhibits three leg coloration types. Specimens from Riihimäki, EH, Finland (n = 6 males, 1 female) and a female from Oulanka, Finland have the entire mid and hind femora and most of the hind tibia pigmented (Fig. 20B). One male from about 27 km SW from Kaesong, Prov. Keng, Korea has the mid femur, hind femur and hind tibia completely pigmented (Fig. 40C). All the other material (see distribution map) exhibited only apically pigmented mid and hind femora and completely pigmented hind tibiae (Fig. 40A). My

experience with North American species, especially S. hilaris, indicates that degree of pigmentation is correlated on all parts of the body. The specimens from Riihimäki, however, which show more coloration on their mid and hind femora, exhibit less on their hind tibia when compared to those S. gibbus from elsewhere in Europe. This suggests that the two populations are distinct species. Rodova (1971) described the female of S. gibbus, from Bork, Yaroslav district, USSR, with apically darkened mid femur, basally darkened mid tibia and entirely darkened hind femur and tibia. This condition is different from that exhibited by any specimens at hand.

Some size differences were also apparent as indicated in thoracic length of males: Riihimäki 1.67 mm (n = 1), Korea 1.64 mm (n = 1) and all other S. gibbus 1.04-1.59 mm (n = 12). Antennal ratios show a discrete difference between the Korean specimen (1.86, n = 1) and all others (1.97-2.35). It is presently impossible to discern if these differences between samples reflects discontinuities in gene flow (i.e. separate species) or intraspecific variation. I was unable to discover additional discrete characters and until more material is available, I prefer a conservative approach and retain the material under one name. (Pinder 1978:140) noted that male S. gibbus can be recognized by the presence of a long lateral seta on appendage 2. None of the specimens of S. gibbus which I examined exhibited this condition but I have noted a similar modification in an occasional specimen of some Nearctic species. This suggests that Pinder examined an aberrant specimen of S. gibbus.

The pupa of S. gibbus has been previously described by Lenz 1957:180. He noted several characteristics which differ from the

specimen described here. These include the following: T/II with posterior row hooklets with median gap (but not so shown in his figure), spicules on tergites with a few rounded areas free of spines and pedes spurii A absent. Lenz (1957) also noted that the male genital lobes extend exactly to the level of swim paddle apex. I have been unable to confirm this observation, as the specimen examined was a female, but all other closely related species exhibit the condition of the genital lobes extending past the apex of the swim paddles (see phylogenetic discussion, pg. 465). These differences probably reflect either intraspecific variation or inaccurate observation but the possibility of specific differences should be considered by future researchers.

The inclusion here of the one available European larva requires comment. Lenz (1957) and Kalugina (1958) have described reared material of S. gibbus, Chernovskii (1949) and Pinder and Reiss (in press) have provided figures of unidentified Stenochironomus larvae, Meschkat (1936) briefly described a larval form and Romaniszyn (1958) gave a brief description of a larva he referred to as S. gibbus. All six of these descriptions match the single larva described here and it seems likely that it is the larva of S. gibbus.

The two other larval forms previously described cannot be confidently associated with a named adult (see pg. 323). The larvae of S. gibbus can be distinguished from these other two forms by the lack of a constriction on the anal papillae. The apically forking spicules of the pecten epipharyngis are also probably characteristic of S. gibbus. Otherwise I cannot confidently indicate differences between the larvae of S. gibbus and the form described as S.

fascipennis by Zabolotskii (1939). S. gibbus larvae differ markedly from the larval form described by Zavrel (1933). Larval head shape, paralabial plate shape, and anal papillae shape all indicate Zavrel's larvae to belong phylogenetically to the leaf-mining lineage,

while characters as described here for S. gibbus, indicate S. gibbus to be a wood miner.

I have attempted to locate the specimens originally examined by Meschat but Dr. H. Weidner (Zoologisches Institut und Zoologisches Museum, Universitat Hamburg, 2 Hamburg 13, Martin-Luther-King Platz 3) has informed me that they were destroyed during World War II.

Pinder and Reiss (in press) shows the larval antenna of S. gibbus with an accessory antennal blade. I have not been able to confirm this observation for this or any other species of Stenochironomus.

Material examined. Numbers of adults are noted above under "taxonomic discussion". These were from New Forest, Staines, and Richmond, England; Killarney, Ireland; Nehmitzsee, Wummsee, and Ingolstadt, West Germany; Lake Gassjon, Lake Grimsgol, Lake Innaren, Lake Helgasjon, and Lake Malaren, Sweden; Oulanko and Riihimaki, Finland; Moscow, USSR; 27 km SW Kaesong, Prov. Kengi, North Korea. A few others, badly bleached, were available from Sweden. One pupa was associated with a female adult from Lake Grimsgol, Sweden. One fourth instar larva was collected from E. Sussex, near Marsh Green, England.

Derivation of specific epithet. The name gibbus (humpbacked. or

protuberant) refers to the projecting scutum and correspondingly reduced pronotum characteristic of Stenochironomus species and of a few other genera.

Stenochironomus (Stenochironomus) n. sp. "Japan"

Chironomus (Stenochironomus) bitensis: Tokunaga and Kuroda 1935:1, misspelling. Not Kieffer 1924:31.

Diagnosis. Male: wing with median band and an apical band not extending into cells R3 and CuA1; appendage 1 elongate; appendage 2 with apical seta elongate. Female: not distinguishable from some specimens of S. gibbus.

Description. Male adult.

Antennae: AR: 1.23.

Thorax: pigmentation on lateral vittae and postnotum.

Legs: all femora and tibiae dark brown, apex of mid tibia brown; in some specimens, extreme base of femora lighter.

Wing: medial band present, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and R pigmented (Fig. 15B).

Genitalia: in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight, apex gradually bent ventrally (Fig. 40I), apex parallel-sided in dorsal aspect; posterior edge of T IX with ventral row of stout setae; appendage 1 somewhat shortened, thick, tapering

from near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta as long as and basally thicker than subapical seta (as in Fig. 44B).

Female adult: As for male except as follows:

Genitalia: setal patch on S VIII bordered posteromedially by moderately produced ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII rounded; spicules of ventrolateral lobe of moderate length, on small raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme unknown.

Pupa and larva. Unknown.

Distribution. The specimens of this species were collected in Japan (Fig. 81, locality 3, and Kamikochi).

Taxonomic discussion. This species is represented by 5 males and 5 females collected by M. Tokunaga from Mt. Daisen, Tottori Pref., Japan, 2-VII-1931, and preserved in alcohol since then. They are so badly bleached and distorted that I am not providing either a new name or a complete description. The above description was based on a combination of Tokunaga's original description and that derivable from the present specimens. The material is housed in the ELKU.

This species was considered by Tokunaga and Kuroda to be conspecific with the Palearctic S. gibbus (as bitensis) but the

different shape of the anal point in lateral view (more slender and more evenly curved apex) (Fig. 40I) and, more importantly, the elongate apical seta of appendage 2 of males of this species indicate it's distinctiveness.

Stenochironomus (Stenochironomus) satorui (Tokunaga and Kuroda)

Chironomus (Stenochironomus) satorui, Tokunaga and Kuroda, 1936:2. Holotype, female adult, presumed lost, from Yamashina, Kyoto, Honshu, Japan, 15-30-VII-1936, S. Takeuchi. Five paratypes, all females, on microscope slides, from type locality (ELKU).

Stenochironomus satorui: Sasa and Yamamoto, 1977:314.

Diagnosis. Male: wing with median band and an apical band not extending into cells R3 and CuA1; posterior region of median vitta with oval dark spot; entire fore and hind tibia pigmented. Female: coloration as for male.

Description. Male adult. Descriptive statistics: see Table 22.

Head: all antennal hairs dark; palpus dark; labellum with dark markings; eye not metallic (when reconstituted in ammonium hydroxide).

Thorax: pigmentation confined to the following areas (Fig. 2A, 7F): posterodorsal edge of mesepimeron, inner margin of anterior 0.20-0.30 of lateral vitta, oval marking on posterior portion of median vitta, dorsal portion of postalar callus in some specimens, and all of postnotum; acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation moderately discrete, distributed as follows (Fig. 19F): entire fore femur; entire fore tibia; (sometimes with extreme apex lightened), fore fifth tarsomere, entire mid femur, basal 0.36-0.57 of mid tibia, mid fifth tarsomere, entire hind femur (some specimens with lightened base and poorly defined, medium brown, subapical annulus, annulus length 0.00-0.16 of femur length, situated 0.00-0.32 from apex), entire hind tibia, hind fifth tarsomere.

Wing: medial band present, extending into Cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and M pigmented (as in Fig. 15E); halter pale.

Abdomen: pigmentation: genitalia brown.

Genitalia (Fig. 33A): in lateral aspect basal 2/3 of dorsal edge slightly concave to straight, apex gradually bent ventrally (Fig. 40J), apex parallel-sided in dorsal aspect; lateral margins of base of anal point weakly to moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX truncated in dorsal aspect, with ventral row of stout setae; dorsal patch of setae in semicircular arrangement; appendage 1 moderately short, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta nearly as long and basally slightly thicker than subapical seta (Fig. 44B, C); gonostylus somewhat swollen at midlength, apex tapering; gonocoxal apodeme truncated anteriorly, with expansion.

Female adult. Descriptive statistics: see Table 73. Similar to male except as follows:

Head: all flagellomeres medium brown.

Thorax: acrostichal setae extending nearly to (paratypes), to around and under anterior point of scutum (other specimens); dorsocentral setae in 1-2 rows; scutellar setae in 2-3 rows.

Legs: dark pigmentation moderately discrete, distributed as follows:
 entire fore femur, entire fore tibia (some with very apex lightened), fore fifth tarsomere, entire mid femur, basal 0.27-0.51 of mid tibia, mid fifth tarsomere, entire hind femur (some with lightened base and poorly defined, medium brown, subapical annulus, annulus length 0.00-0.13 of femur length, situated 0.24-0.28 from apex), basal 0.79 to entire hind tibia, and hind fifth tarsomere.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 49A): setal patch on S VIII extending posteriorly to approximately to level of cleft around opening of oviduct, bordered posteromedially by strong ridges which are not fused medially, or which do meet medially to produce a pronounced, U-shaped ridge anterior to cleft around oviduct; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII markedly darkened, rounded dorsally, broadly U-shaped ventrally;

4

spicules of ventrolateral lobe of moderate length, basally stout, on raised, pronounced dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, widely separated, broad in dorsal aspect, tapering posteriorly, slightly curved.

Pupa and larva. Unknown.

Distribution. S. satorui is known from two localities in Japan: (Fig. 81, localities 4, 7).

Taxonomic discussion. The paratype specimens were first examined preserved in alcohol. They were exceedingly bleached and were subsequently mounted on microscope slides. Fresh material collected by M. Yamamoto is here considered conspecific with S. satorui on the basis of similar coloration of the female as described by Tokunaga and Kuroda (1936). However, two differences were noted between the paratypes and these freshly collected females. The posteromedial ridges bordering the setal patch on S VIII were not strongly pronounced medial to the opening of the oviduct in the paratype while they formed a pronounced U-shaped ridge in the fresh material. Also the cleft between the dorsomesal and ventrolateral lobes of S VIII, not observable in the paratypes, were markedly darkened in the fresh specimens. I attribute these differences to distortion and bleaching of the paratypes but future investigation may indicate these fresh specimens to belong to a different species.

Material examined. All paratypes were examined. Seven males and six females from Kyushu were initially examined as pinned specimens and subsequently mounted on microscope slides. These last specimens are housed in ELKU and CNC.

Derivation of specific epithet. S. satorui is named after the collector of the type series, Satoru Takeuchi.

Stenochironomus (Stenochironomus) colei (Malloch)

Chironomus colei Malloch, 1919:255. Holotype, male adult, pinned, labelled "Forest Grove Ore. [Oregon] VI-3-18", "At light", "Chironomus colei Mall. Type", "Type Chironomus colei male Malloch" (CAS); paratype, male adult, on a microscope slide, labelled as for holotype (INHS).

Stenochironomus colei: Townes, 1945:88. Gillespie, 1974:236. Sublette, 1960:211.

Diagnosis. Male: wing with median band and apical band not extending into cells R3 and CuA1; median vitta and pleural region without dark pigmentation; apical 0.13-0.18 of hind femur with dark pigmentation; appendage 1 short. Female with wing and thoracic pigmentation as for male; Hd Tal/Ti: 0.72-0.77; palpal segment 3/4 = 1.07-1.27. Pupa: (not distinguishable from S. gibbus, S. pulchripennis or S. poecilopterus) horn of respiratory organ originating near base; T II with posterior row of hooklets extending continuously to lateral margin of tergite; spur on S VIII with 2-4 deltoid to elongate lateral teeth of similar size and with a few smaller median teeth. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; mandibular adductor apodeme with light to dark pigmentation; anal papillae with constriction.

Description. Male adult. Descriptive statistics: see Table 23.

Head: apical 0.30-0.40 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 2E, F, 8A): posterodorsal edge of mesepimeron, outer margin to entire lateral vitta, and entire median are postnotum; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation discrete, distributed as follows (Fig. 20D): apical 0.12-0.21 of fore femur, basal 0.14-0.28 of fore tibia, fore fifth tarsomere, apical 0.10-0.18 of mid femur, basal 0.06-0.22 of mid tibia, mid fifth tarsomere, apical 0.13-0.18 of hind femur, basal 0.03-0.17 of hind tibia, and hind fifth tarsomere; in life, forelegs held posterolaterally (Fig. 52C).

Wing: medial band present but pigmentation of membrane reaching only to r-m, sometimes discontinuous between M and Cu1, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and M pale (Fig. 15C); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark, pale at apex.

Genitalia: similar to that of S. poecilopterus (Fig. 33B); in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight,

apex abruptly bent ventrally (Fig. 40K), apex parallel-sided to slightly bulbous in dorsal aspect; lateral margins of base of anal point weakly to moderately produced, originating subapically on T IX, nearly parallel to moderately diverging; posterior edge of T IX rounded to slightly truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in circular to semicircular arrangement; appendage 1 short, somewhat reduced in width, of nearly constant diameter to tapering from near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta nearly as long as, and basally as thick as, subapical seta (Fig. 44D); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme rounded to truncated anteriorly, with slight to moderate expansion.

Female adult. Descriptive statistics: see Table 74. Similar to male except as follows:

Head: flagellomere six dark.

Legs: dark pigmentation discrete, distributed as follows: apical 0.10-0.19 of fore femur, basal 0.19-0.37 of fore tibia, fore fifth tarsomere, apical 0.12-0.18 of mid femur, basal 0.07-0.19 of mid tibia, mid fifth tarsomere, apical 0.13-0.22 of hind femur, basal 0.23-0.38 of hind tibia, and hind fifth tarsomere.

Wings: as for male but medial band more intense, discontinuous in some specimens between M and Cu1 but all with at least some

pigmentation anterior to crossvein r-m; area between C and M pale.

Abdomen: lacking dark pigmentation.

Genitalia (similar to that of S. poecilopterus Fig. 49B): setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered posteromedially by weak ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII rounded; spicules of ventrolateral lobe of moderate length, on small raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, broad in dorsal aspect, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ originating near base to partially fused with anterior stalk near base, length of fused portion approximately equal to width of free portion (as in Fig. 55B), elongate, thin; terminal filaments of respiratory organ of respiratory organ slender, $<4 \mu$ in diameter, apices non-forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly yellowish brown, lateral margin with narrow dark stripe, anterior margin of T VIII with or without dark stripe and T I variably pigmented; spicules

present on the following: T II-VI, S II-VI (weakly produced), S I in some specimens, and anal lobe (weakly produced); anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV, a few spicules on S II or S III in some specimens; T II and T III with rounded bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III markedly larger than posterior spicules (as in Fig. 56C); T II with posterior row of large hooklets extending to lateral margin of tergite, contiguous across middle (as in Fig. 56D); spur on S VIII with teeth light yellowish brown to medium brown, with 2-4 deltoid, lateral teeth of similar size and shape and 1-3 sharply pointed to blunt, deltoid to elongate, smaller medial teeth (Fig. 61E); in dorsal aspect, teeth arranged in an evenly curved row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae; throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 110.

Head capsule (as in Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness; seta

submenti lateral to paired ridges supporting labiohypopharynx, micropore anterolateral to, to posterolateral to, seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 59B): S I pinnate; S II pinnate; S III simple or pinnate; S I and labral lamella on semicircular plate; labral lamella with up to 10 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally, sometimes grouped medially.

Mandible: posterior portion of adductor apodeme with light to dark pigmentation (Fig. 72B).

Labiohypopharynx (as in Fig. 73P): ligular lobes joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76B): apically bilobed with paralabial portion of greater width than maxillary portion, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 77J): without constriction.

Bionomics and distribution. S. colei is distributed in the western Nearctic Region, from B.C. and Alberta to California and Colorado (Fig. 84A). Larvae were recorded from three localities: Coquitlam River at Hwy. 7, Simikameen River, and Osoyoos, B.C.; Berry Creek, Oregon; Hayden, Colorado. All these localities were lotic habitats.

Adults were observed at Starvation Creek near Viento, Oregon on 26-27-VI-1981. Four males and 26 females were swept from light dappled leaves of shrubs and saplings at a height of about 2-4 m. One female, of a number kept alive, laid an egg mass (see description, pg. 102) but no embryogenesis was observed. The egg mass eventually disintegrated under laboratory conditions.

Taxonomic discussion. Although Townes (1945:88) believed the location of the type of S. colei was unknown, Arnaud (1979) recorded its presence in CAS.

S. colei is morphologically similar to as well as allopatric with S. pulchripennis (Fig. 84A) and Townes (1945) suggested that they may be conspecific. To test this possibility, I examined clinal variation of two male characters which differed significantly between these two species: number of dorsocentral setae and Gc/Gs. I could detect no clinal variation which would suggest that S. colei and S. pulchripennis are merely extreme variants of a geographical cline. However, it should be noted that only small samples of S. colei were

available. Gillespie (1974:237) suggested three other differences which are discrete between S. cole and S. pulchripennis (shape of apex of T IX, shape of gonostylus and relative length of appendage 1) but I have been unable to confirm these differences.

Material examined. Larvae, pupae and adults were examined from the localities noted under bionomics and distribution, except that only larvae were examined from Berry Creek. Otherwise, only 20 males and 11 females were available from other localities. These included a male adult from Cooking Lake, Alberta and 15 mi.E. Bakersfield, Kern Co., California.

Derivation of specific epithet. This species was named after F.R. Cole.

Stenochironomus (Stenochironomus) pulchripennis (Coquillett)

Chironomus pulchripennis Coquillett, 1902:94. Holotype, female adult, pinned, labelled "Franconia, N.H. [New Hampshire]", "Mrs. Slosson Collector", "Type No. 6176 U.S.N.M.", "Chironomus pulchripennis Coq." (USNM). Johannsen, 1905:204. Kieffer, 1917:343.

Chironomus (Stenochironomus) pulchripennis: Johannsen, 1938:28.

Stenochironomus pulchripennis: Kieffer, 1919:44. Townes, 1945:88, 1952:65.

Diagnosis. Male: wing with a median band and apical band which does not extend into cells R3 and CuA1; median vitta and pleural region without dark pigmentation; apical 0.23-0.28 of hind femur with dark pigmentation; appendage 1 short. Female: wing and thoracic pigmentation as for male, Hd Tal/Ti = 0.77-0.83, palpal segment 3/4 = 1.28-1.46. Pupa: not distinguishable from S. gibbus, S. pulchripennis or S. poecilopterus, see S. colei. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe; mandibular adductor apodeme with dark pigmentation; anal papillae with constriction, distance of antennal seta from base/length of antenna segment one = 0.68-0.82 (0.63-0.72 for S. poecilopterus which is otherwise similar to S. pulchripennis).

Description. Male adult. Descriptive statistics: see Table 24.

Head: apical 0.32-0.48 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 2G, H, 8B): posterodorsal edge of mesepimeron, posterior portion to all of lateral vitta, and almost entire postnotum except anterior margin in some specimens; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation discrete, distributed as follows (Fig. 20E, F): apical 0.12-0.21 of fore femur, basal 0.20-0.34 of fore tibia, fore fifth tarsomere, apical 0.19-0.28 of mid femur, basal 0.13-0.28 of mid tibia, mid fifth tarsomere, apical 0.23-0.28 of hind femur, basal 0.24-0.56 of hind tibia, and hind fifth tarsomere; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and R pale except for area anterior to arculus (Fig. 15D); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark, pale at apex.

Genitalia (similar to that of S. poecilopterus (Fig. 33B): in lateral aspect basal 2/3 of dorsal edge of anal point concave to

straight, apex abruptly bent ventrally (as in Fig. 40K), apex parallel-sided to slightly bulbous in dorsal aspect; lateral margins of base of anal point weakly to moderately produced, originating subapically on T IX, nearly parallel to moderately diverging; posterior edge of T IX rounded to truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in semicircular to longitudinally elongate, oval arrangement; appendage 1 short, somewhat reduced in width, of nearly constant diameter to tapering near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta nearly as long as and basally as thick as subapical seta (Fig. 44E); gonostylus somewhat swollen subapically; apex tapering; gonocoxal apodeme rounded to truncated anteriorly, with slight expansion.

Female adult. Descriptive statistics: see Table .75. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 2-3 rows.

Legs: dark pigmentation discrete, distributed as follows: apical 0.02-0.19 of fore femur, basal 0.18-0.35 of fore tibia, fore fifth tarsomere, apical 0.19-0.67 of mid femur, basal 0.08-0.26 of mid tibia, mid fifth tarsomere, apical 0.19-0.69 of hind femur, basal 0.29-0.61 of hind tibia, and hind fifth tarsomere.

Wings: pigmentation: as for male except area between C and M darkened.

Abdomen: lacking dark pigmentation.

Genitalia: as for S. colei (but see descriptive statistics) (Fig. 49B).

Pupa. Descriptive statistics: see Tables 88-90. Spur on S VIII with 2-5 deltoid to elongate, lateral teeth of similar size or with most lateral teeth smaller than those in mid region of spur and 0-3 elongate, smaller, medial teeth (Fig. 61D); otherwise as for S. colei.

Larva. Descriptive statistics: see Table 111.

Head capsule (as in Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore anterolateral or lateral to seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 69B): S I pinnate; S II pinnate; S III simple or pinnate; S I and labral lamella on semicircular plate; labral lamella with up to 10⁺ spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme with dark pigmentation (Fig. 72C).

Labiohypopharynx (Fig. 73P): ligular lobes joined by continuous pigmentation extending posteriorly past median cleft; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76B): apically bilobed with paralabial portion of greater width than maxillary portion, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 77K): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. S. pulchripennis is distributed in the eastern Nearctic Region, from southern Ontario and Quebec to

Pennsylvania and Michigan (Fig. 84A). Johnson (1925) recorded the species from Maine, N.H., Mass., R.I. and Conn. but I have not been able to confirm his identifications. However, these localities are within the range given here.

Larvae were recorded from both lotic (n=3) and lentic (n=2) habitats. Townes (1945) suggested adults are associated with running waters and Harper and Cloutier (1979) record adults of S. pulchripennis from emergence traps as being "more common in slow streams than in lakes". It should be noted that some specimens identified as S. pulchripennis in their study were actually S. tectus. I collected large numbers of larvae of S. pulchripennis in Lac Croche and Lac Triton from Betula and Nemopanthus. The stream "Tributary G" produced very few larvae suggesting that adult emergence trap records along this stream by Harper and Cloutier (1979) may have come from pupae which drifted down from Lac Croche.

Rochon (1977) showed a scattered adult emergence period from the end of May to the end of August. My rearings suggest that third and fourth instars are the overwintering stage.

Taxonomic discussion. The morphological similarities between S. pulchripennis and S. oolei are discussed under the latter species.

Material examined. Larvae, pupae and adults were examined from Madawaska River, Ont.; Riviere La Pêche, Yamaska River, and Lac Triton (near St. Hippolyte), Que.; Eaton Lake, N.Y. A single larva was identified from Agimak River, Ignace Kenora Twp., Ontario. Other localities were based on a few adults.

Derivation of specific epithet. The name pulchripennis refers to the beautiful (pulcher) wings (pinnae) exhibited by, although not unique to this species.

Stenochironomus (Stenochironomus) poecilopterus (Mitchell)

Chironomus poecilopterus Mitchell, 1908:10. Holotype, male adult, pinned, labelled "CabnJn Md [Cabin John, near Rockville, Maryland]", "June 10", "Type No. 11023 U.S.N.M.", "Chironomus poecilopterus Mitchell" (USNM); paratypes, two female adults, pinned, labelled "CabnJn Md", "Paratype No. 11023 U.S.N.M." (USNM).

Chironomus (Stenochironomus) poecilopterus: Johannsen, 1938:28.

Stenochironomus poecilopterus: Townes, 1945:87, 1952:65.

Stenochironomus pulchripennis: Malloch 1915b:429, misidentification

Diagnosis. Male: wing with median band and apical band not extending into cells R3 and CuA1; median vitta with oval spot on posterior portion; pleural region without dark pigmentation; entire fore femur pigmented; appendage 1 short. Female: wing and thoracic pigmentation as for male; annulus on fore femur equal to 0.05-0.14 of total femur length. Pupa: not distinguishable from S. gibbus, S. pulchripennis or S. colei, see S. colei. Fourth instar larva: dorsolateral stripes originating on anterior 2/3 of dorsomedian stripe, mandibular adductor apodeme with dark pigmentation, anal papillae constricted; distance of antennal seta from base/length of antennal segment one = 0.63-0.72 (0.68-0.82 for S. pulchripennis which is otherwise similar to S. poecilopterus).

Description. Male adult. Descriptive statistics: see Table 25.

Head: apical 0.38-0.50 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 21, J, 8C): posterodorsal edge of mesepimeron, inner margin of anterior half lateral vitta, oval marking on posterior portion of median vitta, and all of postnotum; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation discrete, distributed as follows (Fig. 21A, B): entire fore femur (except extreme base and subapical annulus pale, annulus length 0.05-0.22 of femur length, situated 0.17-0.24 femur apex), basal 0.43-0.67 of fore tibia, fore fifth tarsomere, entire mid femur (except in some specimens, for a subapical, pale annulus, annulus length 0.00-0.18 of femur length, situated 0.22-0.32 from apex), basal 0.31-0.44 of mid tibia, mid fifth tarsomere; entire hind femur (except, in some specimens for a subapical, pale annulus, annulus length 0.00-0.18 of femur length, situated 0.21-0.27 from apex), basal 0.60-0.77 of hind tibia, hind fifth tarsomere; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and R

pigmented, between R and M pale (Fig. 15E); halter pale.

Abdomen: . pigmentation; genitalia brown; anal point dark, pale at apex.

Genitalia (similar to that of S. poecilopterus (Fig. 33B): in lateral aspect basal 2/3 of dorsal edge of anal point concave to convex, apex gradually bent ventrally (Fig. 40L), apex parallel-sided to slightly bulbous in dorsal aspect; lateral margins of base of anal point weakly to moderately produced, originating subapically on T IX, nearly parallel to moderately diverging; posterior edge of T IX somewhat rounded to truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae semicircular to longitudinally elongate, oval arrangement; appendage 1 short, somewhat reduced in width, of nearly constant diameter to tapering from near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta nearly as long and basally as thick as subapical seta (Fig. 44F); gonostylus somewhat swollen at midlength to subapically, apex tapering; gonocoxal apodeme truncated anteriorly, with slight expansion .

Female adult. Descriptive statistics: see Table 76. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 2-3 rows.

Legs: dark pigmentation discrete, distributed as follows: entire fore femur (except extreme base and subapical annulus pale, annulus length 0.05-0.16 of femur length, situated 0.19-0.23 from apex), basal 0.30-0.64 of fore tibia, fore fifth tarsomere, entire mid femur (except, in some specimens, for a subapical, pale annulus, annulus length 0.00-0.10 of femur length, situated 0.25-0.29 from apex), basal 0.32-0.49 of mid tibia, mid fifth tarsomere, entire hind femur (except, in some specimens, for a subapical, pale annulus, annulus length 0.00-0.10 of femur length, situated 0.23-0.26 from apex), basal 0.68-0.78 of hind tibia; and hind fifth tarsomere.

Wing: as for male but area between C and M dark.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 49B): setal patch of S VIII extending posteriorly past level of cleft around opening of oviduct, bordered posteromedially by weak ridge; ventrolateral lobes moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII rounded; spicules of ventrolateral lobe of moderate length, on small, raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, broad in dorsal aspect, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90. Spur on S VIII with 3-6 deltoid to elongate lateral teeth of similar size or with

most lateral teeth smaller than those in mid region of spur and 0-3 elongate, smaller medial teeth (Fig. 61F); otherwise as for S. colei.

Larva. Descriptive statistics: see Table 112.

Head capsule (as in Fig. 65B): medium to dark brown; cuticular surface sculpturing forming geometrical patterns ventrally, in area around and posterior to seta submenti; base of dorsolateral stripe originating on at least anterior two-thirds of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with moderate posterior projection; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore anterolateral to posterolateral to seta submenti or absent; posterior coronal pore canal long, arising from apex of dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (Fig. 69B): S I pinnate; S II pinnate; S III simple or pinnate; S I and labral lamella on semicircular plate; labral lamella with up to 10 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme with dark pigmentation (as in Fig. 72C).

Labiohypopharynx (as in Fig. 73P): ligular lobes joined by continuous pigmentation extending posteriorly past median cleft;

shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (Fig. 76B): apically bilobed with paralabial portion of greater width than maxillary portion, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77K): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. S. poecilopterus is broadly distributed in the eastern Nearctic Region, from southern Quebec and Ontario to Florida and is additionally known from a single locality in Colorado (Yampa River at Hayden) (Fig. 84C). This peculiar distribution may be the result of unrecognized differences (i.e. lack of conspecificity) between the Colorado and eastern samples but I could detect no such differences when comparing larvae, pupae, males or females. I doubt that the species is distributed across the prairies but the possibility remains that S. poecilopterus may be more broadly distributed in the Rocky Mountains and in Canada. Finally, the Colorado sample may represent a relict population of a formerly more widespread S. poecilopterus.

Larvae of S. poecilopterus were collected from both lotic (n=4)

and lentic (n=2) habitats. However, this species appeared to be absent from many lentic habitats where I collected other Stenochironomus species and my impression is that larvae are more common in moving waters.

Rearings and collections suggest that third and fourth instar larvae are the overwintering stage.

Taxonomic discussion. Although not given on the labels of the type specimen, Mitchell (1908) mentions that the date of collection was June 6, 1905. In addition Mitchell states that six males and two females were collected, but I have been able to locate only one male (holotype) and two females (paratypes).

Material examined. Larvae, pupae and adults were examined from Riviere La Pêche, Yamaska River, 8 km W Sutton, and Lac Gillis (in Port Daniel Prov. Pk.), Que.; Red Mill Creek, Va.; Yampa River at Hayden, Colo.. A single larva was available from Okaloosa Co., Fla. (identified on the basis of distribution). All other localities were represented by small numbers of adults.

Derivation of specific epithet. The name poecilopterus refers to the "spotted" (poecilo) wings (ptero).

Stenochironomus (Stenochironomus) tectus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype Stenochironomus tectus Borkent, St. Hippolyte, Quebec, 2-VI-1973, L. Cloutier"; allotype labelled as for holotype but date 9-VI-1973; paratypes 40 males, 17 females, labelled as for holotype but with variable dates of collection (CNC); 3 males from Vesuvius, Rockbridge Co., Virginia, ?-VII-1960 (USNM); 1 male from Deer Lake, Newfoundland, 25-26-VII-1977 (CNC); 2 males from Narrows Mountain Brook, New Brunswick, 16-VI-1972 and 11-VIII-1972 (CNC); 1 male from Lusk Cave, Gatineau Pk., Quebec, 26-V-1982 (CNC); 10 males, 2 females from Lac Nathalie, 52-54 N, 76-78 W, Quebec, variables dates of collection (CNC); 1 male from Cape Breton Highlands Nat. Pk., Nova Scotia, 16-VII-1981 (CNC); 1 male, 3 females from Tuxedo, New York, ?-VIII-1928 (BMNH); 1 male, Martha Vineyard, Mass. (MCZ).

Diagnosis. Male: wings with median band and apical band not extending into cells R3 and CuA1; pleural region of thorax without dark pigmentation; apical 0.15-0.23 of femur pigmented; entire hind femur pigmented, with or without faint annulus; appendage 1 short. Female: pigmented as for male except fore femur nearly completely pigmented, with subapical annulus 0.20-0.50 of total femur length.

Description. Male adult. Descriptive statistics: see Table 26.

Head: apical 0.39-0.51 of antenna with dark hairs; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 2I-K, 8B, C): posterodorsal edge of mesepimeron; posterior portion of lateral vitta, oval marking present on posterior portion of median vitta present or absent, and all of postnotum, except anterior margin in some specimens; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 2-3 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation discrete, distributed as follows (Fig. 21C, D): apical 0.15-0.23 of fore femur, basal 0.34-0.54 of fore tibia, fore fifth tarsomere, mid femur (except, in some specimens, for a subapical, pale annulus, annulus length 0.00-0.22 of femur length; situated about 0.30 from apex); basal 0.27-0.46 of mid tibia, mid fifth tarsomere, hind femur (except, in some specimens, for a faint annulus, annulus length 0.00-0.12 of total femur length, situated 0.27-0.33 from femur apex), basal 0.64-0.75 of hind tibia, hind fifth tarsomere.

Wing: medial band present, extending into cell CuA1; apical band restricted, not including cells R3 or CuA1; area between C and R pigmented, between R and M pale (as in Fig. 15E); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark, pale at apex.

Genitalia: similar to that of S. poecilopterus (Fig. 33B); in lateral aspect basal 2/3 of dorsal edge of anal point concave to convex, apex abruptly to smoothly bent ventrally, in some specimens with bent apex elongate (Fig. 40M, N), apex parallel-sided to slightly bulbous in dorsal aspect, lateral margins of base of anal point weakly to moderately produced, originating subapically on T IX, nearly parallel to moderately diverging; posterior edge of T IX somewhat rounded to truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in semicircular to longitudinally elongate, oval arrangement; appendage 1 short, somewhat reduced in width, of nearly constant diameter to tapering from near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta nearly as long and basally as thick as subapical seta (Fig. 44G); gonostylus swollen at midlength to subapically, apex tapering; gonocoxal apodeme truncated anteriorly, with slight expansion.

Female adult. Descriptive statistics: see Table 77. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 2-3 rows; scutellar setae in 3-4 rows.

Legs: dark pigmentation poorly defined to discrete, distributed as follows: entire fore femur (except extreme base and subapical annulus

pale, annulus length 0.20-0.50 of total femur length, situated 0.15-0.21 from femur apex), basal 0.20-0.48 of fore tibia, fore fifth tarsomere, entire mid femur (except, in some specimens, for a poorly defined subapical pale annulus, annulus length 0.00-0.10 of total femur length, situated 0.25-0.32 from femur apex), basal 0.23-0.45 of mid tibia, mid fifth tarsomere, entire hind femur (except, in some specimens, for a poorly defined subapical, pale annulus, annulus length 0.00-0.10 of total femur length, situated 0.24-0.29 from femur apex), basal 0.63-0.74 of hind tibia, and hind fifth tarsomere.

Wings: pigmentation: as for male except area between C and M dark.

Abdomen: lacking dark pigmentation.

Genitalia: as for S. poecilopterus (Fig. 49B).

Pupa and larva. Unknown.

Distribution and bionomics. S. tectus is distributed in the northeastern Nearctic Region, from James Bay, Quebec and Newfoundland to Virginia (Fig. 84B).

Because immature stages are unknown for this species, I cannot be certain which specific habitat it occupies.

Part of the sample recorded as S. pulchripennis by Harper and Cloutier (1979) was composed of S. tectus. These samples indicate that S. tectus occupies lotic habitats. Also, the specimens labelled as from Lac Nathalie were actually collected from two streams

draining into the lake.

Derivation of specific epithet. The name tectus (concealed) refers to the elusive larvae and pupae which have not yet been collected (in spite of some concerted efforts!).

Petalopholeus new subgenus

Type species: Stenochironomus cinctus Townes, by present designation.

Diagnosis. Adults cannot be presently diagnosed. Pupa: T II with posterior row of hooklets restricted to medial portion of T II. Fourth instar larva: dorsolateral stripes originating near base of dorsomedian stripe.

Description. Adult male and female. No distinguishing features are recognized.

Pupa. At least some spicules present on T VII and VIII (absent in two species); T II with posterior row of hooklets restricted to medial portion of T II.

Fourth instar larva. Head capsule squat and narrowed anteriorly, with head length/maximal width = 0.87-1.04 and anterior width/maximal width = 0.51-0.68; dorsolateral stripes originating near base of dorsomedian stripe; posterior coronal pore canals arising subapically on posterolateral section of postoccipital carina, directed anterolaterally; fused maxilla and paralabial plate anterolaterally truncate; anal papillae with one constriction at midlength, with basal and apical portions of approximately equal size.

Taxonomic discussion. Only the larval and pupal stage of.

Petalopholeus can be presently characterized. All species in this taxon have larvae which mine leaves. Petalopholeus forms the sister group to the subgenus Stenochironomus s.str.

Derivation of subgeneric name. The name Petalopholeus (leaf, den) refers to the leaf mining habit exhibited by larvae of all species in this subgenus.

Stenochironomus (Petalopholeus) totifuscus Sublette

Stenochironomus totifuscus Sublette, 1960:210. Holotype male adult, pinned, labelled "Orosi, Calif. 6 mi. E. 8 VII '47 W.W. Wirth", "Holotype No. 64713", "Stenochironomus totifuscus Sublette" (USNM); allotype, on a microscope slide, labelled "Visalia Cal. 4-VII-1947", "Stenochironomus totifuscus Sublette", "Allotype" (USNM); paratypes, 2 male adults, one pinned, one on a microscope slide, labelled "Orosi, Calif. 6 mi.E. 8 VII '47 W.W. Wirth", "Paratype", "Stenochironomus totifuscus Sublette" (USNM).

Diagnosis. Male: basal 0.57-0.68 of antenna with dark hairs; wing with dark pigmentation on M-Cu, fork of Cu and along apical edge; abdomen with dark pigmentation along posterior margins of T II-IV. Female: palpus dark brown; wing coloration as for male; no dark pigment on abdomen. Pupa: only Nearctic species with posterior row of hooklets on T II restricted to median area and with median gap of missing hooklets. Fourth instar larva: dorsolateral stripes originating at base of dorsomedian stripe; fused paralabial plate, maxilla projecting markedly anterior to hypostomal teeth.

Description. Male adult. Descriptive statistics: see Table 27.

Head: basal 0.57-0.68 of antenna with dark hairs; palpus brown; labellum with dark markings; eye not metallic.

Thorax: with marked pilosity on scutum between lateral and median

vittae and some lateral sclerites (evident only on pinned and live specimens), medium brown with the following areas notably more darkly pigmented (Fig. 2L, 8D): dorsal portion of medioanepisternum, portions of postanepisternum and mesepimeron, posterior portion of katepisternum, stripe along lateral edge of lateral vitta extending from patch of supraalar setae nearly to anterior point of mesonotum (best seen in living and in alcohol-preserved specimens), dorsal portion of postalar callus, entire postnotum; acrostichal setae extending past anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2-3 rows; anterior edge of scutum angular in lateral aspect (Fig. 13C).

Legs: dark pigmentation moderately defined, distributed as follows (Fig. 21E): apices of all tarsi (extent of pigmented area variable), apical 0.07-0.09 of fore femur, basal 0.00-0.12 and apical 0.02-0.07 of fore tibia, apical 0.06-0.08 of mid femur, basal 0.00-0.04 of mid tibia, apical 0.05-0.09 of hind femur, basal 0.06-0.08 of hind tibia; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: pigmentation restricted to m-cu, fork of Cu and along apical edge (Fig. 15F); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig.): posterior 0.12-0.16 of T II, posterior 0.11-0.14 of T III, posterior 0.06-0.09 of T IV; and posterolateral edge of T VII; genitalia brown; anal point not more darkly pigmented.

Genitalia (Fig. 33C): in lateral aspect base of anal point wide and basal 3/4 of dorsal edge of anal point nearly straight, apex abruptly bent ventrally (Fig. 41A), apex parallel-sided to tapering in dorsal aspect; lateral margin of base of anal point strongly produced, originating subapically, markedly anteriorly, on T IX, moderately diverging; posterior edge of T IX wedge shaped to truncated in dorsal aspect with ventral row of somewhat stout setae; dorsal patch of setae in longitudinal arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae restricted to apical half; apex of appendage 2 slightly curved with apical seta nearly as long as and basally thicker than, subapical seta (Fig. 44H); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme truncated anteriorly with expansion.

Female adult. Descriptive statistics: see Table 78. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsal portion of postalar callus not marked; dorsocentral setae in 2-3 rows; scutellar setae in 2-3 rows.

Legs: dark pigment discrete, distributed as follows: apices of all tarsi (pigmented area variable in size), apical 0.11 of fore femur, basal 0.15 and apical 0.04 of fore tibia, apical 0.10 of mid femur, basal 0.17 of mid tibia, apical 0.13 of hind femur, and basal 0.18 of hind tibia.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 49C): setal patch on S VIII extending posteriorly past level of cleft around opening of oviduct, bordered posteromedially by a continuous, strong, U-shaped ridge lying posterior to median cleft, weakly merging laterally with apodeme of S VIII; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped; spicules of ventrolateral lobe short, not on raised dorsoventral ridge; apodeme of S VIII straight, ending on base of dorsomesal lobe; posterior apodeme of S IX well developed, broad in dorsal aspect and rounded posteriorly, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

•Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ originating near base (as in Fig. 54C), of moderate length and thickness; terminal filaments of respiratory organ slender, $<4 \mu$ in diameter, apices forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VIII, S I-VII (weakly produced), and anal lobe; spicules present on T VIII restricted to posterior 2/3 (Fig. 58B); anterior spicules on T IV with single point; fine spicules (pedes spurii A) absent; T

II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (Fig. 57A); T II with posterior row of large hooklets restricted to medial area of tergite, divided medially into two groups (Fig. 57A); spur on S VIII with teeth yellowish brown, apex of large tooth distinctly paler, with one elongate, large tooth and 2-5 markedly smaller teeth, in some specimens with an additional tooth about 1/2 size of large tooth (Fig. 62A); male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 113.

Head capsule (as in Fig. 65C): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating at base of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection, pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterolateral or posterior to seta submenti or absent; posterior coronal pore canal short, arising subapically on dorsolateral section of postoccipital carina, directed anterolaterally.

6

Labrum (Fig. 69C): S I simple or pinnate; S II simple or pinnate; S III pinnate; S I and labral lamella on somewhat transversely broadened plate; labral lamella with numerous spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 74A): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, not extending posteriorly as far as lateral edge of base of lobe; each lobe somewhat broadened to truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (Fig. 76C): apically truncate with lateral edge of maxilla slightly thickened, projecting anteriorly well beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (Fig. 77L): one constriction at midlength, with basal and apical portions of approximately equal size.

Distribution and bionomics. , S. totifuscus is distributed in California and Arizona (Fig. 84D).

I collected immature stages from streams at two localities. At Stewart Campground, 3.2 Km SW of Portal, Arizona (7-IV-81) larvae mined the leaves of Platanus wrightii, which formed leaf packets between the rocks of the fast flowing, shallow stream. In some slower moving stretches of the stream, some leaves lying flat against the bottom contained mining larvae. I collected all instars of larvae, but fourth instars were the most common. At Sycamore Canyon, 19 km W. of Nogales, Arizona (9-IV-1981) larvae were more common, mining leaves of Salix which had compiled in deposition areas of the stream. Only third and fourth instar larvae were collected.

Taxonomic discussion. The allotype and one paratype were first examined as pinned specimens and subsequently mounted on microscope slides.

Material examined. Larvae, pupae and adults were from the two localities mentioned above, all type specimens and five males from the Southwest Research Station, Portal Arizona (5-9-VI-1972, light trap) were examined.

