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MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN, NO. 147

A TAXONOMIC REVISION OF THE LIZARD FAMILY PYGOPODIDAE

by

ARNOLD G. KLUGE

Ann Arbor
MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN
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INTRODUCTION

One of the most conspicuous and frequently recurrent themes among lizards is the evolution of a snake-like morphology. Some of the more obvious characteristics of this trend are the reduction and ultimate loss of digits, limbs, girdles and external and middle ear structures, decrease in circumference and increase in length of the body, increase in imbrication of body scales, and reduction in number and increase in size of head scales. These adaptations have evolved for life above as well as below ground. A cursory review of the 21 lizard families usually recognized, including amphisbaenoids,[1] reveals that 11 tend to exhibit such a series of modifications. Among the 11 examples only the dibamid and anelytropsid and the trogonophid and amphisbaenid pairs of families appear to have had a snake-like common ancestor, while the remainder have almost certainly evolved independently from different tetrapod progenitors. Furthermore, within the cordylids and the anguinids the snake-like trend has evolved at least once independently, and within the scincids many times. The most conservative estimate of the number of times that this evolutionary trend has been realized independently is 12. As intrafamilial revisions are completed the estimate of convergence will probably greatly increase.

The lizard family Pygopodidae is a small group of snake-like species having a typical saurian tetrapod ancestor. While the most recent common ancestor of all known pygopodids almost certainly exhibited numerous snake-like adaptations, a more distant ancestor was probably a gekkonid lizard with well-developed tetrapod morphology (Underwood, 1957b). Wermuth's (1965) check-list indicates that pygopodids are restricted to Australia and New Guinea and that only the following seven genera and 16 species and subspecies are currently recognized: *Aprasia pulchella, A. repens repens, A. r. rostrata, A. striolata striolata, A. s. glauerti, Delma fraseri fraseri, D. f. tincta, D. impar, Lialis burtonis, L. jicari, Ophidiocephalus taeniatus, Paradelma orientalis, Pletholax gracilis, Pygopus baileyi, P. lepidopodus, P. nigriceps.* The fact that the Pygopodidae is geographically restricted and readily diagnosed by numerous shared-derived character states (Hennig, 1966; Farris, Kluge and Eckardt, 1970; Underwood, 1957b) strongly suggests that the family is monophyletic.

[1] Gekkonidae, Pygopodidae, Xantusiidae, Iguanidae, Agamidae, Chamaeleonidae, Scincidae, Anelytropsidae, Dibamidae, Feylinidae, Cordylidae (including Gerrhosauridae), Lacertidae, Teiidae, Anguinidae, Anniellidae, Xenosauridae, Helodermatidae, Varanidae, Lanthanotidae, Trogonophidae, Amphisbaenidae.

Apparently no one has considered the possibility that pygopodid phylogeny represents anything but a classic example of orthogenesis, beginning with the most tetrapod-like form and culminating in the most snake-like species. Stephenson (1962) viewed the reduction in size and ultimate loss of various limb and associated girdle bones as those characters which best illustrate the linearity of this evolutionary trend. Stephenson's study supports the contentions that *Pygopus* is the most tetrapod-like member of the family and *Aprasia* the most snake-like member, and that *Delma* is more like *Pygopus* while *Lialis* and *Pletholax* are similar to *Aprasia. Ophidiocephalus* and *Paradelma* were not investigated by Stephenson.

Several years ago I began to accumulate those osteologic and external morphologic data on pygopodids that I could use to test the hypothesis that the evolution of snake-like habits in the family has been undirectional. If the hypothesis can be supported and the morphologic details of the transition clearly documented, then perhaps by example similar trends in other families might be investigated more readily and accurately. The recently developed numerical taxonomic methods of Kluge and Farris (1969) and Farris (1970) provide the objective analytic and graphic tools for such testing, and they were used in my pilot investigations of the problem. During the process of data collection and preliminary analysis it became apparent that the species now recognized in the family were poorly defined and that many new taxa required description. A complete taxonomic revision was the logical first step in my program of study. The following revision provides the taxonomic basis for the quantitative phyletic study of the family which will be published elsewhere.

ACKNOWLEDGMENTS

During the four years of my study of pygopodid lizards many persons and institutions have given me assistance. There can be no doubt that the present study would not have been completed without their aid. I wish to thank the following persons who provided me with specimens and related information, art work, and field and laboratory companionship: B. Anton, E. Arnold, W. Auffenberg, J. Bailey, R. Barwick, M. Boeseman, F. Braestrup, W. Brandon, R. Brewer, M. Brooker, C. Burdon-Jones, R. Bury, J. Calaby, C. W. Christman, H. Cogger, J. Covacevich, A. Coventry, C. Cowan, J. M. Dixon, J. R. Dixon, W. Duellman, A. Echternacht, J. Estbergs, G. Foley, C. Gans, A. Grandison, B. Harty, H. Heatwole, J. Hickman, T. Houston, D. Howe, B. Humphries, R. Jenkins, W. Jolley, K. Klemmer, J. A. Kluge, J. B. Kluge, K. Kluge, M. Lackey, A. Leviton, T. Low, B. Lyon, R. Mackay, A. Main, L. Martonyi, H. Marx, F. Mitchell, F. Obst, F. Parker, J. Paxton, G. Peters, J. Peters, M. Peterson, E. Pianka, P. Rawlinson, G. Smith, L. Smith, A. Stimson, G. Storr, B. Taylor, T. Walsh, H. Waring, E. Williams, B. Wilson, J. Woods, G. Zug, R. Zweifel.

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MATERIALS AND METHODS

ABBREVIATIONS.—At various places throughout the paper, particularly in the species descriptions and specimens examined (Appendix II) sections, I have used abbreviations in order to reduce the length of the text. The following abbreviations are associated with locality data: ca (approximately), ck (creek), dist (district), e (east), is (island), jct (junction), lat (latitude), long (longitude), m (meters), mi (miles), mt (mount), n (north), natl (national), no (number), nr (near), pt (point), r (river), rte (route), rwy (railway), s (south), st (saint), stn (station), vic (vicinity), w (west).

For catalogued specimens the following abbreviations of the repositories are used: AK, author's skeletal collection; AM, Australian Museum, Sydney; AMNH, American Museum of Natural History, New York; AU, University of New England, Armidale; BM, British Museum of Natural History, London; CAS, California Academy of Sciences, San Francisco; CAS-SU, Stanford University (collection housed at CAS); DU, Duke University, Durham; EP, Eric Pianka, University of Texas, Austin (collection housed at the Los Angeles County Museum of Natural History, Los Angeles); FM, Field Museum of Natural History, Chicago; JSE, Joint Services Expedition (material to be deposited in either BM or WAM); KNS, Königlich Naturalienkabinets, Stuttgart; KZMD, Königlich Zoologischen Museums, Dresden; MB, Museum de Bocage, Lisboa; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge; NMV, National Museum of Victoria, Melbourne; NMW, Naturhistorische Museum, Wiesbaden; NTM, Northern Territory Museum, Alice Springs; PM, Muséum National d'Histoire Naturelle, Paris; QM, Queensland Museum, Brisbane; RNHL, Rijksmuseum van Natuurlijke Historie, Leiden; SAM, South Australian Museum, Adelaide; SMF, Senckenberg Museum, Frankfurt; UCB, University of California, Berkeley; UK, University of Kansas Museum of Natural History, Lawrence; UMMZ, University of Michigan Museum of Zoology, Ann Arbor; USNM, United States National Museum, Washington; UZMK, Universitetets Zoologiske Museum, Kjöbenhavn; WAM, Western Australian Museum, Perth; ZMB, Zoologisches Museum, Berlin; ZML, Zoologiska Museum, Lund.

The titles of journals are abbreviated according to the World List of Scientific Periodicals (Brown and Stratton, 1963). The abbreviation for each character used in the study is listed in the next section, preceding the description of the character.

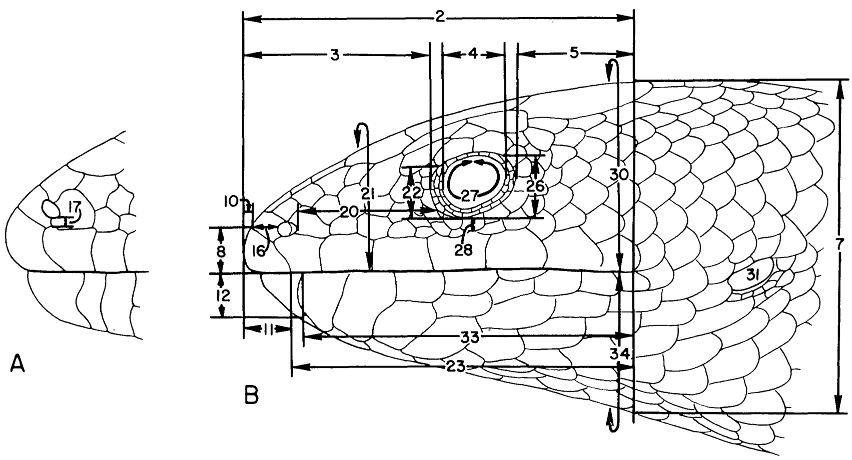

Fig. 1. Left lateral view of the snouts of (A) *Pygopus nigriceps* (EP 10852) and (B) *Pygopus lepidopodus* (UMMZ 129991). The numbers refer to the characters so numbered and described on pages 5-7. The arrows associated with each number describe the points between which measurements or counts are made.

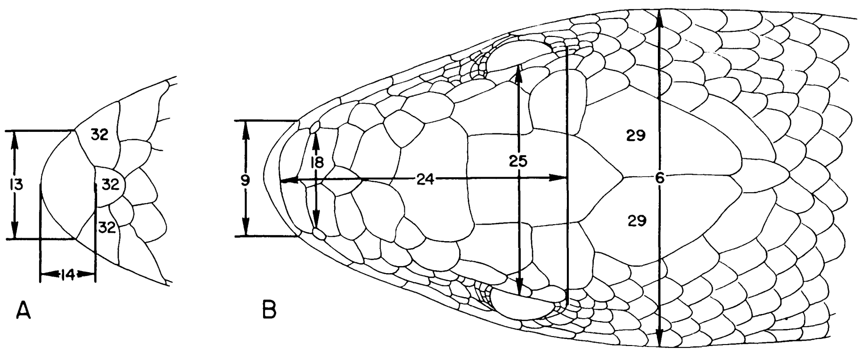

Fig. 2. Ventral view of the mental region (A) and dorsal view of the head (B) of *Pygopus lepidopodus* (UMMZ 129991). The numbers refer to the characters so numbered and described on pages 5-7. The arrows associated with each number describe the points between which measurements or counts are made.

DESCRIPTION AND SCORING OF CHARACTERS.—All measurements, in millimeters, were taken to the nearest tenth. To insure correct interpretation and to facilitate the description of the taxa, the morphometric, scale and color pattern characters used in the revision are defined immediately below. Scores of qualitative characters are given in parentheses.

Morphometric

1. (SVL) Snout to vent length—horizontal distance between median anteriormost extreme of snout and median posteriormost extreme of middle preanal scale. Specimens that had been

preserved in a circular or twisted form were forced into a straight horizontal position on a flat surface when measured. See item 44 (PAS) for description of preanal scale.

2. (HL) Head length—horizontal distance between median anteriormost extreme of snout and posteriormost extreme of angle of mouth. The latter extreme was determined by placing the end of a blunt probe under the upper lip (between it and the maxilla) and moving it posteriorly. The posteriormost extreme of the angle of the mouth was that point at which the end of a blunt probe emerged from beneath the upper lip (Fig. 1).
3. (SL) Snout length—horizontal distance between anteriormost extreme of snout and anteriormost extreme of bony ocular orbit. Measurement does not include ring of ocular scales (Fig. 1).
4. (EW) Eye width—horizontal distance between anterior and posteriormost extremes of transparent portion of cornea. The measurement does not include the ring of ocular scales (Fig. 1).
5. (PL) Postorbital length—horizontal distance between posteriormost extreme of fleshy ocular orbit and posteriormost extreme of angle of mouth. Anterior extreme does not include ring of ocular scales. See item 2 (HL) for description of angle of mouth (Fig. 1).
6. (HW) Head width—distance between widest extremes of head at vertical level even with angle of mouth. See item 2 (HL) for description of angle of mouth (Fig. 2).
7. (HD) Head depth—vertical distance between dorsal surface of head and ventral surface of throat at level of angle of mouth. Slack skin of throat region excluded from measurement by slowly closing jaws of calipers until firm. See item 2 (HL) for description of angle of mouth (Fig. 1).
8. (RD) Rostral depth—vertical distance between dorsal and ventralmost extremes of rostral. Measurement taken at mid-rostral level (Fig. 1).
9. (RW) Rostral width—horizontal distance between lateralmost extremes of rostral (Fig. 2).
10. (RLD) Rostral length dorsally—horizontal distance between anterior and posteriormost extremes of rostral. Measurement taken dorsally at mid-rostral level (Fig. 1).
11. (RLV) Rostral length ventrally—horizontal distance between anterior and posterolateralmost extremes of ventral surface of rostral (Fig. 1).
12. (MD) Mental depth—vertical distance between dorsal and ventralmost extremes of mental. Measurement taken at mid-mental level (Fig. 1).

13. (MW) Mental width—horizontal distance between lateralmost extremes of rostral (Fig. 2).
14. (ML) Mental length—horizontal distance between anterior and posteriormost extremes of mental. Measurement taken at mid-mental level (Fig. 2).
15. (TL) Tail length—horizontal distance between posteriormost extreme of middle preanal scale and tip of tail. Measurement made only on complete and unregenerated tails. Specimens that had been preserved in a circular or twisted form were forced into a straight horizontal position on a flat surface when measured. See item 44 (PAS) for description of preanal scale.

Scutellation

16. (PNS) Prenostril scale—number of scales intersecting imaginary horizontal line drawn between posterolateralmost margin of rostral and anteriormost margin of nostril (Fig. 1).
17. (SNS) Subnostril scale—number of scales intersecting imaginary vertical line drawn between ventralmost margin of nostril and dorsalmost margin of supralabial immediately ventral to nostril (Fig. 1).
18. (INS) Internostril scale—number of scales, excluding rostral, between innermost extremes of two nostrils (Fig. 2). When an internostril scale projects ventrally, either anterior or posterior to the nostril, that scale may be referred to simply as a nasal.
19. (RP) Rostral projection—scored as present (1) if any part of posteriormost extreme of rostral intersects imaginary line drawn between innermost extremes of two nostrils, absent (0) if it does not intersect that line.
20. (LS) Loreal scale—number of scales intersecting imaginary horizontal line drawn between posteriormost extreme of nostril and anteriormost extreme of bony ocular orbit. Count does not include ring of ocular scales (Fig. 1).
21. (AOS) Anterior orbital scale—number of scales intersecting imaginary line drawn between right and left series of supralabials at point midway between posteriormost extreme of nostril and anteriormost extreme of bony ocular orbit (Fig. 1).
22. (PRS) Preorbital scale—number of scales along anterior margin of bony portion of ocular orbit between anteriormost enlarged supraciliary scale and ventralmost margin of orbit (Fig. 1).
23. (SLS) Supralabial scale—number of scales along margin of upper lip between rostral and posteriormost extreme of angle of mouth. See item 2 (HL) for description of angle of mouth (Fig. 1).