Derivation of specific epithet. The name totifuscus (all dark) presumably refers to the darkened thorax.

Stenochironomus (Petalopholeus) leptopus (Kieffer)

Chironomus longimanus Williston, 1896:274, not Chironomus longimanus Meigen, 1830:256. Lectotype designated by Sublette, 1966:28, male adult pinned, genitalia on microscope slide, labelled "1000 feet", "Type No. A.M.N.H.", "Am. Mus. Nat. Hist. Dept. Invert. Zool. No. 20380", "Chironomus longimanus Will.", "(Chironomus) Stenochironomus leptopus (=longimanus Will) Kieff Tow '40", "Lectotype designated by Sublette 1966" (AMNH); paralectotypes, 4 males, pinned, labelled "Cotype", "St. Vincent, W.I. [West Indies] H.H. Smith", "W. Indies. 1097-66", "1500 feet", "Paralectotype Stenochironomus leptopus (BMNH). Johannsen, 1905:233.

Chironomus leptopus Kieffer, 1906:19. New name for longimanus.

Stenochironomus leptopus: Townes, 1945:85. Sublette, 1966:28. Sublette and Wirth, 1972:15.

Diagnosis. Male: pigmentation along lateral margin of lateral vittae extending anteriorly to meet above anterior point of scutum. Female: as for male. Pupa: spicules on T VIII restricted to posterior margin and midregion (may not be separable from all S. totifuscus but with which it is allopatric). Fourth instar larva: dorsolateral stripes originating at base of dorsomedian stripe; spicules of pecten epipharyngis simple, arrayed in row, extending laterally; lateral edge of maxilla slightly thickened, projecting anteriorly to about level of hypostomal teeth.

Description. Male adult. Descriptive statistics: see Table 28.

Head: antennal hairs dark; palpus and labellum pale; eyes not metallic in alcohol or when reconstituted in ammonium hydroxide.

Thorax: with marked pilosity on some lateral sclerites (evident only on pinned specimens); pigmentation confined to the following areas (Fig. 3A, 8E): dorsal portion of medioanepisternum, postanepisternum, mesepimeron and metepisternum, anterior coxa, ventral portion of katepisternum, (dorsal edge of area of pigmentation darker), ventral portion of mid and hind coxa, stripe along lateral margin of lateral vitta extending from patch of supra-alar setae to above anterior point of scutum, entire postnotum; acrostichal seta extending past anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2 rows; anterior edge of scutum somewhat angular to rounded in lateral aspect (as in Fig. 13B, C).

Legs: pigmentation poorly defined, distributed as follows (Fig. 21F): basal 0.00-0.57 of fore femur, very light pigmentation at apex of mid femur, apical 0.23-0.36 of hind femur, basal 0.24-0.34 of hind tibia.

Wing: light medial band, area between C and R and very apex dark (Fig. 15G); halter dark brown.

Abdomen: pigmentation discrete, distributed as follows (Fig. 26J):

lateral margin of T-I, lateral and posterior margins of T II, posterior margin of T III, T V, entire T VI, anterior portion of T VII; genitalia brown, apex of gonostylus pale.

Genitalia (Fig. 33D): in lateral aspect basal $3/4$ of dorsal edge of anal point nearly straight to slightly concave, apex abruptly bent ventrally (Fig. 41B), apex parallel-sided to tapering in dorsal aspect; lateral margin of base of anal point strongly produced, originating subapically, markedly anteriorly, on T IX, moderately diverging; posterior edge of T IX truncated in dorsal aspect with ventral row of somewhat stout setae; dorsal patch of setae in circular to somewhat elongate arrangement; appendage 1 elongate, thick, of nearly constant, with setae restricted to apical $1/3$; apex of appendage 2 straight with apical seta as long as and basally thicker than, subapical seta (Fig. 44I); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme pointed to truncated anteriorly with expansion.

Female adult. Descriptive statistics: see Table 79. Similar to male except as follows:

Head: flagellomere six dark.

Legs: pigmentation poorly defined, distributed as follows: basal 0.51-0.61 of fore femur, entire mid femur (except for subapical annulus pale), very base of mid tibia, entire hind femur (except for subapical annulus pale), basal 0.23-0.65 of hind tibia.

Abdomen: pigmentation discrete, distributed as follows: lateral margin of T I, lateral and posterior margin of T II, T III, posterior margin of T V.

Genitalia (Fig. 49D): setal patch on S VIII extending posteriorly past level of cleft around opening of oviduct, bordered posteromedially by weak ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped; spicules of ventrolateral lobe short, not on raised dorsoventral ridge; apodeme of S VIII straight, ending on base of dorsomesal lobe; posterior apodeme of S IX well developed, broad in dorsal aspect, tapering posteriorly, curved medially.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: respiratory organ with horn originating near base (as in Fig. 54C), of moderate length and thickness; terminal filaments stout, >4 μ in diameter, apex non-forked, smooth.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VIII, S III-VII (weakly produced), anal lobe; spicules present on T VIII restricted to posterior margin and midregion (similar to Fig. 57A); anterior spicules on T IV with single point; fine spicules

(pedes spurii A) absent ; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (as in Fig. 57A); T II with posterior row of large hooklets restricted to medial area of tergite, divided medially into two groups (as in Fig. 57A); spurs on S VIII with teeth yellowish brown, apex of large tooth distinctly paler, with one elongate, large tooth and several markedly smaller teeth, in some specimens with an additional tooth about 1/2 size of large tooth (as in Fig. 62A); male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 114.

Head capsule as in (Fig. 65C): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating at base of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection pale cuticle; seta submenti positioned lateral to paired ridges supporting labiohypopharynx, micropore, located posterolateral or posterior to seta submenti; posterior coronal pore canal short to long, arising subapically on dorsolateral section of postoccipital carina, directed anterolaterally.

Labrum (as in Fig. 69C): S I simple; S II simple to pinnate; S III uncertain; S I and labral lamella on somewhat transversely broadened plate; labral lamella with about 10 spicules, elongate, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis simple, arrayed in row, extending laterally.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 74A): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, not extending posteriorly as far as lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76C): apically truncate with lateral edge of maxilla slightly thickened, projecting anteriorly slightly to well beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77L): one constriction at midlength, basal portion wider than apical portion.

Distribution and bionomics. S. leptopus is distributed in the West Indies and Ecuador (Fig. 85, localities 4-7 and Dominica).

I collected larvae and subsequently reared a large series of adults, from Tinalandia and Rio Palenque Field Station, Ecuador on 16-II-1982. Both habitats were small (less than 1.5 m in width), shallow str

Harrison and Rankin (1976) recorded S. leptopus as restricted to the lotic habitats present on St. Vincent. Larvae mined freshly fallen leaves in the characteristic manner of other leaf miners (Fig. 78).

Taxonomic discussion. Sublette (1966) provided a detailed description of the lectotype of Chironomus longimanus (= S. leptopus). Further specimens of the syntype series are present in the BMNH which are here recognized as paralectotypes.

When comparing the Ecuadorian and West Indian specimens of S. leptopus, I failed to find any differences other than that the Ecuadorian adult males exhibited light pigmentation along the lateral margin of T IV. This pigmentation was absent in the West Indies specimens.

Material examined. Aside from the type series, I examined 15 larvae, 1 pupal exuviae, 4 females, and 3 males from St. Vincent collected by Dr. A.D. Harrison, 1 male from St. Lucia, 19 males and 4 female from Dominica and a large series of larvae, pupae and adults from Tinalandia and Rio Palenque, Ecuador. Dr. Harrison also kindly lent two preserved leaves from St. Vincent exhibiting larval mines.

Derivation of specific epithet. The name leptopus (thin legs) refers

to the elongate legs of this species and many other Chironomidae.

Stenochironomus (Petalopholeus) impendens n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus impendens* Borkent", "A 366-1 U503", "Amazonien [Brazil], Rio Paru, Malloca Apico, 20.IV.1962, leg. E.J. Fittkau"; paratypes 3 males, from Igarape Okueima, Rio Paru, Brazil, 18-IV-1962 (INPA).

Diagnosis. Male: thorax with dark markings; dorsal patch of setae on T IX with posterior setae on posteriorly projecting lobe.

Description. Male adult. Descriptive statistics: see Table 29.

Head: antennal hairs pale; palpal segments 3, 4 and apex of 5 medium brown; labellum pale; eye iridescence unknown.

Thorax: pigmentation confined to the following areas (Figs. 3B, 8F): dorsal portion of medioanepisternum, postanepisternum, and mesepimeron, lateral stripe on katepisternum, fore coxa, anterior portion of lateral vitta extending laterally toward edge of scutum, posterior portion of postnotum; acrostichal setae extending to, to around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 1 row; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: very light brown pigmentation poorly defined on apical 0.5 of

fore femur, entire fore tibia and fore tarsomeres; in some specimens very light pigmentation at apex of hind femur and base of hind tibia (Fig. 22A).

Wing: entire membrane light brown (as in Fig. 14C); halter pale.

Abdomen: pigmentation distributed as follows (Fig. 27A): entire T I-V a light to medium brown, T VI very light brown; genitalia brown.

Genitalia (Fig. 34A): in lateral aspect basal 3/4 of dorsal edge of anal point nearly straight, apex abruptly bent ventrally (Fig. 41C), apex parallel-sided in dorsal aspect; lateral margin of base of anal point moderately produced, originally subapically on T IX, moderately diverging; posterior edge of T IX truncated in dorsal aspect with ventral row of slender setae; dorsal patch of setae with markedly elongate arrangement, posterior setae of patch on posteriorly projecting lobe; appendage 1 markedly elongate, thick, of nearly constant diameter, with a few setae distributed along entire length; apex of appendage 2 somewhat bent dorsally with apical seta nearly as long as, and basally as thick as, subapical seta (as in Fig. 44H); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme truncated to rounded anteriorly with expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known only from the northern Brazil (Fig. 85, localities 15, 16).

Taxonomic discussion. The available specimens were examined only as microscope slide preparations. The adults had not been cleared, so that description of coloration is probably accurate.

Derivation of specific epithet. The name impedens (overhanging) refers to the posteriorly projecting lobe supporting part of the dorsal setal patch on T IX of the male of this species.

Stenochironomus (Petalopholeus) townesi n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus townesi* Borkent, Yacambu Nat. Pk., Lara, Venezuela, 1200 m, 10-V-1981, H. Townes, malaise trap" (CNC).

Diagnosis. Male: anterolateral margin of T I, posterior margins of T III and T IV, anterior portion of T VI and T VIII pigmented; T II and T V pale; anal point originating markedly anterior on T IX.

Description. Male adult. Descriptive statistics: see Table 30.

Head: antennal hairs dark but many missing; palpus pale but palpal segments 3-5 missing; labellum pale, eye iridescence unknown.

Thorax: pigmentation confined to the following areas (Fig. 3C, 9A): dorsal portion of medioanepisternum, entire postanepisternum, portions of mesepimeron and metepisternum; ventral portion of katepisternum (dorsal edge of pigmentation darker), stripe dorsal to anapleural suture, dorsal portion of mid and hind coxae, most of dorsum of scutum very light brown with median and lateral vittae light brown, entire postnotum; acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum somewhat angular in lateral aspect (as in Fig. 13C).

Legs: pigmentation moderately defined, distributed as follows (Fig.

22B): apical 0.14 of fore femur, basal 0.34 and apical 0.27 of fore tibia, slight pigmentation at apex of hind femur; all tarsomeres missing.

Wing: lacking dark pigmentation; halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 28B): anterolateral margin of T I, posterior 0.18 of T III, posterior 0.07 of T IV, anterior portion of T VI (poorly defined), anterior 0.40 of T VII; genitalia brown.

Genitalia: T IX as in Fig. 33C: in lateral aspect basal 3/4 of dorsal edge of anal point nearly straight, apex abruptly bent ventrally (Fig. 41D), apex parallel-sided in dorsal aspect (as in Fig. 33C); lateral margin of base of anal point moderately produced, originating subapically, markedly anteriorly, on T IX, moderately diverging; posterior edge of T IX wedge-shaped in dorsal aspect with ventral row of slender setae; dorsal patch of setae in semicircular arrangement; appendage 1 elongate, thick, tapering from base (as in Fig. 36C), with setae restricted to apical half; apex of appendage 2 somewhat bent dorsally with apical seta somewhat elongate and basally thicker than, subapical seta (as in Fig. 44L); gonostylus swollen subapically, apex tapering; gonocoxal apodeme truncated anteriorly with expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from Venezuela (Fig. 85, locality 3).

Taxonomic discussion. The single available specimen was first examined in ethanol and was subsequently mounted on a microscope slide.

Derivation of specific epithet. This species is named in honor of Dr. H.K. Townes who not only collected the specimens but provided an excellent analysis of North American Chironomini (including Stenochironomus) in 1945.

Stenochironomus (Stenochironomus) discus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype Stenochironomus discus Borke~~pt~~, Yacambu Nat. Pk., Lara, Venezuela, 1200 m, 10-V-1981, H. Townes, malaise trap" (CNC).

Diagnosis. Male: T IX very broad, with dorsal patch of setae in markedly transverse arrangement.

Description. Male adult. Descriptive statistics: see Table 31.

Head: antennal hairs dark; palpus and labellum pale; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 3D, 9B): dorsal portion of medianepisternum, postanepisternum, mesepimeron and metepisternum, anterior coxa, ventral portion of katepisternum (dorsal edge of area of pigmentation darker), ventral portion of mid and hind coxae, lateral margin of lateral vitta, entire postnotum; acrostichal setae extending to around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: pigmentation moderately defined, distributed as follows (Fig. 22C): entire fore femur (except pale annulus situated 0.16 from apex), apical 0.06 of fore tibia, entire mid femur (except pale annulus situated 0.20 from apex), entire hind femur (except pale

annulus situated 0.28 from apex), basal 0.25 of hind tibia; all tarsomeres missing.

Wing: pigmentation restricted to m-cu, fork of Cu and along apical edge (Fig. 15H); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27C): anterolateral margin of T I, posterior 0.89 of T III, posterior and lateral margins of T IV, posterior margin of T V, entire T VI, anterior portion of T VII (poorly defined); genitalia brown, apex of gonostylus pale.

Genitalia (Fig. 34B): in lateral aspect basal 3/4 of dorsal edge of anal point nearly straight, apex abruptly bent ventrally (Fig. 41E), apex parallel-sided; lateral margin of base of anal point moderately produced, originating subapically, markedly anteriorly, on T IX; posterior edge of T IX rounded in dorsal aspect with ventral row of slender setae; T IX markedly broadened; dorsal path of setae in markedly transverse arrangement; posterolateral margin of T IX with markedly elongate spicules; appendage 1 markedly elongate, thick, of nearly constant diameter but with slight subapical expansion, with setae restricted to apical half; apex of appendage 2 straight with apical seta longer and basally thicker than, subapical seta (Fig. 45D); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme markedly truncated anteriorly with no expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from Venezuela (Fig. 85, locality 3).

Taxonomic distribution. The single available specimen was first examined in ethanol and was subsequently mounted on a microscope slide.

Derivation of specific epithet. The name discus (flat, circular plate) refers to the highly modified T IX of the male of this species.

Stenochironomus (Petalopholeus) nelumbus (Tokunaga and Kuroda)

Chironomus (Stenochironomus) nelumbus Tokunaga and Kuroda, 1935:4. Holotype, male adult, presumed lost, from Kyoto, Honshu, Japan, 11-IX-1935, M. Tokunaga; allotype, presumed lost, collection data as for holotype; 12 paratypes, 2 males, 2 female adults, 2 pupal exuviae, 3 fourth instar larvae on microscope slides, 1 pupa, 1 pupal exuviae and 1 larva left in alcohol, from Kitashirakawa, Kyoto Pref., Japan, 10-IX-1935, M. Tokunaga (ELKU).

Stenochironomus nelumbus: Tokunaga, 1956:1563, 1959:646, 1965:179.

Diagnosis. Male: wing with median band extending into cell CuA1 and apical band extending into cells R3 and CuA1; appendage 1 elongate. Female: wing as for male; fore tibia completely darkly pigmented. Pupa: horn of respiratory organ originating near base; T II with posterior row of hooklets restricted to medial area, continuous across middle; spur on S VIII with one elongate, large tooth and 1-2 smaller teeth. Fourth instar larva: dorsolateral stripes originating near base of dorsomedian stripe; ligula a single lobe.

Description. Male Adult. Descriptive statistics: see Table 32.

Head: apex of antenna with dark hairs; palpus dark brown.

Thorax: pigmentation present on the following areas: lateral vittae, postnotum; acrostichal setae extending over and ventral to

anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 3-4 rows.

Legs: dark pigmentation distributed as follows (Fig. 22D): apical 0.25 of fore femur, entire fore tibia, base and apex of fore first tarsomere, base of mid tibia, apical 0.25 of hind femur, and basal 0.50 and extreme apex of hind tibia.

Wing: medial band present, extending into cell CuA1; apical band extensive, including cells R3 and CuA1; area between C and M dark (Fig. 15I); halter pale.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 34C): in lateral aspect basal 2/3 of dorsal edge of anal point slightly concave, apex abruptly bent ventrally (Fig. 41F), apex parallel-sided in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX; posterior edge of T IX wedge-shaped with ventral row of stout setae; appendage 1 elongate, thick, of nearly constant diameter, with setae restricted to apical portion; apex of appendage 2 bent dorsally, swollen subapically, with apical seta shorter and basally thicker than subapical seta (as in Fig. 44J); gonostylus swollen subapically, apex tapering; gonocoxal apodeme rounded anteriorly, with slight expansion.

Female Adult. Descriptive statistics: see Table 80. Similar to

male except as follows:

Head: all flagellomeres pigmented.

Legs: as for male but all femora with additional subapical dark rings.

Genitalia: setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered posteromedially by weak ridge (perhaps appearing weak because of long storage in alcohol); ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped; spicules of ventrolateral lobe short, on small, raised dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S XI straight.

Pupa. Descriptive statistics: see Table 88.

Head capsule: dorsomedial projection short (as in Fig. 53A).

Thorax: horn of respiratory organ partially fused with anterior stalk near base, length of fused portion approximately equal to width of free portion (as in Fig. 54C), of moderate length and thickness; terminal filament shape uncertain.

Abdomen: pigmentation (of exuviae) not known; spicules present on the following: T II-VI, S II-VI (weakly produced), and anal lobe;

anterior spicules on T IV with single point; fine spicules (pedes spurii A) absent; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III moderately larger than posterior spicules (as in Fig. 56D); T II with posterior row of large hooklets restricted to medial area of tergite, continuous across middle (Fig. 57C); spur on S VIII with teeth with unknown coloration, with one elongate, large tooth and 1-2 elongate smaller teeth (similar to Fig. 62A); male genital lobe extending posteriorly past apex of swim paddle.

Larva. Descriptive statistics: see Table 115.

Head capsule (as in Fig. 65C): coloration unknown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating on dorsomedial section of postoccipital carina ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterior to seta submenti; posterior coronal pore canal long, arising subapically on dorsolateral section of postoccipital carina, directed anterolaterally.

Labrum: S I pinnate; S II pinnate; S III pinnate; labral lamella with numerous spicules, arising from cuticle in a continuous, undivided row (as in Fig. 67B); spicules of pecten epipharyngis simple, arrayed in row, extending laterally (as in Fig. 69C).

Mandible: pigmentation of posterior portion of adductor apodeme unknown.

Labiohypopharynx: ligula a single lobe, pigmentation uncertain; shagreen on lobes very fine, not extending posteriorly as far as lateral edge of base of lobe, truncate to somewhat circular; cleft absent, slight dorsal concavity present apically.

Fused maxilla and paralabial plate (as in Fig. 76D): apically truncate with lateral edge of maxilla markedly thickened, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: uncertain.

Anal papillae (as in Fig. 77L): one constriction at midlength, with basal and apical portions of approximately equal size.

Distribution and bionomics. S. nelumbus is known only from the type locality at Kyoto, Japan (Fig. 81, locality 4).

Larvae, which mine the live floating leaves of Nelumbo nucifera, are the only Stenochironomus species known to attack living plant tissues. Tokunaga and Kuroda (1935, 1936) provided further details of mining habitats, pupation and emergence. They noted that the pupa of S. nelumbus does not develop in a special pupal chamber as do all other Stenochironomus species.

Taxonomic discussion. I have examined the available paratypes which have been preserved in alcohol since their collection in 1935. They were so badly bleached that the description, compiled from that given by Tokunaga and Kuroda (1935), and Tokunaga (1956, 1959, 1965) and from the damaged paratypes, is of necessity incomplete. Tokunaga and Kuroda (1935) mentioned that some paratypes had been pinned but I have been unable to locate these. Yamamoto (pers. comm., ELKU) has informed me that the holotype is probably lost.

The larval description given here differs in some ways from that given by Tokunaga and Kuroda (1935). I could not discover the accessory antennal blade as originally illustrated (Fig. 13) and the dorsolateral stripe originates on the dorsomedial section of the postoccipital carina, not at the junction of the medial stripe and the dorsomedial section.

Tokunaga and Kuroda (1935) suggested that S. nelumbus was closely related to S. hilaris (as S. taeniapennis) but the results of this study show them to be only distantly related phylogenetically.

Material examined. Only the paratype material listed at the beginning of the description was examined.

Derivation of specific epithet. The name nelumbus refers to the peculiar larval habitat, the live leaves of Nelumbo nucifera.

Stenochironomus (Petalopholeus) fascipennis (Zetterstedt)

Chironomus fascipennis Zetterstedt, 1838:813. Lectotype, here designated, male adult, pinned, labelled "C. fascipennis Zett. male Joh. Ro Bottnia (sic)", "1981:771", label added "Lectotype of Stenochironomus fascipennis Zett. designated by A. Borkent, 1981" (ZMLS), 1850:3505 (adult). Schiner, 1864:599. Sladen et al., 1913:174.

Tendipes fascipennis: Wahlgren, 1922:84.

Chironomus (Stenochironomus) fascipennis: Edwards, 1929:395.

Stenochironomus fascipennis: Kieffer, 1924:31. Goetghebuer, 1937:12. Zabolotskii, 1939:143. Thienemann, 1954:103. Rodova, 1971:135. Pinder, 1978:140.

Endochironomus (Stenochironomus) fascipennis: Goetghebuer, 1928:35.

Diagnosis. Male: wing with median band extending into cell CuA1 and apical band extending into cells R3 and CuA1; appendage 1 squat. Female: wing as for male; fore tibia only partially darkly pigmented. Pupa: only Palaearctic species with horn of respiratory organ originating near base; T II with posterior row of hooklets restricted to median area but with median gap of missing hooklets; spurs on S VIII with one elongate, large tooth and 1-2 smaller teeth. Fourth instar larva: no diagnostic characters but see taxonomic discussion.

Description. Male Adult. Descriptive statistics: see Table 33.

Head: apex of antenna without, or with slightly darkened hairs but degree of darkening uncertain; palpus dark brown; labellum with dark markings; eye not metallic.

Thorax: pigmentation confined to the following areas (Fig. 3E, 9C): posterodorsal edge of mesepimeron; entire lateral vitta sometimes very light brown (otherwise unpigmented), posterior 0.8 of postnotum, markings very light, acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 3-4 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: pigmentation medium brown, poorly defined to discrete, ground color varying from completely pale to light brown, distributed as follows (Fig. 22E): apical 0.20-0.24 of fore femur, basal 0.29-0.34 and apical 0.08-0.17 of fore tibia, extreme apices of fore first to fourth tarsomeres, fore fifth tarsomere, apical 0.18-0.23 of mid femur, base of mid tibia (very weakly pigmented), mid fifth tarsomere, apical 0.17-0.20 of hind femur, basal 0.27-0.35 and apical 0.17-0.21 of hind tibia, and hind fifth tarsomere.

Wing: medial band present, extending into CuA1; apical band extensive, including cells R3 and CuA1; area between C and M lightly pigmented (Fig. 15J); halter pale.

Abdomen: pigmentation: genitalia brown; anal point dark.

Genitalia (Fig. 34D): in lateral aspect basal 2/3 of dorsal edge of anal point concave to straight, apex abruptly bent ventrally (Fig. 41G, H), apex bulbous from dorsal aspect; lateral margins of base of anal point weakly produced, originating subapically of T IX, nearly parallel to moderately diverging; posterior edge of T IX rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae in transverse arrangement; appendage 1 short, thick, tapering from base with setae distributed along entire length and on projections; apex of appendage 2 bent dorsally with apical seta shorter and basally thicker than subapical seta (Fig. 44J); gonostylus swollen at midlength, apex tapering; gonocoxal apodeme truncated anteriorly, with expansion.

Female Adult. Descriptive statistics: see Table 81. Similar to male except as follows:

Head: flagellomere six dark.

Legs: pigmentation from the single (available specimen), discrete, distributed as follows (mid tibia and tarsi not present): apical 0.22 of fore femur, basal 0.33 and apical 0.16 of fore tibia, apical 0.26 of mid femur, apical 0.23 of hind femur, and basal 0.46 and apical 0.30 of hind tibia.

Abdomen: lacking dark pigmentation.

Genitalia: setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, marked posteromedially by moderately produced ridge (as in Fig. 48A); ventrolateral lobes moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII broadly U-shaped (as in Fig. 48D); spicules of ventrolateral lobe of moderate length, on small, raised dorsoventral ridge; apodemes of S VIII straight, ending on dorsomesal lobe (as in Fig. 48D); posterior apodemes of S IX well developed, broad in dorsal aspect, slightly curved (as in Fig. 49C).

Pupa. Descriptive statistics: see Table 90.

Thorax: horn of respiratory organ originating near base (as in Fig. 54D), short, of moderate thickness; terminal filament shape uncertain.

Abdomen: no areas of discrete pigmentation noted in description by Zabolotskii (1939); spicules present on the following: T II-VI, S III, SIV, and anal lobe; anterior spicules on T II and T III markedly larger than posterior spicules (as in Fig. 56D); T II with posterior row of large hooklets restricted to medial area of tergite, divided medially into two groups (Fig. 57A); spurs on S VIII with teeth with unknown coloration, with one elongate, large tooth and 1-2 elongate smaller teeth (as in Fig. 62A); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobe extending posteriorly past

apex of swim.paddle.

Larva. Previously described by Zabolotskii (1939) but details not sufficient or inconsistent to suggest specific differences (see taxonomic discussion).

Distribution and bionomics. S. fascipennis is broadly distributed in northern Europe, from England, Sweden and Germany to Moscow, U.S.S.R. (Fig. 82D). Uncertainties in larval descriptions do not allow description of specific habitats in which immature stages may be located.

Taxonomic discussion. Rodova (1971) has previously described the female of S. fascipennis in some detail.

Because no pupal material was available for study, the above description of the pupa of S. fascipennis was extracted from that provided by Zabolotskii (1939).

However, it is possible that Zabolotskii incorrectly associated these immature stages with adults of S. fascipennis. Two factors indicate that this may be the case.

Firstly, Zabolotskii noted that immature stages were discovered under the bark of submerged older branches and in leaves of Carex gracilis. All Stenochironomus species which I have studied in the New World are either wood or leaf mining. If this distinction also holds true for Palaearctic species, it would seem that Zabolotskii was referring to the larvae of two species.

Secondly, in his figure of the pupa, Zabolotskii (1939:fig. 6)

shows the posterior row of hooklets on T-II as being restricted to the medial area. This character is otherwise a synapomorphy for the lineage of Stenochironomus species which are leaf miners. However, the shape of the paralabial plate of the larva (Zabolotskii, 1939:fig. 2) suggests to me that it is a wood miner, even though this condition is plesiomorphic within the genus. All leaf miners known to me have a modified paralabial plate.

There is a further enigma concerning Zabolotskii's description of the larva of S. fascipennis which makes the association suspect. His description is incomplete because he referred to the apparently more complete description by Zavrel (1933). Zavrel (fig. 2) provided a sketch of the paralabial plate of the larvae he studied and this is markedly different from that given by Zabolotskii. Zavrel's description was based on a mixed series of unreared larvae from Czechoslovakia and Ngebel Lake, Sunda Islands, Indonesia (see also Thienemann, 1954:103) (and therefore almost undoubtedly represented two species).

Zavrel's (1933) description clearly illustrates some of the synapomorphies of the leaf mining lineage of Stenochironomus species: larval head shape, paralabial plate shape and anal papillae shape. Indeed, he stated that the Czech specimens were collected from submerged, dead leaves. At any rate, Zavrel's Czech specimens represent an unidentified member of the leaf mining assemblage. Zabolotskii's (1939) description of the apparent larva of S. fascipennis suggests that it was a wood miner, and that his larvae were different from those of Zavrel. Therefore the immature stages of S. fascipennis cannot now be characterized with any certainty.

I assume that Zabolotskii, in referring to Zavrel's description, at least recognized that his larvae also had constricted anal papillae. This would probably preclude the possibility that Zabolotskii actually described the larva of S. gibbus which has simple, unstricted anal papillae.

I have attempted to locate the specimens examined by Zavrel but Dr. B. Losos (Faculty of Science, J.E. Purkyne University, 611 37 Brno, Kotlarska 2, Czechoslovakia) has informed me that the specimens are not in what is left of Zavrel's collection.

Material examined. I examined 11 male and 3 female adults, some originally pinned, others in alcohol, all now mounted on microscope slides. These were from Newmarket, England; Tweensee, West Germany; Lake Innaren and Lake Helgasjon, Sweden and Moscow, U.S.S.R.

Derivation of specific epithet. The name fascipennis refers to the banded (fascia) wings (pinna).

Stenochironomus (Petalopholeus) larval form one.

Larva. Descriptive statistics: see Table 116.

Head capsule (as in Fig. 65C): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating at base of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterolateral to seta submenti; posterior coronal pore canal very short, arising subapically on dorsolateral section of postoccipital carina.

Labrum: S I pinnate; S II pinnate; S III uncertain; S I and labpal lamella on transversely broadened plate (as in Fig. 70B); labral lamella with 4 spicules, elongate, arising from cuticle but basally fused, divided into two groups (as in Fig. 69B); spicules of pecten epipharyngis simple, arrayed in rows extending laterally (as in Fig. 69C).

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx: coloration of ligular lobes uncertain; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76D): apically truncate with lateral edge of maxilla slightly thickened, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with one filament and associated seta of about equal length.

Anal papillae (as in Fig. 77L): one constriction at midlength, with basal and apical portions of approximately equal size.

Distribution and bionomics. The single fourth instar larva was collected from the Rio Bella, near Tingo Maria, Peru (Fig. 85, locality 10) on 4-X-1955. Head capsule shape, position of the dorsolateral stripes, the subapical placement of the posterior coronal canals on the posterolateral section of the postoccipital carina are synapomorphies of leaf mining Stenochironomus larvae. Phylogenetic placement, therefore, and the presence of leaf particles in the larval gut indicate this form to be a leaf miner.

Taxonomic discussion. Roback (1966:333) has provided a brief description of this larva (as Stenochironomus sp. 2). In his illustration the antennal blade is extremely elongate (Roback 1966: Fig. 221) but my observation suggests it to be of comparable length to that of other species of Stenochironomus (as in Fig. 71D), extending just beyond segment two.

Material examined. The one fourth instar larva examined is housed in the ANSP.

Stenochironomus (Petalopholeus) pupal form one.

Diagnosis. Pupa: wing sheath with tubercle near base of anterior margin; apex of swim paddle with spicules.

Pupa. Descriptive statistics: see Table 88.

Head capsule: dorsomedial projection markedly elongate (as in Fig. 53C).

Thorax: respiratory organ missing; wing sheath with tubercle on anterior margin, situated 0.14 of total length from wing base.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VIII, S I-IV (weakly produced), S V-VI, anal lobe, and apex of swim paddle; spicules present on T VII and T VIII restricted to anterolateral area of tergite (as in Fig. 58C); some anterior spicules on T IV with two or more points; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (as in Fig. 57C); T II with posterior row of medium sized hooklets restricted to medial area of tergite, divided medially into two groups (as in Fig. 57A); spur on S VIII with teeth yellowish brown, with one extremely elongate lateral tooth, an elongate penultimate tooth about $1/3$ the length of

the most lateral tooth, and four elongate smaller medial teeth; from a dorsal aspect, teeth arranged in a slightly curved row; male genital lobe at most just reaching level of apex of swim paddle.

Distribution. This specimen came from northern Brazil (Fig. 85, locality 14).

Taxonomic discussion. The presence of a tubercle on the wing sheath of the pupa of S. bacrionis and pupal form one are unique for the Stenochironomus complex and are not described elsewhere. Similarly, the presence of spicules on the swim paddle occur in no members of the Stenochironomus complex other than pupal form one.

A male genitalia was associated with the pupal exuviae described here. I could not distinguish between it and the genitalia of S. bacrionis. Nevertheless, the differences between the pupae of these two (coloration, spicules on swim paddle) suggest lack of conspecificity.

Material examined. The single pupal exuviae and associated male genitalia were labelled "Amazonien, Raum Manaus, Rio Cuieiras, 50 km oberhalb der Mündung, 15.12.1960, Leg. E.J. Fittkau".

Stenochironomus (Petalopholeus) bacrionis n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, reared from larva, labelled "Holotype Stenochironomus bacrionis Borkent, 5 km N. Tena, Ecuador, 13-II-1982, A. Borkent and D.M. Wood" (CNC); paratypes, 1 male adult with associated pupal exuviae, each on separate microscope slides labelled as for holotype (CNC), 1 male adult, on a microscope slide, labelled "Paratype Stenochironomus bacrionis Borkent", "A371-1 U655", "Amazonien [Brazil], Rio Paru, Igarapé Okueima, 18.IV.1962, leg. E.J. Fittkau" (INPA).

Diagnosis. Male: dorsum of anal point with marked lateral expansion in dorsal aspect, bulbosus at apex. Pupa: most lateral tooth of spur of S VIII markedly elongate; swim paddle with no apical spicules. Fourth instar larva: paralabial plate with concavity near hypostoma.

Description. Male adult. Descriptive statistics: see Table 34.

Head: antenna with some darkened hairs ventrally and subapical portion dorsally; palpus pale; labellum pale; eye markedly shiny, metallic green when in alcohol.

Thorax: light brown pigmentation confined to the following areas (Fig. 3F, 9D): posterodorsal edge of mesepimeron, stripe across katepisternum, subdorsal marking across mid and hind coxa dorsal portion of fore coxa; acrostichal setae extending to or nearly to

anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum somewhat angular in lateral aspect (as in Fig. 13C).

Legs: light to medium brown pigmentation moderately to poorly defined, distributed as follows (Fig. 22F): apical 0.09-0.12 of fore femur (except for patch of darkened setae in midregion, resulting in a pale subapical annulus), basal 0.16-0.23 and apical 0.06-0.07 of fore tibia, very apex of tarsomeres one and two, basal 0.11-0.15 and apical 0.17-0.22 of mid femur, basal 0.14-0.16 of mid tibia, basal 0.12-0.13 and apical 0.14-0.19 of hind femur, basal 0.23-0.37 of hind tibia.

Wing: medial band present, but very light between C and R and discontinuous between M and Cu, light pigmentation anterior of arculus, very apex of wing (as in Fig. 16A); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27D): posterior 0.13-0.19 of T II, posterior 0.10-0.18 of T III, posterior 0.09-0.11 of T IV, posterolateral corners of T VIII; genitalia brown.

Genitalia (similar to Fig. 35A, but anal point bulbous apically): in lateral aspect basal 2/3 of anal point very high and dorsal edge thickened convex (Fig. 41I), dorsum of anal point with marked lateral expansion in dorsal aspect, bulbous apically; lateral margins of base of anal point strongly produced, originating subapically on T IX, moderately diverging; posterior edge of T IX wedge shaped in dorsal

aspect with ventral row of stout setae; dorsal patch of setae in markedly longitudinal arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter and basally more thick than subapical seta (as in Fig. 44L); gonostylus swollen subapically, apex tapering; gonocoxal apodeme rounded anteriorly, without expansion.

Female adult. Unknown.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection markedly elongate (as in Fig. 53C).

Thorax: horn of respiratory organ arising directly from base, of moderate length and thickness (similar to Fig. 54C); terminal filaments of respiratory organ stout, $>4 \mu$ in diameter, with a few short tubercles scattered along length; wing sheath with tubercle or slight swelling on anterior margin, situated about 0.08 of total length from wing base.

Abdomen: pigmentation (of exuviae) pale brown with patches of darker pigmentation; T II and S IV extensively pigmented; spicules present on the following T II-VIII, S I-VIII (weakly produced, except for posterior edge of S VI where they are stouter), anal lobe; spicules present on T VII and T VIII restricted to anterolateral area of

tergite (as in Fig. 58C, D); some anterior spicules on T IV with two or more points (as in Fig. 57D); fine spicules (pedes spurii A) present on posterolateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches; anterior spicules on T II and T III equal in size to posterior spicules (as in Fig. 57C); T II with posterior row of medium sized hooklets restricted to medial area of tergite, with median gap of about six hooklets (as in Fig. 57A); spur on S VIII with teeth yellowish brown, with one extremely elongate tooth, an elongate penultimate tooth about 1/2 the length of the most lateral tooth, and 2-3 elongate smaller medial teeth (fig. 62C); from a dorsal aspect, teeth arranged in a nearly straight row; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially with larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 117.

Head capsule (as in Fig. 65C): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating at base of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection of pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterior to seta

submenti; posterior coronal pore canal long, arising subapically on dorsolateral section of postoccipital carina, directed anteromedially.

Labrum: S I simple; S II simple; S III simple; S I and labral lamella on transversely, markedly broadened plate (as in Fig. 70A); labral lamella with 2 deltoid spicules; spicules of pecten epipharyngis peg-like, arranged on sclerotized bar (as in Fig. 70A, B).

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (as in Fig. 74B): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe somewhat truncated; cleft between lobes very narrow, nearly parallel-sided.

Fused maxilla and paralabial plate (as in Fig. 76D): apically truncate with lateral edge of maxilla markedly thickened, projecting anteriorly to level of hypostomal teeth; paralabial plate with concavity near hypostoma (as in Fig. 75A).

Procercus: with several filaments and small associated data.

Anal papillae: shape unknown.

Distribution and bionomies. This species is known from northern Brazil and eastern Ecuador (Fig. 85, localities 8, 16).

I collected the larvae of the species mining leaves in a large, clear water stream 5 km N. Tena, Ecuador.

Taxonomic discussion. The paratype of S. bacrionis from Rio Paru, was examined only as a microscope slide preparation. However, the specimen had not been cleared so that description of coloration is probably accurate.

It is possible that the paratype from Rio Paru is incorrectly associated with the specimen from near Tena, Ecuador. As noted under S. pupal form one, S. bacrionis has a similar genitalia to that of S. pupal form one. The specimen from Rio Paru was not reared so I cannot be certain that its pupa would be the same as those of the specimens from near Tena. It should be noted, however, that other, non-genitalic, differences may exist between the Rio Paru specimen and the adult of S. pupal form one.

As noted under the "taxonomic discussion" of S. pupal form one, the description of the tubercle on the pupal wing sheath is given only for this species and S. pupal form one, the only species within the Stenochironomus complex to exhibit such a feature.

S. bacrionis is the only Stenochironomus species which exhibits a concavity in the paralabial plate near the hypostoma and this character is described only for this species.

Derivation of specific epithet. The name bacrionis (ladle) refers to the spoon-shaped, apically bulbous, anal point.

Stenochironomus (Petalopholeus) pectinatus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype Stenochironomus pectinus Borkent", "A151 B79", "Amazonien. [Brazil], Raum Manaus, Rio Cuieiras, Igarape Cachoeira beim Wasserfall Pedra dos Indios, 15.IV.1961, leg. E.J. Fittkau"; paratypes on microscope slides: 4 males, labelled as for holotype, 5 males from Igarape da Cachoeira, Rio Cuieiras, Raum Manaus, Brazil, 18-IV-1961, 1 male from the previous locality collected 13-XII-1960; 1 male from Missao Cururu, Rio Cururu, Brazil, 14.I.1961; 1 male from Mission Tiriyo, Rio Paru, Brazil, 31.IV.1962; 1 male from Rio Paru, Brazil, 7.IV.1962 (INPA).

Diagnosis. Male: pigmentation present on thorax, wing and only posterior margin of some abdominal tergites; dorsum of anal point with marked lateral expansion in dorsal aspect; appendage 1 extending posteriorly past apex of gonocoxite, of nearly constant diameter.

Description. Male adult. Descriptive statistics: see Table 35.

Head: antennal hairs light brown; palpus light brown; eye iridescence unknown.

Thorax: pigmentation confined to the following areas (Fig. 3G, 9E): posterodorsal edge of mesepimeron, in some specimens dorsal portion of medioanepisternum, in some specimens faint stripe across katepisternum, subdorsal mark across hind coxa, posterodorsal portion

of postnotum; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum somewhat angular to angular in lateral aspect (Fig. 13C).

Legs: light brown pigmentation very poorly defined, distributed as follows (Fig. 23A): apical 0.48-0.64 of fore femur, basal 0.27-0.41 and apical 0.07-0.14 of fore tibia, all of fore tarsomeres, ~~on~~ some specimens very apex of hind femur, basal 0.27-0.33 of hind tibia.

Wing: medial band present but light between C and R and between M and Cu, light pigmentation anterior of arculus, very apex of wing (Fig. 16A); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27E): posterior 0.17-0.18 of T I, divided medially (absent in specimens from Rio Paru), posterior 0.17-0.33 of T II, posterior 0.10-0.24 of T III, posterior 0.09-0.13 of T IV, posterior 0.00-0.10 of T V; genitalia brown.

Genitalia (Fig. 35A): in lateral aspect basal 2/3 of dorsal edge of anal point convex and markedly thickened (Fig. 41J), dorsum of anal point with marked lateral expansion in dorsal aspect, somewhat swollen subapically; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX wedge-shaped to somewhat rounded, with ventral row of stout setae; dorsal patch of setae in elongate arrangement;

appendage 1 markedly elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 somewhat bent dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44K); gonostylus swollen subapically, apex tapering; gonocoxal apodeme truncated to rounded anteriorly, without or slight expansion.

Female adult, pupa and larva. Unknown,

Distribution. This species is known from northern Brazil (Fig. 85, localities 12,14,17).

Taxonomic discussion. The available specimens were examined only as microscope slide preparations. Some of these had been cleared, so that I cannot be certain that the description of pigmentation provided here applies to all specimens.

The two specimens from Rio Paru differed in their pattern of pigmentation from each other and from the other specimens. Both specimens lacked dark pigmentation on the posterior margin of T 1. The male collected 31-IV-1962 was particularly pale (but this may be due to preservation) while the male collected 7-IV-1962 was more darkly marked. Otherwise all the material considered seemed homogeneous. However, these pigmentation differences may indicate that more than one species is involved.

Derivation of specific epithet. The name pectinatus (comblike) refers to the setose, elongate appendage 1 exhibited by males of this

species.

Stenochironomus (Petalopholeus) gladius n. sp.

Type information: Holotype, male adult with associated pupal and larval exuviae, each on separate microscope slides, labelled "Holotype *Stenochironomus gladius* Borkent, Pto. Viejo-La Selva, Heredia, Costa Rica, 20-II-1980, D.M. Wood"; paratypes 4 males, 3 pupal exuviae, 2 larval exuviae, labelled as for holotype (CNC).

Diagnosis. Male: dorsum of anal point with marked lateral expansion in dorsal aspect, convex in lateral aspect; appendage 1 extending posteriorly past apex of gonocoxite, tapering from base. Pupa: head capsule with elongate dorsomedial prong; T II with posterior row of medium-sized hooklets restricted to median area of tergite, divided medially into two groups; spur on S VIII with 2-4 elongate longer teeth and 0-3 elongate smaller teeth. Fourth instar larva: dorsolateral stripes originating at base of dorsomedian stripes; labral lamella with 5-7 squat spicules, some basally fused and divided into 4-5 groups.

Description. Male adult. Descriptive statistics: see Table 36.

Head: apical 0.41-0.60 of dorsum and all of ventral surface of antenna with dark hairs, except for very apex which has pale hairs; palpus with very apex of palpal segment five light brown; eye markedly shiny metallic green when alive and in alcohol.

Thorax: light pigmentation confined to the following areas (Fig. 3H,

9F); dorsal portion of medioanepisternum, posterodorsal edge of mesepimeron, ventral portion of katepisternum (dorsal edge of area of pigmentation darker), subdorsal markings on mid and hind coxae, slight darkening on anterolateral margin of lateral vitta, two patches on anterolateral margins of postnotum; acrostichal setae extending to, to around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (as in Fig. 13C).

Legs: dark pigmentation well defined, distributed as follows (Fig. 23B): apical 0.08-0.09 of fore femur, basal 0.14-0.16 and apical 0.08-0.11 of fore tibia, fore tarsomeres a pale brown, in some specimens, very base of mid and hind femur darkened; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present, but discontinuous between C and R and between M and Cu, light pigmentation anterior of arculus, very apex of wing (as in Fig. 16A); halter pale.

Abdomen: pigmentation discrete, distributed as follows (as in Fig. 27I): posterior 0.15-0.19 of T II, posterior 0.11-0.12 of T III, posterior 0.08-0.10 of T IV, in some specimens very apex of T V somewhat darkened; genitalia brown.

Genitalia (Fig. 35B): in lateral aspect basal 2/3 of dorsal edge of anal point convex and markedly thickened (Fig. 41K), dorsum of anal point with marked lateral expansion in dorsal aspect, somewhat

swollen subapically; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX slightly rounded to truncated, with ventral row of stout setae; dorsal patch of setae in elongate arrangement; appendage 1 markedly elongate, thick, tapering from base, with setae distributed along entire length; apex of appendage 2 somewhat bent dorsally with apical seta shorter, and basally thicker than subapical seta (Fig. 44K); gonostylus swollen subapically, apex tapering; gonocoxal apodeme truncated anteriorly, with or without expansion.

Female adult. Unknown.

Pupa. Descriptive statistics: see Table 88.

Head capsule: dorsomedial projection markedly elongate (Fig. 53C).

Thorax: horn of respiratory organ originating near base (as in Fig. 54C), length and shape uncertain.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VI, T VII-VIII (weakly produced), S I-IV (weakly produced), S V-VI, and anal lobe; spicules present on T VIII restricted to anterolateral area of tergite (as in Fig. 58C); anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to

make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (as in Fig. 57C); T II with posterior row of medium-sized hooklets restricted to median area of tergite, divided medially into two groups (Fig. 57A); spur on S VIII with teeth yellowish brown, with 2-4 elongate larger teeth and 0-3 elongate smaller teeth (Fig. 62B); from ~~the~~ dorsal aspect, teeth arranged in an evenly curved row, some specimens with additional ventral teeth; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 118.

Head capsule (as in Fig. 65C): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating at base of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterior to seta submenti or absent; posterior coronal pore canal long, arising subapically on dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (Fig. 70A): S I pinnate; S II simple; S III simple; S I and labral lamella on transversely markedly broadened plate; labral

lamella with 5-7 spicules, squat, arising from cuticle but basally fused, divided into four or five groups; spicules of pecten epipharyngis peg-like, arranged on sclerotized bar.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 74B): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76D): apically truncate with lateral edge of maxilla markedly thickened, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae: shape unknown.

Distribution and bionomics. *S. gladius* is known only from Costa Rica (Fig. 85, locality 17). Adults were reared from larvae which had been mining leaves in a slow moving, clear water stream.

Derivation of specific epithet. The name *gladius* (broadsword) refers to the broad anal point of the male adult.

Stenochironomus (Petalopholeus) fittkaui n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus fittkaui* Borkent", "A371-1 U654", "Amazonien [Brazil], Rio Paru, Igarape Okueima, 18.IV.1962, leg. E.J. Fittkau"; paratypes 3 males labelled as for holotype, 1 male from Brazil, Rio Cururu, Missao Cururu, 14.I.1961, leg E.J. Fittkau (INPA).

Diagnosis. Male: dark pigmentation on postnotum, base of mid and hind femora, and restricted to posterior margin of T II, III and IV of abdomen; dorsum of anal point with marked lateral expansion in dorsal aspect.

Description. Male adult. Descriptive statistics: see Table 37.

Head: apical 0.45-0.46 of dorsum and all of ventral surface of antenna with dark hairs; palpus with very tip of palpal segment five light brown; eye iridescence unknown.

Thorax: pigmentation confined to the following areas (Figs. 3I, 10A): posterodorsal edge of mesepimeron, stripe across katepisternum, subdorsal mark across hind coxa, lateral margin of lateral vitta (in some specimens this pigmentation is discontinuous), posterior portion of postnotum, extending to, or nearly to lateral margin; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum somewhat

angular in lateral aspect (as in Fig. 13C).

Legs: pigmentation poorly to moderately defined, distributed as follows (Fig. 23C): apical 0.09-0.14 of fore femur with very light brown annulus in midregion, basal 0.26-0.33 and apical 0.12-0.14 of fore tibia, all of fore tarsomeres light brown, about basal 0.30 and apical 0.15 of mid femur with poorly defined light brown pigmentation, dark annulus extending from about 0.10-0.20 from base of mid tibia, about basal 0.20 and apical 0.20 of hind femur with poorly defined light brown pigmentation, dark annulus extending from about 0.10-0.25 from base of hind tibia.

Wing: medial band present, but very light between C and R and discontinuous between M and Cu, light pigmentation anterior of arcus, very apex of wing (as in Fig. 16A); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27F): posterior 0.16-0.25 of T II, posterior 0.21-0.24 of T III, posterior 0.10-0.13 of T III (completely pale in one specimen), posterior 0.00-0.11 of T IV; genitalia brown.

Genitalia (similar to Fig. 35D but gonostylus as in Fig. 35B): in lateral aspect basal 2/3 of dorsal edge of anal point convex, bent ventrally about 1/3 from base and markedly thickened (Fig. 41L), dorsum of anal point with marked lateral expansion in dorsal aspect, swollen subapically; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging;

posterior edge of T IX wedge-shaped to somewhat rounded, with ventral row of stout setae; dorsal patch of setae in elongate arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 somewhat bent dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44K); gonostylus swollen subapically, apex tapering; gonocoxal apodeme pointed to truncated anteriorly, with expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from northern Brazil (Fig. 85, localities 12, 16).

Taxonomic discussion. The available specimens were examined only as microscope slide preparations. These had not been cleaned, so that description of coloration is probably accurate.

Derivation of specific epithet. The name fittkaui is proposed in honor of Dr. E.J. Fittkau who collected all the specimens of this and many other species of Stenochironomus from South America.

Stenochironomus (Petalopholeus) prolatus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype Stenochironomus prolatus Borkent", "A429 H424", "Amazonien [Brazil], Raum "Manaus", Rio Cuieiras, Igarape Cachoeira, Cachoeira da Taira, 27.XI.1962, leg. E.J. Fittkau" (INPA).

Diagnosis. Male: markedly elongate thorax; dorsal setal patch on T IX on elongate projection.

Description. Male adult. Descriptive statistics: see Table 38.

Head: antennal hairs light brown; palpus light brown; labellum pale; eye iridescence unknown.

Thorax: lacking dark pigmentation; markedly elongate (Fig. 13A); acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 1 row; anterior edge of scutum rounded in lateral aspect (as in Fig. 13A).

Legs: very light brown pigmentation poorly defined on base and apex of fore tibia.

Wing: entire membrane light brown (as in Fig. 14C); halter pale.

Abdomen: lacking dark pigmentation (but see taxonomic discussion).

Genitalia (Fig. 35C): in lateral aspect basal 2/3 of anal point very high and dorsal edge thickened, convex (Fig. 41M), dorsum of anal point with marked lateral expansion in dorsal aspect, bulbous apically; lateral margins of base of anal point strongly produced, originating subapically on T IX, nearly parallel; posterior edge of T IX pointed and narrow in dorsal aspect with ventral row of slightly thickened setae; dorsal patch of setae with markedly elongate arrangement, posterior setae of patch on posteriorly projecting lobe (Fig. 41M); appendage 1 markedly elongate, thick, tapering from near base, setae distributed along entire length, with subapical constriction; apex of appendage 2 somewhat bent dorsally with apical seta shorter and basally thicker than subapical seta (as in Fig. 44K); gonostylus swollen subapically, apex tapering; gonocoxal apodeme truncated anteriorly, with expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from northern Brazil (Fig. 85, locality 14).

Taxonomic discussion. The single available specimen was examined only as a microscope slide preparation. Only the abdomen had been cleaned, so that description of pigmentation of most of the specimen is accurate. However, I cannot be certain that the abdomen was actually completely pale.

Derivation of specific epithet. The name prolatus (elongated) refers to the elongated thorax of the male of this species.

Stenochironomus (Petalopholeus) vatus n. sp.

Type information: Holotype, male adult with associated pupal exuviae, on microscope slide, labelled "Holotype Stenochironomus vatus Borkent", "Taruma, Manaus, Brazil, XII-1971, leg. Irmiler"; 2 paratypes, male adults, labelled as for holotype (INPA).

Diagnosis. Male: dorsum of anal point with marked lateral expansion in dorsal aspect; gonostylus curved medially. Pupa: head capsule with elongate dorsomedial prong; T II with posterior row of medium-sized hooklets restricted to medial area of tergite, divided medially into two groups, spur on S VIII with one elongate tooth and one elongate smaller tooth.

Description. Male adult. Descriptive statistics: see Table 39.

Head: lacking dark pigmentation except palpus medium brown; eye iridescence unknown.

Thorax: lacking dark pigmentation; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (as in Fig. 13C).

Legs: lacking dark pigmentation.

Wing: lacking dark pigmentation; halter pale.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 35D): in lateral aspect basal $2/3$ of dorsal edge of anal point convex, bent ventrally about $1/3$ from base and markedly thickened (Fig. 41N), dorsum of anal point with marked lateral expansion in dorsal aspect, tapering apically; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging, originating subapically on T IX, moderately diverging; posterior edge of TIX slightly rounded to truncated, with ventral row of stout setae; dorsal patch of setae in elongate arrangement; appendage 1 elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 somewhat bent dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44K); gonostylus markedly curved medially, swollen subapically, apex tapering; gonocoxal apodeme rounded to truncated anteriorly, with expansion.

Female adult. Unknown.

Larva. Unknown.

Pupa. Descriptive statistics: see Table 88.

Head capsule: dorsomedial projection markedly elongate (as in Fig. 53C).

Thorax: respiratory organ damaged, of uncertain shape.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VIII, S II-IV (weakly produced), S V-VI anal lobe; (spicules present on T VII and T VIII restricted to anterolateral area of tergite as in Fig. 58C); anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (Fig. 57C); T II with posterior row of medium sized hooklets restricted to medial area of tergite, divided medially into two groups (as in Fig. 57A); spur on S VIII with teeth yellowish brown, with one elongate tooth and one elongate smaller tooth; male genital lobes extended to level of apex of swim paddle, but because of distortion of specimen, they may actually be relatively longer.

Distribution. This species is known from northern Brazil (Fig. 85, locality 14).

Taxonomic discussion. The available specimens were examined only as microscope slide preparations. The male adults had not been cleared and considering that these were collected relatively recently, the lack of pigmentation is probably not an artifact of preservation or preparation.

5

, Derivation of specific epithet. The name vatus (bowlegged) refers to the medially curved gonostylus.

Stenochironomus (Petalopholeus) albidorsalis n. sp.

Type information: Holotype, male adult with associated pupal exuviae, on a microscope slide, labelled "Holotype *Stenochironomus albidorsalis*, Borkent, Taruma, Brazil, Feb., 1972, Coll. U. Irmler, reared" (INPA).

Diagnosis. Male: mid and hind legs pale; dorsum of anal point with marked lateral expansion in dorsal aspect, markedly bent ventrally in lateral aspect; appendage 1 not extending past apex of gonocoxite. Pupa: head capsule with elongate dorsomedial prong; no spicules on anterolateral portion of T VII; spur with one elongate tooth of 4-5 elongate, smaller teeth.

Description. Male adult. Descriptive statistics: see Table 40.

Head: lacking dark pigmentation except that some apical antennal hairs a very light brown; eye iridescence unknown.

Thorax: lacking dark pigmentation (but see Fig. 10B); acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (as in Fig. 13C).

Legs: light brown pigmentation poorly defined, distributed as follows (Fig. 23D): apical 0.08 of fore femur, basal 0.21 and apical 0.15 of fore tibia.

Wing: faint medial band present, not including area between Cu and R (Fig. 16B); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27G): posterior 0.06 of T II, posterior 0.08 of T III, 0.06 of T IV; genitalia pale.

Genitalia (similar to Fig. 35D, except for anal point bulbosus apically, somewhat damaged by shrivelling); in lateral aspect basal $2/3$ of anal point very high and dorsal edge markedly thickened, markedly bent ventrally at midlength, apex straight (Fig. 42A), dorsum of anal point with marked lateral expansion in dorsal aspect; bulbous apically; lateral margins of base of anal point weakly produced, originating subapically on T IX, nearly parallel; posterior edge of T IX distorted, with ventral row of stout setae; dorsal patch of setae in elongate arrangement; appendage 1 elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 somewhat bent dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44K); gonostylus shape not discernable; gonocoxal apodeme pointed anteriorly, with slight expansion.

Female adult. Unknown.

Pupa. Descriptive statistics: see Table 88.

Head capsule: dorsomedial projection markedly elongate (as in Fig. 53C).

Thorax: respiratory organ damaged, of uncertain shape.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T I-VI, T VIII (weakly produced), S I-IV (weakly produced), S V-VI, anal lobe; spicules present on T VIII restricted to anterolateral area of tergite (as in Fig. 58C); anterior spicules on T IV with single point; fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (as in Fig. 57C); T II with posterior row of medium sized hooklets restricted to medial area of tergite, divided medially into two groups (as in Fig. 57A); spur on S VIII with teeth yellowish brown, with one elongate tooth and 4-5 elongate smaller teeth (similar to Fig. 62B); from a dorsal aspect, teeth arranged in an evenly curved row, with additional small ventral tooth; male genital lobe distorted.

Larva. Unknown.

Distribution. This species is known from northern Brazil (Fig. 85, locality 14).

Taxonomic distribution. The single available specimen was examined only as a microscope slide preparation. The specimen had not, however, been cleared so that description of pigmentation is probably accurate.

Derivation of specific epithet. The name albidorsalis refers to the apparently unpigmented thorax.

Stenochironomus (Petalopholeus) triannulatus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus triannulatus* Borkent", "Lago Cabaliana, Brazil, 16-VI-1971, Leg. F. Reiss"; 2 paratypes, 1 male adult from Rio Cururu, Missao Cururu, Brazil, 20-I-1966, 1 male adult from Rio Cururu by Casa Lucio, 25-I-1961 (INPA).

Diagnosis. Male adult: stripe present across katepisternum; T II-IV pigmentation along lateral and posterior margins of T II-IV.

Description. Male adult. Descriptive statistics: see Table 41.

Head: antennal hairs missing; palpus and labellum pale; eye markedly shiny metallic when in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 3J, 10C): dorsal portion of medioanepisternum, ventral portion of katepisternum (dorsal edge of pigmentation darker), subdorsal markings on mid and hind coxae, fore coxa light brown, anterolateral margin of lateral vitta, posterior portion of postnotum (with central area of patch of pigmentation somewhat lightened); acrostichal setae extending to, to around and under anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: dark pigmentation well defined, distributed as follows (Fig. .

23E): three dark areas on fore femur: basal annuli extending 0.11-0.13 of total femur length, annuli at midlength extending 0.11-0.13 of total femur length and apical 0.15-0.21 of fore femur, basal 0.33-0.35 and apical 0.48-0.54 of fore tibia, basal 0.17-0.20 (except for very base) and apical 0.29-0.31 of mid femur, basal 0.21-0.26 (except for very base) and apical 0.49-0.53 (light brown) of mid tibia, basal 0.15-0.17 (except for very base) and apical 0.20-0.21 of hind femur, basal 0.36-0.38 and apical 0.44-0.46 of hind tibia.

Wing: medial band present, with area of r-m, fork of Cu and where R213 joins costa darker, light pigmentation anterior of arcus (Fig. 16C); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27H): very lateral and posterior margins of T II-IV, posterior margin of T VI; genitalia brown, gonostylus pale.

Genitalia (Fig. 36A): in lateral aspect basal 2/3 very high and dorsal edge of anal point convex and thickened (Fig. 42B), dorsum of anal point with slight lateral expansion in dorsal aspect, apically bulbous; lateral margins of base anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX rounded, with ventral row of stout setae; dorsal patch of setae in markedly elongate arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter but tapering subapically, with setae distributed along entire length; apex of

appendage 2 bent dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44K); gonostylus swollen subapically, apex tapering; gonocoxal apodeme truncated anteriorly, with slight expansion.

Female adult, pupa, and larva. Unknown.

Distribution. This species is known only from northern Brazil (Fig. 85, localities, 12, 13).

Taxonomic discussion. The holotype was examined only as a microscope slide preparation while the paratypes were initially studied in fluid.

Derivation of specific epithet. The name triannulatus (three ringed) refers to the three dark bands on the fore femur of adults of this species.

Stenochironomus (Petalopholeus) quadrinotatus n. sp.

Type information: Holotype, male adult on microscope slide, labelled "Holotype *Stenochironomus quadrinotatus*, Borkent, Pto. Viejo. La Selva, Heredia, Costa Rica, 20-IX-1980, D.M. Wood"; allotype, on microscope slide, labelled as for holotype; paratypes, 34 males, 3 females, 5 pupae, 42 pupal exuviae, 40 larval exuviae, labelled as for holotype (CNC).

Diagnosis. Male: lateral vitta with two patches of dark pigmentation, one placed anterior of the other; fore femur and tibia with setae not longer than those on mid and hind legs. Female: as for male. Pupa: T II entirely medium brown; T II with posterior row of hooklets large. Fourth instar larva: only Neotropical species with base of dorsolateral stripe originating at base of dorsomedian stripe, anterior width/width of head capsule = 0.52-0.65, length = 427-533 μ ; spicules of pecten epipharyngis peg-like, arranged on sclerotized bar; lateral edge of maxilla markedly thickened; procercus composed of several filaments.

Description. Male adult. Descriptive statistics: see Table 42.

Head: antennal hairs light brown; palpus and labellum pale; eye markedly shiny metallic when alive and in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 3K, 10D): posterodorsal edge of epimeron, ventral portion of katepisternum with

dorsal edge of area of pigmentation darker, dorsal markings on mid and hind coxae, lateral vitta with two dark patches, one anterior of other; in some specimens postnotum with two dorsal patches; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (as in Fig. 13C).

Legs: dark pigmentation moderately to poorly defined, distributed as follows (Fig. 23F): apical 0.10-0.14 of fore femur and some darkened setae at midlength, basal 0.17-1.24 and apical 0.04-0.11 of fore tibia; very apex of hind femur and entire hind tibia light brown; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present but light between C and R and between M and Cu, light pigmentation anterior arculus, very apex of wing (as in Fig. 16A); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 27I): posterior 0.12-0.18 of T II, posterior 0.13-0.21 of T III, posterior 0.05-0.14 of T IV, posterior 0.03-0.06 of T V; genitalia brown.

Genitalia (Fig. 36B): in lateral aspect basal 2/3 of dorsal edge of anal point slightly convex, apex evenly curved ventrally (Fig. 42C, D), apex slightly bulbous in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX slightly rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae

in longitudinal arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 slightly curved dorsally with apical seta shorter, and basally thicker than subapical seta (Fig. 44L); gonostylus swollen subapically, apex tapering; gonocoxal apodeme rounded anteriorly to slightly truncated, with or without moderate expansion.

Female adult. Descriptive statistics: see Table 82. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: pigmented as male except some specimens with dorsal patch of dark pigmentation on postnotum.

Legs: dark pigmentation moderately defined, distributed as follows: apical 0.10-0.11, basal 0.24 and apical 0.10 of fore tibia.

Wing: as for male except entire wing membrane a pale smokey brown.

Abdomen: pigmentation discrete, distributed as follows: posterior margins of T II, T III.

Genitalia (Fig. 50A): setal patch on S VIII extending posteriorly past level of cleft around median oviduct, bordered posteromedially by moderately produced ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII

narrowed dorsally, broadly U-shaped ventrally; ventrally cleft directed somewhat medially, giving ventral surface of dorsomesal lobe a bulbous appearance apically; spicules of ventrolateral lobe short, not on raised ridge; apodeme of S VIII straight, in some specimens approximately edge of cleft around median oviduct; posterior apodeme of S IX short, tapering in dorsal aspect, slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection elongate (as in Fig. 53B).

Thorax: horn of respiratory organ partially fused with anterior stalk, length of fused portion more than twice width of free portion (as in Fig. 53C), of moderate length and thickness; terminal filaments of respiratory organ stout, >4 μ in diameter, apices non-forked, with a few short tubercles scattered along length.

Abdomen: pigmentation (of exuviae) pale brown with patches of darker pigmentation; T II entirely medium brown except for area adjacent to row of hooklets; spicules present on the following: T II-VIII, S II-IV (weakly produced), S V, VI, anal lobe; spicules present on T VII and T VIII restricted to anterolateral area of tergite (Fig. 58D); some anterior spicules on T IV with two or more points (Fig. 57D); fine spicules (pedes spurii A) present on lateral margin of S IV; T II and T III with poorly defined bare patches among spicules in addition to double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III moderately

larger than posterior spicules (Fig. 57B); T II with posterior row of very large hooklets restricted to medial area of tergite, continuous medially or with median gap equal to width of no more than 4 hooklets (Fig. 57B); spur on S VIII with teeth yellowish brown, with one or two deltoid, lateral teeth and 1-3 sharply pointed, deltoid to elongate, smaller median teeth each more than $1/4$ length of largest tooth (Fig. 62D); from a dorsal aspect, teeth arranged in an evenly curved row; some specimens with additional ventral teeth; male genital lobe extending posteriorly past apex of swim paddle.

Position of larval exuviae: throughout pupal development, pupal abdomen remaining partially within larval exuviae, larval head capsule positioned halfway along abdomen, larval exuviae retaining elongate form (as in Fig. 52D).

Larva. Descriptive statistics: see Table 119.

Head capsule (as in Fig. 65C): light yellowish brown; cuticular surface sculpturing absent except on labrum; base of dorsolateral stripe originating at base of dorsomedian stripe; ventral, posteromedial area with longitudinal line of weakness, with marked posterior projection of pale cuticle; seta submenti lateral to paired ridges supporting labiohypopharynx, micropore posterolateral or posterior to seta submenti or absent; posterior coronal pore canal long, arising subapically on dorsolateral section of postoccipital carina, directed anteromedially.

Labrum (as in Fig. 70B): S I pinnate; S II simple; S III simple; S I

and labral lamella on transversely broadened plate; labral lamella with 2-7 spicules, squat, arising from cuticle but basally fused, divided into two groups; spicules of pecten epipharyngis peg-like, arranged on sclerotized bar.

Mandible: posterior portion of adductor apodeme without dark pigmentation (as in Fig. 72F).

Labiohypopharynx (Fig. 74C): ligular lobes not joined by continuous pigmentation; shagreen on lobes very fine, extending posteriorly to lateral edge of base of lobe; each lobe truncate to somewhat circular; cleft between lobes very narrow, nearly parallel-sided to V-shaped.

Fused maxilla and paralabial plate (as in Fig. 76D): apically truncate with lateral edge of maxilla markedly thickened, projecting anteriorly to level of or slightly beyond hypostomal teeth.

Procercus: with several filaments and small associated seta.

Anal papillae (as in Fig. 77L): one constriction at midlength, with basal and apical portions of approximately equal size.

Distribution and bionomics. This species is known only from Costa Rica (Fig. 85, locality 1). Adults were reared from larvae collected mining leaves in a slow moving, clear water stream.

Taxonomic discussion. In addition to the type series from Costa Rica, I examined one female from Barro Colorado Island, Panama, 25-II-1967, which was very similar to the females of S. quadrinotatus. However, the wing was lighter apically and the posteromedial ridges bordering the setal patches on S VIII were joined medially to produce a U-shaped ridge (as in Fig.). I have not therefore, included the specimen in this description. The female is housed in the INHS.

Derivation of specific epithet. The name quadrinotatus (four marks) refers to the two dark marks on each of the lateral vittae of adults of this species.

Stenochironomus (Petalopholeus) jubatus n. sp.

Type information: Holotype, male adult, on a microscope slide, labelled "Holotype *Stenochironomus jubatus* Borkent", "Amazonien [Brazil], Raum Manaus, Igarape Cachoeira, 15-IV-1961, Wasserfall [Waterfall] Pedra dos Indios, leg. E.J. Fittkau", "A151+151-1 B104"; allotype, on microscope slide, labelled as for holotype; paratypes, 2 female adults, labelled as for holotype, 1 male from some locality as holotype, collected 18-IV-1961 (INPA).

Diagnosis. Male adult: lateral vitta with two patches of dark pigmentation, one placed anterior of the other; setae on fore femur and tibia markedly more elongate than those on mid and hind legs. Female adult: as for male.

Description. Male adult. Descriptive statistics: see Table 43.

Head: antennal hairs missing; palpus and labellum pale; eye markedly shiny metallic in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 3L, 10E): posterolateral edge of epimeron, lateral vitta with two dark patches, one anterior of other, acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1, sparse (6-7 setae) row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (as in Fig. 13C).

Legs: dark pigmentation well defined, distributed as follows (Fig. 25A): apical 0.11 of fore femur, very base and very apex of fore tibia; apical 0.7 of fore femur and entire fore tibia with markedly elongate setae, distributed along dorsal and ventral margin.

Wing: all of membrane very lightly pigmented; halter pale.

Abdomen: light pigmentation poorly defined, distributed as follows (Fig. 27J): very posterior margins of T II-IV; genitalia brown, anal point very dark.

Genitalia: in lateral aspect dorsal edge of anal point convex, evenly curved (Fig. 42E), apical half of anal point expanded in dorsal aspect (as in Fig. 37C), lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX slightly rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae in semicircular arrangement; appendage 1 elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 curved dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44L); gonostylus slightly swollen subapically, apex tapering; gonocoxal apodeme somewhat pointed anteriorly, with moderate expansion.

Female adult. Descriptive statistics: see Table 83. Similar to male except as follows:

Head: all of flagellomeres dark.

Abomen: light pigmentation poorly defined, restricted to very posterior margins of T I-IV.

Genitalia: setal patch on S VIII extending posteriorly to about level of cleft around median oviduct, bordered posteromedially by well developed ridge; ventrolateral lobe markedly developed (as in Fig. 47A); cleft between dorsomesal and ventrolateral lobes of S VIII narrowed dorsally, broadly U-shaped at midlength, narrowed ventrally (as in Fig. 50B); ventrally cleft directed somewhat medially, giving ventral surface of dorsomesal lobe a bulbous appearance apically (as in Fig. 50B); spicules of ventrolateral lobe elongate, on raised ridge; apodeme of S VIII straight, ending at extreme base of dorsomesal lobe; posterior apodeme of S IX well developed, elongate, tapering posteriorly from dorsal aspect, apices diverging posteriorly (as in Fig. 47A).

Pupa and larva. Unknown.

Distribution. This species is known from northern Brazil (Fig. 85, locality 14).

Taxonomic discussion. The specimens were first examined in alcohol and were subsequently mounted on microscope slides.

Derivation of specific epithet. The named jubatus (maned) refers to the hairy fore femur and tibia of adults of this species.

Stenochironomus (Petalopholeus) nudipupa n. sp.

Type information: Holotype, male adult on microscope slide, labelled "Holotype *Stenochironomus nudipupa* Borkent, Pto. Viejo - La Selva, Heredia, Costa Rica, 20-IX-1980, D.M. Wood"; allotype, on microscope slide, labelled as for holotype; paratypes 62 males, 2 females, 2 pupae, 89 pupal exuviae, 57 larval exuviae, labelled as for holotype, one male from El Tucuco, Zulia, Venezuela, 200 m, 20-23-IV-1981, (CNC).

Diagnosis. Male: lateral vitta pale; T I without dark pigmentation, at least T II, T III with dark pigmentation along posterior margin; anal point slender. Female: pigmentation as for male. Pupa: only South American species with: T II without dark pigmentation; T II with posterior row of medium sized hooklets restricted to medial area of tergite; male genital lobe at most reaching level of apex of swim paddle. Fourth instar larva: only Neotropical species with base of dorsolateral stripe originating at base of dorsomedian stripe; anterior width/width of head capsule = 0.52-0.63, length = 340-388; spicules of pecten epipharyngis peg-like, arranged in sclerotized bar; procercus composed of several filaments.

Description. Male adult. Descriptive statistics: see Table 44.

Head: antennal hairs light brown; palpus and labellum pale; eyes markedly shiny metallic when alive and in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 4A, 10F): posterodorsal edge of epimeron, in some specimens light pigmentation on ventral portion of katepisternum, light pigmentation on dorsal portion of mid and hind coxae, in some specimens postnotum with dorsal pigmentation; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (as in Fig. 13C).

Legs: dark pigmentation moderately defined, distributed as follows (Fig. 24F): apical 0.09-0.12 of fore femur and some darkened setae at midlength, basal 0.31-0.42 and apical 0.12-0.17 of fore tibia; very apex of hind femur and basal portion of hind tibia with poorly defined light pigmentation; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: medial band present but light between C and R and between M and Cu; light pigmentation anterior arcus, very apex of wing (as in Fig. 18A); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 28A): posterior 0.16-0.20 of T II, posterior 0.19-0.21 of T III, posterior 0.17-0.21 of T IV, very posterior margin of T V; genitalia brown.

Genitalia (Fig. 36C): in lateral aspect basal 2/3 of dorsal edge of anal point slightly convex, apex evenly curved ventrally (Fig. 42F), apex slightly bulbous in dorsal aspect; lateral margin of anal point moderately produced, originating subapically on T IX, moderately

diverging; posterior edge of T IX slightly rounded, to truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in semicircular to elongate arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 slightly curved dorsally with apical seta shorter, and basally thicker than subapical seta (as in Fig. 44K); gonostylus swollen subapically, apex tapering; gonocoxal apodeme rounded anteriorly to slightly truncated, with or without slight expansion.

Female adult. Descriptive statistics: see Table 84. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: as for male except all specimens with postnotum pigmented.

Legs: dark pigmentation moderately defined, distributed as follows: apical 0.12-0.14 of fore femur (with slight basal darkening resulting in pale subapical annulus), basal 0.38-0.44 and apical 0.17-0.19 of fore tibia, apical 0.12-0.14 of hind femur, basal 0.34-0.39 of hind tibia.

Abdomen: pigmentation discrete, distributed as follows: posterior margins of T II, T III.

Genitalia: as for S. quadrinotatus (Fig. 50A).

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection elongate (as in Fig. 53B).

Thorax: horn of respiratory organ partially fused with anterior stalk, length of fused portion more than twice width of free portion (as in Fig. 55C), elongate, thin; terminal filaments of respiratory organ stout, >4 μ in diameter, apices non-forked with a few short tubercles scattered along length.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VIII (sometimes lacking on T VII), S I-V (weakly produced), S VI-VII, and anal lobe; spicules present on T VII and VIII restricted to anterolateral area of tergite (as in Fig. 58C); most anterior spicules on T IV with two or more points (as in Fig. 57D); fine spicules (pedes spurii A) absent; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (as in Fig. 57C); T II with posterior row of medium sized hooklets restricted to medial area of tergite, continuous medially or with median gap equal to width of no more than 2 hooklets (as in Fig. 57C); spur on S VIII with teeth yellowish brown, with one or two deltoid, lateral teeth and 1-2 sharply pointed, deltoid to elongate, smaller median teeth each more than $1/4$ length of largest tooth (Fig. 62E); from a dorsal aspect,

teeth arranged in an evenly curved row, some specimens with additional ventral teeth; male genital lobe at most just reaching level of apex of swim paddle.

Position of larval exuviae: at pupation larval exuviae compacted, completely free of pupa (Fig. 52E).

Larva. Descriptive statistics: see Table 120; otherwise as for S. quadrinotatus (pg. 367).

Distribution and bionomics. This species is known only from Costa Rica and Venezuela (Fig. 85, locality 1, 2). Adults were reared from larvae collected mining leaves in a slow moving, clear water stream in Costa Rica.

Derivation of specific epithet. The name nudipupa refers to completely shed larval exuviae characteristic of this and a few other Stenochironomus species.

Stenochironomus (Petalopholeus) browni Townes

Stenochironomus browni Townes, 1945:86. Holotype male adult, pinned, genitalia mounted on a microscope slide, labelled "12 mi. S. St. Cloud, Canoe Cr., Osceola Co., Fla., IV.4.40, S.M. Brown, Jr.", "Gen. No. 37", "Holotype Stenochironomus browni, H.K. Townes", "Type No. 37" (HKTo); paratypes, 10 males, 7 females, pinned, labelled as for holotype (HKTo) (only 7 males, 6 females examined); 2 males, 2 females, on microscope slides, labelled as for holotype (CNC).

Diagnosis. Male: only eastern Nearctic species with a completely brown thorax and a brown halter. Female: as for male.

Description. Male adult. Descriptive statistics: see Table 45.

Head: medium dark brown; palpus brown; labellum brown; eyes markedly shiny metallic brownish green (reconstituted in ammonium hydroxide).

Thorax: medium dark brown with following notably more darkly pigmented areas (Fig. 4B, 11A): dorsal portion of medioanepisternum somewhat darker in some specimens, all of lateral and median vittae, dorsal portion of postalar callus, and all of postnotum; in cleared specimens the anteprenotal lobe, katepisternum, anteanepisternum, postanepisternum and anepimeron darker; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (Fig. 13C).

Legs: pigmentation distributed as follows (Fig. 24A): fore femur with subapical light brown annulus 0.05-0.07 of total femur length situated 0.03-0.18 from femur apex, remainder of legs uniformly medium brown.

Wing: pigmentation: a faint medial cloud, best seen macroscopically; otherwise all membrane smoky light brown (as in Fig. 16D); halter pale brown.

Abdomen: pigmentation discrete, distributed as follows (Fig. 28B): posterior 0.63-0.69 of T II, all of T III except slight dorsomedial lightening, posterior 0.22-0.31 of T IV, posterior 0.21-0.22 of T V, and all of T VI - T VIII; genitalia brown.

Genitalia: similar to that of S. cinctus (Fig. 36D); in lateral aspect dorsal edge of anal point evenly convex (Fig. 42G), apex parallel-sided in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX, slightly diverging; posterior edge of T IX wedge shaped in dorsal aspect with ventral row of somewhat stout setae; dorsal patch of setae in longitudinal arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 straight with apical seta moderately elongate but shorter and basally thicker than subapical setae (as in Fig. 45A); gonostylus somewhat swollen at midlength, apex somewhat rounded; gonocoxal apodeme rounded anteriorly with moderate expansion.

Female adult. Descriptive statistics: see Table 85. Similar to male except as follows:

Head: flagellomere six dark.

Legs: pigmentation distributed as follows: entire fore femur (except for subapical annulus light brown, poorly defined basally, annulus length 0.13-0.20 of total femur length, situated 0.13-0.14 from femur apex), basal 0.45-0.51 and apical 0.18-0.19 of fore tibia, tarsomeres unknown, entire mid femur, basal 0.17-0.34 of mid tibia, tarsomeres unknown, entire hind femur, basal 0.54-0.57 of hind tibia.

Abdomen: pigmentation discrete, distributed as follows: posterior 0.72-0.75 of T II, and posterior 0.74-0.86 of T III; swellings and associated setae of S VIII on mediolateral edges of cleft around median oviduct, darkened.

Genitalia: as for S. cinctus (Fig. 50B).

Pupa and larva. Unknown.

Distribution and bionomics. Known only as adults from type locality. Phylogenetic placement strongly suggests that larvae are leaf miners.

Material examined. This species is known only from the type-series. The four paratypes now on microscope slides, were first examined as

pinned specimens.

Derivation of specific epithet. The name browni refers to the collector of the type-specimens, S.M. Brown.

Stenochironomus (Petalopholeus) cinctus Townes

Stenochironomus cinctus Townes, 1945:87. Holotype, male adult, pinned, genitalia on microscope slide, labelled "12 mi. S. St. Cloud, Canoe Cr., Osceola Co., Fla., 14.4.40, S.M. Brown, Jr.", "Gen. No. 39", "Holotype, Stenochironomus cinctus H.K. Townes", "Type No. 39" (HKTo); 2 paratypes: 1 male from holotype locality; 1 male, pinned, labelled "Westerly, R.I. VII 1 35, M. Chapman", "Paratype Stenochironomus cinctus H.K. Townes", "Gen. No. 1 34" (HKTo). Townes, 1952:64. Beck and Beck 1970:35.

Stenochironomus aestivalis: Townes, 1945:86 (in part). Paratype of S. aestivalis, 1 female, on microscope slide, labelled "Kinderhook, N.Y. Aug.31, 1934 H.K. Townes", "Paratype Stenochironomus aestivalis H.K. Townes".

Diagnosis. Male: palpus pale; wing with membrane lightly pigmented and in some specimens with a faint medial cloud; postnotum with dark pigmentation restricted to dorsal area, not extending to ventral margin; entire hind tibia with dark pigmentation or rarely with some apical lightening. Female: as for male. Pupa: along with S. aestivalis (from which this species cannot be distinguished) the only Nearctic species with short tubercles scattered along length of filaments of respiratory organ; posterior row of hooklets restricted to medial area of T II and continuous across middle. Fourth instar larva: other than S. aestivalis, from which species cannot be distinguished, the only Nearctic species with dorsolateral stripes

originating at base of dorsomedian stripe; fused paralabial plate and maxilla extending anteriorly to about level of hypostomal teeth.

Description. Male adult. Descriptive statistics: see Table 46.

Head: all antennal hairs dark; palpus pale; labellum pale; eye markedly shiny metallic green when alive and in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 4C, 11B); in most specimens, dorsal portion of medioanepisternum (light to dark), posterodorsal edge of mesepimeron, in most specimens, ventral portion of katepisternum (dorsal edge of area of pigmentation darker), in most specimens subdorsal markings on mid and hind coxae, median vitta pale to tan, lateral vitta tan with darker markings along lateral edge extending from posterior margin toward anterior edge, dorsal portion of postalar callus, and less than posterior half of postnotum (in lateral view not extending to ventral margin of postnotum); acrostichal setae extending nearly to, to around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (Fig. 13C).

Legs: dark pigmentation moderately to poorly defined, distributed as follows (Fig. 24B, C): apical 0.11-0.21 of fore femur, entire tibia (rarely with pale medial annulus extending 0.00-0.08 of tibia, sometimes with darker hairs in midregion), all of fore tarsomeres, apical 0.08-0.24 of mid femur, basal 0.13-0.31 of mid tibia

sometimes with setae darkened causing entire mid tibia to appear slightly dark), apical 0.09-0.29 of hind femur, (sometimes with darker hairs in midregion), entire hind tibia rarely with some slight apical lightening), in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: pigmentation: absent or extremely faint medial cloud, best seen macroscopically; otherwise all of membrane lightly pigmented, in pinned specimens appearing smoky gray (Fig. 16D); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 28C): posterior 0.16-0.33 of T II, posterior 0.15-0.32 of T III, posterior 0.06-0.14 of T IV, and posterior 0.06-0.13 of T V; genitalia brown.

Genitalia (Fig. 36D): in lateral aspect basal 2/3 of dorsal edge of anal point slightly convex, apex evenly curved ventrally (Fig. 42H), apex parallel-sided in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately to slightly diverging; posterior edge of T IX wedge shaped in dorsal aspect with ventral row of slender setae; dorsal patch of setae in longitudinal arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 straight to slightly curved dorsally with apical seta moderately elongate but shorter and basally as thick to thicker than subapical seta (Fig. 45A); gonostylus of nearly constant diameter to slightly swollen at midlength, apex rounded; gonocoxal apodeme rounded anteriorly to slightly truncated, with or without

moderate expansion.

Female adult. Descriptive statistics: see Table 86. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 1-2 rows.

Legs: dark pigmentation moderately to poorly defined, distributed as follows: apical 0.12-0.15 of fore femur (in some specimens, hairs and cuticles lightly darkened along basal 0.68-0.79 resulting in a pale subapical annulus, entire fore tibia (rarely with pale medial annulus extending 0.00-0.30 of tibia), all of fore tarsomeres, apical 0.13-0.27 of mid femur, basal 0.17-0.34 of mid tibia, apical 0.14-0.59 of hind femur (when more than about apical 0.30 darkened, pale annulus present 0.11-0.12 of femur length), entire hind tibia (or, rarely, up to basal 0.69).

Wings: pigmentation: a faint medial cloud, best seen macroscopically; otherwise as in male.

Abdomen: pigmentation discrete, distributed as follows (Fig.): posterior 0.28-0.45 of T II, and posterior 0.21-0.43 of T III; swellings and associated setae of S VIII on mediolateral edges of cleft around median oviduct darkened.

Genitalia (Fig. 50B): setal patch on S VIII extending posteriorly past level of cleft around median oviduct, bordered posteromedially by apodemes of S VIII fused with cleft around median oviduct; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII narrowed dorsally, broadly U-shaped ventrally; ventrally cleft directed somewhat medially, giving ventral surface of dorsomesal lobe a bulbous appearance apically; spicules of ventrolateral lobe short, not on raised ridge; apodeme of S VIII curved, joining medially with cleft around median oviduct; posterior apodeme of S IX of moderate length, tapering posteriorly in dorsal aspect, straight to slightly curved.

Pupa. Descriptive statistics: see Tables 88-90.

Head capsule: dorsomedial projection elongate, (Fig. 53B)

Thorax: horn of respiratory organ partially fused with anterior stalk, length of fused portion more than twice width of free portion (Fig. 55C), elongate, thin; terminal filaments of respiratory organ stout, $>4 \mu$ in diameter, apices non-forked, with many short tubercles scattered along length.

Abdomen: pigmentation (of exuviae) uniformly pale brown, lateral margin with narrow dark stripe; spicules present on the following: T II-VIII, S I-IV (weakly produced), S V-VII, S VIII (weakly produced), anal lobe; spicules on T VII and T VIII restricted to anterolateral area of tergite (Fig. 58C); most anterior spicules on T IV with two

or more points (Fig. 57D); fine spicules (pedes spurii A) absent; T II and T III with spicules evenly spaced except for double pair of bare, posterior patches (sometimes fused to make one pair); anterior spicules on T II and T III slightly larger than posterior spicules (Fig. 57C); T II with posterior row of large hooklets restricted to medial area of tergite, continuous across middle (Fig. 57C); spur on S VIII with teeth yellowish brown, with 1-3 short, basally broad teeth and 0-2 smaller teeth (Fig. 62F); from a dorsal aspect, teeth arranged in an evenly curved row; male genital lobe at most just reaching level of apex of swim paddle. Position of larval exuviae: at pupation larval exuviae compacted, completely free of pupa (as in Fig. 52E).

Larva. Descriptive statistics: see Table 121; labrum (Fig. 70B) S I simple or pinnate; S III simple or pinnate; otherwise as for S. quadrinotatus.

Distribution and bionomics. S. cinctus is broadly distributed in the eastern Nearctic Region from southern Quebec and Ontario to Florida (Fig. 84E). The species is not yet recorded west of the southern Appalachians.

Larvae of S. cinctus mine dead submerged leaves and are recorded only from lentic habitats (n=8). Larvae mine a variety of leaves but occur preferentially at a particular locality, in the leaves of certain species. At Duncan Lake, Masham Twp., Quebec, larvae occur in leaves of oak (Quercus rubra) and red maple (Acer rubrum). Larvae were most common in the oak leaves. For example on Aug. 2, 1980 I

picked up 40 oak leaves from the lake bottom at a depth of no more than one m and found 37 of these to contain larvae, two to be almost completely skeletonized but containing some old mines and pupal chambers, and only one leaf to be uninfested. However, beech leaves were never infested and Alnus only rarely.