24. (FS) Frontal scale—number of scales on mid-line between posteriormost extreme of rostral and imaginary line drawn between posteriormost extremes of fleshy portion of right and left ocular orbits. Posterior extreme of orbit does not include ring of ocular scales (Fig. 2).
25. (IOS) Interorbital scale—number of scales between dorsalmost (in view) margins of eyeballs, including both supraocular and supraciliary series of scales, but excluding ring of ocular scales. Count made along imaginary line drawn between centers of two eyeballs (Fig. 2).
26. (POS) Postorbital scale—number of scales along posterior margin of fleshy portion of ocular orbit between posteriormost enlarged supraciliary scale and ventralmost margin of orbit (Fig. 1).
27. (OS) Ocular scale—number of scales in contact with cornea. Ocular scales form continuous circular series (Fig. 1). See page 51 for further discussion.
28. (SOS) Suborbital scale—number of scales intersecting imaginary vertical line drawn between center of ocular orbit and supralabial, excluding ring of ocular scales (Fig. 1).
29. (PS) Parietal scale—when pair of bilaterally symmetrical scales immediately posterior to interorbital are 1.5 times larger than surrounding scales then parietals are scored as present (1), when not obviously bilaterally symmetrical or enlarged (less than 1.5 times) parietals are scored as absent (0). See Fig. 2.
30. (NS) Nuchal scale—number of scales intersecting imaginary line drawn between posteriormost extreme of right and left angles of mouth over dorsal surface of head. Line vertically orientated along cheek regions, horizontally across nuchal region. Count includes supralabials. See item 2 (HL) for description of angle of mouth (Fig. 1).
31. (EAM) External auditory meatus—external ear aperture present (0), or absent (1). See Fig. 1.
32. (PM) Postmental scale—number of scales in direct contact with posterior margin of mental scale, including right and left infralabials (Fig. 2).
33. (ILS) Infralabial scale—number of scales along margin of lower lip between mental and posteriormost extreme of angle of mouth. See item 2 (HL) for description of angle of mouth (Fig. 1).
34. (GS) Gular scale—number of scales intersecting imaginary line drawn between posteriormost extreme of right and left angles of mouth over gular region. Count includes infralabials. See item 2 (HL) for description of angle of mouth (Fig. 1).
35. (DSK) Dorsal scale keel—number of keels per individual scale at dorsal mid-body region (Fig. 3).

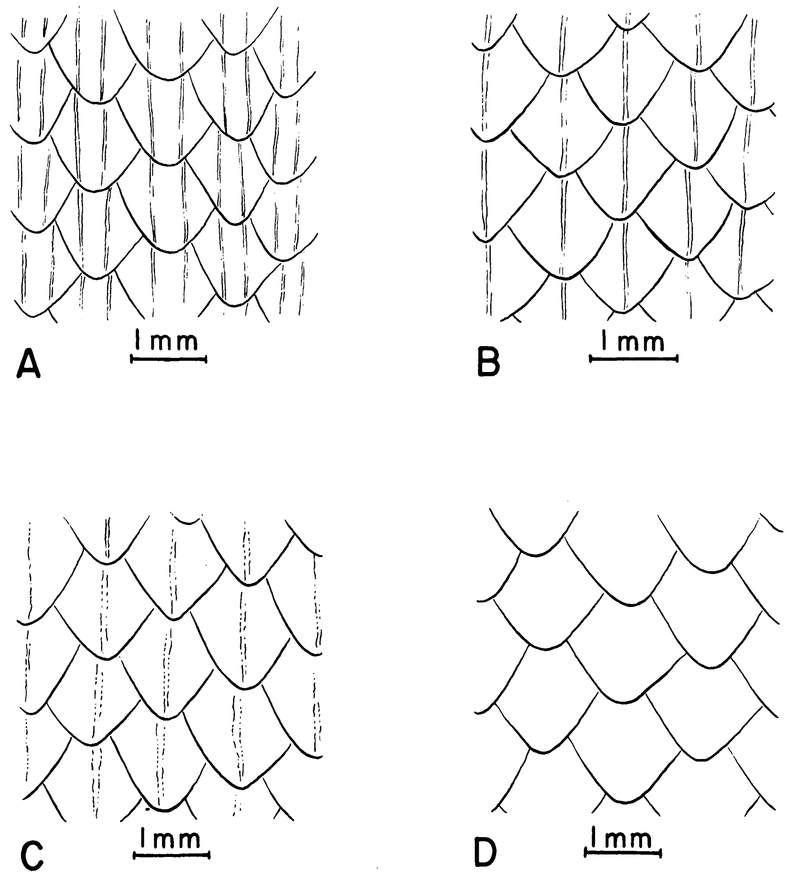

Fig. 3. Examples of dorsal body scales which illustrate different numbers and degrees of keeling (DSK, p. 7). A. DSK = 2 (*Pletholax gracilis*, UMMZ 129997). B. DSK = 1 (*Pygopus lepidopodus*, UMMZ 129991). C. DSK = 1 (*Pygopus lepidopodus*, UMMZ 83427). D. DSK = 0 (*Pygopus nigriceps*, UMMZ 124455).

36. (VSK) Ventral scale keel—number of keels per individual scale at ventral mid-body region (Fig. 4).

37. (VS) Ventral scale—number of scales intersecting imaginary ventral mid-line drawn between posteriormost extreme of mental and vent, including preanal scale. See item 44 (PAS) for description of preanal scale.

38. (PVS) Preventral scale—number of ventral scales at point where ventral body and throat scales obviously differentiate. Count begins anteriorly and is made as in item 37 (VS) (Fig. 5).

39. (MS) Midbody scale—number of scale rows completely around body at one-half item 1 (SVL).

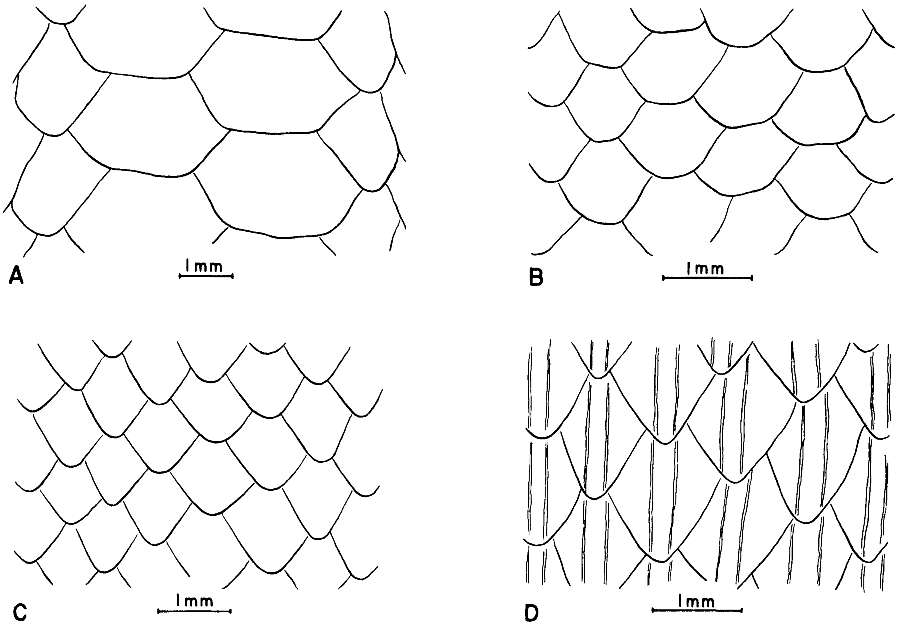

Fig. 4. Examples of ventral body scales which illustrate the presence or absence of keeling (VSK, p. 8) and degree of width of ventral scales relative to ventrolateral rows (VBS, p. 9). A. VSK = 0, VBS = 2 (*Delma fraseri,* UMMZ 84308). B. VSK = 0, VBS = 0 (*Delma australis,* UMMZ 84309). C. VSK = 0, VBS = 0 (*Aclys concinna,* WAM R17312). D. VSK = 2, VBS = 0 (*Pletholax gracilis,* UMMZ 129997).

40. (VBS) Ventral body scale–number of rows of ventral midbody scales which are 1.25 times wider than adjacent lateral body scales (Fig. 4).

41. (PP) Preanal pore–total number of preanal pores–both right and left sides counted (Fig. 6).

42. (IPS) Interpore scale–number of poreless scales between innermost pores of right and left series of preanal pores (Fig. 6).

43. (IGS) Inguinal scale–number of poreless scales between right lateralmost preanal pore and innermost margin of right hind limb (Fig. 6).

44. (PAS) Preanal scale–number of scales forming anterior margin of middle one-third of vent (Fig. 6).

45. (PCS) Precloacal scale–total number of scales forming anterior margin of vent, including those possibly hidden beneath free portion of hind limb.

46. (HLS) Hind limb scale–number of scales forming ventralmost margin of right hind limb between its distalmost extreme and its origin from body, excluding overlapping body scales (Fig. 7).

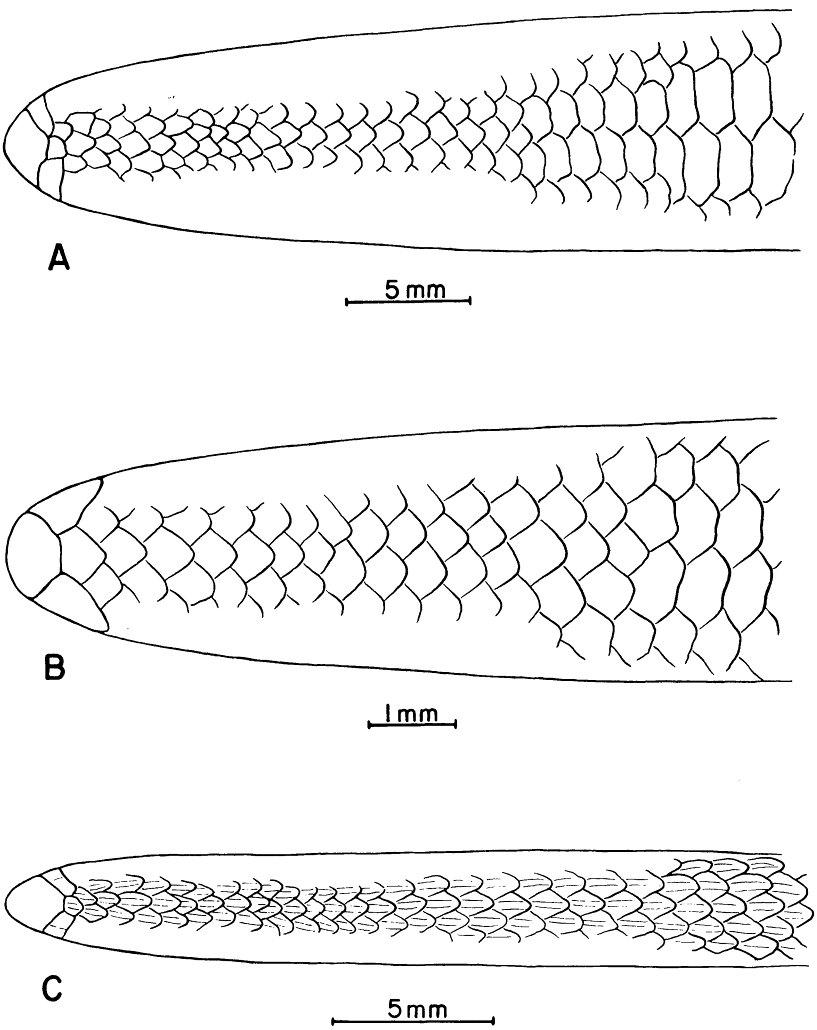

Fig. 5. Ventral views of the mental, throat and anterior end of the body which illustrate the point at which ventral body scales change size (PVS, p. 8). A. PVS = 20 (*Pygopus nigriceps,* UMMZ 124455). B. PVS = 15 (*Aprasia pulchella,* UMMZ 129986). C. PVS = 0 (*Pletholax gracilis,* UMMZ 129997).

47. (CS) Caudal scale—number of rows of scales around tail one body width posterior to vent. Body width measured as widest portion of body at level of vent.

48. (SCS) Subcaudal scale—number of ventral caudal scales one body width posterior to vent. Count includes only those scales within level of width of vent opening. See item 47 (CS) for body width measurement (Fig. 6).

Color Pattern

49. (DSP) Dorsal snout pattern—dorsal surface of snout from anteriormost extreme of snout to imaginary line drawn between anterior margins of right and left ocular orbits with one of following conditions: a) stripes not obvious—(0); b) at least some, bilaterally random, longitudinal dark marks present—(1); c) obvious open lyre-shaped figure present—(2); d) obvious solid lyre-shaped figure present—(3).

50. (DIP) Dorsal interorbital pattern—dorsal surface of head between right and left ocular orbits without dark

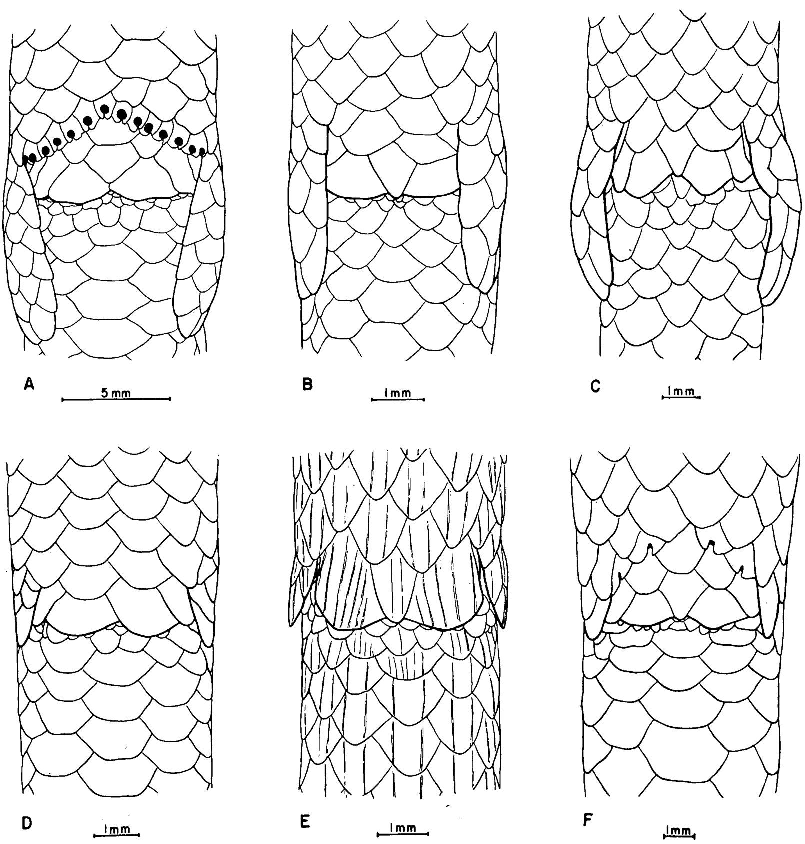

Fig. 6. Ventral views of region of anus which illustrate different hind limb sizes (HLS, p. 9), position and number of preanal pores (PP, p. 9), and number of interpore (IPS, p. 9), inguinal (IGS, p. 9) and preanal scales (PAS, p. 9). A. HLS = 6, PP = 14, IPS = 0, IGS = 0, PAS = 2 (*Pygopus lepidopodus*, UMMZ 129991, male). B. HLS = 4, PP = 0, PAS = 3 (*Delma australis*, UMMZ 84309, male). C. HLS = 5, PP = 0, PAS = 3 (*Aclys concinna*, WAM R17312, male). D. HLS = 2, PP = 0, PAS = 2 (*Delma torquata*, QM J5683, female). E. HLS = 2, PP = 0, PAS = 3 (*Pletholax gracilis*, UMMZ 129997, female). F. HLS = 1, PP = 4, IPS = 2, IGS = 0, PAS = 3 (*Lialis burtonis*, UMMZ 129994, female).

pigmentation, not distinctly differentiated from snout (0), or dark pigmentation present, often appearing as dark band (1).

51. (DPP) Dorsal parietal pattern—dorsal surface of head immediately posterior to interorbital region, often characterized by presence of parietal scale, with one of following conditions: a) without dark pigmentation—(0); b) dark pigmentation present, completely contiguous with dark pigmentation of interorbital region—(1); c) dark pigmentation present, not completely contiguous with dark pigmentation of interorbital region—(2); d) dark pigmentation present, completely separated from interorbital pigmentation when present—(3).

52. (DNP) Dorsal nuchal pattern—dorsal surface of head and neck immediately posterior to parietal region with one of following conditions: a) without dark pigmentation—(0); b) dark pigmentation present, completely contiguous with dark pigmentation of parietal region—(1); c) dark pigmentation present, not completely contiguous with dark pigmentation of parietal region—(2); d) dark pigmentation present, completely separated from parietal pigmentation when present—(3).

53. (PNB) Postnuchal band—narrow area immediately posterior to nuchal region without white band, or with pigmentation present—(0), or with white band, or with pigmentation absent—(1).

54. (LHP) Lateral head pattern—lateral surface of right side of head without pattern of dark stripes—(0), one dark stripe present—(1), or two or more dark stripes present—(2). Stripes of dark pigmentation most conspicuous between eye and ear opening.