At the University of Montreal Biology Field Station near St. Hippolyte, Quebec, I found S. cinctus larvae in leaves of Myrica gale. At Honey Island Swamp in southern Mississippi, larvae were mining leaves of Liquidambar styraciflua and seemed absent from the abundant oak leaves present. At Corkscrew Swamp in SW Florida, larvae were common in leaves of red maple (collected by D.M. Wood, 25-XII-1980).

I studied the life cycle of S. cinctus at Duncan Lake. Table 124 indicates the numbers of larvae collected from the dead submerged leaves of oak I had placed in a cage in the lake in late fall of 1980 or that were naturally occurring in the lake. To verify that first instar larvae diapause I brought six first instar larvae into the laboratory on 2-VIII-1980. Of these six, four larvae did not develop beyond this stage. On 9-X-1980 they died. The following spring, on 9-V-1981, nearly all larvae in naturally occurring oak leaves were first instars. Finally, in the late fall of 1981 I found only first instar larvae. These data suggested that S. cinctus overwinters as first instar larvae in leaves. No larvae were evident in the caged leaves until 13-VI-1981 when one empty pupal chamber was noted. This suggests to me that overwintering first instar larvae may leave their chambers in the spring to infest the leaves which have fallen the previous fall. On this same date, naturally occurring oak leaves

contained pupae and empty pupal chambers with larval exuviae. This suggested the completion of development to adulthood of one generation. By 12-VII-1981 the caged leaves contained numbers of pupae and empty pupal chambers indicating the completion of a second generation. On 19-VII-1981 I removed some non-infested leaves to another cage and these subsequently became infested and produced pupae by 7-IX-1981, suggesting the occurrence of a third generation.

Other collection data support the hypothesis of overwintering as first instar larvae. Collection of larvae from Lac Triton at the University of Montreal Biology Field Station on 29-IV-1980 yielded 24 first instar and two second instar larvae. A sample from Little Shabomeka Lake, Ont. on 14-IX-1980 was composed of 7 first and 3 fourth instar larvae. Two of these first instars did not develop any further under laboratory conditions.

The above data suggest that S. cinctus overwinters as first instar larvae and completes a number of generations in a year.

Taxonomic discussion. S. cinctus is morphologically very similar to S. aestivalis. I could find no discrete differences between fourth instar larvae or between pupae. Adults differ in degree of pigmentation and a few meristic characteristics as indicated in the key but range of variation for these two species abut. Several data suggested to me, however, that these two named forms are reproductively isolated. Most importantly, all rearings from larvae from a given locality resulted in either one of these two forms but not both together; intermediates made up only a small proportion of total rearings. Secondly, distributional data indicate that the two

species are sympatric only in part of their ranges. S. aestivalis does not appear to occur in Canada. Thirdly, S. cinctus and S. aestivalis occur in different habitats. S. cinctus larvae were collected only in lentic habitats (n=8) and S. aestivalis only in lotic habitats (n=5) with one exception, along the shore of Jones Lake, North Carolina, where the shoreline was susceptible to wave action. At one location, Patuxent Wildlife Research Centre, Maryland, both species were collected in close proximity to one another.

Townes (1945) used the antennal ratio (13/1-12) to distinguish males of S. cinctus (about 1.67) and S. aestivalis (about 1.50) but these actually exhibit nearly identical ranges.

One of the paratypes of S. aestivalis, a female from Kinderhook, New York, is here identified as a specimen of S. cinctus. Although the specimen has a lightened fore tibia typical of S. aestivalis, this condition occurs in some S. cinctus also. The extent of pigmentation of the postnotum and the nearly completely pigmented hind femur of this specimen are characteristic only of S. cinctus as recognized here.

Beck and Beck (1970) described the larva and pupa of both S. cinctus and S. aestivalis. However, I was unable to recognize or confirm any of the differences they provided to distinguish the immature stages of these two species.

Material examined. I examined larvae, pupae and adults from the following localities: Duncan Lake, Masham Twp. and Lac Triton, nr. St. Hippolyte, Que.; Little Shabomeka Lake, Frontenac Co., Ont.; Trap

Pond St. Pk., Delaware; Snowden Pond, Patuxent Wildlife Research Center, Maryland; Honey Swamp at junction of Pearl River and hwy. 59, Miss.; Corkscrew Swamp, nr. Immokalee, Florida. A few adults were available from localities otherwise indicated on the distribution map.

Derivation of specific epithet. The name cinctus (belted or girdled) presumably refers to the pigmentation on the posterior portion of tergites 2-4 which give the abdomen a banded appearance.

Stenochironomus (Petalopholeus) aestivalis Townes

Stenochironomus aestivalis Townes, 1945:86 (in part). Holotype male adult, pinned, genitalia mounted on microscope slide, labelled "Atsion, N.J. VI-19, 1939 H.K. Townes", "Gen. No. 38", "Holotype Stenochironomus aestivalis H.K. Townes", "Type No. 38" (Townes); paratypes: 4 females from holotype locality, collected 3-VII-1939 and 25-VII-1939 (HKTo); 1 female from Kinderhook Creek, Kinderhook, New York, 31-VIII-1934 is actually a specimen of S. cinctus (CNC). Townes, 1952:64. Beck and Beck, 1970:33.

Diagnosis. Male: only nearctic species with the following: palpus pale; wing with membrane lightly pigmented, in some specimens with a faint medial cloud; postnotum with dark pigmentation extending to, or very nearly to, ventral margin; basal 0.20-0.69 of hind tibia darkly pigmented. Female: as for male except basal 0.36-0.70 of hind tibia darkly pigmented. Pupa and fourth instar larva: not distinguishable from S. cinctus except that some larvae were larger than any of S. cinctus, see diagnosis under S. cinctus and larval key.

Description. Male adult. Descriptive statistics: see Table 47.

Head: all antennal hairs dark; palpus pale; labellum pale; eye markedly shiny metallic when alive and in alcohol.

Thorax: pigmentation confined to the following areas (Fig. 40D, 11C): dorsal part of medioanepisternum, posterodorsal edge of

mesepimeron, ventral portion of katepisternum with dorsal edge of area of pigmentation darker in most specimens, subdorsal markings on mid and hind coxae, median vitta tan (some specimens with scattered darker markings), lateral vitta tan with darker markings along lateral edge extending from posterior margin toward anterior edge, dorsal portion of postalar callus, and posterior half or more of postnotum (in lateral view extending to or nearly to ventral margin of postnotum); acrostichal setae extending nearly to, to around and under, anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum angular in lateral aspect (Fig. 13C).

Legs: dark pigment moderately to poorly defined, distributed as follows (Fig. 24D, E): apical 0.12-0.60 of fore femur (specimens with more extensive pigmentation, more than about 0.50 of apex of leg with very poorly defined subapical annulus, all with at least darker hairs in midregion), entire fore tibia (with annulus in mid region 0.22-0.40 of total length of tibia), all of fore tarsomeres, apical 0.12-0.19 of mid femur, basal 0.15-0.24 of mid tibia, apical 0.11-0.19 of hind femur (rarely with more basal, faint darkening, all with at least darker hairs in midregion), and basal 0.20-0.69 of hind tibia; in life, forelegs held posterolaterally (as in Fig. 52C).

Wing: pigmentation absent or with extremely faint medial cloud, best seen macroscopically; otherwise all membrane lightly pigmented, in pinned specimens appearing light smoky gray (as in Fig. 16D); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 28D): posterior 0.28-0.58 of T II, posterior 0.24-0.63 of T III, posterior 0.06-0.13 of T IV, and posterior 0.05-0.10 of T V; genitalia brown.

Genitalia: as for S. cinctus (Fig. 36D, 42H).

Female adult. Descriptive statistics: see Table 87. Similar to male except as follows:

Head: flagellomere six dark.

Thorax: dorsocentral setae in 1-2 rows.

Legs: dark pigment moderately to poorly defined, distributed as follows: apical 0.10-0.15 of fore femur (hairs and cuticle slightly darkened along basal 0.53-0.69 resulting in a subapical annulus, entire fore tibia (with medial annulus extending 0.23-0.45 of total tibia length, one paratype with no annulus), all of fore tarsomeres, apical 0.09-0.64 of mid femur (when more than about apical 0.25 darkened, pale annulus present 0.28-0.37 of femur length); basal 0.13-0.21 of mid tibia, apical 0.09-0.79 of hind femur (when more than about apical 0.25 darkened, pale annulus present 0.33-0.48 of femur length), and basal 0.36-0.70 of hind tibia.

Wings: pigmentation: a faint medial cloud best seen macroscopically; otherwise as in male.

Abdomen: pigmentation discrete, distributed as follows: posterior 0.44-0.72 of T II, posterior 0.50-0.65 of T III, swellings and associated setae of S VIII on mediolateral edges of cleft around opening of oviduct darkened.

Genitalia: as for S. cinctus (Fig. 50B).

Pupa. Descriptive statistics: see Tables 88-90; otherwise as for S. cinctus pupae.

Larva. Descriptive statistics: see Table 122; labrum S I simple or pinnate; S III simple or bifurcate at tip; otherwise as for S. quadrinotatus (pg. 367).

Distribution and bionomics. S. aestivalis is known only from eastern U.S.A., from New Jersey to Florida (Fig. 84F). No specimens have been collected west of the Appalachians.

Larvae mine dead submerged leaves in lotic habitats (n=3) and in one instance along the shores of a large lake with evident wave-action. At Croatan National Forest and Jones Lake, North Carolina, larvae mined the leaves of a wide array of species. At Patuxent Wildlife Refuge, Maryland, larvae were mining oak leaves in the Patuxent River.

Taxonomic discussion. S. aestivalis and S. cinctus are morphologically similar (see discussion under S. cinctus).

I have examined only three of the four female paratypes from Atsion, N.J. The female paratype from Kinderhook, N.Y. is actually a specimen of S. cinctus as discussed under that species.

Material examined. I examined larvae, pupae and adults from Patuxent R., Patuxent Wildlife Research Center, Maryland; two localities within Croatan National Forest, and from Jones Lake, N.C.. Otherwise a few adults were examined from other localities as shown in the distribution map (Fig. 84F).

Derivation of specific epithet. The name aestivalis means pertaining to summer (aestivus) and presumably refers to the collection dates of the type series.

Unassigned Species of Stenochironomus

I have been unable to confidently place any of the following Stenochironomus species within either of the two subgenera recognized in this study. None of the following are known as larvae or pupae but once these stages are available, placement should be possible.

Stenochironomus hibernicus (Edwards)

Chironomus (Microtendipes) hibernicus Edwards, 1929:399. Holotype, male adult, pinned, genitalia mounted on celluloid strip, labelled "Holotype", "S.W. Ireland: Killarney. 25-27.V.1929. F.W. Edwards. B.M. 1929.243.", "Chironomus (Microtendipes) hibernicus Edw. F.W. Edwards det. 1930." (BMNH).

Microtendipes hibernicus: Goetghebuer, 1937:53.

Stenochironomus hibernicus: Brundin, 1947:52. Pinder, 1978:140.

Stenochironomus tubanticus Kruseman, 1933:137. Holotype male adult, on microscope slide, labelled "Hengelo (O), Lonnikermeer, 14-VIII-31 Kr." added "Holotype Stenochironomus tubanticus Kruseman, Lonnikermeer, Hengelo, Netherlands, 14-VIII-1931, G. Kruseman, = Stenochironomus hibernicus" (ITZA). Goetghebuer, 1937:13.

Diagnosis. Male: wing pale; thorax and abdomen completely pigmented dark brown, apex of anal point bulbous from dorsal view.

Description. Male adult. Descriptive statistics: see Table 48.

Head: dorsum of head capsule dark brown; all antennal setae dark; palpus dark brown; labellum dark brown; eye not metallic.

Thorax: (as in Fig. 1E, 6A), very dark brown with the following

exceptions: area immediately surrounding supraalar setae light brown, membranous area posterior to anterior spiracle pale, area between lateral vittae and parapsidal suture light brown; lateral vittae and areas between vittae slightly darker than rest of dorsum; acrostichal setae not extending to anterior point of scutum; dorsocentral setae in 1-2 rows; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: uniformly medium brown (Fig. 25B).

Wing: lacking dark pigmentation; halter light brown.

Abdomen: all of abdomen dark brown (Fig. 28E).

Genitalia (Fig. 37A): in lateral aspect basal 2/3 of dorsal edge of anal point concave, apex abruptly bent ventrally (Fig. 42I), apex markedly bulbous in dorsal aspect; lateral margins of base of anal point strongly produced, originating subapically on T IX, strongly diverging; posterior edge of T IX truncated in dorsal aspect with row of somewhat thickened setae; dorsal patch of setae in semicircular arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 bent dorsally with apical seta shorter and basally thicker than subapical seta (Fig. 45B); gonostylus somewhat swollen subapically, apex slightly to markedly rounded; gonocoxal apodeme pointed to truncated anteriorly with expansion.

Female adult, pupa and larva. Unknown.

Distribution and bionomics. S. hibernicus is distributed in Europe (Fig. 82E). Hackman (1980) listed this species from Finland. Fittkau and Reiss (1967) recorded it from northwest of the Caspian Sea.

Meuche (1939) has recorded S. hibernicus (as tubanticus) as occurring in Typha stems and leaves but is uncertain if this is the result of rearings.

Taxonomic discussion. S. hibericus was originally placed in Microtendipes because the unique type-specimen exhibited a single tibial spur on each hind leg. S. tubanticus was later described by Kruseman (1933) who believed his specimen was distinct because it exhibited two tibial spurs on each hind leg. Brundin (1947), on the basis of material collected in Sweden, recognized that the differences between the two species in fact represented intraspecific variation. I have examined both types and material from Sweden and concur with this conclusion.

The holotype of S. tubanticus was first examined in alcohol and subsequently mounted on a microscope slide.

Pinder (1978:fig.171B) figured the male genitalia of S. hibernicus showing the apex of the gonostylus as very rounded. This condition is true for only some specimens.

Material examined. 11 males, including the types from the localities provided on the distribution map. The specimens from Sweden were

badly bleached in alcohol, before being mounted on microscope slides. Localities, aside from the type specimens are as follows: Lake Innaren, Lake Skarshult, and Lake Grimsgöl, Sweden; Murnauer Moos, Oberbagern, West Germany.

Derivation of specific epithet. The name hibernicus refers to the Latin name for Ireland (Hibernia) from which the type originated.

Stenochironomus koreanus n. sp.

Type information: Holotype male adult, on microscope slide, labelled "Holotype *Stenochironomus koreanus* Borkent male, Nordkorea, No. 225, Prov. South Pyongan, Pyongyang Hotel garden; 31.8.1971, leg Horvatovich & Papp" (ZSTM).

Diagnosis. Male: wing and median vitta pale, lateral vitta partially pigmented dark brown.

Description. Male adult. Descriptive statistics: see Table 49.

Head: antenna with pale to dark hairs; palpus pale to very light brown; labellum with pale brown marking; eye not metallic.

Thorax: pigmentation dark, discrete, confined to the following areas (Figs. 4E, 11D): posterodorsal edge of mesepimeron, in some specimens areas immediately around spiracles medium brown; anterior portion of lateral vittae (extending laterally just beyond edge of vitta), and entire dorsal surface of postnotum except lateral margins; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (Fig. 13B).

Legs: dark pigmentation poorly defined, distributed as follows (Fig. 25C): extreme apex of fore femur, entire fore tibia.

Wing: lacking dark pigmentation; halter pale.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 37B): in lateral aspect basal 2/3 of dorsal edge of anal point concave, apex abruptly bent ventrally (Fig. 42J), apex bulbous in dorsal aspect; lateral margins of base of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX truncated in dorsal aspect with ventral row of stout setae; dorsal patch of setae in longitudinally elongate arrangement; appendage 1 elongate, thick, tapering from near base, with setae distributed along entire length; apex of appendage 2 abruptly bent dorsally with apical seta shorter and basally thicker than subapical seta (as in Fig. 43I); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme projected, rounded anteriorly; expansion unknown.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from North Korea (Fig. 81, locality 2).

Taxonomic discussion. Specimens were examined as alcohol specimens and some were subsequently mounted on microscope slide.

Derivation of specific epithet. The name koreanus refers to the type locality in North Korea.

Stenochironomus zonarius n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus zonarius* Borkent", "A371-1, U665", "Amazonien [Brazil], Rio Paru, Igarape Okueima, 18-N-1962, leg. E.J. Fittkau" (INPA).

Diagnosis. Male: lateral vitta on thorax with an anterior mark extending medially, so that a transverse stripe is present across scutum; pigmentation on postnotum restricted to dorsum; pigmentation on T II extending from anterior to posterior margins.

Description. Male adult. Descriptive statistics: see Table 50.

Head: all antennal hairs medium brown; palpus dark brown; labellum with dark markings; eye iridescence unknown.

Thorax: dark brown pigmentation confined to the following areas (Fig. 4F, 11E): posterolateral edge of mesepimeron, anterior portion of scutum to include about anterior half of medial vittae, anterior portion of lateral vitta extending laterally to very edge of scutum and medially to produce a transverse stripe across scutum, narrow band at posterior margin of scutum, dorsum of postnotum (in lateral view not extending to lateral margin of postnotum); acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: dark pigmentation poorly defined, distributed as follows (Fig. 25D): apical 0.21 of fore femur, with some apical setae darkened so that more of femur appears darkened; entire fore tibia, fore tarsomeres not present.

Wing: pigmentation restricted to dark patch on apical half but lightened apically, area posterior to Cu somewhat smokey (as in Fig. 16F); halter pale.

Abdomen: dark pigmentation poorly defined, distributed as follows (Fig 28F): entire T I, medial portion of T II, T III; anal point, appendage 2.

Genitalia (Fig. 37C): in lateral aspect basal 2/3 of dorsal edge of anal point slightly convex, apex abruptly bent ventrally (as in Fig. 42K), apex swollen in dorsal aspect; lateral margins of base of anal point strongly produced, originating subapically on T IX, moderately diverging; posterior edge of T IX rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae in longitudinally elongate arrangement; appendage 1 markedly elongate, thick, of nearly constant diameter, with setae distributed along entire length; apex of appendage 2 moderately bent dorsally with apical seta shorter and basally thicker subapical seta (as in Fig. 44K); gonostylus slightly swollen subapically, apex tapering; gonocoxal apodeme not discernable.

Female adult, pupa and larva. Unknown.

Distribution. The species is known from northern Brazil (Fig. 85, locality 16).

Taxonomic discussion. The single available specimen was examined only as a microscope slide preparation. The specimen had not, however, been cleaned so that description of pigmentation is probably accurate.

Derivation of specific epithet. The name zonarius (of a belt) refers to the transverse stripe across the scutum.

Stenochironomus semifumosus (Edwards) n. comb.

Chironomus (Stenochironomus) semifumosus Edwards, 1931:321. Holotype male adult, pinned, genitalia on a microscope slide, labelled "Bompland [Argentina]. 13-14-I-1927.", "Type", "Chironomus (Stenochironomus) semifumosus Edw. F.W. Edwards. det. 1931", "Argentina : Misiones Terr. F. & M. Edwards. B.M. 1927-63." (BMNH).

Diagnosis. Male: lateral vitta on thorax with two marks, anterior one extending medially, so that a transverse stripe is present across scutum; pigmentation on postnotum extending to lateral margin; pigmentation on T II restricted to about posterior half.

Description. Male adult. Descriptive statistics: see Table 51.

Head: all antennal hairs medium brown; palpus dark brown; labellum with dark markings; eye iridescence unknown.

Thorax: dark brown pigmentation confined to the following areas (Fig. 4G, 12A); posterodorsal edge of mesepimeron, anterior portion of scutum to include about anterior half of medial vittae, anterior portion of lateral vitta extending laterally to very edge of scutum and medially to produce a transverse stripe across scutum, posterior portion of lateral vitta extending posteriorly to include postalar calis, nearly entire postnotum; in addition very light brown pigmentation confined to the following areas: medioanepisternum, between dark markings on anterior portion of scutum and transverse

stripe, between anterior and posterior dark markings on lateral vitta; acrostichal setae extending to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: dark pigmentation poorly defined, distributed as follows (as in Fig. 25D): apical 0.11 of fore femur, with some darkened setae causing approximately apical 0.3 to appear darkened; entire fore tibia, all of fore tarsomeres; hind tibia very light brown.

Wing: pigmentation restricted to dark patch on apical half but lightened apically, area posterior to Cu somewhat smokey (Fig. 16F); halter pale.

Abdomen: pigmentation discrete, distributed as follows (Fig. 28G): entire T I, posterior 0.54 of T II, posterior 0.32 of T III, posterior 0.36 of T IV; genitalia brown.

Genitalia: as for S. zonarius (Fig. 37C), except that appendage 1 about 0.7 the length illustrated.

Female adult, pupa and larva. Unknown.

Distribution. The species is known from northeastern Argentina (Fig. 85, locality 18).

Taxonomic discussion. Edwards (1931:322) noted that the posterior

margin of T V was pigmented. I have not been able to confirm this observation because of marked subcutaneous pigmentation in this segment. He also mentioned that segment VIII was black but the cleaned specimen is entirely pale so that this observation was probably based on the presence of subcutaneous pigmentation.

Material examined. Only the single type specimen was studied.

Derivation of specific epithet. The name semifumosus (half, smokey) refers to the smokey pigmentation on the apical half of the wings.

Stenochironomus reissi n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus reissi* Borkent", "A473 U778", "Amazonien [Brazil], Raum oberer Rio Negro, Rio Marauia, Mission S. Antonio, 9-I-1963, leg. E.J. Fittkau"; paratypes on microscope slides 2 males from Mission Tiriyo, Rio Paru, Brazil, 31-IV-1962 and 1 male collected 9-IV-1962; 1 male from Missao Cururu, Rio Curura, Brazil, 12-I-1961; 1 male from Igarape Okueima, Rio Paru, Brazil, 18-IV-1962; (INPA).

Diagnosis. Male: lacking dark pigmentation; anal point slender, parallel-sided in dorsal aspect; appendage 1 with setae restricted to basal half except for one apical seta.

Description. Male adult. Descriptive statistics: see Table 52.

Head: lacking dark pigmentation; eye not metallic.

Thorax: lacking dark pigmentation; acrostichal setae extending to or nearly to anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 1 row; anterior edge of scutum rounded to somewhat angular in lateral aspect (as in Fig. 13B).

Legs: lacking dark pigmentation.

Wing: lacking dark pigmentation; halter pale.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 37D): in lateral aspect dorsal edge of anal point convex, somewhat thickened (Fig. 42L), dorsum of anal point with slight lateral expansion in dorsal aspect, parallel-sided; lateral margins of base of anal point moderately produced, originating subapically on T IX, slightly diverging; posterior edge of T IX truncated in dorsal aspect with slight concavity on either side of anal point in some specimens, with ventral row of stout setae; dorsal patch of setae in elongate arrangement; appendage 1 markedly elongate, thick, tapering slightly from base, with setae distributed along basal $1/2$ and one seta at apex; apex of appendage 2 somewhat bent dorsally with apical seta shorter and basally thicker than subapical seta (as in Fig. 45D); gonostylus somewhat swollen subapically, apex tapering; gonocoxal apodeme, truncated anteriorly, with no or slight expansion.

Female adult, pupa and larva. Unknown.

Distribution. The species is known from northern Brazil (Fig. 85, localities 12, 14, 16, 17).

Taxonomic discussion. One of the specimens was first examined in ethanol. Others were studied only as microscope slide preparations. None had been cleared. However, the complete lack of pigmentation may be due to bleaching since they were collected. Future material

which exhibits the diagnostic features of the genitalia (shape of anal point and appendage 1) will help to further resolve this potential difficulty.

Derivation of specific epithet. This species is named for Dr. F. Reiss for his contribution to our understanding of chironomid taxonomy and South American chironomids in particular.

Stenochironomus aculeatus n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus aculeatus* Borkent, Ig. do Curubau, Rio Branco, Brazil, 25-VIII-1971, F. Reiss" (INPA).

Diagnosis. Male: thorax with pigmentation on portions of lateral and medial vittae and postnotum; anal point markedly slender, straight.

Description. Male adult. Descriptive statistics: see Table 53.

Head: antennal hairs pale; palpus light brown; labellum pale; eye iridescence unknown.

Thorax: pigmentation confined to the following areas (Fig. 4H, 12B): posterior portion of medial vitta, anterior portion of lateral vitta, posterodorsal portion of postnotum; acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 2 rows; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: lacking dark pigmentation.

Wing: all of wing light brown (as in Fig. 14C); halter pale.

Abdomen: lacking dark pigmentation.

Genitalia (Fig. 38A): in lateral aspect basal 2/3 of dorsal edge of anal point slightly concave, apex with slightly bent ventrally (Fig. 42M), parallel-sided, markedly slender in dorsal aspect; anal point originating apically on T IX; posterior edge of T IX markedly wedge-shaped with ventral row of slender setae, with posterolateral projection of cuticle; dorsal patch of setae in elongate arrangement; appendage 1 markedly elongate, slender, with setae distributed along apical 3/4; apex of appendage 2 somewhat curved dorsally with apical seta nearly as long and basally thicker than subapical seta; gonostylus somewhat swollen at midlength, apex tapering; gonocoxal apodeme slightly truncated anteriorly, with slight expansion.

Female adult, pupa and larva. Unknown.

Distribution. This species is known from northern Brazil (Fig. 85, locality 11).

Taxonomic discussion. The single specimen was examined only as a microscope slide preparation. However, the male had not been cleaned, so that description of coloration is probably accurate.

Derivation of specific epithet. The name aculeatus (sharp-pointed) refers to the slender, pointed anal point of the male of this species.

Stenochironomus palliaculeatus n. sp.

Type information: Holotype, male adult on microscope slide, labelled "Holotype *Stenochironomus palliaculeatus* Borkent", "A473 U777", Amazonien [Brazil], Raum oberer Rio Negro, Rio Marauia, Mission S. Antonio, 9.I.1963, leg. E.J. Fittkau"; 2 paratypes, 1 male adult, on microscope slide, from Mozambique, Columbia, 25-II-1972, leg. Foster; 1 male adult from Rio Cuieiras Igarape Cachoeira, by Waterfall Pedra dos indios, 15-IV-1961 (INPA).

Diagnosis. Male: thorax lacking dark pigmentation; anal point markedly slender, straight.

Description. Male adult. Descriptive statistics: see Table 54.

Head: antennal hairs pale; palpus light brown; labellum pale; eye iridescence unknown.

Thorax: lacking dark pigmentation; acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 2 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: very light brown pigmentation restricted apical portion of fore femur, entire fore tibia and fore tarsomeres.

Wing: all of wing membrane very light brown; halter pale.

Abdomen: lacking dark pigmentation.

Genitalia: as for S. aculeatus (Fig. 38A).

Female adult, pupa and larva. Unknown.

Distribution. This species is recorded from northern Brazil and Columbia (Fig. 85, locality 14).

Taxonomic discussion. The two males were examined only as microscope slide preparations. However, neither had been cleared so that description of pigmentation is probably accurate.

Derivation of specific epithet. The name palliaculeatus (pale, sharp-pointed) refers to its phylogenetic relationship with S. aculeatus from which it differs by its general lack of pigmentation.

Stenochironomus varius n. sp.

Type information: Holotype, male adult, on microscope slide, labelled "Holotype *Stenochironomus varius* Borkent, Yacambu Nat. Pk., Lara, Venezuela, 1200 m, 10-V-1981, H. Townes, malaise trap"; allotype, on microscope slide, labelled as for holotype; paratypes, 1 male, 38 females, labelled as for holotype (CNC).

Diagnosis. Male: entire thorax dark brown except for ventral portion of katepisternum which is medium brown; abdomen other than genitalia, lacking dark pigmentation. Female: as for male.

Description. Male adult. Descriptive statistics: see Table 55.

Head: antennal hairs missing; palpus pale; labellum pale; eye not metallic.

Thorax: nearly entire thorax dark brown with the following somewhat lighter brown (Fig. 12C): ventral portion of katepisternum, ventral portion of mid and hind coxae; acrostichal setae extending around and under anterior point of scutum; dorsocentral setae in 1 row; scutellar setae in 1 row; anterior edge of scutum somewhat angular in lateral aspect (as in Fig. 13C).

Legs: pigmentation moderately defined, distributed as follows (Fig. 25E): basal 0.41-0.48 of fore femur, all fore tarsomeres missing.

Wing: lacking dark pigmentation; halter dark brown.

Abdomen: lacking dark pigmentation except for genitalia; apex of gonostylus pale.

Genitalia (Fig. 38B): in lateral aspect basal 2/3 of dorsal edge of anal point straight, apex abruptly bent ventrally (Fig. 42N), apex slightly bulbous in dorsal aspect; lateral margin of anal point moderately produced, originating subapically on T IX, moderately diverging; posterior edge of T IX slightly rounded in dorsal aspect with ventral row of stout setae; dorsal patch of setae small, in semicircular arrangement; appendage 1 elongate, nearly constant in diameter, with setae restricted to apical 1/2; apex of appendage 2 curved dorsally with apical seta shorter, and basally thicker than subapical seta (Fig. 45C); gonostylus subapically, apex tapering; gonocoxal apodeme pointed anteriorly with marked expansion.

Female adult. Similar to male except as follows:

Head: flagellomere six dark; apex of palpal segment 5 somewhat darkened.

Legs: pigmentation moderately defined, distributed as follows: basal 0.33-0.41 of fore femur.

Genitalia: setal patch on S VIII extending posteriorly approximately to level of cleft around opening of oviduct, bordered posteromedially

by weak ridge; ventrolateral lobe moderately developed; cleft between dorsomesal and ventrolateral lobes of S VIII very shallow (similar to that in Fig. 46A); spicules of ventrolateral lobe of moderate length, stout, on small dorsoventral ridge; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, long and slender in dorsal aspect, slightly curved (as in Fig. 47A).

Pupa and larva. Unknown.

Distribution. This species is known from Venezuela (Fig. 85, locality 3).

Taxonomic discussion. Specimens were first examined in ethanol and were subsequently mounted on microscope slides.

Derivation of specific epithet. The name varius (different) refers to the marked contrast between the dark thorax and pale abdomen of adults of this species.

Previously Unrecognized Species of Stenochironomus

While searching for possible examples of homoplasy, I encountered a species of Polypedilum from the Caroline Islands (Micronesia) which, on the basis of the literature, exhibited certain features in common with species of Stenochironomus (see pg. 435). Examination of the male holotype of Polypedilum longilobatus Tokunaga (1964:592) showed that it had all the characteristics of the genus. In addition, the apex of T IX exhibited a row of stout setae. The apex of the mid and hind tibiae had only one spur, but this feature is also present in some species of Stenochironomus (S. hibernicus, S. unicalar, S. harrisoni). The apical seta on appendage 2 is basally thicker than the subapical seta. This species is otherwise adequately characterized by Tokunaga (1964). I have not examined the allotype.

This species must now be named Stenochironomus longilobatus (Tokunaga) new combination.

Nomen dubium

Kieffer (1917:349) described a new species of Chironomus from Callanga, Peru as C. gracilivalva. His description and figure of the male genitalia strongly suggest that the specimen is actually a Stenochironomus. The elongate appendage 2 and its somewhat elongate apical seta and description of pigmentation suggest to me that it may be related to S. niger, S. crusanticus and S. innocuus. This species should now be recognized, therefore, as S. gracilivalva (Kieffer) n. comb.

I have attempted to locate the type of this species. However, Dr. L. Papp, (Zoological Department, Hungarian Natural History Museum, H-1088 Budapest, Baross ü.13) has informed me that the type was destroyed in a fire in 1956. As the description of S. gracilivalva does not match any of the species recognized in this revision, the name must for the present be considered a nomen dubium.

Excluded Species

One species, Stenochironomus ancudensis (Edwards), probably does not belong to this genus. The single available specimen exhibits separate tibial spurs on the hindleg and fused spurs on the midleg. Adults of all known Stenochironomus species exhibit fused tibial spurs on both mid and hind legs. This species may be phylogenetically related to any one of the major lineages within the Stenochironomus complex (as in Fig. 86) or not belong within this group at all. However, the fused tibial spurs on the midleg, but separate spurs on the hindleg, may indicate that this specimen represents the sister lineage of Stenochironomus (see character A, pg. 444). Certain placement will probably not be possible until males, pupae and larvae become available for study. I am describing the only available specimen (holotype female) below to enhance future collecting and comparison. All characteristics given in the description of the members of the Stenochironomus complex apply to this female.

Stenochironomus ancudensis (Edwards)

Chironomus (Stenochironomus) ancudensis Edwards, 1931:313. Holotype, female adult, on microscope slide, labelled "Ancud [Chile], 17-19.XII.1926", "Chironomus (Stenochironomus) ancudensis Edw. F.W. Edwards. det. 1931", "Type", "S. Chile: Chiloe I. F. & M. Edwards. B.M. 1927-63" (BMNH).

Stenochironomus ancudensis: Ortiz, 1946:46.

Diagnosis. Female: lacking dark pigmentation, except for flagellomere six; tibial spurs on midleg fused, spurs of hindleg separate.

Description. Female adult.

Head: only flagellomere six darkened; eye not metallic (when reconstituted in ammonium hydroxide).

Thorax: lacking dark pigmentation; acrostichal setae nearly to anterior point of scutum; dorsocentral setae in 2-3 rows; scutellar setae in 3 rows; anterior edge of scutum rounded in lateral aspect (as in Fig. 13B).

Legs: lacking dark pigmentation.

Wing: lacking dark pigmentation.

Abdomen: lacking dark pigmentation.

Genitalia: setal patch on S VIII extending posteriorly to level of cleft around opening of oviduct, bordered posteromedially by strong ridge (as in Fig. 47D); ventrolateral lobe weakly developed; cleft between dorsomesal and ventrolateral lobe of S VIII shallow (similar

to Fig. 46A); spicules of ventrolateral lobe short; apodeme of S VIII straight, ending on dorsomesal lobe; posterior apodeme of S IX well developed, straight (as in Fig. 48D).

Male adult, pupa and larva. Unknown.

Phylogeny

In this section I provide the basis for my analysis of the phylogenetic relationships of species in the Stenochironomus complex and suggest hypotheses concerning the polarity (plesiomorphy-apomorphy) of character states within the genus. These hypotheses are summarized by cladograms indicating the relationships between species.

Methods. My approach to character analysis and phylogenetic interpretation is essentially the cladistic methodology as clearly outlined by Griffiths (1972), Kavanaugh (1972), Ross (1974) and Wiley (1981). However, some aspects of this methodology require special comment as follows:

- 1) In general, the analysis of character state polarity was based on outgroup comparisons (Stevens, 1980). However, in one instance I used ontogenetic data for interpretation of polarity, because outgroup comparisons were not available.
- 2) When all character states of a particular character were recognized as occurring in members of the outgroup (i.e. presence of homoplasy (=parallelism, convergence)) the method suggested by Watrous and Wheeler (1981) was applied in which the considered outgroup was narrowed to that assemblage of species most closely related cladistically to the group under analysis.
- 3) Some cladists have recently advocated the strict use of parsimony when constructing cladograms (e.g. Eldredge and Cracraft, 1980; Nelson and Platnick, 1981) and have developed techniques to

incorporate all apomorphies equally in the hope of avoiding value judgements about homoplasy and relative worth of apomorphies for cladistic analysis. Such an approach reflects a belief that all characters are, a priori, of equal value in indicating phylogenetic relationships and that this avoids intuitive appraisal of character worth. Parsimony in this sense refers to "that tree implying the fewest evolutionary gains and losses with the fewest lines" (Nelson and Platnick, 1981:202). In a general sense, parsimony is fundamental to scientific inquiry in that it provides the simplest explanation of a phenomenon or pattern. However, in regard to construction of phylogenetic trees, I am not convinced that a minimal number of evolutionary steps, when all characters are considered equally, is always the simplest explanation of a pattern of synapomorphies.

One difficulty in applying parsimony techniques concerns the difficulty of delimiting and recognizing characters. Each hypothesis concerning the polarity of a character state is generally considered an independent indicator of relationship. Data from developmental sciences however, suggest that many characters are mutually influenced during ontogeny. Simple calculations of minimum number of evolutionary changes as a basis for a proposed cladogram could result in misleading conclusions if characters are not independent of one another.

A second difficulty in the use of strict parsimony is apparent in the use of computer techniques. When a data base contains a certain amount of homoplasy, different computer techniques sometimes

produce different cladograms, presumably because of differing assumptions (i.e. minimal number of evolutionary changes, no reversals, etc.). In addition, some workers have noted that small changes in data can result in marked changes in a resulting cladogram when using computer analysis (Coombs et al., 1981).

Griffiths (1972), Hecht and Edwards (1976), Hennig and Schlee (1978), Ross (1974) and Schlee (1976) have suggested that apomorphies vary in their value in indicating cladistic relationships and I agree with these authors. Indeed this was the basis for choosing only certain characters for study.

In my initial investigation of Stenochironomus species I examined many characters to obtain an overview of their distribution and variability. ~~Certain~~ characters were intraspecifically variable, (e.g. presence of a tooth on the fore tibial spur) and others exhibited interspecific differences (e.g. setal counts on the thorax) which fluctuated markedly within what seemed clearly to be monophyletic species groups. I chose not to study these characters any further and concentrated on those which showed some "reasonable" grouping of species.

Ross (1974:177) noted several criteria for resolving conflicts between two or more apomorphies and these were applied for my analysis also. These are as follows: 1) nature of character states (i.e. losses are more likely to occur than gained attributes; relative complexity) 2) parsimony when appraisal of characters is not clear 3) evaluation of possible selection pressures (i.e. that synapomorphy related to a specific environmental parameter is suspect).

As discussed by Nelson and Platnick (1981), synapomorphies occur at many levels and hypotheses concerning the apomorphic nature of a particular character state often depend on hypotheses at other levels of grouping. Certain of these hypotheses are of particular importance. For this study, I assumed that the highly modified, mining larval form exhibited by species in the Stenochironomus complex indicated the monophyly of this assemblage. I started with the basic assumption that such a larval form evolved only once. Therefore, any similar apomorphic states exhibited by some species within this assemblage and species in the outgroup were interpreted as the result of homoplasy. Such an appraisal of the relative worth of characters in indicating relationships has been interpreted by some as "ad hoc", "a priori" or "authoritarian" but I believe there is no workable alternative. It seems certain to me that characters do vary in their value in providing evidence of monophyly. Appraisal of the relative worth of characters may indeed seem to be a difficult task and, in some circumstances appear to be impossible, but to avoid the problem by consideration of all characters as equal when they may not be, seems to me to be undesirable. At the very least, I believe it to be the responsibility of a worker to point out to readers, that, for example, in some instances, a synapomorphy grouping a given assemblage of species is particularly susceptible to homoplasy and/or is directly associated with a particular environmental parameter in all species exhibiting that character state. This would indicate to future workers what areas of a cladogram are in particular need of testing.

For the apomorphies for which I do provide an appraisal of some

sort, I have considered the following factors. I reiterate that almost all apomorphies (see pg. 441 for one exception) were hypothesized on the basis of outgroup comparisons and in some cases, especially comparisons with other Chironominae.

1) Distribution of the hypothesized synapomorphy in the outgroup. I have attempted to indicate the distribution of such homoplasy and to discuss the cladistic consequences if the character state is not viewed as homoplastic.

2) Functional significance of the character. When observations are available I have discussed my assessment of the function of a character or character state. Such data may provide indications of the relative probability for homoplasy.

The understanding of functional significance of characters also provides evidence of relative independence among apomorphies supporting a node in a cladogram. The shape of the larval head capsule is related to a markedly different function than are the male genitalia and these are probably independent indications of the monophyly of a group of species. In contrast, the shape of the larval mandible and thorax both are intimately related to the mining feeding behaviour (as described on pg. 99) and I would be less willing to accept these two features as independent evidences of monophyly.

Other means are also available for appraising characters. Comparisons between different but conspecific instars indicating, for example, that a character state reflects neoteny may indicate an increased likelihood of homoplasy. Similarly, transfer of a normally

sex linked characteristic to the other sex (i.e. male chironomids attaining a female-like antenna) suggests the character to be a poorer indicator of relationship. This last criterion, however, was not applicable to the characters I studied.

In some instances I have interpreted the polarity of meristic data. In general, I consider a shift in range as the most significant statistic indicating cladistic relationship.

Analysis

The phylogenetic analysis is divided into three sections. The first deals with the relationships between the lineages that I believe to be closely related to Stenochironomus, namely those which exhibit the mining larval habitus (= the Stenochironomus complex). These include the genera Harrisius and Xestochironomus and two unnamed larval forms (Africa and New Zealand). The elucidation of these relationships was important to an interpretation of some character states within Stenochironomus, especially those exhibited by the larvae.

The second section provides a phylogenetic interpretation of species of Xestochironomus. Although secondary to the main goal of this study, to investigate Stenochironomus, my examination of the group indicated that some characters were interpretable and I provide this analysis as a basis for future, more intensive investigation.

The third section deals with the cladistic relationships of Stenochironomus species which occur in the Holarctic and Neotropical Regions. In some instances, data from my investigation of extra territorial species are included.

In each of these sections, the character states are numbered and each number is the same as that appearing on the concluding cladograms. Arrangement of characters follows a morphological rather than a phylogenetic sequence.

Characters which were difficult to analyze or which provided conflicting evidence, are listed at the end of each section.

Autapomorphies of single species are not discussed in each

section but are relegated to a separate discussion (pg. 476). These may become important to the phylogenetic placement of new species or previously unknown stages discovered in the future. They could not, however, contribute to the analysis at hand.

One difficulty in depicting cladistic information in this analysis is that some species were represented only in the adult stage, while many larval and pupal characters are important for indicating relationships. It should be noted, therefore, that the depiction of a synapomorphy at a particular node in the cladogram may in fact group a larger number of species (i.e. be moved basally down the branching sequence) when that character becomes available for study in those more basal lineages. This can be recognized as the situation for a particular lineage by checking the stages available for study as indicated on the cladogram.

For each character discussed (p)=plesiomorphic and (a)=apomorphic. Morphoclines are denoted by (a'), (a''), etc., indicating successive evolutionary modifications.

Cladistic Analysis of Basal Lineages Comprising the *Stenochironomus*
Complex

In the discussion that follows, it is important to know that *Stenochironomus* is considered a genus in the tribe Chironomini and that this group, together with the tribes Tanytarsini and Pseudochironomini, constitute the subfamily Chironominae. Saether (1977) has provided a cladistic analysis of major lineages within this subfamily.

In the following discussion, I have generally analyzed each character separately. However, there are so many unique larval characters defining the *Stenochironomus* complex that these are listed in one place (character 6).

Adult.

1. Wing membrane free of macrotrichiae (p); wing membrane with macrotrichiae (a).

Within the subfamily Chironominae, most Tanytarsini have macrotrichiae. Within the Chironomini most genera have wings devoid of macrotrichiae; however, the genus *Phaenopsectra* and some *Polypedilum* species have them.

2. Posteroventral margin of TI X of male with slender setae, scattered or arranged in a row (p); these setae stout and arranged in a row (e.g. Fig. 30A) (a).

The plesiomorphic condition occurs in all Chironominae except *Stenochironomus*. The apomorphic condition is present in all *Stenochironomus* species with the exception of a few species which I

have interpreted as at least three reversals to the plesiomorphic condition (S. bisetosus, S. impendens, S. townesi, S. discus, S. cinctus and S. aestivalis).

3. Appendage 1 of male genitalia with setae on swollen base, apical portion slender, elongate, with bend, bearing a single seta (as in Fig. 29A-C) (p); appendage 1 evenly tapering or with parallel sides, with no bend, with linearly arranged setae more or less evenly distributed along length (a).

I know of only a few other chironomids which exhibit an appendage 1 with the above combination of characters which is considered apomorphic. These are Micronesian species described as new by Tokunaga (1964): Chironomus (Endochironomus) tenuicaudus, Polypedilum ponapensis, P. insulanus, and P. nigribasalis. I examined material of each of the species to confirm the similar appearance of appendage 1 with that described here. Tokunaga (1964), in his key to this group, noted that the pronotum of Chironomus tenuicaudus, is not reduced. All members of the Stenochironomus complex exhibit a reduced pronotum and this condition is probably apomorphic although I am not sure at what branching sequence, nor if the character is homoplastic. At any rate, this suggests that the shape of appendage 1 of C. tenuicaudus is not a homologous character state with those of Stenochironomus species.