55. (LLP) Lateral lip pattern—upper and lower lips on right side of head between anteriormost extreme of ear opening and tip of snout with one of following conditions of dorsoventrally oriented narrow bands of dark pigmentation: a) absent—(0); b) pattern inconspicuous, number of bands equal to or less than three—(1); c) pattern conspicuous, number of bands equal to or less than three—(2); d) pattern inconspicuous, number of bands more than four—(3); e) pattern conspicuous, number of bands more than four—(4). Bands sometimes continuous with dorsal head pigmentation.

56. (TP) Throat pattern—central part of throat region with one of following conditions: a) pattern absent, no dark pigmentation present—(0); b) pattern absent, completely (or nearly so) covered with dark pigmentation—(1); c) pattern present consisting of reticulation or spots—(2); d)

pattern present, consisting of solid lyre-shaped mid-ventral mark—(3); e) pattern present, consisting of open lyre-shaped mid-ventral mark—(4).

57. (DBP) Dorsal body pattern—dorsal body surface, at cross-sectional level midway between item 1 (SVL), with one of following conditions: a) pattern absent, uniformly (or nearly so) covered with background pigmentation—(0); b) pattern present, consisting of reticulation of dark marks (e.g., scales with dark margins)—(1); c) pattern present, stripes of dark pigmentation (mid-dorsal and immediately dorsolateral pair) interrupted—(2); d) pattern present, stripes of dark pigmentation (mid-dorsal and immediately dorsolateral pair) continuous—(3).

58. (VBP) Ventral body pattern—ventral body surface, at cross-sectional level one-half of item 1 (SVL), with one of following conditions: a) pattern absent, pigmentation uniformly (or nearly so) absent—(0); b) pattern absent, pigmentation uniformly (or nearly so) present—(1); c) pattern present, consisting of reticulation of dark marks (e.g., scales with dark margins)—(2); d) pattern present, stripes of dark pigmentation (mid-ventral and immediately

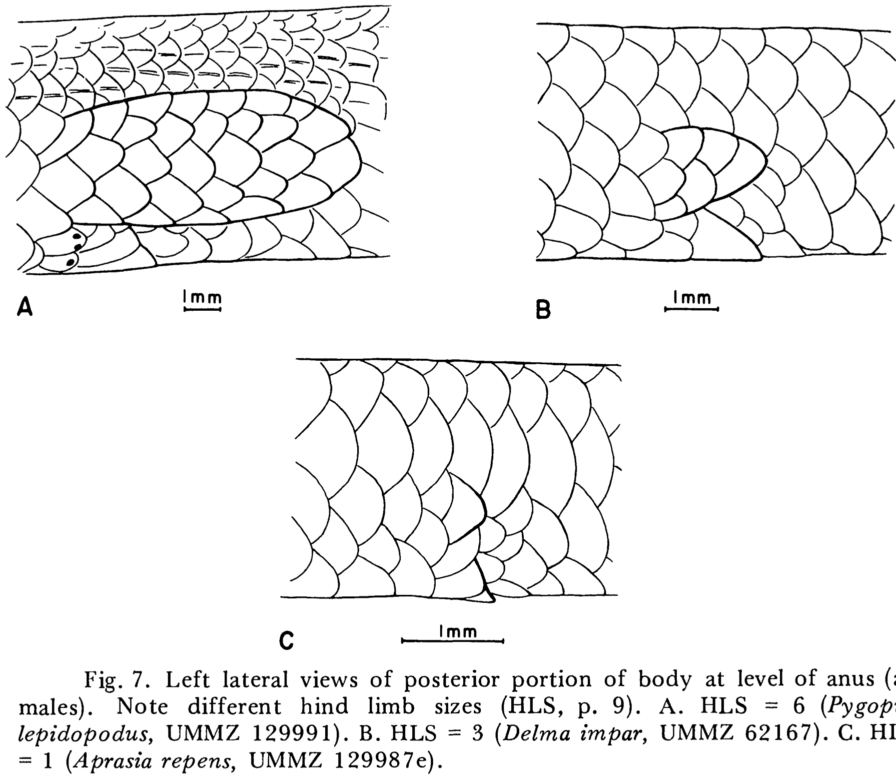

Fig. 7. Left lateral views of posterior portion of body at level of anus (all males). Note different hind limb sizes (HLS, p. 9). A. HLS = 6 (*Pygopus lepidopodus,* UMMZ 129991). B. HLS = 3 (*Delma impar,* UMMZ 62167). C. HLS = 1 (*Aprasia repens,* UMMZ 129987e).

ventrolateral pair) interrupted—(3); e) pattern present, stripes of dark pigmentation (mid-ventral and immediately ventrolateral pair) continuous—(4). The dark marks on the scales do not include the pigmentation which may be present at the base of individual scales.

59. (VP) Visceral pigmentation—pigmentation of visceral peritoneum dorsal to gonads a) absent—(0); b) slightly to moderately dense—(1); or c) extremely dense, giving black appearance—(2).

All measurements were taken with a plastic ruler, Helios dial vernier caliper or linear ocular micrometer fitted to a dissecting microscope. All of the scales in the photographs are millimeter rulers. All characters were recorded from the right side of the individual.

In the pilot study I examined approximately 100 characters. The 59 characters listed above were finally considered acceptable for later use on the basis of the following biological and statistical arguments. As a group, these characters 1) do not appear to be logically redundant, except for IPS and IGS being dependent on PP, 2) exhibit little statistical correlation, except for the morphometric characters (see discussion of CHARACTER CORRELATION on p. 19), 3) exhibit little sexual dimorphism, except for VS (see individual species accounts for data on sexual dimorphism), 4) exhibit low sampling error (see discussion of REPEATABILITY OF MEASUREMENT on p. 19), and 5) represent three qualitatively different phenotypic systems—size and shape, scutellation, and color pattern. Perhaps most important, each of the 59 characters is almost certainly a set of homologous character states (Kluge, 1971a:11-3). A homologous set of quantitative states is ensured when clearly homologous reference points are used. For example, character LS, number of loreal scales, is defined as the number of scales between the posteriormost extreme of the nostril and the anteriormost extreme of the bony ocular orbit. The nostril and bony ocular orbit are the reference points which I believe can be identified with certainty in any pygopodid.

Each specimen used in the morphological analysis was X-rayed with a General Electric LC-90 Industrial low voltage machine (Kluge, 1968b) to determine the condition of the individual's tail and sex. A regenerated lizard tail does not appear to have the same growth rate, nor does it grow as long, as the original. In many species of pygopodids, e.g., *Aprasia, Lialis,* and *Pletholax,* the regenerated state cannot be accurately inferred from the appearance of tail scutellation and color pattern. Only the continuous cartilaginous rod that replaces the original caudal sequence of vertebrae can be used as unequivocal evidence of regeneration. For reasons of preservation and size, the sex of many individuals could not be determined by dissection and examination of gonads. The secondary sexual character of cloacal bones (Kluge, 1967) was used to corroborate the sex. Male pygopodids, like many gekkonids, possess cloacal bones, whereas females do not, and this state can be determined readily from low voltage X-rays.

SAMPLING.—I examined a total of 3321 pygopodids. All of these specimens were used to reconstruct the geographic distributions of the species. Whenever possible, the gazetteer of Australia published by the Office of Geography, Department of the Interior (1957) and The Reader's Digest Complete Atlas of Australia, Including Papua-New Guinea (The Reader's Digest Association, 1968) were followed for accepted spelling of place names and their latitude-longitude coordinates. Unfortunately, the gazetteer and atlas contain some errors and, more important, a great many of the pygopodid localities are not given. These deficiencies forced me to consult other sources, written and verbal, and I have therefore included a gazetteer to all pygopodid localities cited in the text (Appendix I).

All 59 characters listed on pages 4-14, except TL, were scored on each specimen (1690 in all) that was well preserved, undamaged, not obviously faded, and accompanied by specific locality data. Only in the case of the abundant *Aprasia repens, Lialis burtonis, Pygopus lepidopodus* and *P. nigriceps* did I ignore many acceptable individuals for the sake of my time and effort. The likelihood that additional examples of these species could significantly affect the mean or observed extremes was very low. I consciously attempted to measure specimens from all parts of the geographic ranges of these species while excluding only obviously geographically redundant individuals and samples. Large local samples were retained whenever possible.