The similar condition exhibited by the Polypedilum species listed above, could be homologous to that of Stenochironomus. I consider the genus Polypedilum to be poorly defined. The presence of only one spur on the hind tibia represents a simple loss which occurs intraspecifically in some Stenochironomus species (see pg.421). The

pronotum of some Polypedilum is as reduced as it is in species of the Stenochironomus complex (pers. obs.) and the widely cited basal constriction of abdominal segment VIII of male adults of some Polypedilum is similar to those of the Stenochironomus complex.

It seems possible, therefore, that some or all of the species of Polypedilum listed above form a sister lineage(s) to Stenochironomus. However, I am reticent to make any formal changes until the larvae of these species of Polypedilum become known.

One species also described by Tokunaga (1964), Polypedilum longilobatus, is here considered a member of Stenochironomus (see page 421).

4. Appendage 2 of male genitalia relatively short, thick (finger-like), more or less circular in cross section, with setae scattered on dorsal portion (Fig. 29A-C) (p); appendage 2 elongate, slender, laterally compressed, with setae linearly arranged along dorsal edge (e.g. 30A) (a).

The apomorphic condition, described above, is unique. Appendage 2 is slender in some other Chironomini (i.e. some Dicrotendipes, Nilothauma, Parachironomus but these species do not exhibit the other modifications listed.

Appendage 2 is viewed as elongate in the apomorphic state, relative to the length of the gonocoxite. The length of appendage 2 in species of Harrisius and Xestochironomus is shorter, and a ratio of length of appendage 2/length of gonocoxite is 0.62-0.89. A relatively short appendage 2 is typical of most Chironominae. The ratio for all Stenochironomus species as a combined range is 0.77-1.35. However, the lower end of the range is due to one

Ambiguous Character States

A. Spurs on apex of adult tibiae. Xestochironomus and Harrisius species have only closely approximated spurs, while species of Stenochironomus exhibit completely fused spurs. Both conditions occur in the outgroup. However, considering the phylogenetic relationships hypothesized here, the fused condition is probably a synapomorphy of Stenochironomus.

B. Setae on appendage 2 of male adult. In Xestochironomus and Harrisius, all species have at least one apically forked seta on appendage 2. All Stenochironomus species exhibit simple setae. Both conditions, however, occur in the outgroup.

C. Cleft between dorsomesal and ventrolateral lobes of female adult; relative development of ventrolateral lobe. All Harrisius and Xestochironomus species, with the exception of a species of Harrisius (see pg. 89) and X. bulbosus, exhibit a very shallow cleft. The ventrolateral lobe is thus barely, if at all, discernable. All Stenochironomus species have a well developed cleft, with a very small to well developed ventrolateral lobe. In particular the following have a well developed ventrolateral lobe - S. unictus, S. maculatus, S. angustatae, S. niger, S. jubatus.

Saether (1977) has extensively used the development and relative proportions of the dorsomesal and ventrolateral lobes in analyzing the cladistic relationships between genera of Chironominae (pg. 131-138: Trends 28, 33, 34, 37, 45, 47, 63, 65). The data from this study, however, suggest that this character is markedly plastic interspecifically, and that, even though it provides some good

two dorsolateral and a dorsomedial portion, labrum not differentiated into separate sclerites, mandibles triangular, moving in an horizontal plane, in direct opposition to one another, shape of anterior margin of hypostoma concave, prothorax and mesothoracic of greater diameter than succeeding segments, somewhat dorsoventrally compressed, anterior prolegs reduced to a transverse, swollen ridge with hooks separated medially into two groups, abdomen slender, flaccid in life, procerci with filaments thin (under dissecting scope not differing in diameter from other body setae), pair of posterior prolegs reduced to short stumps (a).

All chironomids other than the lineages described here, have each of the plesiomorphies listed, with the exception that some have reduced anterior prolegs and proceri, which are probably independent developments.

All the apomorphic features listed above probably are a reflection of the particular larval mining mode of life. See page 97 for a discussion of larval feeding behaviour and locomotion, most of which relate to these character states.

It should be noted that although all these characters are listed together, the future discovery of more primitive lineages may show that some of the character states evolved sequentially. Some of these synapomorphies may therefore define increasingly inclusive groups of species.

7. Ecdysial lines present on dorsum of head capsule (p); ecdysial lines absent on dorsum of head capsule (Fig. 64B) (a).

All other Chironomidae larvae I examined exhibit ecdysial lines.

Although larval head capsules of all mining larvae of the lineages other than Xestochironomus have ecdysial lines, I am not certain of their function. In those Stenochironomus species studied, the pupal head capsule develops in the thorax of the larva so that, upon ecdysis, the larval head capsule is left intact. Intact larval head capsules were also present on larval exuviae of Harrisius pallidus and Xestochironomus species.

8. Antennal blade extending well beyond apex of segment three (Fig. 71A) (p); antennal blade extending to, or just beyond apex of segment two (Fig. 71B-D) (a).

The plesiomorphic occurs in all other Chironominae examined. Pinder and Reiss (in press) illustrates the antennae for each Holarctic genus of Chironominae and, with the exception of Stenochironomus, all exhibit the plesiomorphic condition. This character was not available for study for the African larval form.

9. S I and labral lamellae not associated (p); S I and labral lamellae on raised plate (Fig. 67B, C, 68-70) (a).

The apomorphic condition appears to be unique in the Chironominae.

10. Chaeta media with slender spicules (p); chaeta media with one markedly stout spicule, others slender (Fig. 67B, C, 68-70) (a).

My observations and those of Pinder and Reiss (in press) indicate that all other Chironominae have equal, more or less slender spicules.

11. Recten epipharyngis with three stout medial spicules (Fig. 68B) (p); pecten epipharyngis with many slender medial spicules (a).

Pinder and Reiss (in press) shows that other Chironominae have either

three scale-like spicules, as do some of the lineages described here, or have a comb composed of blunt spicules.

Saether (1977:134, Trend 35) has suggested that the presence of a comb of elongate spicules in the Stenochironomus, is homologous to the comb of blunt spicules present in some Chironominae. The presence of three stout spicules in the African and New Zealand larval forms and in Harrisius pallidus makes this hypothesis unlikely. Xestochironomus species exhibit a row of small spicules.

12. Chaetulae lateralis with spicules equal (p); chaetulae lateralis with one spicule markedly stout (Fig. 66A, 68B) (a).

As far as I know (see also Pinder and Reiss, in press) the apomorphic condition is unique within the Chironominae.

13. Mandible with seta interna present (Fig. 72A) (p); seta interna absent (Fig. 72B-G) (a).

Almost all Chironominae have a seta interna, with the exception of Beckidia, Chernovskia, Robackia, and some Parachironomus. These are probably independent losses from that within the Stenochironomus complex.

14. SM1 and SM2 of maxilla anterolateral to paralabial plate (Fig. 75A) (p); SM1 and SM2 posterolateral to paralabial plate (Fig. 75B-F) (a).

All Chironominae other than the lineages described here, have the maxilla (and SM1 and SM2) placed anterior to the paralabial plate.

15. Lobe lateral to hypostomium composed only of paralabial plate (Fig. 75A, B) (p); lobe lateral to hypostomium composed of fused

paralabial plate and portion of maxilla (Fig. C-F) (a).

In all Chironominae other than the lineages described here, the only lobe associated with the hypostomium is the paralabial plate. In the African larval form and Xestochironomus the maxilla and paralabial plate are closely associated.

16. Ligula single lobed (Fig. 73A) (p); ligula bilobed (Fig. 73B-P) (a).

In other Chironominae, the apex of the labiohypopharynx is composed of a complex series of scales and, although it seems likely, I am not confident of the homology between these scales and the ligular lobes as described here. However, the first instars of three Stenochironomus species (S. hilaris, S. cinctus and S. gibbus (Kalugina, 1958)) have a single lobed ligula and I hypothesize that the condition represents a plesiomorphy in later instars. This clue is tenuous and hopefully further research will resolve the exact homologies of the parts of the labiohypopharynx between the lineages described here and other chironomids. S. nelumbus has reverted to the plesiomorphic condition.

17. Hypostoma with nine or more teeth (p); hypostoma with eight teeth (Fig. 75B) (a).

All other Chironominae exhibit the plesiomorphic condition. The reduction in number of teeth is due to the loss of the two most lateral teeth which are otherwise placed dorsolaterally to the third most lateral tooth. A consequence of the loss of these teeth is that the edge of the paralabial plate is fused directed to the edge of the hypostomium.

18. Penultimate tooth of hypostoma arising dorsolaterally in

relation to third most lateral tooth so that the apex is visible in ventral view (Fig. 75E) (p); penultimate tooth placed dorsally so that its apex is not visible in a ventral view (Fig. 75C, D) (a).

The plesiomorphic condition occurs in all Chironominae other than those in the Stenochironomus complex. However, within the complex, the plesiomorphic condition (African larval form, Stenochironomus) is only slightly different from the apomorphic state. Accurate observation can only be made on an undisturbed head capsule.

Finally I note that species of Xestochironomus do not possess the most lateral teeth of the hypostomium (see character 17), so that appraisal of the phylogenetic position of Xestochironomus on the basis of this character is not possible.

19. Paralabial plate forming an anterior notch where it fuses with the lateral tooth of hypostoma (Fig. 75A, B) (p); paralabial plate forming a more or less straight margin lateral to where it fuses with the hypostoma (Fig. 75C-F) (a).

The plesiomorphic condition occurs in all Chironominae other than the Stenochironomus complex. I am not absolutely certain however, that the condition considered plesiomorphic in the African larval form and Xestochironomus is homologous to that of other Chironominae. In addition, the plesiomorphic condition is approximated by S. bacrionis (a reversal).

20. Dorsum of paralabial plate striated (p); at most, with a few, weak striae (a).

All other Chironominae have striated paralabial plates.

21. Anal papillae variable in shape and length (p); anal papillae

elongate with one constriction at midlength, with dorsal pair exhibiting an additional, slight, subapical constriction (Fig. 77B, C) (a).

The anal papillae of other Chironominae range from being absent to simple to, rarely, with one or more constrictions. I know of no other Chironominae, however, which have the apomorphic condition exhibited by Harrisius pallidus and the New Zealand larval form, which are undistinguishable from one another.

22. Anal papillae of moderate length and variable in shape (p); anal papillae markedly elongate, with 2-4 constrictions (Fig. 77A) (a).

No other Chironominae I have examined, except for an undetermined Polypedilum from Ecuador, have such elongate multiconstricted anal papillae.

This apomorphy, as hypothesized here, occurs independently twice within the Stenochironomus complex: in Xestochironomus and the African larval form. Of the larvae of Xestochironomus I examined, the anal papillae contained many trachae, probably an additional apomorphy. A comparison with the African larva was not possible.

A cladogram which summarizes the above hypotheses of the polarity of character states is provided in Figure 86.

Ambiguous Character States

A. Spurs on apex of adult tibiae. Xestochironomus and Harrisius species have only closely approximated spurs, while species of Stenochironomus exhibit completely fused spurs. Both conditions occur in the outgroup. However, considering the phylogenetic relationships hypothesized here, the fused condition is probably a synapomorphy of Stenochironomus.

B. Setae on appendage 2 of male adult. In Xestochironomus and Harrisius, all species have at least one apically forked seta on appendage 2. All Stenochironomus species exhibit simple setae. Both conditions, however, occur in the outgroup.

C. Cleft between dorsomesal and ventrolateral lobes of female adult; relative development of ventrolateral lobe. All Harrisius and Xestochironomus species, with the exception of a species of Harrisius (see pg. 89) and X. bulbosus, exhibit a very shallow cleft. The ventrolateral lobe is thus barely, if at all, discernable. All Stenochironomus species have a well developed cleft, with a very small to well developed ventrolateral lobe. In particular the following have a well developed ventrolateral lobe - S. unictus, S. maculatus, S. angustae, S. niger, S. jubatus.

Saether (1977) has extensively used the development and relative proportions of the dorsomesal and ventrolateral lobes in analyzing the cladistic relationships between genera of Chironominae (pg. 131-138: Trends 28, 33, 34, 37, 45, 47, 63, 65). The data from this study, however, suggest that this character is markedly plastic interspecifically, and that, even though it provides some good

characters for distinguishing species and/or species groups, its use in suggesting relationships between genera must be viewed with caution.

Assuming the monophyly of each of Xestochironomus, Harrisius, and Stenochironomus, the ventrolateral lobe has either been markedly reduced at least five times or the lobe has been developed twice within Stenochironomus and once within Harrisius (parallel to some other Chironominae).

D. Branching of pupal respiratory organ (Fig. 54, 55). Harrisius pallidus has an unbranched respiratory organ. Xestochironomus and Stenochironomus species exhibit a multifilamentous respiratory organ with an additional unbranched spiculate "horn" arising from near its base (modified in some, see pg. 459).

Chironomini are the only chironomids with at least four divisions of the respiratory organ. Almost all others have a single organ, generally with some surface sculpturing. A subgroup of the Chironomini, to which the Stenochironomus complex belongs, exhibits a respiratory organ with at least 20 branches (Saether, 1977).

The condition found in Xestochironomus and Stenochironomus (multifilamentous, with horn) is unique and this in itself suggests that it is an apomorphic state. However, it seems possible that in fact, the condition is part of a transformation series and cannot, therefore, be used to argue for monophyly of, or within, the Stenochironomus complex.

It seems likely that the "horn" of Xestochironomus and Stenochironomus, especially because it is simple and the only branch to exhibit spicules, is homologous to the simple respiratory horn of

chironomids other than Chironomini and, presumably to one of the branches of those Chironomini with only a few branches on the respiratory organ. For this latter group of Chironomini, Lenz, 1962: fig. 369 illustrates one branch of the respiratory organ of a Polypedilum as possessing some spicules and the same (fig. 422) for a species of Microtendipes.

A possible transformation series of the respiratory organ would therefore be as follows (from plesiomorphic to apomorphic): 1) simple (chironomids other than Chironomini); 2) a few branches forming at base of horn (lineage defined by Trends 42 and 48 by Saether, 1977:139); 3) multifilamentous, with horn present (Xestochironomus and Stenochironomus); 4) horn lost (lineage defined by Trends 33 and 36 by Saether, 1977:139).

This hypothesis would modify the cladogram suggested by Saether so that the Stenochironomus complex would become the sister group of the lineage defined by his trends 33 and 36. The resulting conflict presented by his Trend 35 is only apparent (see character 11, pg. 439).

The condition in Harrisius would consequently reflect a reverse to the plesiomorphic condition.

Lehmann (1981:74) shows the pupal respiratory organ of S. africanus Lehmann as a simple, unbranched stalk. It is possible that the anterior and posterior multifilamentous branches had broken off at the base of the respiratory organ, as I have observed in some other Stenochironomus species, leaving behind only the "horn".
E. Row of hooklets on posterior margin of T II of pupa.
Xestochironomus and Harrisius exhibit small hooklets (hard to see

under a dissecting microscope at 60x) (Fig. 56A, B). Stenochironomus species have hooklets of larger size (easily discerned at 60x) (Fig. 56C-F). Both conditions occur in Chironomini, so that these character states cannot be interpreted.

F. Length of posterior coronal canal. The African larval form exhibits a short coronal canal (Fig. 64A) while all other lineages described here have an elongate canal.

Some Chironomini (e.g. Endochironomus, Dicrotendipes, Chironomus, Polypedilum) exhibit a short coronal canal, while other Chironomini (e.g. Glyptotendipes, Stictochironomus, Cryptochironomus, Paralauterborniella, Paratendipes, Microtendipes, Goeldichironomus, Pseudochironomus and at least some Tanytarsini) have elongate canals. Saether's hypotheses concerning the cladistic relationships of genera of Chironominae do not provide any insight for interpreting this character state. However, first instar larvae of S. aestivalis exhibit a short canal which may suggest that the condition found in the African larval form is plesiomorphic, at least within the Stenochironomus complex.

The pore which is present at the apex of the canal, is homologous to Seta 12 of other chironomids. Seta 12 is not present on this sensillum in the Stenochironomus complex (also missing, or very reduced in some other Chironominae).

G. Presence of cuticular weakened area close to the campaniform organ on antennal segment one of fourth instar larvae. Both Xestochironomus and the New Zealand larval form exhibit a weakened area on antennal segment one (Fig. 71A, C). This condition appears to be unique in the Chironominae and therefore apomorphic. However,

the grouping produced by this possible synapomorphy conflicts with grouping by a number of other synapomorphies, so that I assume that the character is homoplastic, or, more likely, has been lost by Stenochironomus.

H. Number of teeth on mandible of fourth instar larva. The New Zealand larval form exhibited three ventral teeth (Fig. 72E). All other members of the Stenochironomus complex have two ventral teeth.

Most Chironominae have three or more ventral teeth on the mandible, although a few exhibit two (e.g. some Stictochironomus, some Polypedilum, see Pinder and Reiss, in press). In addition, first instar S. gibbus (Kalugina, 1958) and S. aestivalis have three ventral teeth. All these data suggest that presence of two ventral teeth is apomorphic. This, however, produces a grouping of species in conflict with all other synapomorphies. Possibly, considering its cladistic position as hypothesized here, the New Zealand larval form exhibits a neotenic character state.

Discussion

The hypothesized relationships between major lineages in the Stenochironomus complex are depicted in Figure 86.

Character states which suggest alternative relationships are discussed under "Ambiguous character states" above: characters F and G.

Cladistic Analysis of Species of Xestochironomus

The character states indicating the monophyly of the genus Xestochironomus are discussed above under "Cladistic analysis of lineages comprising the Stenochironomus complex".

Only two species are known in the pupal and larval stage and these were virtually indistinguishable from one another. Therefore all character states refer to adult characters. The only two characters which I could interpret are details of the male genitalia.

23. Appendage 1' with distal seta situated about half way along elongate portion (Fig. 29A) (p); distal seta situated on apical bend of elongate portion (Fig. 29B) (a).

The plesiomorphic condition hypothesized here occurs in Harrisius, and, when the seta is present, in most other Chironomini. However, the apomorphic condition is probably homoplastic, having occurred at least in some members of Polypedilum and Stictochironomus. The condition is obscure in Stenochironomus because appendage 1 is modified.

24. Apex of gonostylus evenly tapering (p); apex of gonostylus attenuated (a'), apex somewhat cleft (a''), apex moderately cleft (a'''), apex deeply cleft (a''').

No other Chironominae exhibit a forked gonostylus. The condition occurs rarely in some Orthocladinae and in a few other chironomids (Saether 1981:30, Wood and Borkent, in press), but these are almost certainly not homologous to that exhibited by some Xestochironomus species.

Ambiguous character states

A. Most of the setae on appendage 2^d of males of X. nebulosus, X. flinti and X. luteifurcatus are forked near their apices. This character provides the same grouping of these species as the synapomorphy 24''', with the possible exception of X. furcatus for which observations were not available. In all other Xestochironomus species I studied, only one or two subapical setae were forked near their apices and the rest were unforked. Outgroup comparisons however, suggest that the condition of most setae forked occurs in some other genera (ie. Ophryophorus, some Polypedilum, some Chironomus).

Discussion

The hypothesized relationships between species of Xestochironomus are depicted in Figure 87.

Cladistic Analysis of Species of Stenochironomus

The character states indicating the monophyly of the genus Stenochironomus are discussed above under "Cladistic analysis of lineages comprising the Stenochironomus complex".

Adult.

25. Eyes dull or only slightly metallic (p); eyes markedly metallic in life, when preserved in alcohol or when reconstituted in ammonium hydroxide (a).

The apomorphic condition is virtually unique in the Chironomidae. Some species of Coelotanypus, e.g., concinus (Coquillett) (Tanypodinae) exhibit the same condition. Metallic eyes also occur, but rarely, in some Simuliidae, Cecidomyiidae, and Tipulidae, as well as in some Brachycera.

Within Stenochironomus, the apomorphic condition also occurs in some Old World species: S. micronyx (Africa), S. albicoxa (Africa) and two undescribed species, one from Africa and one from Ceylon.

26. Length of flagellomere 13/length of flagellomeres 1-12 > 0.98 (p); length of flagellomere 13/length of flagellomeres 1-12 < 0.72 (a).

The apomorphic condition occurs twice within Stenochironomus, once as an autapomorphy of S. bisetosus and occurs only rarely in some other genera of Chironominae (e.g. some Nilothauma, some Polypedilum).

This character is recorded by other chironomid workers as

6

1.0

1.1

1.25

1.4

1.6

1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

2.8

2.5

3.2

2.2

3.6

2.0

4.0

1.8

AR (antennal ratio).

27. Lateral vitta variably pigmented or pale (p); lateral vitta with two discrete dark patches (a).

The apomorphic condition appears to be unique.

28. Extent of dark pigmentation of scutum variable but not as follows (p); scutum with stripe along lateral portion of lateral vitta extending anteriorly but not fusing an anterior point of scutum (Fig. 2L, 8D) (a'), lateral stripes fusing on anterior point of scutum (Fig. 3A, 8E) (a'').

Thoracic pigmentation is markedly variable within the Stenochironomus complex and particularly within Stenochironomus. However, I know of no other chironomid which exhibits the apomorphic conditions described above.

29. Pleural region of thorax bare, lacking microtrichae (p); pleural region pilose (a).

The apomorphic condition appears to be unique in the Stenochironomus complex. Although I have not seen such pilosity on any other chironomid, the condition may occur in some. Specimens must either be alive or pinned for observation of this character; collections in alcohol or on slides were not satisfactory.

This character was not recorded for S. impendens, S. townesi, or X. discus.

30. Median vitta variably marked or pale (p); a small oval spot on posterior portion of median vitta (Fig. 2I, J, 8C) (a).

This condition is unique. However, a grouping of the three species exhibiting this apomorphy (S. satorui, S. poecilopterus and S. tectus) partially conflicts with the group suggested by the

modification of the apical seta on appendage 2 (see character 40). As hypothesized here, the unpigmented median vitta of S. coleii and S. pulchripennis represents a loss of the apomorphy. It should be noted also that the spot is sometimes absent in S. tectus.

I find the loss of pigmentation a more likely evolutionary event than either the independent evolution of the modified seta on appendage 2 in two lineages or the evolution of the spotted median vitta twice; once in S. satorui and once in the ancestor of S. poecilopterus and S. tectus.

31. When alive, adult forelegs directed posterolaterally to posteriorly (Fig. 52A, C) (p); forelegs directed anterolaterally with occasional, momentary movement into a posterolateral position (Fig. 52B) (a).

This condition is unique within the genus. Adult Xestochironomus hold their forelegs directed posteriorly. Further outgroup comparisons indicate this character to be variable, but I have observed no other chironomids to hold their legs in a posterolateral to posterior position.

This character was not observed for S. innocuus.

32. Wing with no pigmentation or with apical band restricted to apex (p); wing with apical band extending into cells R3 and CuA1 (Fig. 14E-H, 15I, J) (a).

The wing pattern recognized as apomorphic is unique to the genus Stenochironomus. However, the condition appears to have evolved twice; once in the ancestor of S. hilaris, S. fuscipatellus and S. albipalpus and once in the ancestor of S. nelumbus and S. fascipennis. One further feature of the wing pigmentation differs

between these two groups of species. The median band of the S. hilaris group does not enter cell CuA1 (probably an apomorphic condition), while in S. nelumbus and fascipennis the median band does extend into cell CuA1 (probably plesiomorphic). Although the overall wing pattern of S. nelumbus and fascipennis may be viewed as intermediate, it may also indicate the lack of homology of the apical wing band of the two groups.

33. Setal patch on T IX of male in transverse to elongate arrangement (p); setal patch in markedly elongate arrangement (Fig. 35A-D) (a). The apomorphic condition appears to be unique.

34. T IX of male with no subapical constriction (p); T IX with subapical constriction (Fig. 31B) (a). The apomorphic condition appears to be unique.

35. Anal point curved in lateral aspect (p); anal point straight (Fig. 40D, E) (a).

All other members of the Stenochironomus complex exhibit the plesiomorphic condition, as do most other Chironominae. However, I am not completely confident that the derived conditions exhibited by S. macateei and S. recticaudatus are homologous and this should be tested by future workers.

36. Anal point with no lateral extension of dorsal edge (p); anal point with lateral extension of dorsal edge (Fig. 31A, 35A-D) (a).

The apomorphic condition is a character which exhibits a moderate amount of homoplasy. It occurs in some other Chironominae (e.g. some Kiefferulus, Chironomus, Dicrotendipes, Einfeldia, Cryptochironomus) and at least twice within Stenochironomus. Details, however, indicate the two conditions exhibited by

Stenochironomus species to be nonhomologous. All species have similar anal points within each group but the two groups differ in a number of details. S. bipunctatus and S. polychaetus from Africa has a similar anal point to those species in the leaf mining group. Harrison (pers. comm.) has reared adults of S. polychaetus from leaves in a stream 32 km NNW of Salisbury, Zimbabwe (same locality as for the African larval form, see pg.). However, both these species lack the markedly shiny eyes otherwise present in this assemblage of species (character 25).

37. Anal point either evenly curved ventrally or with about apical 1/3 bent ventrally (p); anal point with extreme apex bent ventrally (Fig. 41A-E) (a).

The apomorphic condition appears to be unique, although it is approached in some other Stenochironomus species.

38. Very apex of anal point straight (p); apex of anal point with dorsal curve (Fig. 39L, M) (a).

The apomorphic condition is unique except that it is approached by some specimens of S. palliaculeatus.

39. Dorsal margin of anal point arising near apex of T IX (p); dorsal margin arising anteriorly on T IX (Fig. 33C, D) (a).

The apomorphic condition appears to be unique.

40. Appendage 1 elongate (p); appendage 1 short (a'); appendage 1 very short (Fig. 33B) (a'').

This character presents some difficulties in interpretation. Taken only as total length, the plesiomorphic condition within Stenochironomus is that found in the majority of other Chironomini. In Pseudochironomini and Tanytarsini, appendage 1

is somewhat more stout and elongate. However, I am not certain that the comparison of total length is justified. Appendage 1 of Stenochironomus has setae scattered along its length. In the plesiomorphic condition, setae are restricted to a basal swelling of appendage 1 and with at most, one setae on a posterior, elongate portion (= appendage 1a of Tanytarsini) which generally makes up most of the length of appendage 1. Therefore, this may indicate that appendage 1 of Stenochironomus species is homologous only to the basal portion of appendage 1 of other Chironominae and that the plesiomorphic condition in Stenochironomus is a short appendage 1.

I do not, however, believe this to be the situation. On the basis of other character state distributions, it seems most likely that the short appendage 1 is apomorphic.

Reduction in the size of appendage 1 has occurred, as hypothesized here, three times within Stenochironomus, once as an autapomorphy of S. fascipennis.

41. Apex of appendage 2 bent dorsally (p); apex of appendage 2 straight (Fig. 44D-G) (a). This condition is present in at least 3 lineages within Stenochironomus in S. totifuscus, S. leptopus, S. browni, S. cinctus and S. aestivalis. Both conditions occur in other Chironominae, but immediate outgroup comparisons suggest the polarity hypothesized here.

42. Apical seta on appendage 2 short, stout (p); seta elongate (a'), seta equal in diameter to subapical seta (Fig. 44D-G) (a').

The interpretation of the polarity of these character states contradicts all outgroup comparisons with species outside of the genus Stenochironomus. Males of Harrisius, Xestochironomus and

most Chironomini have only elongate, slender setae on appendage 2.

Nevertheless, on the basis of congruence with other character states it seems likely to me that the apomorphic condition has occurred a number of times within the genus. I have used this hypothesis to argue for cladistic relationships in two species groups for which immediate outgroup comparisons in a few sister lineages suggested the stout condition to be plesiomorphic.

A few other species also exhibit the elongate, slender condition: S. totifuscus, S. leptopus, S. impendens, S. licinus, S. bisetosus, S. n. sp. "Peru", S. aculeatus and S. palliaculeatus. I am not certain of the homology of the elongate condition found in these species, although suggested relationship on the basis of other synapomorphies suggests that elongate slender setae have evolved at least five times within Stenochironomus.

43. Length of gonocoxite/gonostylus < 1.13 (p); at least portion of range of gonocoxite/gonostylus > 1.14 (a).

The plesiomorphic condition is exhibited by many Chironominae, Xestochironomus, Harrisius and some Stenochironomus species. The apomorphic condition is susceptible to homoplasy and occurs in many other genera of Chironominae (e.g. Pseudochironomus, Polypedilum, Microtendipes, Stictochironomus). As hypothesized here the apomorphic condition has reversed to the plesiomorphic state in S. jubatus.

Other chironomid workers record this character as HR (hypopygium ratio) but it should be noted that not all measure the gonocoxite in the same way.

44. Gonocoxal apodeme truncated to pointed anteriorly (p); gonocoxal

apodeme bilobed anteriorly (Fig. 31B) (a).

The apomorphic condition appears to be unique.

45. Apodeme of S VIII of female well separated from cleft around opening of oviduct (p); apodeme of S VIII close to cleft around opening of oviduct (Fig. 50A) (a'), apodeme fused with cleft (Fig. 50B) (a'').

The apomorphic condition appears to be unique. As hypothesized here S. jubatus exhibits a reversal to the plesiomorphic condition.

46. Ventrolateral lobe of S VIII of female without pronounced, spiculose ridge (p); ventrolateral lobe with markedly produced, spiculose dorsoventral ridge (Fig. 47C, D) (a).

The apomorphic condition appears to be unique.

47. Ventral margin of cleft between dorsomesal and ventrolateral lobes of female directed anteriorly or anterolaterally (p); ventral margin of cleft directed anteromedially, (so that dorsomesal lobe appears swollen apically) (Fig. 50A, B) (a).

This apomorphy appears to be unique except that the lobes of some species of Polypedilum approximate this condition.

48. Posterior apodemes of S IX of female variable (p); posterior apodemes of S IX long and slender (Fig. 47A, B) (a).

The apomorphic condition appears to be unique, except that a similar condition occurs in X. latilobus, S. jubatus and S. varius.

49. Spermathecae of moderate to large size (p); spermathecae small (Fig. 47A, B) (a).

The apomorphic condition is unique in the Stenochironomus

complex, but occurs rarely in some other Chironominae.

Pupa.

50. Head capsule with short, dorsomedial projection (p); head capsule with elongate projection (Fig. 53B) (a); head capsule with markedly elongate projection (Fig. 53C) (a).

The apomorphic condition is unique in the Stenochironomus complex and I have not observed it in other genera of Chironominae.

51. Anterior margin of wing pad smooth, with no discontinuities (p); anterior margin of wing with tubercle near base (a).

The condition is unique in the Chironomini. Some Tanytarsini have tubercles on the wing pad but none, to my knowledge, in the same location as these Stenochironomus species.

52. Horn of respiratory organ of moderate length, extending just beyond apices of filaments (p); horn elongate, extending well beyond apices of filaments (Fig. 55B) (a).

The apomorphic condition is unique in the Stenochironomus complex. Further outgroup comparisons are tenuous because of unsure homologies (see character D, pg. 445).

This character is also a reflection of the ratio of length of respiratory organ horn/length of T II (Table 89).

53. Horn of respiratory organ of moderate length, extending just beyond apices of filaments (p); horn short, not extending beyond apices of filaments (Fig. 54D) (a).

This condition is unique within the Stenochironomus complex. See character D (pg. 445 for further discussion).

54. Horn of respiratory organ arising from near base or partially

fused with anterior stalk (p); horn fused for most of its length with ventral region of anterior stalk (Fig. 55A) (a).

The apomorphic condition is unique in the Stenochironomus complex. Further comparisons are not yet possible (see character D, (pg. 445).

55. Filaments of respiratory organ smooth (p); filaments with a few short tubercles scattered along their lengths (a'); filaments with many short tubercles scattered along their lengths (Fig. 55C) (a'').

The apomorphic condition appears to be unique.

56. Row of hooklets on T II with wide median gap (p); row of hooklets continuous across median area of tergite (Fig. 56D-F) (a).

The polarity of this character state as interpreted here contradicts outgroup evidence from Harrisius and Xestochironomus in which the row of hooklets is either continuous or with a small gap. Further outgroup comparisons indicate the character to be homoplastic.

My consideration of the apomorphic condition as such is on the basis of the distribution of other synapomorphies within Stenochironomus. For example, S. cinctus, S. aestivalis and S. nudipupa exhibit a continuous row of hooklets. Many other characters indicate that these three species belong to a cladistically advanced group, so that comparison with immediate sister groups within the leaf-mining assemblage provides evidence that the character state is apomorphic.

As here hypothesized, the apomorphic condition has evolved three times within Stenochironomus, once as an autapomorphy of S. nelumbus. S. albipalpus has reverted to the plesiomorphic state.

57. Row of hooklets along posterior margin of T II comprising about three-quarter total width of tergite (p); row of hooklets extending to lateral margin of tergite (Fig. 56C-F) (a).

The apomorphic condition is unique within the Stenochironomus complex and the plesiomorphic condition occurs in Harrisius and Xestochironomus. Further outgroup comparisons are difficult to interpret because of the variability of this character. A similar apomorphic condition occurs in some Polypedilum, Stictochironomus, Xenochironomus and Demicryptochironomus. The character state is therefore probably homoplastic.

58. Row of hooklets along posterior margin of T II comprising about three-quarters of the total width of tergite (p); row of hooklets restricted to medial portion of tergite (Fig. 57A-C) (a).

Although the apomorphic state is unique within the Stenochironomus complex, it does occur in some other Chironomini: e.g. Chironomus, Einfeldia, Parachironomus, Pseudochironomus, Polypedilum, Paratendipes, Microtendipes, Paralauterborniella.

59. Hooklets along posterior margin of T II of moderate size (p); hooklets large (Fig. 57B) (a).

The apomorphic condition is unique within the Stenochironomus complex, but varies within the Chironominae.

60. Spicules on T II and T III of approximately equal size or with anterior spicules somewhat larger than posterior spicules (not including row of spicules on posterior margin of T II) (p); spicules on anterior margin of each of T II and T III markedly larger than those placed more posteriorly (Fig. 56A-F) (a).

Both Harrisius and Xestochironomus and most Chironomini

exhibit the plesiomorphic condition. Some Polypedilum, Endochironomus, and Microtendipes possess the apomorphic character state.

Within Stenochironomus the apomorphic condition has evolved once, in which one species (S. n.sp. "Peru") has reverted to the plesiomorphic condition, and once as a synapomorphy for S. fascipennis and S. nelumbus.

61. Spicules on T VIII present on anterolateral and posteromedial area (p); spicules on T VIII restricted to posteromedial area (Fig. 58B) (a).

The plesiomorphic condition occurs in Harrisius and Xestochironomus. The character is otherwise variable in the Chironominae, although most Chironomini have at least some spicules on the anterolateral area. Some Einfeldia exhibit a similar apomorphic state.

62. Spicules on T VIII present on anterolateral and posteromedial area (p); spicules on T VIII restricted to anterolateral area (Fig. 58C, D) (a).

The plesiomorphic character state occurs in Harrisius and Xestochironomus and some other Chironomini. However, this apomorphy is homoplastic and occurs in a number of other genera: e.g. Endochironomus, Paralauterborniella, Paratendipes, Polypedilum, Xenochironomus and Pseudochironomus.

S. fascipennis and S. nelumbus have lost all spicules on T VIII.

63. Spicules present on T VII and VIII (p); spicules absent from T VII and VIII (a).

I have not recorded the apomorphic state for any other Chironomini. As hypothesized here the condition has evolved twice within Stenochironomus. All others seem to have at least some spicules on either T VII or T VIII.

The loss of spicules on T VII and T VIII is correlated to the ability of these two tergites to be hydrophobic during adult emergence. In species which exhibit this condition, the floating terminal abdominal tergites make the abdomen stretch out behind the hydrophobic dorsum of the thorax. This ~~probably~~ increases the stability of the floating pupal exuviae during adult emergence. Species which have spicules on T VII and T VIII always have the pupal abdomen hanging down in the water and only the dorsum of the thorax is emergent.

The loss of spicules also appears to be related to a larger size of adults. Members of Stenochironomus s. str. (without spicules) are generally larger than those of Petalopholeus (generally with spicules). The only members of Petalopholeus which show the loss of these spicules (and for which pupae are known) are also the largest. I suggest therefore, that the loss of spicules is related to increasing the stability of the pupal exuviae during the emergence of larger species. This apomorphic condition may reflect evolutionary pressures associated with increase in overall size.

64. Spicules well developed on anal lobe (p); spicules absent or reduced on anal lobe (a).

The apomorphic condition is unique within the Stenochironomus complex but occurs in some other Chironomini: e.g. Einfeldia, Paratendipes, some Polypedilum. As hypothesized here, S.

n.sp. "Peru" has reverted to the plesiomorphic condition.

65. All teeth on spurs of S VIII elongate (p); 1 or 2 of the largest teeth on spurs of S VIII deltoid (Fig. 59F, 60A, C, D) (a'); 1-6 largest teeth deltoid and all of similar size and shape (Fig. 60E, F, 61A-F) (a''). The shape and configuration of the teeth of the spurs, because of their intraspecific variability, were both difficult to describe and to interpret phylogenetically. Nevertheless, I believe the apomorphic character states as given above suggest relationships.

The plesiomorphic condition is exhibited by Xestochironomus, Harrisius and most other Chironominae. Most notable is the similarity between the spurs of Harrisius pallidus and those of Stenochironomus unictus, S. maculatus, S. totifuscus, S. leptopus, S. nelumbus and S. fascipennis.

The condition (a') is similar to that apomorphy described below as (66'). Consideration of the distribution of other synapomorphies suggests that they are not homologous character states.

The condition (a'') requires comment. The range given for the number of deltoid teeth is 1-6 with the lower extreme equal to (a'). This is due to the variation of S. macateei (1-2) which is a small species and probably belongs to the suggested assemblage of species on the basis of other synapomorphies. Otherwise I would probably have excluded it from the grouping suggested by (a'').

If S. macateei is ignored, the variation would be 2-10, which appears to be unique in the Chironominae. This synapomorphy, however, as described here, may appear weaker than it actually is. The assemblage of species described by the apomorphy is easily

recognized on the basis of the teeth of the pupal spurs, both numbers and shape.

As hypothesized a'' has evolved (twice, once as an autapomorphy of n. sp. "Peru").

66. Spurs of S VIII with teeth elongate (p); lateral most 1-2 teeth deltoid (Fig. 62D, E) (a'); lateral most 1-3 teeth broad basally (Fig. 62F) (a'').

See character 65 for discussion. The apomorphy a'' appears to be unique.

67. Length of teeth of spur on S VIII variable (p); most lateral of spur on S VIII markedly elongate (a).

The apomorphic condition is unique within the Stenochironomus complex but is approximated by some Phytochironomus.

68. Pupal spur with teeth scattered or in curved row (p); teeth arranged in a straight row (Fig. 60A, B) (a).

The apomorphic condition occurs twice within Stenochironomus but does not appear elsewhere outside of the genus.

69. Male genital lobe extending posteriorly past apex of swim paddle (p); male genital lobe not extending past apex of swim paddle (a).

Xestochironomus and Harrisius exhibit the plesiomorphic condition.

The apomorphic condition occurs twice in Stenochironomus, elsewhere as an autapomorphy of pupal form one. I consider the conditions to be not homologous because of the distribution of other synapomorphies (see list of characters noted on cladogram).

In addition, S. gibbus possibly exhibits the apomorphic condition but this needs to be corroborated (see pg. 249).

70. Larval exuviae not entirely shed by pupa, larval head capsule positioned halfway down pupal abdomen (Fig. 52D) (p); larval exuviae completely shed by pupa, assuming a compacted form (Fig. 52E) (a).

The apomorphic condition is unique.

Larva.

71. Head capsule elongate, length/width > 1.00 , with a mean < 1.05 (p); head capsule somewhat square, length/width < 1.04 , with a mean < 0.99 (a).

The apomorphic condition is unique within the Stenochironomus complex. Although not measured exactly, it is clear that other Chironominae have elongate head capsules.

72. Head capsule moderately narrowed anteriorly, anterior width/maximum width = $0.65-0.89$, with a mean > 0.68 (p); head capsule more markedly narrowed anteriorly, anterior width/maximum width = $0.51-0.68$, with a mean < 0.67 (a).

Within the Stenochironomus complex, this apomorphy occurs twice; once in the African larval form and once within Stenochironomus. However, it is correlated with leaf mining habits and as such may be susceptible to homoplasy.

73. Sculpturing on ventrum of head capsule absent or composed of homogeneously distributed spicules (p); sculpturing forming geometric patterns in area immediately posterior to ridges supporting labiohypopharynx (Fig. 65B) (a).

The apomorphic condition appears to be unique.

74. Dorsolateral stripes originating on anterior two-thirds or more of dorsomedian stripe (p); dorsolateral stripes originating at base

of dorsomedian stripe (Fig. 65C) (a).

As hypothesized here, this apomorphy also has evolved in the African larval form. The New Zealand larval form, Harrisius, Xestochironomus and some Stenochironomus exhibit the plesiomorphic condition. Further exgroup comparisons are not available.

The two character states are correlated with differences in larval substrate. All wood miners exhibit the plesiomorphic condition and all leaf miners the apomorphic. This suggests that the character may be particularly susceptible to homoplasy and may have evolved in response to different feeding conditions. However, this apomorphy is congruent with other synapomorphies, thus supporting its validity as an indication of relationship, (albeit, not an entirely independent indicator).

75. Ventral, posteromedial area of head capsule with or without projection of pale cuticle; if projection present, then posteromedial angle oblique (p); projection squared posteromedially (Fig. 65C) (a).

The apomorphic condition is unique.

76. Micropore when present, lateral to, to posteromedial to seta submenti (p); position of micropore varying intraspecifically from anterolateral to, posterolateral to, seta submenti (a).

The apomorphic condition is unique in the Stenochironomus complex. I could discover no homologue of this micropore in other Chironominae but my search was not exhaustive.

77. Seta submenti positioned lateral to paired ridges supporting labiohypopharynx (p); seta submenti positioned posterolateral to paired ridges supporting labiohypopharynx (Fig. 65A) (a).

The apomorphic condition is unique within the

Stenochironomus complex. Further outgroup comparisons do not seem feasible.

78. Posterior coronal pore canal originating from apex of dorsolateral section of postoccipital carina (p); coronal pore canal originating subapically from dorsolateral section of postoccipital carina (Fig. 65C) (a).

Within the Stenochironomus complex, the apomorphic character state occurs in the African larval form and in some Stenochironomus. This character state is correlated with a leaf mining habit which suggests it may be particularly susceptible to homoplasy.

Further outgroup comparisons are difficult to make because of present uncertainties of homology between portions of the head capsules.

79. Posterior coronal pore canal directed anteromedially (p); coronal pore canal directed anterolaterally (Fig. 65C) (a).

Immediate outgroup comparisons indicate that the species of Xestochironomus, the New Zealand larval form and Harrisius pallidus exhibit the plesiomorphic condition. The character is not available for appraisal in the African larval form because the canal is so short (as for Endochironomus and Chironomus).

However, further outgroup comparisons show that all other Chironominae I examined exhibit an anteriorly or anterolaterally directed canal.

80. Labral lamella and S.I on a semi-circular plate (p); labral lamella and S.I on a transversely broadened plate (a') (Fig. 70B); on markedly broadened plate (a'') (Fig. 70A).

The apomorphic condition is unique within the Stenochironomus complex. The character does not seem to occur in other Chironominae (see character 9, pg. 439).

81. Labral lamella composed of numerous spicules (p); labral lamella composed of less than eight spicules (Fig. 68C) (a).

This character was difficult to interpret and should be viewed with caution. The apomorphic condition occurs in two groups of Stenochironomus species and in Harrisius pallidus. The plesiomorphic condition occurs in some Stenochironomus, the New Zealand larval form, Xestochironomus, the African larval form and all other Chironominae.

The consideration of this apomorphy as having evolved twice in Stenochironomus was on the basis of the distribution of other synapomorphies. Its presence in Harrisius pallidus confirms that this character state is homoplastic.

82. Spicules of pecten epipharyngis elongate, arranged in a row (p); spicules peg-like, arranged on a sclerotized bar (Fig. 70A, B) (a).

The apomorphic condition is restricted to one species group of Stenochironomus and the interpretation of its polarity depends on whether some other leaf miners and the wood mining Stenochironomus may be considered as successive outgroup. Further outgroup comparisons do not seem feasible (see character 11, pg. 439).

83. Length/width of antennal segment one < 5.00 (p); upper range of intraspecific variation exceeding 5.00 (a).

Within the Stenochironomus complex the condition is unique.

84. Posterior portion of adductor apodeme of mandible without dark pigmentation (p); posterior portion of adductor apodeme with dark

pigmentation (Fig. 72B, C) (a).

The apomorphic condition is unique.

85. Ligula lobes with shagreen not delimited by abrupt margin (p); shagreen abruptly delimited at its margins (Fig. 73P) (a).

This apomorphy is unique in the Stenochironomus complex although I have seen some S. hilaris and S. macateei in which this condition was approached.

Further outgroup comparisons do not seem feasible (see character 16, pg. 441).

86. Fused maxilla and paralabial plate bilobed apically (p); fused maxilla and paralabial plate squared apically (Fig. C, D) (a).

The apomorphic condition is unique.

87. Fused maxilla and paralabial plate extending anteriorly to about level of most lateral tooth of hypostoma (p); fused maxilla and paralabial plate extending anteriorly past level of most lateral tooth of hypostoma (Fig. 76C) (a).

The apomorphic condition is unique in the Stenochironomus complex.

88. Lateral margin of maxilla thickened (p); lateral margin of maxilla only slightly thickened (a).

The apomorphic condition is unique within Stenochironomus. The plesiomorphic condition occurs in some Stenochironomus, in Harrisius pallidus and in the New Zealand form. Further outgroup comparisons are not possible because the maxilla is not fused with the paralabial plate in other lineages and does not exhibit this thickening.

89. Procercus composed of several filaments (p); procercus composed

of a single filament (a).

The apomorphic condition occurs twice within Stenochironomus, elsewhere an autapomorphy of Stenochironomus larval form one. Otherwise the condition does not occur in other Chironominae.

90. Posterior proleg with 12-19 claws (p); lower range of variation of number of claws < 12 (a).

The apomorphic condition occurs twice within Stenochironomus, once as a reduction in number to 9-12 claws and once as a reduction to 9-14 claws. Some Stenochironomus and all other members of the Stenochironomus complex exhibit the plesiomorphic character state. Other Chironominae exhibit both conditions and I have not been able to interpret further outgroup comparisons.

This apomorphy suggests that S. quadrinotatus with a range of 11-16 may in fact be the sister lineage to S. gladius, nudipupa, browni, cinctus and aestivalis which exhibit a total range of 9-14. I consider that S. quadrinotatus has reverted to the plesiomorphic state.

As hypothesized here, S. n.sp. "Peru" also exhibits a partial return to the plesiomorphic condition with a range of 11-14.

91. Anal papillae variably shaped (p); anal papillae constricted, the two with portions of equal diameter (Fig. 77L) (a).

The apomorphic condition is unique.

Ambiguous Character States

A. Coloration of hairs on antenna of male. Some Stenochironomus species exhibit antennae with darkened apical hair. This condition appears to be otherwise unique. However, this apparent apomorphy produces a grouping of species which contradicts numerous other synapomorphies. the character state is present in S. unictus, S. hilaris, S. albipalpus, S. fuscipatellus, S. pannus, S. balteatus, S. gibbus, S. colei, S. pulchripennis, S. poecilopterus, S. tectus, S. nelumbus, and S. nudipupa.

B. Head width/width between eyes. The total range of variation for male adults of Xestochironomus species is 3.27-4.42. Within Stenochironomus only S. annettae and most members of the subgenus Petalopholeus exhibit a range of variation which exceeds 6.00. The following are the exceptions: S. townesi, S. fascipennis, S. nelumbus, S. gladius, S. prolatus, S. vatius, and S. albidorsalis. Possibly this character is a synapomorphy of the species of Petalopholeus with a few reversals to the plesiomorphic condition. In addition, this may indicate that S. fascipennis and S. nelumbus may form the sister group of the rest of Petalopholeus species.

C. Extent of median wing band. In some species of Stenochironomus the median wing band has a basal extension along the posterior margin of the wing which is not present in any other chironomid genera.

This condition appears in at least two lineages: in S. hilaris and related species and in S. nelumbus and S. fascipennis. However, I am not confident that this condition hasn't been lost a

number of times. Many other Stenochironomus species have only weak pigmentation in the medial area of the wing.

D. Cleft between dorsomesal and ventrolateral lobes of female genitalia. S. unictus, S. maculatus, S. bisetosus, S. annettae, and S. niger all have a very narrow cleft between the two lobes. This character state is unique within the Stenochironomus complex but a similar condition appears in some other Chironominae (e.g. Polypedilum, Stictochironomus, Dicrotendipes, Nilodorum, Xenochironomus, Parachironomus, and Demicryptochironomus).

The grouping of species suggested by this possible synapomorphy contradicts that suggested by character 65'.

E. Apodemes of S VIII fused or not fused to medioposterior ridges of female. Within the Stenochironomus complex, the fused condition occurs in S. niger, S. annettae, S. totifuscus, Harrisius pallidus and many other Chironominae (see Saether, 1977). The nonfused condition, however, is the most common condition in the Stenochironomus complex and also is widespread within the Chironominae.

F. Coloration of large teeth of spur on S VIII of pupa. In some Stenochironomus pupae the apex of the largest tooth is pale. I have not observed this condition in other Chironominae, which suggests that it is apomorphic.

However, the grouping of species suggested by this condition S. unictus, S. maculatus, S. totifuscus and S. leptopus, is inconsistent with other synapomorphies.

G. Spur of S VIII of pupa. The pupal spurs of S. unictus and S. maculatus are virtually identical in appearance to one another (Fig.

59E, F). However, I could not define such similarity in terms of an apomorphic condition because the spurs of Harrisius pallidus look somewhat the same.

H. Pigmentation of ligular lobes. Within Stenochironomus, one group of species, defined by synapomorphies 40', 56, 65'', 73, 76, and 81, is unique in exhibiting lobes which are joined by coloration. This suggests that it too is a synapomorphy. However, both conditions (joined or not joined by coloration) occur in the outgroup.

Discussion

Cladograms which summarize the above hypotheses of the polarity of character states within the genus Stenochironomus are provided in Figures 88, 89. The subgenus Petalopholeus (Fig. 89) forms the sister group of Stenochironomus s. str. (Fig. 88). The monophyly of the genus is justified elsewhere (Fig. 89).

I have examined all previously described and nine new species of Stenochironomus from the Afrotropical, Oriental and Australian Regions, (except S. unicalar Freeman, S. antennalis Kieffer and S. harrisoni Freeman which are known only from single specimens). I could not relate any of these to the species depicted in (Fig. 88, 89) with the exception of the species noted under characters 25 and 36.

Townes (1945) on the basis of his investigation of adults of the Nearctic fauna briefly suggested several groupings of Stenochironomus species. S. browni, S. aestivalis, S. cinctus and S. leptopus were grouped on the basis of color pattern, size and genitalia and

labelled as the cinctus group. S. poecilopterus, S. pulchripennis and S. colei were associated by their wing pattern and genitalia. S. macateei and S. unictus were considered intermediate between the pulchripennis group and S. hilaris. This hypothesis is partially borne out by the results of the analysis here.

I consider the cladistic position of several species as particularly tentative and particularly in need of further investigation. These are S. recticaudatus, and S. fascipennis.

The following species, known only as adult males, could not be placed phylogenetically: S. semifumosus, S. zonarius, S. palliaculeatus, S. aculeatus, S. reissi, S. varius, S. hibernicus, S. koreanus. However, on the basis of similar pigmentation of the scutum (unique with Chironominae) and genitalia, S. semifumosus and S. zonarius are probable sister species. S. pallaculeatus and S. aculeatus are probable sister species on the basis of two unique character states: long and slender anal point, and T IX with projecting edge along posterolateral edge of dorsal setal patch.

Autapomorphies of Species in the Stenochironomus Complex

Autapomorphies at the species level cannot be used for phylogenetic analysis. However, Stenochironomus is probably rich in numbers of species and many species are not yet known as larvae or pupae. The following list may therefore be helpful to future workers for the cladistic placement of new forms. Not all autapomorphies are included in this compilation. Only those which were unique to the Stenochironomus complex (unless otherwise noted) and were particularly striking were recorded.

Only the apomorphic state is described, followed by the name of the species exhibiting the condition.

Adult.

- male wing with only CuA1, darkly pigmented (Fig. 14A):
S. unictus.
- pair of pale spots on abdominal tergite 3 (Fig. 26H):
S. bisetosus.
- thorax markedly elongated anteriorly: S. prolatus.
- male T IX markedly produced posteriorly present in two species which I believe to be independent development:
S. impendens (Fig. 34A), S. prolatus (Fig. 35C).
- female setal patch on S VIII anterior to level of cleft around opening of oviduct (Fig. 47A): S. unictus.
- female spermathecal ducts markedly elongate (Fig. 49D):
S. leptopus.
- T IX markedly broadened with lateral patch of dense,

elongate spicules: S. discus.

- female apodemes of S VIII directed transversely (Fig. 48A): S. bisetosus.
- female cleft between dorsomesal and ventrolateral lobes markedly sclerotized (Fig. 49A): S. satorui.

Pupa.

- respiratory organ simple, unbranched (Fig. 54B):
Harrisius pallidus.
- spicules present on apex of swim paddle: pupal form 1.

Larva.

- dorsolateral stripes on head capsule barely discernible (Fig. 76E): New Zealand larval form.
- head capsule markedly pigmented (Fig. 64D): S. maculatus.
- head capsule with pale, Y-shaped line of weakness ventrally (Fig. 64A); this condition is unique in the Chironominae: African larval form.
- seta submenti ventral to paired ridges supporting labiohypopharynx and situated far anteriorly (Fig. 75A); this condition is unique within the Chironominae: African larval form.
- pecten epipharyngis with spicules forked apically although the condition occurs twice these are almost certainly parallelisms: S. gibbus, S. bisetosus.

- chaetula media divided into two groups (Fig. 67A); the condition appears to be unique within the Chironominae: African larval form.
- premandible with four teeth; the condition occurs twice but these almost certainly are independent developments: New Zealand larval form and S. n. sp. "Peru".
- mandible with outer margin deeply indented (Fig. 72G): S. albipalpus.
- cleft between ligular lobes rounded posteriorly (Fig. 73K): S. albipalpus.
- simple seta usually situated near base of procercus absent: S. unictus.

Zoogeography

Hypothesized cladistic relationships may be used to interpret the historical zoogeography of species (Nelson and Platnick, 1981). Such interpretation can reflect repeated patterns of distribution between monophyletic groups, concordance of a cladistic pattern with the known geological and climatological history of an area, or a sequential series of bifurcations that suggest directionality in the origin of a later lineage. I have used all of these possibilities in interpreting some of the cladistic patterns.

Many more species of the Stenochironomus complex undoubtedly await discovery and I am therefore hesitant to provide a detailed interpretation of the zoogeography of the known species. However, some patterns have emerged which seem of particular interest. I discuss these patterns in the expectation that they will be tested as additional information becomes available.

1. Southern continental affinities. The relationships between major lineages of the Stenochironomus complex (Fig. 86) indicate the possibility that continental drift played a role in speciation. However, the cladistic pattern does not match the pattern of geological breakup of Gondwanaland (Rosen, 1978), other than that the African larval form is the sister group to all other members of the Stenochironomus complex.

2. Affinities of Caribbean species. Three species groups within the Stenochironomus complex each have a single Caribbean member. One

group, a lineage of Xestochironomus, contains X. brunneus from southwestern U.S.A., X. latilobus from Venezuela and X. dominicanus from Dominica. I could not further resolve the phylogenetic relationships between these three species. A second group, a lineage of Stenochironomus (Stenochironomus) consists of S. niger from Arizona, S. crusanticus from Ecuador and S. innocuus from St. Vincent. S. innocuus and S. niger are sister species. The third group, a lineage of Stenochironomus (Petalopholeus), contains S. totifuscus from Arizona and California, S. impendens from northern Brazil, and S. leptopus from the Pacific side of Ecuador, St. Vincent, St. Lucia and Dominica. The closest sister groups of each of these lineages are also found in the New World. These congruent patterns therefore suggest that the historical zoogeography of these lineages is best understood in terms of events in the New World.

Recent students of the fauna of the West Indies disagree as to whether distributions are best explained as a result of vicariance (Rosen, 1975) or dispersal (Pregill, 1981). Harrison and Rankin (1976), in their analysis of the freshwater fauna of St. Vincent, suggested that the Caribbean patterns of distribution were best understood as the result of vicariance events although their argument was not supported by cladograms. They recognized circum-Caribbean and African affinities. Saether (1981), in the only detailed study of chironomid species of the West Indies, agreed with the conclusions of Harrison and Rankin (1976) and reported that more species showed phylogenetic affinities with African species than with South American ones (and, as pointed out, perhaps explained as due to a lack of

collecting in South America). My results indicate that Caribbean species in the Stenochironomus complex are most closely related to other New World species.

3. North and South America relationships. Some species groups are represented in both North and South America. Some of these are already discussed above under "Caribbean species". S. bisetosus from Arizona and S. licinus from northern Brazil are sister species and S. n.sp. "Peru" is the sister species of these.

The group browni + cinctus + aestivalis have been found only in eastern North America, their three successive sister groups have been found only in the Neotropical Region. This suggests that the ancestor of S. browni, S. cinctus and S. aestivalis invaded North America from the Neotropical Region. Furthermore, S. browni, as the sister species of the more northerly S. cinctus and S. aestivalis, has not been found outside of Florida. This distribution supports the hypothesized southern origin of the ancestor of these species.

4. Nearctic and Palaearctic affinities. A few species groups reveal patterns within the Holarctic region. S. macateei from eastern North America and S. rcticaudatus from North Korea are hypothesized sister species but, as noted elsewhere (pg. 454), I am not sure of the homology of the single apomorphy used to group them.

Three successive sister groups of the Nearctic species group S. colei + S. pulchripennis + S. poecilopterus + S. tectus are Palaearctic and two of these are confined to Japan (Fig. 88). All these species are now found well south of treeline and their larvae

mine angiosperm wood. Therefore the dispersal of their common ancestor across Beringia probably took place during the existence there of a more continuous mixed mesophytic forest in the Miocene (Matthews, 1979).

5. Affinities within the Nearctic Region. Several pairs of sister species have allopatric distributions within North America. One pair, the eastern S. unictus and the western S. maculatus, are apparently both absent from eastern Texas (Fig. 82F). A second pair, the eastern S. pulchripennis and the western S. colei, are not present in central North America (Fig. 84A). A third pair, S. hilaris which is transcontinental (Fig. 83D), and S. fuscipatellus localized in the Pacific northwest (Fig. 83C), are apparently absent from southern British Columbia although they are sympatric on Vancouver Island (these two species form a trichotomy with the eastern S. albipalpus and may not, therefore, actually be sister species).

Ecological Divergence

Previous knowledge of the ecological requirements of Stenochironomus species concerned only the nature of the larval substrate for a few species (e.g. Kalugina, 1959; Tokunaga and Kuroda, 1936). Information gathered during this study considered primarily whether larvae mined leaves or wood and whether they occurred in running or standing waters.

Ecological differences between species may reflect historical changes. Cladograms developed from structural characteristics can be used, as shown below, to suggest directionality in such ecological divergence.

Fig. 90 shows the relationships of the major lineages of the Stenochironomus complex with the larval substrate added. Three alternate hypotheses suggest either three independent origins of a wood mining habit from leaf mining ancestors, two invasions of leaves from wood mining ancestors, or a reversion to a plesiomorphic leaf mining condition by the ancestor of Stenochironomus (Petalopholeus). Until further lineages can be added to the cladogram, it is difficult to choose between these possibilities. However, independent invasion of wood is the least likely.

Fig. 91 summarizes the distribution of type of habitat (running or standing water) of each species for which information is available, superimposed on the cladogram of those lineages. It is important to note that some species groups are represented by a single line. For example, S. niger, S. cruenticus, S. annettae, S. bisetosus and S. n. sp. "Peru" all form a monophyletic group and are

all in running waters. They are depicted only as a single lineage with the symbol "R" (running water).

The earliest three lineages of the Stenochironomus complex all occur only in running waters. This suggests that the plesiotypic condition for the subsequent lineages is presence in running water habitats.

Within the genus Stenochironomus, numbers of lineages occur in either or both standing and running waters. Cladistic relationships suggest at least four invasions into standing water from running water habitats.

However, it should be noted that some species of Stenochironomus are plastic in their requirements and occur intraspecifically in both standing and running habitats. The remainder seem restricted to one or the other. For example the sister species S. cinctus which occurs in standing water, and S. aestivalis, present only in running water, are broadly sympatric, although the range of S. cinctus extends farther north. Their divergence in habitat requirements illustrates the evolutionary plasticity within the genus.

If rate of movement of water were studied for each species of Stenochironomus, a more refined pattern of habitat occurrence might be apparent.

Conclusion and Suggestions for Future Research

This study of the species of the Stenochironomus complex provides the first comprehensive revision of this structurally diverse and monophyletic assemblage of species.

A general conclusion which emerges from the phylogenetic analysis of this complex is that apomorphic character states of larval, pupal and male and female adult stages indicate congruent patterns of nested sets. This provides a strong basis for the belief that cladistic analysis accurately depicts patterns of evolutionary divergence. Only in a few instances were there indications that convergence or parallelism might have resulted in misleading results.

These congruent patterns from different stages lend support to a methodology based on the recognition that some apomorphic states are more obvious indicators of relationships than are others. Congruence between cladograms of the different life stages indicates that my choice of character states and my interpretation of them as synapomorphies was probably correct. A lack of congruence would have indicated that I had chosen some plesiomorphic or homoplastic character states instead of synapomorphies. My results, however, do not negate the validity of the use of the parsimony techniques as described, for example, by Eldredge and Cracraft (1980).

On the basis of my studies, several areas of future research may be particularly fruitful, and these are outlined below.

Firstly, future collecting of species of the Stenochironomus complex will undoubtedly result in the discovery of many new species. In particular, discovery of the immatures of Afrotropical, Oriental

and Australian species will allow an interpretation of these faunas, an aspect which was generally ~~not~~ possible in this work (see pg. 474). Discovery of new forms will provide a test of the relationships hypothesized in this study. Most critical of all will be the discovery of the pupa and adult stages of the "African larval form" which is the suggested sister group to all other members of the Stenochironomus complex.

Cytological information can be used to infer some phylogenetic relationships (Martin, 1979; Rothfels, 1979) and investigation of the polytene chromosomes of Stenochironomus species would provide an interesting and powerful test of cladistic methods of phylogenetic reconstruction. Alternatively, phylogenetic reconstruction based on cytological investigation might be tested by morphology.

Some of the differences between structurally similar species are discussed under the "taxonomic discussion" of appropriate species. The following would profit from more intensive investigation: S. hilaris (possibly a complex of species); S. hilaris - S. fuscipatellus (possibly conspecific); S. colel - S. pulchripennis (possibly conspecific); S. cinctus - S. aestivalis (possibly ecotypes of a single species).

Finally, the present revision and evolutionary analysis provides a basis for ecological investigations not previously possible. For the first time immatures of at least Nearctic Stenochironomus species can be identified. Because larvae are sedentary and in such a specialized habitat Stenochironomus species would be conducive to life cycle studies. Furthermore, a study of habitat requirements of different species within one habitat and/or intraspecific variation

in different localities would test some ecological hypotheses concerning the nature of resource partitioning, interspecific competition, etc.

All of the above suggests that Stenochironomus species have great potential for further exciting research.

References

- Albu, P. 1963. Chironomidae (Adulte) din bazinul Somessului si al Viseului (Muntii Rodnei). Studii Cerc. Biol. 15:233-236.
- Arnaud, P.H. 1979. A catalog of the types of Diptera in the collection of the California Academy of Sciences. Myia Vol. 1. 505 pp.
- Beck, W.M. and Beck, E.C. 1970. The immature stages of some Chironomini (Chironomidae). Q. Jl. Fla Acad. Sci 33:29-42.
- Borkent, A. 1979. Systematics and bionomics of the species of the subgenus Schadonophasma Dyar and Shannon (Chaoborus, Chaoboridae, Diptera). Quaest. ent. 15:122-255.
- Brundin, L. 1947. Zur Kenntnis der schwedischen Chironomiden. Ark. Zool. 39:1-95.
- Chernovskii, A.A. 1949. Opredelitel lichinok komarov semeistva Tendipedidae. (Identification of larvae of the midge family Tendipedidae). Izd. Akad. Nauk, SSSR 31:1-186.
- Coffman, W. (in press). 22. Chironomidae. In. An introduction to the aquatic insects of North America. 2nd edition. R.W. Merritt, K.W. Cummins (ed.).
- Cocks, E.A.K., M.J. Donoghue and R.J. McGinley. 1981. Characters, computers and cladograms: a review of the Berkeley Cladistics Workshop. Syst. Bot. 6:359-372.
- Coquillett, D.W. 1901. New Diptera in the U.S. National Museum. Proc. U.S. Natn. Mus. 23:593-618.
- Coquillett, D.W. 1902. New Diptera from North America. Proc. U.S. natn. Mus. 25:83-126.

- Craig, D.A. and A. Borkent. 1980. Intra- and inter-familial homologies of maxillary palpal sensilla of larval Simuliidae (Diptera: Culicomorpha). Can. J. Zool. 58:2264-2279.
- Edwards, F.W. 1929. British non-biting midges (Diptera, Chironomidae). Trans. R. ent. Soc. Lond. 77:279-430.
- Eldredge, N. and J. Cracraft. 1980. Phylogenetic patterns and evolutionary processes. Method and theory in comparative biology. Columbia University Press, New York, VIII + 349 pp.
- Fabricius, J.C. 1794. Entomologia systematica emendata et aucta. 4:1-472, Hafniae.
- Fabricius, J.C. 1805. Systema antliatorum secundum ordines, genera, species. 373 pp. + 30 pp., Brunsvigae.
- Fittkau, E.J., D. Schlee and F. Reiss. 1967. Chironomidae. pp. 346-381 In: Limnofauna Europaea. Gustav Fischer Verlag, Stuttgart, XV+474 pp.
- Fleutiaux, E. 1933. Genre nouveau et especes nouvelles d'Eucnemididae de Madagascar (Col.). Bull. Soc. ent. Fr. (1932) : 286-288.
- Fourcroy, A.F. 1785. Entomologia Parisiensis. Vol. 1. Paris, 231 pp.
- Freeman, P. 1957. A study of the Chironomidae (Diptera) of Africa south of the Sahara. III. Bull. Br. Mus. nat. Hist., Ent. 5:323-426.
- Freeman, P. 1959. A study of the New Zealand Chironomidae (Diptera, Nematocera). Bull. Br. Mus. nat. Hist., Ent. 7:395-437.
- Freeman, P. 1961. The Chironomidae (Diptera) of Australia. Aust. J. Zool. 9:611-737.

- Gillespie, J.M. 1974. A biosystematic study of Idaho Chironomini (Diptera: Chironomidae). Ph.D. dissertation, U. of Idaho. 389 pp.
- Gimmerthal, B.A. 1845. Ester Beitrag zu einer kunftig zu bearbeitenden Dipterologie Russlands. Bull. Soc. Imp. Nat. Moskov 17:288-329.
- Goetghebuer, M. 1928. Dipteres (Nematoceres). Chironomidae. III. Chironomariae. Faune Fr. 5:1-174.
- Goetghebuer, M. 1937. Tendipedidae (Chironomidae). b) Subfamilie Tendipedinae) (Chironominae). A. Die Imagines. In: Lindner, E. (ed.): Die Fliegen der palaearktischen Region 13c:1-48, pls. 1-7.
- Griffiths, G.C.D. 1972. The phylogenetic classification of Diptera Cyclorrhapha. W. Junk, The Hague, 340 pp.
- Hackman, W. 1980. A check list of the Finnish Diptera. 1. Nematocera and Brachycera (s.str.). Notul. ent. 60:17-48.
- Harper, P.P. and Cloutier, L. 1979. Chironomini and Pseudochironomini of a Quebec highland stream (Diptera:Chironomidae). In: Saether, O.A. (ed.): Recent development in chironomid studies (Diptera:Chironomidae). Ent. scand. Suppl. 10:81-94.
- Harrison, A.D. 1966. Recolonization of a Rhodesian stream after drought. Arch. Hydrobiol. 62:405-421.
- Harrison, A.D. and J.J. Rankin. 1976. Hydrobiological studies of Eastern Lesser Antillean Islands. II. St. Vincent: Freshwater fauna - its distribution, tropical river zonation and biogeography. Arch. Hydrobiol. Supp. 50:275-311.

- Hecht, M.K. and J.L. Edwards. 1977. The methodology of phylogenetic inference above the species level. In Hecht, M.K., P.C. Goody, and B.M. Hecht (ed.). Major patterns in vertebrate evolution. Vol. 14. NATO Advanced Study Institute Series A. Plenum Press, New York and London.
- Hennig, W. and D. Schlee. 1978. Abriss der phylogenetischen Systematik. Stuttg. Beitr. Naturk. Ser. A. 319. 11 pp.
- Johannsen, O.A. 1905. Aquatic nematoceros Diptera. In: Needham, I.G., Morton, K.I., Johannsen, O.A. (eds.): Mayflies and midges of New York. Bull. N.Y. St. Mus. 86:76-331.
- Johannsen, O.A. 1908. New North American Chironomidae. In: Felt, E.P. (ed): 23rd report of the State Entomologist on injurious and other insects of the State New York, 1907. Bull. N.Y. St. Mus. 124:264-285.
- Johannsen, O.A. 1926. Notes on the synonymy of some New York State Chironomidae. Jl. N.Y. ent. Soc. 34:273-277.
- Johannsen, O.A. 1938. New species of Nematocera from Puerto Rico. J. Agric. Univ. P. Rico 22:219-226.
- Johannsen, O.A. 1942. Immature and adult stages of new species of Chironomidae (Diptera). Ent. News 53:70-77.
- Johnson, C.W. 1925. Fauna of New England. 15. List of the Diptera or two-winged flies. Occ. Pap. Boston Soc. nat. Hist. 7:1-326, 1 fig.
- Kalugina, N.S. 1958. Biologiya i razvitie Stenochironomus gibbus Fabr. (Diptera, Chironomidae). (Biology and development of Stenochironomus gibbus Fabr). Nauch. Dokl. vyssh. Shk. 1:21-26.
- Kalugina, N.S. 1959. O nekotorykh vozrastnykh izmeneniyakh v

- stroenii i biologii lichinok Khironomid (Diptera, Chironomidae). (Some age changes of anatomy and biology of the chironomid larvae). Trudy vses. gidrobiol. Obschch. 9:85-107.
- Kavanaugh, D.H. 1972. Hennig's principles and methods of phylogenetic systematics. Biologist 3:115-127.
- Kieffer, J.J. 1906. Diptera Fam. Chironomidae. - In Wytsman, P. (ed.): Genera insectorum 42:78 pp.
- Kieffer, J.J. 1917. Chironomides d'Amerique conserves au Musee National Hongrois de Budapest. Annls hist.-nat. Mus. natn. hung. 15:292-364.
- Kieffer, J.J. 1919. Chironomiden der Nordlichen Polarregion. Entomol. Mitt. 8:40-48.
- Kieffer, J.J. 1922. Chironomides de l'Afrique Equatoriale (2nd partie). Ann. Soc. ent. Fr. 91:1-72.
- Kieffer, J.J. 1924. Chironomides nouveaux ou rares de l'Europe centrale. Bull. Soc. Hist. nat. Metz 30:11-110.
- Kruseman, G. 1933. Tendipedidae Neerlandicae. I: Genus Tendipes cum generibus finitimis. Tijdschr. Ent. 76:119-216.
- Lehmann, J. 1981. Chironomidae (Diptera) aus Fließgewässern Zentralafrikas. Teil II: Die Region um Kisangani, Zentralzaire. Spixiana Suppl. 5. 85 pp.
- Lenz, F. 1957. Tendipedidae (Chironomidae). b) Subfamilie Tendipedinae (Chironominae). B. Die Metamorphose der Tendipedinae. In: Lindner, E. (ed.): Die Fliegen der palaearktischen Region 13c:169-200.
- Lenz, F. 1962. Tendipedidae (Chironomidae). b) Subfamilie Tendipedinae (Chironominae). B. Die Metamorphose der

Tendipedinae. In Lindner, E. (ed.): Die Fliegen der palaearktischen Region 13 c: 233-260.

Lindeberg, B. 1967. Sibling species delimitation in the Tanytarsus lestagei aggregate (Diptera, Chironomidae). Ann. zool. fenn. 4:45-86.

Linnaeus, C. 1767. Systema Naturae 1(2):533-1068.

Macquart, J. 1834. Historie Naturelle des Insectes. Tome 1. 2. Dipteres: 578 pp., Paris.

Malloch, J.R. 1915a. Four new North American Diptera. Proc. Biol. Soc. Wash. 28:45-48.

Malloch, J.R. 1915b. The Chironomidae, or midges, of Illinois, with particular reference to the species occurring in the Illinois River. Bull. Illin. St. Lab. Nat. Hist. 10:273-543, pls. 17-40.

Malloch, J.R. 1919. The Diptera collected by the Canadian Expedition, 1913-1918 (excluding the Tipulidae and Culicidae). Part C.-Rep. Can. arct. Exped. 3:34-41.

Martin, J. 1979. Chromosomes as tools in taxonomy and phylogeny of chironomidae (Diptera). Entomol. scand. Suppl. 10:67-74.

Matthews, J.V. 1979. 2. Tertiary and Quaternary environments: historical background for an analysis of the Canadian insect fauna. pp. 31-86. In. Canada and its insect fauna. H.V. Danks (ed.). Mem. Entomol. Soc. Can. 108. 573 pp.

Mayr, E. 1969. Principles of systematic zoology. McGraw-Hill Book Co., New York. xi + 428 pp.

McAlpine, J.F. 1981. 2. Morphology and terminology - adults. pp. 9-63. In Manuel of Nearctic Diptera. Vol. 1. Agriculture Canada, Monograph No. 27, 674 pp.

- Meigen, J.W. 1818. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Vol. 1. Aachen.
- Meigen, J.W. 1830. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Vol. 6. Hamm.
- Meigen, J.W. 1851. Systematische Beschreibung der bekannten europäischen zweiflügeligen Insekten. Vol. 1. Halle.
- Meschkat, A. 1936. Zwei neue minierende Insektenlarven aus dem Balaton. Arb. ung. biol. Forsch. Inst. 8:101-105.
- Meuche, A. 1939. Die Fauna im Algenbewuchs. Nach Untersuchungen im Litoral ostholsteinischer Seen. Arch. Hydrobiol. 34:349-520.
- Mitchell, E.G. 1908. Descriptions of nine new species of gnats. J. N.Y. ent. Soc. 16:7-14.
- Nelson, G.J. 1974. Classification as an expression of phylogenetic relationships. Syst. Zool. 23:344-359.
- Nelson, G. and N. Platnick. 1981. Systematics and biogeography. Cladistics and vicariance. Columbia University Press, New York. xi + 567 pp.
- Oliver, D.R. 1981. 29. Chironomidae. pp. 423-458. In. Manual of Nearctic Diptera. Vol. 1. Agriculture Canada, Monograph No. 27, 674 pp.
- Ortiz, C.S. 1946. Catalogo de los Dipteros de Chile. Ministerio de Agricultura. Santiago de Chile. 250 pp.
- Patterson, C. and D.E. Rosen. 1977. Review of Ichthyodectiform and other Mesozoic Teleost fishes and the theory and practice of classifying fossils. Bull. Am. Mus. nat. Hist. 158:81-172.
- Panzer, G.W.F. 1813. Faunae insectorum germanicae initiae oder Deutschlands Insekten. H. 109, 24 pp., Nurnberg.

- Pinder, L.C.V. A key to the adult males of British Chironomidae. Vol. 1, The Key; Vol. 2, Illustrations of the hypopygia. Freshwat. Biol. Assoc., Scient. Publ. 37:169 pp + 189 fig.
- Pinder, L.C.V. and F. Reiss (in press). Chironomidae of the Holarctic Region. Part 1. Larvae. Entomol. scand. Suppl.
- Pregill, G.K. 1981. An appraisal of the vicariance hypothesis of Caribbean biogeography and its application to West Indian terrestrial vertebrates. Syst. Zool. 30:147-155.
- Roback, S.S. 1966. The Catherwood Foundation Peruvian-Amazon Expedition. XII. Diptera, with some observations on the salivary glands of the Tendipedidae. Monogr. Acad. Nat. Sci. Philad. 14:305-375.
- Rochon, R. 1977. L'Entomofaune benthique du Lac Triton a la Station de Biologie de Saint-Hippolyte, Quebec. M.Sc. dissertation, U. of Montreal.
- Rodova, R.A. 1971. Samki Khironomid (Diptera, Chironomidae) VI. (Females of chironomids VI). Trudy Inst. Biol. vnútr. Vod. 22:131-144.
- Romaniszyn, W. 1958. Klucze do oznaczania owadów Polski. Cz. 28, Muchowki-Diptera, Zesz. 14a, Ochotkowate-Tendipedidae. Larwy. (Keys for the identification of Polish insects). Polski Związek entomologiczny 22:1-137.
- Rosen, D.E. 1975. A vicariance model of Caribbean biogeography. Syst. Zool. 24:431-464.
- Rosen, D.E. 1978. Vicariant patterns and historical explanation in biogeography. Syst. Zool. 27:159-188.
- Ross, H.H. 1974. Biological Systematics. Addison-Wesley Pub.

Company, Reading, Mass., 345 pp.

Rothfels, K.H. 1979. Cytotaxonomy of blackflies (Simuliidae). A.

Rev. Ent. 24:507-539.

Saether, O.A. 1977. Female genitalia in Chironomidae and other

Nematocera: morphology, phylogeny, keys. Bull. Fish. Res. Bd.

Can. 197:209 pp.

Saether, O.A. 1981. Orthoclaadiinae (chironomidae: Diptera) from the

British West Indies with descriptions of Antillocladius n.gen.,

Lipurometriocnemus n.gen., Compterosmittia n.gen., and

Diplosmittia n.gen.. Entomol. scand. Suppl. 16:1-46.

Sasa, M. and Yamamoto, M. 1977. A checklist of Chironomidae

recorded from Japan. Jap. J. sanit. Zool. 28:301-318.

Schlee, D. 1976. Structures and functions, their general

significance for phylogenetic reconstruction in recent and

fossil taxa. Zool. Scripta 5:181-184.

Scopoli, J.A. 1763. Entomologia carniolica exhibens insecta

carnioliae indigene et distributa in ordines, genera, species,

varietates methodo Linnaeana. Vindobonae, 421 pp.

Sladen, F.W.L., R.S. Bagnall and J.E. Collin. 1913. Some

interesting British insects. Entomologist's mon. Mag.

49:171-174, pls. 2,3.

Shilova, A.I. 1976. Khironomidy Rybinskogo Vodokhranilishcha.

(Chironomiden des Rybinsker Stausees). Izd. Nauka, Leningrad

1976, 249 p.

Schiner, J.R. 1864. Fauna Austriaca. Die Fliegen (Diptera). II.

Theil, Wien 574-622.

Schlee, D. 1966. Preparation und Ermittlung von Messwerten an

- Chironomiden (Diptera). Gewass. Abwass. 41/42:169-193.
- Skuse, F.A.A. 1889. Diptera of Australia. Part VI. The Chironomidae. Proc. Linn. Soc. N.S.A. 2:215-311.
- Smith, E.L. 1969. Evolutionary morphology of external insect genitalia. 1. Origin and relationships to other appendages. Ann. ent. Soc. Am. 62:1051-1079.
- Soponis, A.R. 1977. A revision of the Nearctic species of Orthocladius (Orthocladius) van der Wulp (Diptera: Chironomidae). Mem. ent. Soc. Can. 102. 187 pp.
- Stark, J. 1981. Chironomidae (nonbiting midges). In Guide to the aquatic insects of New Zealand, ed. by M.J. Winterbourn and K.L.O. Gregson. Bull. ent. Soc. N.Z. 5:80 pp.
- Stevens, P.F. 1980. Evolutionary polarity of character states. Ann. Rev. Ecol. Syst. 11:333-358.
- Sublette, J.E. 1957. The ecology of the macroscopic bottom fauna in Lake Texoma (Denison Reservoir), Oklahoma and Texas. Am. Midl. Nat. 57:371-402.
- Sublette, J.E. 1960. Chironomid midges of California. I. Chironominae, exclusive of Tanytarsini (=Calopsectrini). Proc. U.S. natn. Mus. 112:197-226.
- Sublette, J.E. 1964. Chironomidae (Diptera) of Louisiana I. Systematics and immature stages of some lentic chironomids of west-central Louisiana. Tulane Stud. Zool. 11:109-150.
- Sublette, J.E. 1966. Type specimens of Chironomidae (Diptera) in the American Museum of Natural History. J. Kans. ent. Soc. 39:1-32.
- Sublette, J.E. 1967. Type specimens of Chironomidae (Diptera) in

the Cornell University Collection. J. Kans. ent. Soc.
40:477-564.

Sublette, J.E. and M. Sublette. 1979. Evaluation of long term effects of thermal effluents on stream biota. Part II. A synopsis of the Chironomidae of New Mexico. New Mexico Energy Institute (at New Mexico State University) Final Report 32:53-128.

Sublette, J.E. and Wirth, W.W. 1972. New genera and species of West Indian Chironomidae (Diptera). Fla Ent. 55:1-17.

Teskey, H.J. 1981. 3. Morphology and terminology - larvae. pp. 65-88. In. Manual of Nearctic Diptera. Vol. 1. Agriculture Canada, Monograph No. 27, 674 pp.

Thienemann, A. 1954. Chironomus. Leben, Verbreitung und wirtschaftliche Bedeutung der Chironomiden. Binnengewasser 20:834 pp.

Tokunaga, M. 1956. In Iconographia Insectorum Japonicorum. Hokuryukan Ltd., Tokyo, 1738 pp. + 203 pp. index.

Tokunaga, M. 1959. In Illustrated insect larvae of Japan. Hokuryukan Co., Ltd., Tokyo, 712 pp. + 123 pp. index.

Tokunaga, M. 1964. Insects of Micronesia. Diptera:Chironomidae. Bernice P. Bishop Mus. 12:485-628.

Tokunaga, M. 1965. In. Iconographica Insectorum Japonicorum Colore naturali edita. Vol. 3. Hokuryukan, Tokyo, 358 pp. + 156 pls.

Tokunaga, M. and M. Kuroda. 1935. Unrecorded chironomid flies from Japan (Dipt.) with a description of a new species. Trans. Kansai ent. Soc. 6:1-8.

Tokunaga, M. and M. Kuroda. 1936. Stenochironomid midges from Japan

(Diptera) with notes on controlling methods of a leaf mining midge. Trans. Kansai ent. Soc. 7:1-6.

Townes, H.K. 1945. The nearctic species of Tendipedini (Diptera: Tendipedidae (= Chironomidae)). An. Midl. Nat. 34:1:-206.

Townes, H.K. 1952. Tribe Tendipedini (= Chironomini). In. Johannsen, O.A. and Townes, H.K. Jr.: Guide to the insects of Connecticut. Fifth fascicle. Midges and gnats. Tendipedidae (Chironomidae). Bull. Comm. St. ged. nat. Hist. Surv. 80:3-147, 232-250.

Wahlgren, E. 1922. 1. Orthorapha. Forsta gruppen myggor. Nemocera. In Entomologiska Foreningen, i Stockholm, Svensk Insektfauna. [Order] 11: Diptera. Stockholm 273 pp.

Walker, F. 1848. List of the specimens of dipterous insects in the collection of the British Museum. 1:1-299, London.

Walker, F. 1856. Insecta Britannica: Diptera. Vol. 3 London, 352 pp.

Watrous, L.E. and Q.D. Wheeler. 1981. The out-group comparison method of character analysis. Syst. Zool. 30:1-11.

Wiley, E.O. 1981. Phylogenetics: The theory and practice of phylogenetic systematics. J. Wiley and Sons, Toronto. xv + 439 pp.

Williston, S.W. 1896. On the Diptera of St. Vincent (West Indies). Trans. R. ent. Soc. Lond. 3:253-276.

Wood, D.M. and A. Borkent (in press). Description of the female of Parasimulium crosskeyi Peterson, and a discussion of the phylogenetic position of the genus. Mem. ent. Soc. Wash.

Wulp, F.M. van der. 1877. Diptera Neerlandica, I. M. Nijhoff,

Gravenhage, 497 pp. + 14 pls.

Zabolotskii, A.A. 1939. Lichinki i Kukolki Stenochironomus fascipennis Zett. (Larvae and nymphs of Stenochironomus fascipennis). Uchen. Zap. leningr. gos. Univ. 35:143-148.

Zavrel, J. 1933. Zvlastni larva pakomari (Cryptochironomus sp.) (A peculiar midge larva (Cryptochironomus sp.)). Sb. Klubu prir. Brne 16:10-14.

Zetterstedt, J.W. 1838. Dipterologis Scandinaviae. Sect. 34 Diptera, 477-868.

Zetterstedt. 1850. Diptera Scandinaviae disposita et discripta. IX - 3367-3710, Lund.

Table 1. Descriptive statistics for male adult X. subletti.

Character	N	Range	Mean	SD.
HW/WE	7	3.40-4.00	3.78	0.20
Ant 13/1-12	7	1.25-1.53	1.35	0.11
Palp 3/4	7	0.90-1.12	1.03	0.08
Thorax L (mm)	6	0.91-0.98	0.94	0.02
Fo Tal/Ti	7	1.11-1.20	1.15	0.03
Hd Fe/Ti	7	1.00-1.13	1.04	0.04
WL/M	7	2.47-2.62	2.52	0.05
Cu/M	7	1.21-1.27	1.23	0.02
Gc/Gs	7	0.70-1.00	0.87	0.10
App 2/1	7	1.42-1.78	1.66	0.13

Table 2. Descriptive statistics for male adult X. bulbosus.

Character	N	Range
HW/WE	1	3.85
Ant 13/1-12	1	1.04
Palp 3/4	1	1.14
Thorax L (mm)	1	0.97
Fo Tal/Ti	0	-
Hd Fe/Ti	1	0.96
WL/M	1	2.50
Cu/M	1	1.26
Gc/Gs	1	0.56
App 2/1	1	-

Table 3. Descriptive statistics for male adult X. gilvus.

Character	N	Range
HW/WE	2	3.27-3.43
Ant 13/1-12	2	1.38-1.43
Palp 3/4	1	1.20
Thorax L (mm)	1	0.93
Fo Tal/Ti	1	1.21
Hd Fe/Ti	1	0.98
WL/M	2	2.35-2.54
Cu/M	2	1.20-1.35
Gc/Gs	2	0.68-0.73
App 2/1	2	1.20-1.28

Table 4. Descriptive statistics for male adult X. brunneus.

Character	N	Range	Mean	SD.
HW/WE	8	3.71-4.23	3.94	0.20
Ant 13/1-12	10	1.26-1.42	1.37	0.06
Palp 3/4	10	0.84-1.00	0.92	0.06
Thorax L(mm)	10	0.95-1.15	1.03	0.06
Fo Tal/Ti	10	1.05-1.12	1.08	0.02
Hd Fe/Ti	10	0.97-1.04	1.00	0.02
WL/M	10	2.47-2.58	2.50	0.03
Cu/M	10	1.14-1.24	1.18	0.03
Gc/Gs	9	0.61-0.72	0.66	0.03
App 2/1	9	1.40-1.90	1.66	0.18

Table 5. Descriptive statistics for male adult X. latilobus.