For purposes of analyzing character correlation and conservatism I delimited 27 local samples from the following taxa (number of samples per taxon is enclosed in parentheses): *Aprasia aurita* (1), *A. parapulchella* (1), *A. pulchella* (1), *A. repens* (2), *A. striolata* (1), *Delma australis* (1), *D. borea* (1), *D. fraseri* (2), *D. impar* (1), *D. tincta* (2), *D. inornata* (1), *D. nasuta* (1), *D. plebeia* (1), *Lialis burtonis* (4), *L. jicari* (2), *Pletholax gracilis* (1), *Pygopus lepidopodus* (2), *P. nigriceps* (2). The sample sizes ranged from 8 to 18, and only adult and subadult males were included. Almost all of the samples consisted of individuals collected at or near the same locality.

STATISTICS.—All univariate and multivariate analyses were carried out on the University of Michigan's IBM 360/67 computer with statistical programs (MIDAS and CONSTAT) written and maintained by the staff of the University's Statistical Research Laboratory. Each species description begins with regression statistics for each morphometric character and these are presented in the following form: b_{YX}, one standard error of b_{YX} in parentheses, a_{YX}, one standard error of a_{YX} in parentheses, and the range of variation of the actual observations. For example, in *Lialis burtonis* the regression statistics for head length (HL) are -.21 (0.003), 2.78 (0.003), 8.0-25.9. Pages

26-7 describe the basis for the selection of the independent variable. All morphometric characters were transformed to their natural logarithms when analyzed statistically. Only the range of variation of the observations is listed for all characters in those species with a sample size less than or equal to three. For all scale and color pattern characters, the mean, one standard error of the mean, enclosed in parentheses, and the observed range of variation are listed following the morphometric statistics. The format, as exemplified by loreal scales (LS) in *Lialis burtonis*, is 16.5 (0.16) 11-21. Only the mean and range of variation of scale and color pattern variables are given for those species represented by two individuals, and of course only a single value is presented for invariant characters. The sample size (n) is listed at the beginning of each species description, except for the sample size of TL, which immediately precedes that character's description. The significance of sample mean differences is derived from the Student's two-tailed t-distribution. I consider a significant difference to be $P \leqslant .001$ unless otherwise stated. My method of comparing a single specimen (observation) with a sample is described in Simpson, Roe and Lewontin (1960:182-3). Only the scale and color pattern characters are treated in the INDIVIDUAL, GEOGRAPHIC VARIATION and SEXUAL DIMORPHISM sections in the species accounts. Correlation analyses are based on Pearson's product moment coefficient and the linear regression analysis (Model I) on the method of least squares (Sokal and Rohlf, 1969). Details of the principal component computation are presented by Morrison (1967). The analysis used herein is of the correlation matrix which is based on a standardized set of data. Principal component analysis was chosen over other multivariate statistics because the conclusions are relatively easily interpreted and there are no assumptions underlying the computations of the principal components themselves. The interpretation of principal components makes only the weak presumption that the distribution from which the sample was drawn was multivariate normal.

Multiple stepwise linear discriminant analysis was used to find the best set of characters with which to distinguish between two or more predefined samples. The posterior probabilities used in classifying individuals according to these samples were proportionate to sample size. Details of the calculation of the discriminant functions and Mahalanobis' generalized distance (D^2) are presented by Morrison (1967) and Sokal and Sneath (1963), respectively.

I have used the Prim Network form of cluster analysis in my study of species relationships because it accepts continuous variables, unweighted or weighted, as input data and it does not assume directed character state trees or the irreversibility of evolution. The Network produced is not a "complete" phylogenetic hypothesis because the direction of evolution is not specified nor are hypothetical most recent common ancestors reconstructed. The Prim algorithm provides an objective method of approximating the most parsimonious solution for a given set of data. The Prim algorithm (Prim, 1957) was programmed by J. S. Farris (Farris, 1970).

INDIVIDUAL AND GEOGRAPHIC VARIATION.—In the sections on individual variation I have noted only exceptional individuals. In particular, I have described all those individuals which possess character states that either violate the species' diagnosis or might be easily considered diagnostic of an undescribed taxon.

My description and interpretation of intraspecific geographic variation in the Pygopodidae have been hampered by the facts that few species are represented by local samples of reasonable size, and that the preponderance of the locality records tend to be concentrated in and around the more populous regions. It is because of these difficulties that the few geographic trends I have been able to delimit must be restudied under better sampling conditions. Furthermore, the fact that I have made no reference to a trend in a species does not necessarily mean that it will not become readily apparent with larger, more numerous and evenly distributed samples.

Males were studied first, and when a pattern was tentatively identified the corresponding set of females was examined to verify its presence. The states of a character in a given species were plotted according to latitude and longitude. An average state was employed when the local sample size was greater than one. Similarly, the set of individual projections from a given principal component were plotted on a latitude and longitude grid. When the local sample consisted of two or more individuals their average projection was plotted. Only scale and color pattern characters were analyzed and only principal components I-III were extracted from that set of characters. The first three components accounted for 30%-65% of the total variance present. All univariate and multivariate character states were referenced with respect to latitude and longitude coordinates by the University of Michigan Digital Plotting System. Each "map" was inspected by eye for regions of precipitous and gradual clinal variation. My ideas on phyletic and geographic historical relationships among the populations of a species, particularly the more isolated ones, are based entirely on these patterns; see individual species accounts, and Gould and Johnston (1972). Linear discriminant analysis and classification and D^2 statistics were applied to the samples recognized in order to identify more precisely the distinguishing characters and the between-sample differences. With few exceptions I have not attempted to identify probable environmental causes of the clinal variation because of the inadequate sampling.

SPECIES RECOGNITION.—In the present research I have employed a purely phenetic species concept (Sokal and Crovello, 1970). The probability of potential or actual interbreeding and the nature of the reproductive isolating mechanisms between any pair of previously

TABLE 1

GEOGRAPHIC DISTRIBUTION OF PYGOPODIDS

Species	Territory of Papua	Territory of New Guinea	New Britain	Western Australia	Northern Territory	South Australia	Victoria	Australian Capital Territory	New South Wales	Queensland
Aclys concinna				X						
Aprasia aurita							X			
Aprasia inaurita				X		X	X			
Aprasia parapulchella								X	X	
Aprasia pseudo-pulchella						X				
Aprasia pulchella				X						
Aprasia repens				X						
Aprasia rostrata				X						
Aprasia smithi				X						
Aprasia striolata				X	X	X	X			
Delma australis				X	X	X	X			
Delma borea				X	X	X				X
Delma elegans				X						
Delma fraseri				X		X				
Delma grayii				X						
Delma impar						X	X	X	X	
Delma inornata						X	X	X	X	X
Delma molleri						X				
Delma nasuta				X	X	X				X
Delma pax				X						
Delma plebeia									X	X
Delma tincta				X	X				X	X
Delma torquata										X
Lialis burtonis	X			X	X	X	X		X	X
Lialis jicari	X	X	X							
Ophidiocephalus taeniatus					X					
Paradelma orientalis										X
Pletholax gracilis				X						
Pygopus lepidopodus				X		X	X		X	X
Pygopus nigriceps				X	X	X	X		X	X
Total species in each geographic unit	2	1	1	19	8	13	9	3	8	10

recognized pygopodid species are unknown, and consequently the biological species concept (*sensu* Mayr, 1963) cannot be applied realistically within the family at this time. I have recognized a set of individuals as a species when they exhibit a high degree of phenotypic similarity among themselves and are obviously different from other species in at least two characters; see individual species diagnoses. The 30 species that are delineated by this approach are listed in Table 1 with their general geographic distribution. The supraspecific categories that I have recognized are based on cluster analysis; see pp. 38-45.

Because of the fact that there is little significant geographic variation within almost all of the species that I have recognized (see individual species accounts) and because most are delimited by numerous obvious character discontinuities, the task of species recognition by the phenetic method is made relatively easy and repeatable. These particular conditions of character variation suggest that the phenetic species that I have recognized in the Pygopodidae are probably equivalent to biological species. All of the species that I have recognized are locally sympatric with one or more other pygopodids and the absence of morphological intermediates in the areas of overlap lends support to the idea that effective reproductive isolating mechanisms have evolved.