Character	N	Range
HW/WE	1	3.93
Ant 13/1-12	1	1.25
Palp 3/4	1	1.08
Thorax L(mm)	1	1.09
Fo Tal/Ti	1	1.14
Hd Fe/Ti	1	0.99
WL/M	1	2.54
Cu/M	1	1.22
Gc/Gs	1	0.77
App 2/1	1	1.50

Table 6. Descriptive statistics for male adult S. unictus.

Character	N	Range	Mean	SD.
HW/WE	9	4.22-5.00	4.68	0.25
Ant 13/1-12	11	2.20-2.55	2.33	0.12
Palp 3/4	11	1.10-1.56	1.24	0.13
Thorax L(mm)	12	1.40-1.77	1.57	0.10
Fo Tal/Ti	12	1.16-1.28	1.21	0.04
Hd Fe/Ti	11	1.02-1.09	1.07	0.02
WL/M	13	2.28-2.40	2.34	0.04
Cu/M	13	1.08-1.14	1.11	0.02
Gc/Gs	13	0.91-1.15	1.03	0.08
App 2/1	12	2.78-4.03	3.45	0.38

Table 7. Descriptive statistics for male adult S. maculatus.

Character	N	Range	Mean	SD.
HW/WE	8	4.69-5.67	5.32	0.31
Ant 13/1-12	10	1.53-1.83	1.64	0.08
Palp 3/4	10	1.04-1.16	1.12	0.04
Thorax L (mm)	9	1.07-1.46	1.22	0.11
Fo Tal/Ti	10	1.20-1.33	1.24	0.04
Hd Fe/Ti	10	1.03-1.08	1.06	0.04
WL/M	10	2.28-2.32	2.31	0.02
Cu/M	10	1.04-1.08	1.06	0.01
Gc/Gs	10	0.93-1.07	1.01	0.04
App 2/1	10	2.86-4.36	3.55	0.47

Table 8. Descriptive statistics for male adult S. annettae.

Character	N	Range	Mean	SD.
HW/WE	7	4.83-6.56	5.64	-
Ant 13/1-12	8	1.20-1.31	1.26	0.04
Palp 3/4	8	1.16-1.32	1.21	0.06
Thorax L (mm)	8	0.95-1.14	1.06	0.06
Fo Tal/Ti	8	1.16-1.23	1.20	0.02
Hd Fe/Ti	8	1.15-1.18	1.16	0.01
WL/M	8	2.35-2.47	2.41	0.03
Cu/M	8	1.12-1.17	1.14	0.01
Gc/Gs	8	1.08-1.40	1.24	0.11
App 2/1	8	2.67-3.37	3.00	0.24

Table 9. Descriptive statistics for male adult S. crusanticus.

Character	N	Range
HW/WE	1	6.00
Ant 13/1-12	1	1.45
Palp 3/4	1	1.75
Thorax L (mm)	1	1.28
Fo Tal/Ti	1	1.32
Hd Fe/Ti	1	1.08
WL/M	1	2.38
Cu/M	1	1.10
Gc/Gs	1	1.24
App 2/1	1	2.48

Table 10. Descriptive statistics for male adult S. niger.

Character	N	Range
HW/WE	1	5.00
Ant 13/1-12	1	0.70
Palp 3/4	1	1.26
Thorax L(mm)	1	0.99
Fo Tal/Ti	1	1.23
Hd Fe/Ti	1	1.08
WL/M	1	2.46
Cu/M	1	1.08
Gc/Gs	1	1.18
App 2/1	1	2.84

Table 11. Descriptive statistics for male adult S. innocuus.

Character	N	Range	Mean
HW/WE	1	7.38	-
Ant 13/1-12	2	0.57-0.75	0.66
Palp 3/4	2	1.15-1.26	1.20
Thorax L(mm)	2	0.99-1.08	1.03
Fo Tal/Ti	0	-	-
Hd Fe/Ti	2	1.05-1.07	1.06
WL/M	2	2.44-2.45	2.45
Cu/M	2	1.11-1.14	1.13
Gc/Gs	2	1.01-1.08	1.05
App 2/1	2	2.13-2.96	2.55

Table 12. Descriptive statistics for male adult S. bisetosus.

Character	N	Range	Mean
HW/WE	2	5.08-5.18	5.13
Ant 13/1-12	6	0.65-0.71	0.67
Palp 3/4	6	1.04-1.15	1.09
Thorax L(mm)	6	1.08-1.25	1.19
Fo Tal/Ti	6	1.26-1.36	1.30
Hd Fe/Ti	6	1.08-1.11	1.10
WL/M	6	2.40-2.52	2.46
Cu/M	6	1.14-1.16	1.15
Gc/Gs	6	0.99-1.13	1.07
App 2/1	6	2.50-3.23	2.69

Table 13. Descriptive statistics for male adult S. licinus.

Character	N	Range
HW/WE	0	-
Ant 13/1-12	2	1.93-2.60
Palp 3/4	2	1.92-3.33
Thorax L(mm)	2	1.54-1.55
Fo Tal/Ti	0	-
Hd Fe/Ti	2	1.08
WL/M	2	2.42-2.43
Cu/M	2	1.10-1.13
Gc/Gs	2	1.12-1.19
App 2/1	2	3.53-4.13

Table 14. Descriptive statistics for male adult S. fuscipatellus.

Character	N	Range	Mean	SD.
HW/WE	9	3.78-4.63	4.23	0.23
AR	11	1.90-2.09	1.97	0.06
Palp 3/4	11	1.46-1.69	1.57	0.07
Thorax L(mm)	10	1.38-1.54	1.46	0.06
Fo Tal/Ti	10	1.11-1.19	1.15	0.02
Hd Fe/Ti	11	1.09-1.15	1.12	0.02
WL/M	11	2.20-2.31	2.25	0.04
Cu/M	11	1.02-1.07	1.04	0.02
# M setae	11	2-9	5.9	1.9
Gc/Gs	15	.70-.84	0.77	0.04
App 2/1	8	3.62-5.48	4.68	0.63

Table 15. Descriptive statistics for male adult S. albipalpus.

Character	N	Range	Mean	SD.
HW/WE	10	4.13-4.73	4.49	0.21
AR	12	2.06-2.37	2.21	0.10
Palp 3/4	10	1.43-1.67	1.55	0.09
Thorax L(mm)	11	1.29-1.50	1.39	0.07
Fo Tal/Ti	10	1.09-1.22	1.15	0.04
Hd Fe/Ti	12	1.14-1.20	1.17	0.02
WL/M	12	2.23-2.33	2.27	0.04
Cu/M	12	1.00-1.05	1.02	0.02
# M setae	15	0-3	1.13	1.13
Gc/Gs	11	.84-1.00	.90	0.05
App 2/1	11	3.92-4.86	4.28	0.27

Table 16. Descriptive statistics for male adult S. hilaris.

Character	N	Range	Mean	SD.
HW/WE	70	4.00-5.58	4.78	0.35
AR	27	1.80-2.36	2.07	0.12
Palp 3/4	55	1.20-1.68	1.41	0.11
Thorax L (mm)	110	0.90-1.69	1.33	0.16
Fo Tal/Ti	21	1.12-1.31	1.21	0.05
Hd Fe/Ti	113	1.05-1.24	1.14	0.03
WL/M	24	2.17-2.30	2.22	0.04
Cu/M	24	1.00-1.09	1.05	0.02
# M setae	27	5-14	8.8	2.5
Gc/Gs	26	0.82-0.98	0.89	0.05
App 2/1	25	2.74-4.07	3.42	0.36

Table 17. Descriptive statistics for male adult S. macateei.

Character	N	Range	Mean	SD.
HW/WE	9	4.17-4.67	4.47	0.17
Ant 13/1-12	12	1.50-2.10	1.78	0.18
Palp 3/4	13	1.24-1.48	1.38	0.08
Thorax L (mm)	12	0.87-1.23	1.00	0.10
Fo Tal/Ti	8	1.08-1.25	1.19	0.06
Hd Fe/Ti	13	1.01-1.09	1.05	0.02
WL/M	13	2.33-2.42	2.38	0.01
Cu/M	13	1.05-1.15	1.10	0.03
Gc/Gs	14	0.74-0.89	0.81	0.04
App 2/1	14	2.59-4.50	3.45	0.48

Table 18. Descriptive statistics for male adult S. recticaudatus.

Character	N	Range
HW/WE	1	5.60
Ant 13/1-12	1	1.90
Palp 3/4	0	-
Thorax L (mm)	1	1.12
Fo Tal/Ti	1	1.15
Hd Fe/Ti	1	1.06
WL/M	1	2.38
Cu/M	1	1.12
Gc/Gs	1	1.00
App 2/1	1	4.00

Table 19. Descriptive statistics for male adult S. pannus.

Character	N	Range
HW/WE	1	4.83
Ant 13/1-12	2	0.98-1.00
Palp 3/4	2	1.43-1.43
Thorax L (mm)	1	1.27
Fo Tal/Ti	1	1.25
Hd Fe/Ti	2	1.13-1.13
WL/M	2	2.30-2.32
Cu/M	2	1.08-1.10
Gc/Gs	2	0.80-0.84
App 2/1	2	3.46-4.47

Table 20. Descriptive statistics for male adult S. balteatus.

Character	N	Range
HW/WE	1	5.21
Ant 13/1-12	2	2.06-2.10
Palp 3/4	2	1.41-1.47
Thorax L (mm)	2	1.46-1.63
Fo Tal/Ti	2	1.32-1.38
Hd Fe/Ti	2	1.12-1.12
WL/M	2	2.28-2.28
Cu/M	2	1.05-1.06
Gc/Gs	2	0.93-0.97
App 2/1	2	3.84-5.10

Table 21. Descriptive statistics for male adult S. gibbus.

Character	N	Range	Mean	SD
HW/WE	13	4.00-5.33	4.46	0.27
Ant 13/1-12	21	1.86-2.35	2.14	1.12
Palp 3/4	13	1.16-1.58	1.34	0.11
Thorax L (mm)	14	1.04-1.67	1.39	0.18
Fo Tal/Ti	11	1.20-1.33	1.25	0.04
Hd Fe/Ti	23	1.06-1.15	1.09	0.03
WL/M	16	2.18-2.33	2.28	0.04
Cu/M	16	1.03-1.10	1.06	0.02
Gc/Gs	23	0.83-1.00	0.90	0.04
App 2/1	16	4.17-6.00	5.01	0.55

Table 22. Descriptive statistics for male adult S. satorui.

Character	N	Range	Mean
HW/WE	5	4.92-5.70	5.35
Ant 13/1-12	7	1.21-1.94	1.52
Palp 3/4	7	1.30-1.78	1.50
Thorax L(mm)	7	0.85-1.38	1.14
Fo Tal/Ti	7	1.31-1.43	1.39
Hd Fe/Ti	7	1.16-1.22	1.17
WL/M	7	2.18-2.31	2.25
Cu/M	7	1.06-1.09	1.08
Gc/Gs	7	0.78-1.01	0.92
App 2/1	7	4.13-4.87	4.48

Table 23. Descriptive statistics for male adult S. colei.

Character	N	Range	Mean	SD.
HW/WE	8	4.40-4.80	4.61	0.14
AR	20	1.85-2.19	2.04	0.10
Palp 3/4	18	1.13-1.53	1.26	0.11
Thorax L(mm)	10	1.18-1.59	1.45	0.12
# DC setae	9	26-42	34.2	6.3
Fo Tal/Ti	8	1.09-1.20	1.14	0.04
Hd Fe/Ti	8	1.10-1.15	1.13	0.02
Hi Tal/Ti	17	0.74-0.80	0.77	0.02
WL/M	24	2.09-2.29	2.19	0.04
Cu/M	23	.98-1.05	1.01	0.02
Gc/Gs	17	0.74-0.93	0.86	0.05
App 2/1	10	5.63-9.36	7.34	1.07

Table 24. Descriptive statistics for male adult S. pulchripennis.

Character	N	Range	Mean	SD.
HW/WE	11	4.25-4.85	4.53	0.15
AR	18	1.72-2.10	1.91	0.11
Palp 3/4	21	1.14-1.58	1.41	0.11
Thorax L(mm)	10	1.17-1.60	1.38	0.12
# DC setae	11	17-32	23.2	4.5
Fo Tal/Ti	10	1.07-1.23	1.16	0.05
Hd Fe/Ti	11	1.10-1.16	1.13	0.02
Hi Tal/Ti	18	0.78-0.88	0.81	0.02
WL/M	21	2.18-2.39	2.27	0.06
Cu/M	21	1.02-1.11	1.05	0.03
Gc/Gs	19	0.84-1.03	0.95	0.05
App 2/1	11	5.63-11.0	7.28	1.57

Table 25. Descriptive statistics for male adult S. poecilopterus.

Character	N	Range	Mean	SD.
HW/WE	9	4.19-4.92	4.55	0.25
Ant 13/1-12	17	1.94-2.48	2.15	0.15
Palp 3/4	11	1.22-1.51	1.37	0.09
Thorax L(mm)	9	1.16-1.52	1.38	0.13
Fo Tal/Ti	11	1.09-1.30	1.16	0.06
Hd Fe/Ti	11	1.12-1.18	1.15	0.02
WL/M	11	2.21-2.35	2.28	0.04
Cu/M	11	1.03-1.10	1.07	0.02
Gc/Gs	11	0.86-1.09	0.97	0.07
App 2/1	11	5.36-8.00	6.71	0.91

Table 26. Descriptive statistics for male adult S. tectus.

Character	N	Range	Mean	SD.
HW/WE	10	4.06-5.17	4.43	0.35
Ant 13/1-12	19	1.44-1.79	1.63	0.09
Palp 3/4	10	1.37-1.50	1.43	0.05
Thorax L(mm)	10	1.11-1.59	1.33	0.14
Fo Tal/Ti	11	1.07-1.23	1.18	0.05
Hd Fe/Ti	11	1.07-1.19	1.13	0.04
WL/M	12	2.27-2.42	2.33	0.04
Cu/M	12	1.05-1.11	1.08	0.02
Gc/Gs	11	0.86-1.05	0.95	0.07
App 2/1	12	6.53-10.10	7.51	1.25

Table 27. Descriptive statistics for male adult S. totifuscus.

Character	N	Range	Mean
HW/WE	3	5.55-6.33	5.89
Ant 13/1-12	6	1.32-1.41	1.37
Palp 3/4	6	0.95-1.10	1.02
Thorax L(mm)	6	1.07-1.20	1.14
Fo Tal/Ti	5	1.09-1.17	1.13
Hd Fe/Ti	6	1.14-1.19	1.16
WL/M	6	2.36-2.47	2.42
Cu/M	6	1.13-1.17	1.15
Gc/Gs	5	0.97-1.14	1.02
App 2/1	6	3.00-4.00	3.47

Table 28. Descriptive statistics for male adult S. leptopus.

Character	N	Range	Mean	SD.
HW/WE	7	5.88-7.83	6.84	0.34
Ant 13/1-12	10	0.98-1.17	1.09	0.07
Palp 3/4	9	1.08-1.28	1.17	0.06
Thorax L(mm)	11	0.74-0.99	0.89	0.07
Fo Tal/Ti	9	1.20-1.30	1.24	0.03
Hd Fe/Ti	10	1.05-1.15	1.10	0.04
WL/M	11	2.34-2.63	2.41	0.08
Cu/M	11	1.17-1.31	1.21	0.03
Gc/Gs	11	1.03-1.20	1.10	0.05
App 2/1	11	3.47-4.55	3.86	0.33

Table 29. Descriptive statistics for male adult S. impendens.

Character	N	Range	Mean
HW/WE	4	5.22-7.08	6.11
Ant 13/1-12	4	1.24-1.27	1.26
Palp 3/4	4	0.95-1.05	1.02
Thorax L(mm)	4	0.76-0.79	0.77
Fo Tal/Ti	3	1.21-1.26	1.23
Hd Fe/Ti	4	1.04-1.08	1.06
WL/M	4	2.41-2.94	2.56
Cu/M	4	1.20-1.44	1.27
Gc/Gs	4	0.92-1.04	1.01
App 2/1	4	2.06-2.53	2.24

Table 30. Descriptive statistics for male adult S. townesi.

Character	N	Range
HW/WE	1	4.64
Ant 13/1-12	1	1.22
Palp 3/4	0	-
Thorax L(mm)	1	0.96
Fo Tal/Ti	0	-
Hd Fe/Ti	1	1.10
WL/M	1	2.37
Cu/M	1	1.19
Gc/Gs	1	0.97
App 2/1	1	3.71

Table 31. Descriptive statistics for male adult S. discus.

Character	N	Range
HW/WE	1	6.63
Ant 13/1-12	1	0.96
Palp 3/4	0	-
Thorax L (mm)	1	1.00
Fo Tal/Ti	0	-
Hd Fe/Ti	1	1.17
WL/M	1	2.40
Cu/M	1	1.24
Gc/Gs	1	1.03
App 2/1	1	1.72

Table 32. Descriptive statistics for male adult S. nelumbus.

Character	N	Range
HW/WE	1	4.64
Ant 13/1-12	0	-
Palp 3/4	2	1.57-1.61
Thorax L (mm)	2	1.31-1.40
Fo Tal/Ti	2	1.17-1.18
Hd Fe/Ti	2	1.01-1.09
WL/M	2	2.11-2.16
Cu/M	2	1.01-1.04
Gc/Gs	2	0.92-0.94
App 2/1	2	4.39-4.56

Table 33. Descriptive statistics for male adult S. fascipennis.

Character	N	Range	Mean	SD.
HW/WE	6	3.63-4.59	4.07	-
Ant 13/1-12	10	2.08-2.39	2.24	0.10
Palp 3/4	2	1.53-1.78	1.66	-
Thorax L (mm)	9	1.19-1.76	1.48	0.22
Fo Tal/Ti	8	1.14-1.25	1.20	0.04
Hd Fe/Ti	10	1.09-1.13	1.11	0.02
WL/M	11	2.26-2.36	2.32	0.03
Cu/M	11	0.99-1.06	1.04	0.02
Gc/Gs	8	0.76-0.97	0.84	0.09
App 2/1	10	5.79-9.33	7.62	0.02

Table 34. Descriptive statistics for male adult S. bacrionis.

Character	N	Range	Mean
HW/WE	3	4.92-6.90	5.70
Ant 13/1-12	3	1.94-2.16	2.08
Palp 3/4	3	1.33-1.63	1.49
Thorax L (mm)	3	1.04-1.19	1.13
Fo Tal/Ti	3	1.35-1.46	1.40
Hd Fe/Ti	3	1.05-1.07	1.06
WL/M	3	2.29-2.35	2.33
Cu/M	3	1.08-1.12	1.10
Gc/Gs	3	1.01-1.09	-
App 2/1	2	1.94-2.57	-

Table 35. Descriptive statistics for male adult S. pectinatus.

Character	N	Range	Mean	SD.
HW/WE	9	4.92-7.00	5.88	0.58
Ant 13/1-12	11	1.63-1.94	1.77	0.08
Palp 3/4	10	1.22-1.38	1.30	0.05
Thorax L (mm)	9	1.05-1.21	1.08	0.05
Fo Tal/Ti	8	1.31-1.39	1.36	0.03
Hd Fe/Ti	11	1.01-1.04	1.03	0.01
WL/M	11	2.37-2.51	2.44	0.03
Cu/M	11	1.14-1.21	1.17	0.02
Gc/Gs	10	0.85-1.05	0.97	0.06
App 2/1	10	2.05-2.70	2.43	0.17

Table 36. Descriptive statistics for male adult S. gladius.

Character	N	Range	Mean
HW/WE	3	4.67-5.30	4.99
Ant 13/1-12	4	1.56-1.81	1.66
Palp 3/4	4	1.40-1.64	1.49
Thorax L (mm)	3	0.93-1.13	1.02
Fo Tal/Ti	3	1.30-1.43	1.35
Hd Fe/Ti	3	1.08-1.09	1.09
WL/M	5	2.29-2.36	2.31
Cu/M	4	1.07-1.13	1.10
Gc/Gs	3	1.00-1.08	1.03
App 2/1	3	2.20-2.26	2.24

Table 37. Descriptive statistics for male adult S. fittkau.

Character	N	Range	Mean
HW/WE	5	5.64-6.89	6.33
Ant 13/1-12	3	1.59-1.77	1.70
Palp 3/4	5	1.27-1.36	1.31
Thorax L(mm)	4	0.84-1.03	0.97
Fo Tal/Ti	5	1.35-1.41	1.39
Hd Fe/Ti	5	1.04-1.09	1.06
WL/M	5	2.46-2.55	2.51
Cu/M	5	1.14-1.19	1.17
Gc/Gs	5	1.11-1.22	1.14
App 2/1	5	2.96-3.68	3.35

Table 38. Descriptive statistics for male adult S. prolatus.

Character	N	Range
HW/WE	1	4.77
Ant 13/1-12	1	1.88
Palp 3/4	1	1.19
Thorax L(mm)	1	1.12
Fo Tal/Ti	1	1.39
Hd Fe/Ti	1	1.02
WL/M	1	2.42
Cu/M	1	1.18
Gc/Gs	1	1.09
App 2/1	1	2.25

Table 39. Descriptive statistics for male adult S. vatius.

Character	N	Range	Mean
HW/WE	2	4.55-5.40	4.97
Ant 13/1-12	3	1.52-1.68	1.58
Palp 3/4	3	1.52-1.81	1.65
Thorax L(mm)	3	0.81-0.92	0.88
Fo Tal/Ti	1	1.49	-
Hd Fe/Ti	2	1.00-1.04	1.02
WL/M	3	2.30-2.38	2.33
Cu/M	3	1.13-1.16	1.15
Gc/Gs	3	0.89-1.04	0.95
App 2/1	3	3.67-5.55	4.38

Table 40. Descriptive statistics for male adult S. albidorsalis.

Character	N	Range
HW/WE	1	5.75
Ant 13/1-12	1	2.27
Palp 3/4	1	1.44
Thorax L (mm)	1	1.12
Fo Tal/Ti	1	1.50
Hd Fe/Ti	1	1.07
WL/M	1	2.43
Cu/M	1	1.13
Gc/Gs	1	0.85
App 2/1	1	4.05

Table 41. Descriptive statistics for male adult S. triannulatus.

Character	N	Range	Mean
HW/WE	0	-	-
Ant 13/1-12	3	1.89-2.02	1.97
Palp 3/4	1	1.16	-
Thorax L (mm)	3	1.00-1.16	1.10
Fo Tal/Ti	3	1.25-1.36	1.29
Hd Fe/Ti	3	1.10-1.12	1.11
WL/M	3	2.30-2.39	2.34
Cu/M	3	1.13-1.15	1.14
Gc/Gs	3	1.00-1.11	1.04
App 2/1	3	2.12-2.92	2.53

Table 42. Descriptive statistics for male adult S. quadrinotatus.

Character	N	Range	Mean	SD.
HW/WE	10	5.73-6.78	6.26	0.32
Ant 13/1-12	10	1.51-1.80	1.64	0.11
Palp 3/4	10	1.23-1.44	1.32	0.07
Thorax L (mm)	10	1.04-1.22	1.11	0.06
Fo Tal/Ti	10	1.36-1.44	1.39	0.02
Hd Fe/Ti	10	1.01-1.08	1.05	0.02
WL/M	10	2.35-2.48	2.42	0.05
Cu/M	10	1.11-1.17	1.14	0.02
Gc/Gs	7	1.00-1.21	1.08	0.07
App 2/1	7	3.57-4.53	3.99	0.28

Table 43. Descriptive statistics for male adult S. jubatus.

Character	N	Range
HW/WE	1	8.0
Ant 13/1-12	2	2.03-2.15
Palp 3/4	2	1.89-2.00
Thorax L (mm)	2	1.52-1.62
Fo Tal/Ti	1	1.45
Hd Fe/Ti	2	1.14-1.15
WL/M	2	2.31-2.37
Cu/M	2	1.07
Gc/Gs	2	0.99-1.01
App 2/1	2	2.84-3.55

Table 44. Descriptive statistics for male adult S. nudipupa.

Character	N	Range	Mean	SD.
HW/WE	9	5.75-6.71	6.13	0.35
Ant 13/1-12	10	1.28-1.55	1.43	0.09
Palp 3/4	10	1.27-1.43	1.36	0.05
Thorax L (mm)	10	0.78-1.03	0.89	0.08
Fo Tal/Ti	9	1.49-1.61	1.54	0.04
Hd Fe/Ti	10	0.99-1.05	1.02	0.05
WL/M	10	2.31-2.57	2.42	0.06
Cu/M	10	1.11-1.20	1.16	0.02
Gc/Gs	10	1.09-1.30	1.20	0.08
App 2/1	10	3.69-4.82	4.38	0.30

Table 45. Descriptive statistics for male adult S. browni.

Character	N	Range
HW/WE	1	6.22
Ant 13/1-12	1	1.43
Palp 3/4	1	1.65
Thorax L (mm)	1	1.03
Fo Tal/Ti	0	-
Hd Fe/Ti	1	1.03
WL/M	2	2.28-2.39
Cu/M	2	1.10-1.15
Gc/Gs	2	1.05-1.23
App 2/1	2	3.33-3.44

Table 46. Descriptive statistics for male adult S. cinctus.

Character	N	Range	Mean	SD.
HW/WE	15	5.09-6.13	5.60	0.31
Ant 13/1-12	12	1.32-1.67	1.55	0.09
Palp 3/4	14	1.27-1.50	1.37	0.06
Thorax L (mm)	12	0.79-1.11	0.95	0.10
Fo Tal/Ti	22	1.28-1.43	1.35	0.02
Hd Fe/Ti	15	1.02-1.12	1.07	0.02
WL/M	13	2.35-2.54	2.42	0.02
Cu/M	13	1.11-1.21	1.14	0.03
Gc/Gs	14	1.07-1.28	1.19	0.07
App 2/1	14	3.82-5.00	4.37	0.40

Table 47. Descriptive statistics for male adult S. aestivalis.

Character	N	Range	Mean	SD.
HW/WE	10	5.18-6.63	5.71	0.51
Ant 13/1-12	11	1.31-1.64	1.51	0.09
Palp 3/4	11	1.30-1.60	1.49	0.10
Thorax L (mm)	11	0.90-1.14	1.01	0.08
Fo Tal/Ti	13	1.39-1.53	1.45	0.05
Hd Fe/Ti	11	1.06-1.13	1.08	0.02
WL/M	12	2.28-2.49	2.38	0.02
Cu/M	12	1.10-1.14	1.13	0.01
Gc/Gs	13	1.05-1.35	1.24	0.09
App 2/1	13	3.33-5.42	4.37	0.61

Table 48. Descriptive statistics for male adult S. hibernicus.

Character	N	Range	Mean
HW/WE	3	4.21-4.53	4.42
Ant 13/1-12	4	1.73-1.85	1.79
Palp 3/4	4	1.50-1.63	1.56
Thorax L (mm)	5	1.10-1.36	1.20
Fo Tal/Ti	0	-	-
Hd Fe/Ti	5	0.91-1.01	0.98
WL/M	3	2.39-2.43	2.41
Cu/M	3	1.14-1.18	1.16
Gc/Gs	4	0.84-0.88	0.86
App 2/1	5	4.13-5.71	4.84

Table 49. Descriptive statistics for male adult S. koreanus.

Character	N	Range
HW/WE	1	5.08
Ant 13/1-12	1	2.18
Palp 3/4	1	1.30
Thorax L(mm)	1	1.19
Fo Tal/Ti	1	1.18
Hd Fe/Ti	1	1.11
WL/M	1	2.28
Cu/M	1	1.08
Gc/Gs	1	0.89
App 2/1	1	4.17

Table 50. Descriptive statistics for male adult S. zonarius.

Character	N	Range
HW/WE	1	6.46
Ant 13/1-12	1	2.48
Palp 3/4	1	1.88
Thorax L(mm)	1	1.71
Fo Tal/Ti	0	-
Hd Fe/Ti	1	1.10
WL/M	1	2.25
Cu/M	1	1.05
Gc/Gs	1	1.12
App 2/1	1	3.26

Table 51. Descriptive statistics for male adult S. semifumosus.

Character	N	Range
HW/WE	0	1
Ant 13/1-12	1	2.42
Palp 3/4	1	1.44
Thorax L(mm)	0	-
Fo Tal/Ti	1	1.37
Hd Fe/Ti	1	1.10
WL/M	1	2.19
Cu/M	1	0.97
Gc/Gs	1	1.06
App 2/1	1	3.39

Table 52. Descriptive statistics for male adult S. reissi.

Character	N	Range	Mean
HW/WE	5	4.92-5.80	5.25
Ant 13/1-12	4	1.48-1.87	1.65
Palp 3/4	5	1.40-1.67	1.52
Thorax L(mm)	4	0.95-1.11	1.02
Fo Tal/Ti	5	1.23-1.34	1.26
Hd Fe/Ti	5	0.98-1.02	1.00
WL/M	5	2.40-2.51	2.47
Cu/M	5	1.13-1.25	1.19
Gc/Gs	4	0.91-0.97	0.94
App 2/1	5	2.48-3.00	2.63

Table 53. Descriptive statistics for male adult S. aculeatus.

Character	N	Range
HW/WE	1	4.86
Ant 13/1-12	1	2.04
Palp 3/4	1	1.05
Thorax L(mm)	1	1.20
Fo Tal/Ti	1	1.50
Hd Fe/Ti	1	1.03
WL/M	1	2.56
Cu/M	1	1.21
Gc/Gs	1	1.30
App 2/1	1	2.50

Table 54. Descriptive statistics for male adult S. palliaculeatus.

Character	N	Range	Mean
HW/WE	2	4.27-4.42	4.34
Ant 13/1-12	2	1.60-1.91	1.75
Palp 3/4	2	1.46-1.59	1.52
Thorax L(mm)	2	0.97-1.09	1.03
Fo Tal/Ti	2	1.42-1.44	1.43
Hd Fe/Ti	2	1.04-1.05	1.04
WL/M	2	2.34-2.37	2.36
Cu/M	2	1.15-1.17	1.16
Gc/Gs	2	1.13-1.24	1.18
App 2/1	2	3.00-3.41	3.18

Table 55. Descriptive statistics for male adult S. varius.

Character	N	Range
HW/WE	2	5.56-5.89
Ant 13/1-12	2	1.20-1.26
Palp 3/4	0	-
Thorax L(mm)	2	0.94-0.98
Fo Tal/Ti	0	-
Hd Fe/Ti	2	1.09-1.10
WL/M	2	2.51-2.52
Cu/M	2	1.14-1.28
Gc/Gs	2	0.68-0.78
App 2/1	2	3.32-3.61

Table 56. Descriptive statistics for female adult X. subletti.

Character	N	Range	Mean	SD.
Palp 3/4	10	0.88-1.00	0.95	0.05
Thorax L(mm)	9	0.84-1.06	0.92	0.06
Fo Tal/Ti	10	1.17-1.25	1.23	0.02
Hi Fe/Ti	10	0.99-1.06	1.03	0.02
WL/M	10	2.57-3.17	2.75	0.16
Gen Fk/Cer	10	2.22-2.58	2.37	0.14

Table 57. Descriptive statistics for female adult X. bulbosus.

Character	N	Range	Mean	SD.
Palp 3/4	4	0.98-1.07	1.01	-
Thorax L(mm)	8	1.05-1.29	1.18	0.08
Fo Tal/Ti	7	1.20-1.30	1.25	-
Hi Fe/Ti	8	0.96-1.04	1.01	0.03
WL/M	8	2.58-2.80	2.71	0.07
Gen Fk/Cer	8	1.64-2.04	1.78	0.13

Table 58. Descriptive statistics for female adult X. brunneus.

Character	N	Range	Mean	SD.
Palp 3/4	9	0.74-0.88	0.81	0.05
Thorax L (mm)	9	0.94-1.25	1.10	0.13
Fo Tal/Ti	9	1.11-1.17	1.14	0.02
Hi Fe/Ti	9	1.00-1.07	1.03	0.03
WL/M	9	2.65-2.84	2.71	0.05
Gen Fk/Cer	8	1.79-2.32	2.06	0.17

Table 59. Descriptive statistics for female adult X. latilobus.

Character	N	Range
Palp 3/4	0	-
Thorax L (mm)	2	1.13-1.29
Fo Tal/Ti	2	1.13
Hi Fe/Ti	2	1.02-1.05
WL/M	2	2.74-2.85
Gen Fk/Cer	2	1.66-1.70

Table 60. Descriptive statistics for female adult H. pallidus.

Character	N	Range
Palp 3/4	1	1.14
Thorax L (mm)	1	1.29
Fo Tal/Ti	0	-
Fi Fe/Ti	1	1.00
WL/M	1	2.79
Gen Fk/Cer	1	1.84

Table 61. Descriptive statistics for female adult S. unictus.

Character	N	Range	Mean	SD.
Palp 3/4	10	1.02-1.13	1.06	0.04
Thorax L(mm)	9	1.66-1.98	1.85	0.12
Fo Tal/Ti	8	1.26-1.36	1.29	0.04
Hi Fe/Ti	10	1.03-1.07	1.05	0.01
WL/M	10	2.51-2.71	2.59	0.06
Gen Fk/Cer	9	1.28-1.78	1.59	0.16

Table 62. Descriptive statistics for female adult S. maculatus.

Character	N	Range	Mean	SD.
Palp 3/4	10	0.92-1.14	1.07	0.07
Thorax L(mm)	10	1.27-1.75	1.54	0.14
Fo Tal/Ti	7	1.23-1.31	1.28	-
Hi Fe/Ti	10	1.02-1.10	1.05	0.02
WL/M	10	2.36-2.54	2.44	0.05
Gen Fk/Cer	10	1.38-1.85	1.61	0.14

Table 63. Descriptive statistics for female adult S. annettae.

Character	N	Range
Palp 3/4	1	1.10
Thorax L (mm)	2	1.35-1.50
Fo Tal/Ti	2	1.24-1.25
Hi Fe/Ti	2	1.11-1.16
WL/M	2	2.58-2.62
Gen Fk/Cer	1	1.59

Table 64. Descriptive statistics for female adult S. crusanticus.

Character	N	Range
Palp 3/4	1	1.49
Thorax L (mm)	1	1.31
Fo Tal/Ti	1	1.35
Hi Fe/Ti	1	1.09
WL/M	1	2.44
Gen Fk/Cer	1	1.66

Table 65. Descriptive statistics for female adult S. niger.

Character	N	Range
Palp 3/4	2	1.17-1.18
Thorax L (mm)	2	1.50-1.68
Fo Tal/Ti	2	1.28-1.31
Hi Fe/Ti	2	1.06-1.12
WL/M	2	2.47-2.51
Gen Fk/Cer	1	1.35

Table 66. Descriptive statistics for female adult S. bisetosus.

Character	N	Range	Mean	SD.
Palp 3/4	10	1.02-1.15	1.08	0.05
Thorax L (mm)	10	1.36-1.63	1.52	0.09
Fo Tal/Ti	10	1.30-1.39	1.34	0.03
Hi Fe/Ti	10	1.07-1.13	1.09	0.02
WL/M	10	2.51-2.66	2.62	0.04
Gen Fk/Cer	10	1.26-1.43	1.32	0.06

Table 67. Descriptive statistics for female adult S. fuscipatellus.

Character	N	Range	Mean	SD.
Palp 3/4	13	1.27-1.54	1.41	0.08
Thorax L(mm)	13	1.41-1.94	1.64	0.14
Fo Tal/Ti	13	1.21-1.30	1.27	0.03
Hi Fe/Ti	13	1.11-1.16	1.14	0.01
WL/M	13	2.28-2.46	2.38	0.04
Gen Fk/Cer	13	1.48-1.84	1.73	0.11

Table 68. Descriptive statistics for female adult S. albipalpus.

Character	N	Range	Mean	SD.
Palp 3/4	9	1.30-1.48	1.40	0.07
Thorax L(mm)	6	1.50-1.70	1.62	-
Fo Tal/Ti	5	1.19-1.26	1.22	-
Hi Fe/Ti	8	1.15-1.21	1.18	-
WL/M	9	2.31-2.40	2.35	0.04
Gen Fk/Cer	9	1.64-1.93	1.79	0.01

Table 69. Descriptive statistics for female adult S. hilaris.

Character	N	Range	Mean	SD.
Palp 3/4	22	1.14-1.43	1.30	0.08
Thorax L(mm)	28	0.99-1.94	1.58	0.23
Fo Tal/Ti	27	0.71-1.41	1.27	0.13
Hi Fe/Ti	28	1.09-1.23	1.15	0.03
WL/M	26	2.26-2.54	2.38	0.07
Gen Fk/Cer	34	1.60-2.50	2.01	0.21

Table 70. Descriptive statistics for female adult S. macateei.

Character	N	Range	Mean	SD.
Palp 3/4	10	1.13-1.42	1.28	0.09
Thorax L(mm)	10	1.08-1.38	1.27	0.10
Fo Tal/Ti	9	1.24-1.36	1.28	0.05
Hi Fe/Ti	10	1.02-1.07	1.05	0.02
WL/M	10	2.35-2.63	2.49	0.09
Gen Fk/Cer	10	1.66-2.09	1.80	0.15

Table 71. Descriptive statistics for female adult S. balteatus.

Character	N	Range	Mean
Palp 3/4	3	1.29-1.30	1.29
Thorax L(mm)	2	1.80-1.87	1.84
Fo Tal/Ti	3	1.30-1.46	1.38
Hi Fe/Ti	3	1.10-1.14	1.12
WL/M	3	2.38-2.51	2.43
Gen Fk/Cer	3	1.53-1.54	1.54

Table 72. Descriptive statistics for female adult S. gibbus.

Character	N	Range	Mean	SD.
Palp 3/4	9	1.15-1.52	1.29	0.12
Thorax L(mm)	8	1.57-2.01	1.85	0.19
Fo Tal/Ti	5	1.24-1.39	1.30	-
Hi Fe/Ti	7	1.09-1.16	1.13	-
WL/M	6	2.33-2.43	2.39	-
Gen Fk/Cer	7	1.39-1.70	1.59	-

Table 73. Descriptive statistics for female adult S. satorui.

Character	N	Range	Mean	SD.
Palp 3/4	10	1.16-1.60	1.41	0.13
Thorax L(mm)	9	1.12-1.68	1.34	0.17
Fo Tal/Ti	8	1.30-1.48	1.37	0.07
Hi Fe/Ti	10	1.09-1.17	1.13	0.03
WL/M	10	2.35-2.51	2.41	0.05
Gen Fk/Cer	8	1.27-1.89	1.60	0.21

Table 74. Descriptive statistics for female adult S. colei.

Character	N	Range	Mean	SD.
Palp 3/4	9	1.07-1.27	1.14	0.07
Thorax L(mm)	7	1.41-1.91	1.60	-
# DC setae	7	46-89	60.9	-
Fo Tal/Ti	12	1.15-1.28	1.21	0.04
Hi Fe/Ti	9	1.10-1.19	1.14	0.03
Hi Tal/Ti	12	0.73-0.77	0.75	0.01
WL/M	18	2.23-2.36	2.30	0.04
# M setae	18	13-40	25.0	7.7
Gen fk/Cer	9	1.35-1.91	1.55	0.18

Table 75. Descriptive statistics for female adult S. pulchripennis.

Character	N	Range	Mean	SD.
Palp 3/4	14	1.29-1.46	1.37	0.05
Thorax L(mm)	13	1.32-1.69	1.55	0.11
# DC setae	14	24-50	40.4	7.7
Fo Tal/Ti	23	1.24-1.41	1.30	0.04
Hi Fe/Ti	14	1.11-1.17	1.14	0.02
Hi Tal/Ti	22	0.77-0.84	0.81	0.02
WL/M	26	2.34-2.51	2.42	0.04
# M setae	26	2-9	4.9	2.1
Gen Fk/Cer	14	1.29-1.71	1.49	0.12

Table 76. Descriptive statistics for female adult S. poecilopterus.

Character	N	Range	Mean	SD.
Palp 3/4	11	1.13-1.38	1.29	0.07
Thorax L(mm)	11	1.28-1.55	1.46	0.08
Fo Tal/Ti	9	1.27-1.38	1.32	0.04
Hi Fe/Ti	11	1.07-1.16	1.13	0.02
WL/M	11	2.34-2.48	2.41	0.04
Gen Fk/Cer	11	1.27-1.48	1.38	0.07

Table 77. Descriptive statistics for female adult S. tectus.

Character	N	Range	Mean	SD.
Palp 3/4	15	1.17-1.40	1.31	0.06
Thorax L(mm)	17	1.30-1.89	1.64	0.17
Fo Tal/Ti	12	1.22-1.32	1.27	0.03
Hi Fe/Ti	15	1.10-1.16	1.13	0.02
WL/M	15	2.38-2.62	2.47	0.06
Gen Fk/Cer	18	1.22-1.45	1.31	0.07

Table 78. Descriptive statistics for female adult S. totifuscus.

Character	N	Range	Mean
Palp 3/4	2	0.90-0.92	0.91
Thorax L(mm)	3	1.30-1.46	1.38
Fo Tal/Ti	3	1.25-1.28	1.27
Hi Fe/Ti	3	1.16-1.18	1.17
WL/M	3	2.45-2.52	2.49
Gen Fk/Cer	3	1.27-1.56	1.40

Table 79. Descriptive statistics for female adult S. leptopus.

Character	N	Range	Mean
Palp 3/4	4	1.10-1.19	1.15
Thorax L (mm)	4	0.82-1.16	0.97
Fo Tal/Ti	2	1.40	1.40
Hi Fe/Ti	5	1.09-1.21	1.14
WL/M	5	2.40-2.54	2.46
Gen Fk/Cer	4	1.62-2.00	1.85

Table 80. Descriptive statistics for female adult S. nelumbus.

Character	N	Range
Palp 3/4	1	1.51
Thorax L (mm)	2	1.39-1.41
Fo Tal/Ti	2	1.33-1.42
Hi Fe/Ti	2	1.12-1.14
WL/M	2	2.30-2.33
Gen Fk/Cer	1	1.64

Table 81. Descriptive statistics for female adult S. fascipennis.

Character	N	Range
Palp 3/4	1	1.60
Thorax L (mm)	2	1.39-1.89
Fo Tal/Ti	1	1.30
Hi Fe/Ti	2	1.08-1.11
WL/M	2	2.06-2.42
Gen Fk/Cer	1	1.64

Table 82. Descriptive statistics for female adult S. quadrinotatus.

Character	N	Range	Mean
Palp 3/4	3	1.07-1.30	1.18
Thorax L (mm)	3	1.14-1.20	1.17
Fo Tal/Ti	1	1.50	-
Hi Fe/Ti	3	0.99-1.04	1.01
WL/M	3	2.41-2.57	2.48
Gen Fk/Cer	2	2.31-2.51	2.41

Table 83. Descriptive statistics for female adult S. jubatus.

Character	N	Range	Mean
Palp 3/4	3	1.60-1.77	1.67
Thorax L (mm)	3	2.13-2.22	2.16
Fo Tal/Ti	0	-	-
Hi Fe/Ti	3	1.12-1.13	1.12
WL/M	3	2.39-2.44	2.41
Gen Fk/Cer	3	1.31-1.48	1.38

Table 84. Descriptive statistics for female adult S. nudipupa.

Character	N	Range
Palp 3/4	2	1.30-1.52
Thorax L (mm)	2	0.85-1.01
Fo Tal/Ti	2	1.67-1.69
Hi Fe/Ti	2	0.98-1.01
WL/M	2	2.47-2.48
Gen Fk/Cer	2	2.03-2.09

Table 85. Descriptive statistics for female adult S. browni.

Character	N	Range
Palp 3/4	2	1.52-1.68
Thorax L (mm)	2	1.02-1.16
Fo Tal/Ti	0	-
Hi Fe/Ti	2	1.03-1.04
WL/M	2	2.43-2.50
Gen Fk/Cer	2	1.86-1.91

Table 86. Descriptive statistics for female adult S. cinctus.

Character	N	Range	Mean	SD.
Palp 3/4	11	1.21-1.50	1.33	0.08
Thorax L (mm)	10	0.90-1.24	1.08	0.12
Fo Tal/Ti	10	1.38-1.52	1.43	0.04
Hi Fe/Ti	10	1.03-1.07	1.05	0.01
Hi Tal/Ti	10	0.68-0.73	0.71	0.02
WL/M	10	2.43-2.59	2.49	0.05
Gen Fk/Cer	11	1.71-2.26	2.04	0.15

Table 87. Descriptive statistics for female adult S. aestivalis.

Character	N	Range	Mean	SD.
Palp 3/4	10	1.42-1.70	1.52	0.11
Thorax L (mm)	10	1.06-1.54	1.30	0.17
Fo Tal/Ti	9	1.42-1.56	1.47	0.05
Hi Fe/Ti	10	1.04-1.09	1.07	0.06
Hi Tal/Ti	10	0.72-0.77	0.74	0.01
WL/M	10	2.39-2.63	2.49	0.07
Gen Fk/Cer	8	1.61-2.24	1.94	0.24

Table 88. Descriptive statistics for length of pupal T II (in u).

Species	N	Mean	Minimum	Maximum	SD
<u>X. subletti</u>	11	439	359	563	64.9
<u>X. brunneus</u>	6	408	359	466	-
<u>H. pallidus</u>	3	427	388	485	-
<u>S. unictus</u>	17	832	708	1077	116.5
<u>S. maculatus</u>	21	665	524	854	95.8
<u>S. crusanticus</u>	4	648	563	728	-
<u>S. niger</u>	3	634	514	844	-
<u>S. annettae</u>	9	599	456	786	101.9
<u>S. bisetosus</u>	15	677	553	844	98.5
<u>S. n.sp. "Peru"</u>	2	844	776	912	-
<u>S. hilaris</u>	29	813	620	980	106.7
<u>S. albipalpus</u>	12	656	582	805	66.1
<u>S. fuscipatellus</u>	15	794	660	921	78.8
<u>S. macateei</u>	23	582	417	728	79.2
<u>S. gibbus</u>	1	1057	-	-	-
<u>S. poecilopterus</u>	28	700	466	854	92.3
<u>S. colei</u>	16	694	621	815	50.3
<u>S. pulchripennis</u>	17	743	650	902	81.4
<u>S. totifuscus</u>	12	518	340	922	154.8
<u>S. leptopus</u>	2	441	417	466	-
<u>S. nelumbus</u>	3	588	524	630	-
<u>S. pupal form 1</u>	1	582	-	-	0.0
<u>S. bacrionis</u>	2	509	495	524	-
<u>S. gladius</u>	3	449	427	466	-
<u>S. vatus</u>	1	485	-	-	-
<u>S. albidorsalis</u>	1	543	-	-	-
<u>S. quadrinotatus</u>	10	500	446	563	37.8
<u>S. nudipupa</u>	10	396	340	514	65.1
<u>S. cinctus</u>	17	507	436	611	53.3
<u>S. aestivalis</u>	19	565	427	757	91.0

Table 89. Descriptive statistics for pupal respiratory organ horn length/length of T II.

Species	N	Mean	Minimum	Maximum	SD
<u>X. subletti</u>	11	.52	0.33	0.64	0.11
<u>X. brunneus</u>	6	0.69	0.57	0.74	-
<u>H. pallidus</u>	1	1.03	-	-	-
<u>S. unictus</u>	8	0.71	0.57	1.00	0.15
<u>S. maculatus</u>	9	0.87	0.72	1.04	0.11
<u>S. cruentatus</u>	2	0.82	0.74	0.90	-
<u>S. niger</u>	3	0.74	0.66	0.84	-
<u>S. annettae</u>	7	0.89	0.85	0.96	0.04
<u>S. bisetosus</u>	9	0.38	0.32	0.42	0.02
<u>S. n. sp. "Peru"</u>	2	0.50	0.44	0.56	-
<u>S. hilaris</u>	14	0.25	0.07	0.40	0.01
<u>S. albipalpus</u>	7	0.12	0.00	0.20	-
<u>S. fuscipatellus</u>	13	0.10	0.00	0.36	0.09
<u>S. macateei</u>	11	0.82	0.57	1.08	0.16
<u>S. poecilopterus</u>	16	1.01	0.81	1.22	0.10
<u>S. colei</u>	12	0.96	0.76	1.12	0.12
<u>S. pulchripennis</u>	13	1.04	0.87	1.18	0.09
<u>S. totifuscus</u>	11	0.69	0.45	0.87	0.11
<u>S. leptopus</u>	2	0.70	0.63	0.77	-
<u>S. bacrionis</u>	2	1.13	1.10	1.17	-
<u>S. quadrinotatus</u>	7	0.86	0.75	0.97	-
<u>S. nudipupa</u>	8	1.02	0.70	1.23	0.19
<u>S. cinctus</u>	11	1.14	0.78	1.36	0.22
<u>S. aestivalis</u>	10	1.06	0.80	1.21	0.14

Table 90. Descriptive statistics for pupal respiratory organ horn length/width.

Species	N	Mean	Minimum	Maximum	SD
<u>X. subletti</u>	11	9.2	5.4	16.0	3.6
<u>X. brunneus</u>	6	18.1	12.8	23.0	-
<u>H. pallidus</u>	1	10.3	-	-	-
<u>S. unictus</u>	8	12.1	9.0	16.7	2.7
<u>S. maculatus</u>	9	17.7	15.0	24.1	2.8
<u>S. crusanticus</u>	2	9.7	9.5	10.0	-
<u>S. niger</u>	3	8.4	6.3	11.0	2.4
<u>S. annettae</u>	7	13.7	12.3	16.0	1.6
<u>S. bisetosus</u>	9	5.7	5.0	6.5	.45
<u>S. hilaris</u>	14	10.4	3.8	20.2	4.8
<u>S. albipalpus</u>	7	5.8	0.0	10.0	3.3
<u>S. fuscipatellus</u>	13	4.7	0.0	13.3	3.4
<u>S. macateei</u>	11	16.6	12.7	20.2	2.3
<u>S. poecilopterus</u>	15	20.0	15.4	28.0	3.3
<u>S. colei</u>	12	22.2	14.8	28.3	4.1
<u>S. pulchripennis</u>	13	24.0	19.2	30.6	4.1
<u>S. totifuscus</u>	11	11.4	7.3	14.4	1.8
<u>S. leptopus</u>	2	13.5	11.7	15.4	2.6
<u>S. fascipennis</u>	1	5.0	-	-	-
<u>S. bacronis</u>	2	10.2	10.0	10.5	-
<u>S. quadrinotatus</u>	7	10.4	8.0	12.0	1.4
<u>S. nudipupa</u>	9	16.1	10.0	18.2	2.4
<u>S. xinctus</u>	11	13.8	8.7	19.8	3.1
<u>S. aestivalis</u>	11	13.2	9.6	18.1	2.8

Table 91. Descriptive statistics for fourth instar larvae of African larval form.

Character	N	Range
Head L (u)	1	5.14
Head L/W	1	1.06
Anterior W/W	1	0.62
Ant. seg. 1 L/W	1	4.00
Ant. seg. 1 seta/L	1	0.62
# anal hooks	1	15

Table 92. Descriptive statistics for fourth instar larvae of X. subletti.

Character	N	Range	Mean
Head L (u)	7	3.69-4.36	4.07
Head L/W	7	1.15-1.23	1.20
Anterior W/W	7	0.73-0.76	0.75
Para W/Anterior W	7	0.71-0.77	0.74
Ant. seg. 1 L/W	5	3.50-4.17	3.74
Ant. seg. 1 seta L	6	0.45-0.58	0.52
# anal hooks	4	12-15	13.8

Table 93. Descriptive statistics for fourth instar larvae of X. brunneus.

Character	N	Range	Mean	SD.
Head L (u)	10	446-533	485	30.3
Head L/W	10	1.07-1.22	1.15	0.04
Anterior L/W	9	0.74-0.78	0.75	0.01
Para W/Anter. W	9	0.59-0.63	.61	0.02
Ant. seg. 1 L/W	10	3.86-4.86	4.20	0.37
Ant. seg. 1 seta/l	10	0.59-0.63	0.61	0.01
# anal hooks	9	13-15	14.1	0.60

Table 94. Descriptive statistics for fourth instar larvae of
X. larval form one.

Character	N	Range
Head L (u)	1	427
Head L/W	0	-
Anterior W/W	0	-
Para W/Anterior W	1	0.64
Ant.seg.1 L/W	1	4.17
Ant.seg.1 seta/L	1	0.44
# anal hooks	1	15

Table 95. Descriptive statistics for fourth instar larvae of
X. larval form two.

Character	N	Range	Mean
Head L (u)	0	-	-
Head L/W	0	-	-
Anterior W/W	0	-	-
Para W/Anterior W	0	-	-
Ant.seg.1 L/W	7	3.71-4.50	4.08
Ant.seg.1 seta/L	7	0.50-0.60	0.54
# anal hooks	5	12-15	13.2

Table 96. Descriptive statistics for fourth instar larvae of
New Zealand larval form.

Character	N	Range	Mean
Head L (u)	6	533-620	592
Head L/W	6	1.00-1.13	1.07
Anterior W/W	6	0.69-0.76	0.73
Ant.seg.1 L/W	5	2.75-3.57	3.27
Ant.seg.1 seta/L	5	0.61-0.77	0.68
# anal hooks	3	16-19	17.0

Table 97. Descriptive statistics for fourth instar larvae of Harrisius pallidus.

Character	N	Range	Mean	SD.
Head L (u)	8	504-659	560	49.1
Head L/W	6	1.00-1.13	1.07	-
Anterior W/W	8	0.70-0.77	0.73	0.03
Ant. seg. 1 L/W	7	2.89-4.00	3.34	-
Ant. seg. 1 seta L	7	0.61-0.69	0.65	-
# anal hooks	5	14-17	15.4	-

Table 98. Descriptive statistics for fourth instar larvae of S. unictus.

Character	N	Range	Mean	SD.
Head L (u)	29	650-970	811	85.9
Head L/W	27	1.00-1.19	1.09	0.05
Anterior W/W	27	0.71-0.85	0.76	0.03
Ant. seg. 1 L/W	30	2.92-4.55	3.77	0.35
Ant. seg. 1 seta L	30	0.61-0.76	0.69	0.04
# anal hooks	21	9-11	10.5	0.68

Table 99. Descriptive statistics for fourth instar larvae of S. maculatus.

Character	N	Range	Mean	SD.
Head L (u)	10	514-660	584	52.9
Head L/W	10	1.03-1.15	1.11	0.04
Anterior W/W	10	0.68-0.75	0.42	0.02
Ant. seg. 1 L/W	9	3.25-4.14	3.81	0.33
Ant. seg. 1 seta L	10	0.56-0.64	0.60	0.03
# anal hooks	7	10-11	10.6	-

Table 100. Descriptive statistics for fourth instar larvae of S. annettae.

Character	N	Range	Mean
Head L (u)	3	640-679	653
Head L/W	3	1.06-1.12	1.09
Anterior W/W	3	0.71-0.75	0.73
Ant.seg.1 L/W	3	3.33-3.50	3.99
Ant.seg.1 seta/L	3	0.67-0.70	0.69
# anal hooks	1	11	-

Table 101. Descriptive statistics for fourth instar larvae of S. cruentatus.

Character	N	Range
Head L (u)	1	640
Head L/W	1	1.12
Anterior W/W	1	0.66
Ant.seg.1 L/W	1	4.57
Ant.seg.1 seta/L	1	0.72
# anal hooks	1	11

Table 102. Descriptive statistics for fourth instar larvae of S. niger.

Character	N	Range	Mean
Head L (u)	4	708-757	737
Head L/W	4	1.07-1.18	1.15
Anterior W/W	4	0.72-0.89	0.78
Ant.seg.1 L/W	3	3.78-4.22	4.00
Ant.seg.1 seta/L	3	0.75-0.77	0.76
# anal hooks	1	10	-

Table 103. Descriptive statistics for fourth instar larvae of S. bisetosus.

Character	N	Range	Mean	SD.
Head L (u)	14	534-786	693	83.6
Head L/W	14	1.06-1.21	1.14	0.05
Anterior W/W	14	0.72-0.79	0.75	0.02
Ant.seg.1 L/W	8	3.57-4.44	4.08	0.28
Ant.seg.1 seta L	8	0.67-0.78	0.72	0.04
# anal hooks	10	9-11	10.2	0.6

Table 104. Descriptive statistics for fourth instar larvae of S. n. sp. "Peru".

Character	N	Range	Mean
Head L (u)	0	-	-
Head L/W	0	-	-
Anterior W/W	0	-	-
Ant.seg.1 L/W	3	3.80-4.11	3.94
Ant.seg.1 seta/L	3	0.70-0.73	0.71
# anal hooks	3	11-14	12.7

Table 105. Descriptive statistics for fourth instar larvae of S. fuscipatellus.

Character	N	Range	Mean	SD.
Head L (u)	16	582-766	6.54	48.1
Head L/W	15	1.07-1.19	1.13	0.03
Anterior W/W	16	0.65-0.72	0.68	0.02
Ant.seg.1 L/W	14	3.50-4.71	4.15	0.39
Ant.seg.1 seta L	14	0.66-0.80	0.74	0.04
# anal hooks	10	9-11	10.1	0.57

Table 106. Descriptive statistics for fourth instar larvae of
S. albipalpus.

Character	N	Range	Mean	SD.
Head L (u)	11	601-795	675	67.7
Head L/W	11	1.07-1.21	1.12	0.05
Anterior W/W	11	0.66-0.72	0.70	0.02
Ant.seg.1 L/W	12	3.44-4.86	4.14	0.40
Ant.seg.1 seta L	12	0.66-0.77	0.72	0.04
# anal hooks	5	10-11	10.4	-

Table 107. Descriptive statistics for fourth instar larvae of
S. hilaris.

Character	N	Range	Mean	SD.
Head L (u)	13	534-757	670	73.6
Head L/W	12	1.05-1.25	1.14	0.07
Anterior W/W	12	0.66-0.72	0.69	0.02
Ant.seg.1 L/W	21	3.50-5.00	4.20	0.40
Ant.seg.1 seta L	21	0.69-0.83	0.76	0.04
# anal hooks	12	9-11	10.3	0.75

Table 108. Descriptive statistics for fourth instar larvae of
S. macateef.

Character	N	Range	Mean	SD.
Head L (u)	16	407-640	468	55.7
Head L/W	15	1.05-1.19	1.11	0.04
Anterior W/W	16	0.62-0.74	0.67	0.03
Ant.seg.1 L/W	14	3.14-4.80	3.62	0.46
Ant.seg.1 seta L	12	0.48-0.71	0.64	0.07
# anal hooks	9	9-11	10.0	0.50

Table 109. Descriptive statistics for fourth instar larvae of male adult S. gibbus.

Character	N	Range
Head L (u)	0	-
Head L/W	0	-
Anterior W/W	0	-
Ant.seg.1 L/W	1	3.44
Ant.seg.1 seta/L	1	0.74
# anal hooks	1	10

Table 110. Descriptive statistics for fourth instar larvae of S. colei.

Character	N	Range	Mean	SD.
Head L (u)	18	620-766	690	48.6
Head L/W	18	1.03-1.23	1.15	0.05
Anterior W/W	18	0.66-0.75	0.72	0.03
Ant.seg.1 L/W	17	3.44-4.88	4.16	0.41
Ant.seg.1 seta L	17	0.67-0.79	0.71	0.03
# anal hooks	11	9-11	10.5	0.69

Table 111. Descriptive statistics for fourth instar larvae of S. pulchripennis.

Character	N	Range	Mean	SD.
Head L (u)	16	592-776	695	46.7
Head L/W	16	1.03-1.18	1.11	0.05
Anterior W/W	16	0.66-0.74	0.70	0.03
Ant.seg.1 L/W	16	3.67-4.63	4.24	0.28
Ant.seg.1 seta L	16	0.68-0.82	0.73	0.04
# anal hooks	7	10-11	10.1	-

Table 112. Descriptive statistics for fourth instar larvae of
S. poecilopterus.

Character	N	Range	Mean	SD.
Head L (u)	10	534-698	614	48.6
Head L/W	8	1.07-1.18	1.13	0.04
Anterior W/W	8	0.65-0.71	0.68	0.02
Ant.seg.1 L/W	11	3.44-4.67	4.04	0.41
Ant.seg.1 seta L	11	0.63-0.72	0.67	0.03
# anal hooks	7	10-12	10.6	-

Table 113. Descriptive statistics for fourth instar larvae of
S. totifuscus.

Character	N	Range	Mean	SD.
Head L (u)	11	398-485	450	25.0
Head L/W	11	0.87-1.04	0.97	0.05
Anterior W/W	11	0.58-0.68	0.64	0.03
Ant.seg.1 L/W	8	2.86-4.75	3.70	0.61
Ant.seg.1 seta L	8	0.55-0.67	0.61	0.04
# anal hooks	7	12-16	13.4	-

Table 114. Descriptive statistics for fourth instar larvae of
S. leptopus.

Character	N	Range	Mean	SD.
Head L (u)	13	339-407	371	19.5
Head L/W	12	0.89-1.00	0.94	0.04
Anterior W/W	12	0.51-0.60	0.57	0.03
Ant.seg.1 L/W	6	3.20-4.75	3.93	-
Ant.seg.1 seta L	6	0.50-0.67	0.59	-
# anal hooks	4	12-15	13.3	-

Table 115. Descriptive statistics for fourth instar larvae of S. nelumbus.

Character	N	Range	Mean
Head L (u)	3	466-485	479
Head L/W	3	0.88-0.96	0.93
Anterior W/W	3	0.57-0.58	0.58
Ant. seg. 1 L/W	2	3.50-3.50	3.50
Ant. seg. 1 seta L	2	0.57-0.62	0.60
# anal hooks	2	14-16	15

Table 116. Descriptive statistics for fourth instar larvae of S. larval form one.

Character	N	Range
Head L (u)	0	-
Head L/W	0	-
Anterior W/W	0	-
Ant. seg. 1 L/W	1	6.00
Ant. seg. 1 seta/L	1	0.63
# anal hooks	1	9

Table 117. Descriptive statistics for fourth instar larvae of S. bacronis.

Character	N	Range
Head L (u)	2	427-466
Head L/W	2	0.92-0.98
Anterior W/W	2	0.60-0.63
Ant. seg. 1 L/W	2	3.83-6.50
Ant. seg. 1 seta/L	2	0.61-0.65
# anal hooks	2	10-11

Table 118. Descriptive statistics for fourth instar larvae of S. gladius.

Character	N	Range	Mean
Head L (u)	2	320-388	354
Head L/W	2	0.92-0.95	0.94
Anterior W/W	2	0.64-0.67	0.66
Ant.seg.1 L/W	2	3.60-5.50	4.55
Ant.seg.1 seta/L	2	0.50-0.59	0.55
# anal hooks	2	10-12	11

Table 119. Descriptive statistics for fourth instar larvae of S. quadrinotatus.

Character	N	Range	Mean	SD.
Head L (u)	11	427-534	485	38.1
Head L/W	11	0.87-0.98	0.93	0.04
Anterior W/W	11	0.55-0.65	0.62	0.03
Ant.seg.1 L/W	9	2.71-6.50	3.67	1.10
Ant.seg.1 seta L	9	0.50-0.67	0.60	0.05
# anal hooks	7	11-16	13.7	-

Table 120. Descriptive statistics for fourth instar larvae of S. nudipupa.

Character	N	Range	Mean	SD.
Head L (u)	10	340-388	366	17.1
Head L/W	10	0.88-1.00	0.94	0.04
Anterior W/W	10	0.52-0.63	0.59	0.03
Ant.seg.1 L/W	9	3.60-6.33	4.49	0.90
Ant.seg.1 seta L	9	0.56-0.67	0.61	0.04
# anal hooks	9	9-10	9.56	0.53

Table 121. Descriptive statistics for fourth instar larvae of S. cinctus.

Character	N	Range	Mean	SD.
Head L (u)	20	388-495	440	34.8
Head L/W	20	0.90-1.04	0.99	0.03
Anterior W/W	21	0.53-0.62	0.58	0.03
Ant.seg.1 L/W	14	2.83-6.33	3.98	0.99
Ant.seg.1 seta L	14	0.41-0.65	0.59	0.06
# anal hooks	17	9-12	10.2	0.75

Table 122. Descriptive statistics for fourth instar larvae of S. aestivalis.

Character	N	Range	Mean	SD.
Head L (u)	12	388-553	475	51.7
Head L/W	12	0.89-1.04	0.98	0.05
Anterior W/W	12	0.55-0.61	0.58	0.02
Ant.seg.1 L/W	9	2.86-5.40	3.62	0.77
Ant.seg.1 seta L	9	0.55-0.67	0.61	0.04
# anal hooks	10	9-14	11.2	1.5

Table 123. Numbers of Stenochironomus unictus larvae collected from Alnus branches placed in Duncan Lk., Masham Twp.; Quebec on 20-X-1979. * indicates the presence of many old mines from which pupae have emerged. (C) indicates Alnus branches placed in plexiglas cage in the early spring of 1981 (see pg. 147 for further details).

	Larval Instar		
Sampling Date	2	3	4
23-V-1980	-	-	-
18-X-1980	1	7	54
9-V-1981	-	-	33
16-V-1981	-	2	28
13-VI-1981 (C)	-	-	9*
12-VII-1981 (C)	-	-	7*
19-VII-1981	-	23	6*
19-VII-1981 (C)	-	-	3*
8-IX-1981 (C)	-	-	18*

Table 124. Numbers of *Stenochironomus cinctus* larvae and pupae collected from oak leaves in Duncan Lk., Masham Twp., Quebec. * indicates leaves in cage placed in lake in fall of 1980. ** indicates leaves not infested on 19-VII-1981.

Sampling Date	Larval Instar				Pupae	Larval exuviae
	1	2	3	4		
2-VIII-1980	6	16	15	30	11	14
9-V-1981	25	1	-	-	-	-
9-V-1981*	-	-	-	-	-	-
18-V-1981	7	12	-	-	-	-
18-V-1981*	-	-	-	-	-	-
13-VI-1981	-	1	1	21	3	5
13-VI-1981*	-	-	-	-	-	1
12-VII-1981*	1	5	4	17	4	17
19-VII-1981*	-	4	3	9	-	34
25-VII-1981*	7	22	16	6	-	21
25-VII-1981**	1	2	-	-	-	-
7-IX-1981**	11	-	-	1	1	-
10-X-1981**	1	-	-	-	-	2
10-X-1981	1	-	-	-	-	-

Table 125. Intraspecific variation of male adult *S. hilaris*.
 A= both fore and hind tibiae entirely pigmented; B= fore tibia only partially pigmented; C= both fore and hind tibiae only partially pigmented.

Character	n	X	<u>A</u>	2 SE	1.5 SD
			range		
Thorax L	46	1227	902-1406	33	167
Fo Fe/Ti	50	1.09	0.93-1.26	0.01	0.07
Hi Fe/Ti	48	1.15	1.09-1.24	0.01	0.04
Hi Tal/Ti	15	0.77	0.73-.80	0.01	0.04

Character	n	X	<u>B</u>	2 SE	1.5 SD
			range		
Thorax L	22	1357	1154-1601	54	190
Fo Fe/Ti	13	1.08	1.05-1.12	0.02	0.04
Hi Fe/Ti	24	1.14	1.09-1.16	0.01	0.02
Hi Tal/Ti	5	0.78	0.76-.79	-	-

Character	n	X	<u>C</u>	2 SE	1.5 SD
			range		
Thorax L	42	1436	1096-1687	41	200
Fo Fe/Ti	36	1.05	1.00-1.14	0.01	0.05
Hi Fe/Ti	41	1.13	1.05-1.19	0.01	0.04
Hi Tal/Ti	12	0.80	0.76-.90	0.02	0.05

Figure 1 A - L. Pigmentation of dorsum of thorax of adults:

- (A) X. brunneus; (B) X. latilobus; (C) S. maculatus;
(D) S. annettae; (E) S. niger; (F) S. innocuus;
(G) S. bisetosus; (H) S. licinus; (I) S.
fuscipatellus; (J) S. albipalpus; (K-L) S. hilaris

Figure 2 A - L. Pigmentation of dorsum of thorax of adults:

(A) S. pennus; (B) S. balteatus; (C) S. gibbus;

(D) S. satorui; (E-F) S. colei; (G-H) S.

pulchripennis; (I-J) S. poecilopterus; (K) S. tectus;

(L) S. totifuscus

7

Figure 3 A - L. Pigmentation of dorsum of thorax of adults:

- (A) S. leptopus; (B) S. impendens; (C) S. townesi;
(D) S. discus; (E) S. fascipennis; (F) S. bacrionis;
(G) S. pectinatus; (H) S. gladius; (I) S. fittkaui;
(J) S. triannulatus; (K) S. quadrinotatus;
(L) S. jubatus
-

Figure 4 A - H. Pigmentation of dorsum of thorax of adults:

- (A) S. nudipupa; (B) S. browni; (C) S. cinctus;
(D) S. aestivalis; (E) S. koreanus; (F) S. zonarius;
(G) S. semifumosus; (H) S. aculeatus

estimated from
lateral view

Figure 5 A - E. Pigmentation of adult thorax in lateral aspect:

(A) X. brunneus; (B) X. latilobus; (C) S. maculatus;

(D) S. annettae; (E) S. crusanticus

Figure 6 A-F. Pigmentation of adult thorax in lateral aspect:

- (A) S. niger; (B) S. innocuus; (C) S. bisetosus;
(D) S. licinus; (E) S. fuscipatellus;
(F) S. albipalpus

A

B

C

D

E

F

Figure 7 A - F. Pigmentation of adult thorax in lateral aspect:

(A-B) S. hilaris; (C) S. pannus; (D) S. balteatus;

(E) S. gibbus; (F) S. satorui

Figure 8 A - F. Pigmentation of adult thorax in lateral aspect:

- (A) S. colei; (B) S. pulchripennis; (C) S. poecilopterus; (D) S. totifuscus; (E) S. leptopus;
(F) S. impendens

A

B

C

D

E

F

Figure 9 A - F. Pigmentation of adult thorax in lateral aspect:

- (A) S. townesi; (B) S. discus; (C) S. fascipennis;
(D) S. bacrionis; (E) S. pectinatus; (F) S. gladius

A

B

C

D

E

F

Figure 10 A - F. Pigmentation of adult thorax in lateral aspect:

- (A) S. fittkau; (B) S. albidorsalis; (C) S. triannulatus; (D) S. quadrinotatus; (E) S. jubatus;
(F) S. nudipupa

A

B

C

D

E

F

Figure 11 A - F. Pigmentation of adult thorax in lateral aspect:

- (A) S. browni; (B) S. cinctus; (C) S. aestivalis;
(D) S. hibernicus; (E) S. koreanus; (F) S. zonarfus.

Figure 12 A - C. Pigmentation of adult thorax in lateral aspect:

(A) S. semifumosus; (B) S. aculeatus; (C) S. varius

Figure 13 A - E. Shape of thorax in lateral aspect:

(A) S. prolatus; (B-E) Shape of scutum in lateral aspect;

(B) S. unictus; (C) S. cinctus; (D) S. hilaris;

(E) S. albipalpus

Figure 14 A - J. Pigmentation of wing:

- (A) S. unictus male; (B) S. unictus female; (C) S. maculatus; (D) S. annettae; (E) S. fuscipatellus; (F) S. albipalpus; (G-H) S. hilaris; (I) S. pannus; (J) S. balteatus

Figure 15 A - J. Pigmentation of wing:

- (A) S. gibbus; (B) S. n. sp. "Japan" female, from Tokunaga and Kuroda (1935); (C) S. colei; (D) S. pulchripennis;
(E) S. poecilopterus; (F) S. totifuscus;
(G) S. leptopus; (H) S. discus; (I) S. nelumbus
female, from Tokunaga and Kuroda (1935); (J) S. fascipennis

Figure 16 A - F. Pigmentation of wing:

- (A) S. pectinatus; (B) S. albidorsalis; (C) S. triannulatus; (D) S. cinctus; (E) S. jubatus;
(F) S. semifumosus

Figure 17 A - F. Pigmentation of male fore and hind legs:

(A) X. subletti; (B) X. brunneus; (C) X. latilobus;

(D) S. maculatus; (E) S. annettae; (F) S. crusanticus

Figure 18, A - F. Pigmentation of male fore and hind legs:

(A) S. niger; (B) S. bisetosus; (D) S. licinus;

(E) S. fuscipatellus; (F) S. albipalpus

Figure 19 A - F. Pigmentation of male fore and hind legs:
(A-B) S. hilaris; (C) S. pannus; (D) S. balteatus;
(E) S. n. sp. "Japan"; (F) S. satorui

Figure 20 A - F. Pigmentation of male fore and hind legs:
(A) S. gibbus from Europe; (B) S. gibbus from Riihimäki;
(C) S. gibbus from Korea; (D) S. colei maximum
pigmentation; (E-F) S. pulchripennis

Figure 21 A - F. Pigmentation of male fore and hind legs:

(A-B) S. poecilopterus; (C-D) S. tectus;

(E) S. totifuscus; (F) S. leptopus

Figure 22 A - F. Pigmentation of male fore and hind legs:

(A) S. impendens; (B) S. townesi; (C) S. discus;

(D) S. nelumbus; (E) S. fascipennis; (F) S. bacrionis

Figure 23 A - F. Pigmentation of male fore and hind legs:

- (A) S. pectinatus; (B) S. gladius; (C) S. fittkaui;
- (D) S. albidorsalis; (E) S. triannulatus;
- (F) S. quadrinotatus

Figure 24 A - F. Pigmentation of male fore and hind legs:

(A) S. browni; (B-C) S. cinctus; (D-E) S. aestivalis;

(F) S. nudipupa

Figure 25 A - E. Pigmentation of male fore and hind legs:

(A) S. jubatus; (B) S. hibernicus; (C) S. koreanus;

(D) S. zonarius; (E) S. varius

Figure 26 A - J. Pigmentation of male abdomen:

- (A) X. brunneus; (B) X. latilobus; (C) S. maculatus;
(D) S. annettae; (E) S. crusanticus; (F) S. niger;
(G) S. innocuus; (H) S. bisetosus; (I) S. totifuscus;
(J) S. leptopus

Figure 27 A - J. Pigmentation of male abdomen:

- (A) S. impendens; (B) S. townesi; (C) S. discus;
(D) S. bacrionis; (E) S. pectinatus; (F) S. fittkaui;
(G) S. albidorsalis; (H) S. triannulatus; (I) S.
quadrinotatus; (J) S. jubatus

Figure 28 A - G. Pigmentation of male abdomen:

- (A) S. nudipupa; (B) S. browni; (C) S. cinctus maximum
pigmentation; (D) S. aestivalis minimum pigmentation;
(E) S. hibernicus; (F) S. zonarius; (G) S. semifumosus

Figure 29 A - C. Male genitalia:

(A) X. subletti; (B) X. brunneus; (C) H. montanus

Figure 30 A - C. Male genitalia:

(A) S. unictus; (B) S. maculatus; (C) S. annettae

Figure 31 A - D. Male genitalia:

(A) S. niger; (B) S. bisetosus; (C) S. albipalpus;

(D) S. hilaris

Figure 32 A - D. Male genitalia:

- (A) S. macateei; (B) S. recticaudatus; (C) S. pannus;
(D) S. gibbus

Figure 33 A.- D. Male genitalia:

(A) S. satorui; (B) S. poecilopterus; (C) S.
totifuscus; (D) S. leptopus

Figure 34 A - D. Male genitalia:

- (A) S. impendens; (B) S. discus; (C) S. nelumbus;
(D) S. fascipennis

Figure 35 A - D. Male genitalia:

(A) S. pectinatus; (B) S. gladius; (C) S. prolatus;

(D) S. vatius

Figure 36 A - D. Male genitalia:

(A) S. triannulatus; (B) S. quadrinotatus; (C) S.
nudipupa; (D) S. cinctus

Figure 37 A - D. Male genitalia:

(A) S. hibernicus; (B) S. koreanus; (C) S. zonarius;

(D) S. reiss.

Figure 38 A - B. Male genitalia:

(A) S. aculeatus; (B) S. varius

Figure 39 A - N. Anal point of male adult in lateral aspect:

- (A) X. subletti; (B) X. bulbosus; (C) X. gilvus;
(D) X. brunneus; (E) X. latilobus; (F) H. montanus;
(G) S. unictus; (H) S. maculatus; (I) S. annettae;
(J) S. niger; (K) S. innocuus; (L) S. bisetosus;
(M) S. licinus; (N) S. fuscipatellus

Figure 40 A - N. Anal point of male adult in lateral aspect:

- (A) S. albipalpus; (B-C) S. hilaris; (D) S. macateei;
(E) S. recticaudatus; (F) S. pannus; (G-H) S. gibbus;
(I) S. n. sp. "Japan"; (J) S. satorui; (K) S. colei;
(L) S. poecilopterus; (M-N) S. tectus.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

Figure 41 A - N. Anal point of male adult in lateral aspect:

(A) S. totifuscus; (B) S. leptopus; (C) S. impendens;

(D) S. townesi; (E) S. discus; (F) S. nelumbus;

(G-H) S. fascipennis; (I) S. bacrionis; (J) S.

pectinatus; (K) S. gladius; (L) S. fittkaui;

(M) S. prolatus; (N) S. vatius.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

Figure 42 A - N. Anal point of male adult in lateral aspect:

- (A) S. albidorsalis; (B) S. triannulatus; (C-D) S. quadrimotatus; (E) S. jubatus; (F) S. nudipupa;
(G) S. browni; (H) S. cinctus; (I) S. hibernicus;
(J) S. koreanus; (K) S. semifumosus; (L) S. reissi;
(M) S. aculeatus; (N) S. varius

Figure 43 A - L. Appendage 2 of male adult in lateral aspect:

- (A) S. unictus; (B) S. maculatus; (C) S. bisetosus;
- (D) S. annettae; (E) S. niger; (F) S. innocuus;
- (G) S. fuscipatellus; (H) S. albipalpus;
- (I) S. hilaris; (J) S. macateei; (K) S. gibbus;
- (L) S. balteatus

Figure 44 A - L. Appendage 2 of male adult in lateral aspect:

- (A) S. pannus; (B-C) S. satorui; (D) S. colet;
(E) S. pulchripennis; (F) S. poecilopterus;
(G) S. tectus; (H) S. totifuscus; (I) S. leptopus;
(J) S. fascipennis; (K) S. gladius;
(L) S. quadrinotatus

Figure 45 A - D. Appendage 2 of male adults in lateral aspect:

- (A) S. cinctus; (B) S. hibernicus; (C) S. varius;
(D) S. discus

Figure 46 A - C. Female genitalia:

(A) X. subletti; (B) H. pallidus; (C) H. montanus

Figure 47 A - D. Female genitalia:

(A) S. unictus; (B) S. maculatus; (C) S. annettae;

(D) S. niger

Figure 48 A - D. Female genitalia:

(A) S. bisetosus; (B) S. fuscipatellus;

(C) S. hilaris; (D) S. macateei

Figure 49 A - D. Female genitalia:

(A) S. satorui; (B) S. poecilopterus;

(C) S. totifuscus; (D) S. leptopus

Figure 50 A - B. Female genitalia:

(A) S. quadrinotatus; (B) S. cinctus

8

OF/ DE

8

Figure 51 A - F. Tibial spurs of male adult:

- (A) X. subletti midleg; (B) X. subletti hindleg;
- (C) Harrisius midleg, arrow pointing to gap between spurs;
- (D) Harrisius hindleg, arrow pointing to gap between spurs;
- (E) S. hilaris midleg; (F) S. hilaris hindleg

Figure 52 A - C. Leg postures of male adults (positions determined with photographs of live individuals):
(A) X. brunneus; (B) S. niger; (C) S. colei. Position of larval exuviae during pupal development (drawn from photographs): (D) S. unictus; (E) S. nudipupa (note compacted larval exuviae)

D

E

Figure 53 A - C. Dorsomedial projection of pupal head capsule:

(A) S. unictus; (B) S. cinctus; (C) S. gladius

Figure 54 A - D. Left pupal respiratory organ in lateral aspect:

(A) S. subletti; (B) H. pallidus; (C) S. unictus;

(D) S. bisetosus

Figure 55. A - C. Left pupal respiratory organ in lateral aspect:

(A) S. hilaris; (B) S. poecilopterus; (C) S. cinctus

(also showing apex of filament)

Figure 56 A - F. Pupal tergites II - III:

- (A) H. pallidus; (B) X. brunneus; (C) S. unictus;
(D) S. hilaris; (E) S. albipalpus; (F) S. gibbus

Figure 57 A - C. Pupal tergites II - III:

(A) S. totifuscus; (B) S. quadrinotatus; (C) S.
cinctus; (D) tergite IV of S. quadrinotatus

Figure 58 A - D. Pupal tergites of VII - VIII:

- (A) X. brunneus; (B) S. totifuscus; (C) S. cinctus;
(D) S. quadrinotatus

Figure 59 A - F. Pupal spurs on S VIII;

(A-B) H. pallidus; (C) X. brunneus; (D) X. subletti;

(E) S. unictus; (F) S. maculatus

A

B

C

D

E

F

Figure 60 A - F. Pupal spurs on S VIII:

- (A) S. bisetosus; (B) S. n. sp. "Peru"; (C) S. annettae;
(D) S. niger; (E) S. fuscipatellus; (F) S. albipalpus

Figure 61 A - F. PupaI spurs on S VIII:

- (A) S. hilaris; (B) S. macateei; (C) S. gibbus;
(D) S. pulchripennis; (E) S. ^{LP}colei;
(F) S. poecilopterus

Figure 62 A - F. Pupal spurs on S.VIII:

- (A) S. totifuscus; (B) S. gladius; (C) S. pupal form one
(D) S. quadrinotatus; (E) S. nudipupa; (F) S. cinctus

Figure 63 A - B. Measurements and parts of larval head capsule
of S. unictus:
(A) dorsal; (B) ventral

A

B

Figure 64 A - D. Larval head capsule:

- (A) African larval form; (B) X. subletti; (C) H. pallidus;
(D) S. maculatus

Figure 65 A - C. Larval head capsule:

(A) S. bisetosus; (B) S. hilaris; (C) S. cinctus

Figure 66 A - I. SEM photomicrographs of larval head capsule
of S. unictus: —

(A) anterolateral aspect; (B) ventral aspect of anterolateral
portion of head capsule; (C) labrum; (D) antennal segment
two; (E) maxilla; (F) apex of maxillary palp; (G) labio
hypopharynx in dorsal aspect; (H) labiohypopharynx in
ventral aspect; (I) hooks of anterior proleg

Figure 67 A - C. Labrum of fourth instar larva:

(A) African larval form; (B) X. subletti; (C) New Zealand
larval form

Figure 68 A - C. Labrum of fourth instar larva:

(A) H. pallidus; (B) S. unictus; (C) S. hilaris

A

B

C

Figure 69 A - C. Labrum of fourth instar larva:

(A) S. macateei; (B) S. poecilopterus; (C) S.
totifuscus

A

B

C

Figure 70 A - B. Labrum of fourth instar larvae:

(A) S. gladius; (B) S. cinctus

A

B

Figure 71 A - D. Antenna of fourth instar larva:

(A) X. subletti; (B) H. pallidus; (C) New Zealand larval
form; (D) S. unictus

Figure 72 A - G, Larval mandible with attached apodemes:

(A) African larval form; (B) S. colei; (C) S. pulchripennis; (D) S. fuscipatellus; (E) New Zealand larval form; (F) S. hilaris; (G) S. albipalpus

Figure 73 A - P. Larval labiohypopharynx:

(A) African larval form; (B) X. brunneus; (C) New Zealand larval form; (D) H. pallidus; (E) S. unictus; (F) S. bisetosus; (G-J) S. hilaris; (K) S. albipalpus; (L-M) S. fuscipatellus; (N-O) S. macateei; (P) S. pulchripennis

Figure 74 A - G. Larval labiohypopharynx:

(A) S. totifuscus; (B) S. gladius; (C) S.
quadrinotatus; (D-E) S. nudipupa; (F-G) S. cinctus

Figure 75 A - F. Larval paralabial plate and hypostomium:

- (A) African larval form; (B) X. subletti; (C) New Zealand larval form; (D) H. pallidus; (E) S. unictus; (F) S. bisetosus

Figure 76 A - D. Larval paralabial plate and hypostomium:

(A) S. hilaris; (B) S. poecilopterus; (C) S.

totifuscus; (D) S. cinctus; E-F. Larval head capsule:

(E) New Zealand larval form; (F) H. pallidus. G-H. Tergite

IX of larval abdomen showing proceri: (G) H. pallidus;

(H) New Zealand larval form

Figure 77 A - I. Larval anal papillae:

(A) X. subletti; (B) H. pallidus; (C) New Zealand larval form; (D) S. unictus; (E) S. maculatus; (F) S. bisetosus; (G) S. fuscipatellus; (H) S. albipalpus; (I) S. hilaris; (J) S. colei; (K) S. pulchripennis; (L) S. totifuscus

Figure 78. Leaf mined by larvae of S. aestivalis (from
Croatan National Forest, North Carolina, 30-V-1980)

Figure 79. Map of North America showing localities and corresponding sampling numbers for analysis of geographical variation of leg pigmentation of male adults of S. hilaris - depicted in Figure 80

Figure 80. Geographical variation of extent of leg pigmentation of male adults of S. hilaris. Locality numbers refer to the map in Figure 79. Asterisks refer to reared samples. For the Hubbs-Hubbs diagrams, the horizontal line depicts range, the vertical line depicts mean, the shaded box depicts 2 SE and the open box depicts 1.5 SD

Figure 81. Collecting localities for specimens of Japanese and Korean Stenochironomus. 1. Kaesong; 2. South Pyongan Prov.; 3. Mt. Daisen; 4. Kyoto; 5. Chojabaru; 6. Kikuchi-suigen; 7. Miike

Figure 82 A - F. Distribution of:

- (A) X. subletti; (B) X. brunneus; (C) S. gibbus;
(D) S. fascipennis; (E) S. hibernicus;
(F) S. maculatus (✱), S. unictus (●)

Figure 83 A - D. Distributions of:

- (A) S. niger and S. bisetosus (★), S. annettae (●),
S. albipalpus (■, all eastern localities);
- (B) S. macateei; (C) S. fuscipatellus;
- (D) S. hilaris

Figure 84 A - F. Distributions of:

- (A) S. colei (★), S. pulchripennis (●); (B) S. tectus;
(C) S. poecilopterus; (D) S. totifuscus;
(E) S. cinctus; (F) S. aestivalis

Figure 85. Collecting localities for specimens of Neotropical Stenochironomus. 1. Puerto Viejo; 2. El Tucuco; 3. Yacambu National Park; 4. St. Lucia; 5. St. Vincent; 6. Tinalandia; 7. Rio Palenque; 8. 5 km N. Tena; 9. Iquitos; 10. Tingo Maria; 11. Rio Branco; 12. Rio Cururu; 13. Lago Caballana; 14. Igarape Cachoeira, Rio Taruma, Rio Marauia; 15. Maloca; 16. Igarape Okueima, Rio Paru; 17. Mission Tiriyos; 18. Bompland.

Figure 86. Cladogram of basal lineages of the Stenochironomus complex. See text for discussion of character states (pg. 434). Synapomorphies 1-4 refer to adult characters, 5-20 refer to larval characters

Figure 87. Cladogram of Xestochironomus species. See page 449 for discussion of character states

Figure 88. Cladogram of the subgenus Stenochironomus. See text for discussion of character states (pg. 451). Synapomorphies 25-49 refer to adult characters, 50-70 to pupal characters and 71-91 to larval characters

Figure 89. Cladogram of the subgenus Petalopholeus. See text for discussion of character states (pg. 451). Synapomorphies 25-49 refer to adult characters, 50-70 to pupal characters and 71-91 to larval characters

Figure 90. Distribution and larval* substrate of major
lineages of the Stenochironomus complex

Figure 91. Larval habitat of species of the Stenochironomus complex superimposed on a cladogram showing their relationships

END

30H10H85

FIN