REPEATABILITY OF MEASUREMENT

Thirteen individuals representing different species of *Aprasia, Delma, Lialis* and *Pygopus* were selected at random from the total sample of 1690 that were initially scored. The order in which the 59 characters used in this study were recorded a second time was randomized for each of these 13 specimens. Table 2 lists the correlation coefficient between the values recorded for the first and second samplings of each character. The fact that the coefficients are highly significant indicates that all 59 characters have been recorded with a considerably high degree of accuracy in the total sample of 1690.

CHARACTER CORRELATION

Pairwise correlation coefficients were calculated between all of the 59 characters used in this study in each of the 27 local samples. A pair of characters were considered significantly correlated when $P \leqslant .05$. The number of populations in which each pair of characters was found to be significantly correlated is shown in Tables 3-5. No significant correlation was observed between the three qualitatively different sets of characters, morphometric, scutellation and color pattern. Within sets, most of the morphometric variables are significantly correlated in many populations while almost all of the scutellation and color pattern characters exhibit no significant correlation.

TABLE 2

CORRELATION COEFFICIENTS BETWEEN THE VALUES RECORDED FOR THE FIRST AND SECOND SAMPLINGS OF EACH CHARACTER IN PYGOPODIDS

SVL	.999	PNS	1.000	EAM	1.000	HLS	.966
HL	.996	SNS	1.000	PM	1.000	CS	1.000
SL	.999	INS	1.000	ILS	.959	SCS	1.000
EW	.994	RP	1.000	GS	.991	DSP	.617*
PL	.986	LS	1.000	DSK	1.000	DIP	1.000
HW	.997	AOS	.934	VSK	1.000	DPP	1.000
HD	.995	PRS	.999	VS	.998	DNP	1.000
RD	.863	SLS	.769***	PVS	.949	PNB	1.000
RW	.996	FS	1.000	MS	1.000	LHP	.779***
RLD	.815	IOS	1.000	VBS	1.000	LLP	1.000
RLV	.663**	POS	1.000	PP	1.000	TP	1.000
MD	.948	OS	1.000	IPS	1.000	DBP	.934
MW	.991	SOS	1.000	IGS	1.000	VBP	.750***
ML	.986	PS	1.000	PAS	1.000	VP	.677***
TL	.997	NS	.983	PCS	1.000		

df = 11 except for TL where df = 5
All correlation coefficients P < .001 except as follows: *** P < .01 > .001; ** P < .02 > .01; * P < .05 > .02

TABLE 3

NUMBER OF SIGNIFICANT CORRELATIONS BETWEEN MORPHOMETRIC CHARACTERS IN 27 LOCAL SAMPLES OF PYGOPODIDS (MALES ONLY)

HL	20												
SL	17	25											
PL	14	19	12										
HW	19	16	16	12									
HD	17	17	16	14	18								
RD	18	17	16	9	18	17							
RW	18	19	18	13	19	18	18						
RLD	4	3	4	3	3	2	6	3					
RLV	12	11	12	5	8	9	9	12	4				
MD	10	8	8	5	9	9	8	6	0	7			
MW	17	16	13	12	16	15	15	20	2	10	8		
ML	10	13	11	6	9	8	7	8	4	5	3	14	
EW	13	12	13	7	14	17	11	16	2	9	6	11	8
	SVL	HL	SL	PL	HW	HD	RD	RW	RLD	RLV	MD	MW	ML

WITHIN AND BETWEEN POPULATION VARIATION AND DIFFERENTIAL CHARACTER WEIGHTING

Recently, Kluge and Kerfoot (1973) discovered a large significant positive correlation between measures of within ($\bar{s}_A$) and between (RD_A) population variation in a variety of vertebrate

TABLE 4

NUMBER OF SIGNIFICANT CORRELATIONS BETWEEN MERISTIC SCALE CHARACTERS IN 27 LOCAL SAMPLES OF PYGOPODIDS (MALES ONLY)

	PNS	SNS	INS	RP	LS	AOS	PRS	SLS	FS	IOS	POS	OS	SOS	PS	NS	EAM	PM	ILS	GS	DSK	VSK	VS	PVS	MS	VBS	PP	IPS	IGS	PAS	PCS	HLS	CS
SNS	0																															
INS	0	0																														
RP	0	0	0																													
LS	0	0	0	0																												
AOS	0	0	0	0	2																											
PRS	0	0	0	0	1	1																										
SLS	0	0	0	0	0	0	0																									
FS	0	1	0	0	0	0	0	0																								
IOS	0	0	0	0	1	0	0	0	0																							
POS	0	0	0	0	1	1	0	1	0	0																						
OS	0	0	0	0	0	0	0	0	0	0	0																					
SOS	0	0	0	0	1	0	1	0	0	0	1	0																				
PS	0	0	0	0	0	1	0	0	0	0	0	1	1																			
NS	0	0	0	0	1	1	0	0	0	0	0	0	0	0																		
EAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																	
PM	0	0	0	0	1	1	0	0	0	0	1	0	0	0	2	0																
ILS	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0															
GS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0														
DSK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0													
VSK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0												
VS	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0											
PVS	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1										
MS	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	1	0	0	0	0	1	1									
VBS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
PP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
IPS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
IGS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
PAS	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0				
PCS	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2			
HLS	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1		
CS	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SCS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0

examples. In addition to the contribution to general evolutionary theory that such a finding appears to make, it provides justification for differentially weighting characters; see pp. 41-4. In the present pygopodid study the 27 local samples were used to estimate $\bar{s}_A$ and RD_A; see Kluge and Kerfoot (1973) for derivation and justification of these estimators. In this study $\bar{s}_A$ is the unweighted average standard deviation. Only the 32 scale and 11 color pattern characters were analyzed; the morphometric variables were not included because of their extremely high within population correlation (see pp. 19-20), and EAM was excluded because it did not vary within the local samples. Table 6 lists the unweighted average standard deviation ($\bar{s}$), range of divergence (RD) and mean of local sample means ($\bar{x}$) for the

TABLE 5

NUMBER OF SIGNIFICANT CORRELATIONS BETWEEN COLOR PATTERN CHARACTERS IN 27 LOCAL SAMPLES OF PYGOPODIDS (MALES ONLY)

	DSP	DIP	DPP	DNP	PNB	LHP	LLP	TP	DBP	VBP
DIP	0									
DPP	0	2								
DNP	0	0	0							
PNB	0	0	0	0						
LHP	0	0	0	0	0					
LLP	0	0	0	1	0	0				
TP	0	0	0	0	0	1	0			
DBP	1	0	0	0	0	0	0	0		
VBP	0	0	0	0	0	1	0	1	1	
VP	0	0	0	0	0	0	1	1	0	0

TABLE 6

MEASURES OF WITHIN AND BETWEEN POPULATION VARIATION IN PYGOPODIDS

	$\bar{s}$	RD	$\bar{x}$		$\bar{s}$	RD	$\bar{x}$
PNS	.014	1.71	1.14	PVS	.140	20.00	15.72
SNS	.021	2.00	0.23	MS	.123	10.89	16.75
INS	.038	4.43	2.44	VBS	.036	2.00	1.28
RP	.016	1.00	0.25	PP	.161	13.50	1.92
LS	.151	17.57	6.47	IPS	.018	2.00	0.14
AOS	.112	11.86	5.30	IGS	.008	1.00	0.06
PRS	.078	7.86	5.45	PAS	.019	1.36	2.69
SLS	.111	13.14	7.21	PCS	.042	3.84	5.49
FS	.098	11.43	5.29	HLS	.066	6.33	3.10
IOS	.045	4.57	4.96	CS	.077	7.79	11.03
POS	.068	7.43	4.50	SCS	.025	1.78	3.29
OS	.229	23.71	12.50	DSP	.026	2.00	0.27
SOS	.029	3.71	1.03	DIP	.015	1.00	0.21
PS	.015	1.00	0.77	DPP	.037	2.86	0.49
NS	.147	15.69	13.23	DNP	.044	3.00	0.66
EAM	.000	1.00	0.18	PNB	.013	1.00	0.15
PM	.046	4.57	2.90	LHP	.021	1.57	0.32
ILS	.140	16.36	6.67	LLP	.062	4.00	1.57
GS	.118	11.81	13.42	TP	.036	3.00	0.65
DSK	.029	2.00	0.26	DBP	.041	3.00	0.89
VSK	.021	2.00	0.11	VBP	.036	4.00	0.80
VS	1.106	89.70	91.98	VP	.030	2.00	1.09

$\bar{s}$ = unweighted mean standard deviation
RD = range of divergence
$\bar{x}$ = mean of local sample means

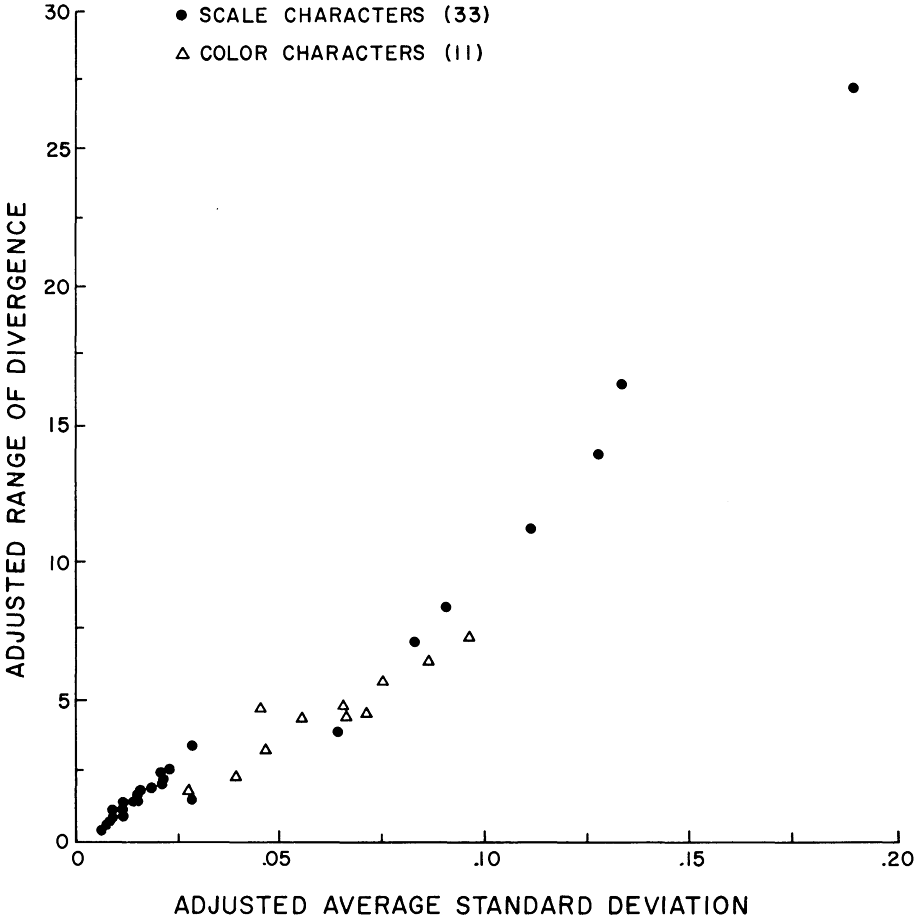

Fig. 8. Bivariate plot of adjusted range of divergence (RD_A) against adjusted average standard deviation ($\bar{s}_A$) for 43 characters. See pages 20-1 for further explanation.

44 characters. The $\bar{s}_A$ and RD_A of each character can be calculated by dividing by that character's $\bar{x}$. The correlation coefficient between $\bar{s}_A$ and RD_A is .960 ($P < .001$). A bivariate plot of $\bar{s}_A$ and RD_A (Fig. 8) indicates that the relationship is curvilinear. A log transformation of the data increases the correlation coefficient slightly (r_{log} = .967). Kerfoot and Kluge (1971) provided a biological explanation for the curvilinearity based on the log normal distribution.

In 1966, Farris discussed the inverse relationship between character conservatism and within population variation. He suggested differentially weighting characters by dividing each character's states by the character's local population standard deviation; also see Kluge and Farris (1969). The original arguments in favor of this particular weighting scheme were theoretical, and it was not until 1973 that Kluge and Kerfoot demonstrated empirically that within population variation ($\bar{s}_A$) is in fact an accurate predictor of a character's "potential" to evolve (RD). The significant correlation between $\bar{s}_A$ and RD_A in 43 meristic variables which I have found in pygopodids further supports their conclusion and justifies the use of Farris' weighting method in the present research.

ANALYSIS OF SIZE AND SHAPE

When a snake-like form evolves from a tetrapod ancestor, natural selection usually produces considerable divergence in size and shape and some dimensions may change more than others. I believe it is important to estimate the relative conservatism among morphometric variables and the trends and relationships based on size and shape in the Pygopodidae because the family appears to have had a relatively recent tetrapod ancestor and it has undergone considerable divergence in the time elapsed (Underwood, 1957b). Such analyses of morphometric data may be particularly useful in characterizing independent evolutionary trends should they exist.

CONSERVATISM AMONG MORPHOMETRIC VARIABLES.–I have chosen to estimate relative conservatism as a function of the degree of character correlation within and between local samples. The initial step in this estimation was the calculation of a matrix of pairwise correlation coefficients among all 14 morphometric characters in each of the 27 local samples described above. Tail length was excluded because of small sample sizes. A pairwise character matrix of means and one of standard deviations of the correlation coefficients found in all 27 local samples were then computed. Next, each character's mean correlation ($\bar{x}_r$) and average standard deviation of correlation ($\bar{s}_r$) was calculated from these two matrices. The mean correlation coefficients and the average standard deviation of the correlation coefficients were ranked: the highest $\bar{x}_r$ value was given rank 1 while the lowest $\bar{s}_r$ was ranked 1. Each character's $\bar{x}_r$ and $\bar{s}_r$ ranks were then summed and the grand rank based on this sum was used to estimate the relative degree of conservatism; the variable with the lowest grand rank is considered to be the most conservative. Table 7 summarizes the correlation analysis. Rostral width is estimated by this method to be the most conservative variable measured.

Principal component analysis was also used to estimate relative conservatism among the 14 morphometric characters recorded. Again tail length was excluded because of small sample sizes. In each of the 27 local samples an eigenvector by component correlation coefficient matrix was calculated. The mean and standard deviation of each character's component correlation coefficients were determined for each sample. Each character's within-sample mean coefficient and

TABLE 7

CORRELATION ANALYSIS OF MORPHOMETRIC CHARACTERS IN PYGOPODIDS

	$\bar{x}_r$	rank	$\bar{s}_r$	rank	rank sum	grand rank
SVL	.758	5	.167	9	14	8
HL	.776	1	.153	7	8	4
SL	.770	4	.143	5	9	5
EW	.684	11	.176	12	23	11
PL	.665	12	.182	14	26	13
HW	.771	3	.140	3	6	2
HD	.758	5	.139	2	7	3
RD	.736	8	.172	10	18	9
RW	.773	2	.138	1	3	1
RLD	.580	14	.176	12	26	13
RLV	.688	10	.154	8	18	9
MD	.637	13	.175	11	24	12
MW	.749	7	.148	6	13	6
ML	.697	9	.141	4	13	6

$\bar{x}_r$ = mean of correlation coefficients
$\bar{s}_r$ = standard deviation of correlation coefficients

TABLE 8

PRINCIPAL COMPONENT ANALYSIS OF MORPHOMETRIC CHARACTERS IN PYGOPODIDS

	$\bar{x}_E$	rank	$\bar{s}_E$	rank	rank sum	grand rank
SVL	.900	7	.127	11	18	8
HL	.925	1	.079	7	8	3
SL	.914	4	.066	5	9	4
EW	.820	11	.111	9	20	11
PL	.787	12	.195	14	26	13
HW	.922	2	.057	2	4	1
HD	.908	5	.063	4	9	4
RD	.873	8	.115	10	18	8
RW	.919	3	.052	1	4	1
RLD	.646	14	.181	13	27	14
RLV	.821	10	.102	8	18	8
MD	.756	13	.147	12	25	12
MW	.901	6	.073	6	12	7
ML	.835	9	.057	2	11	6

$\bar{x}_E$ = mean of component correlation coefficients
$\bar{s}_E$ = standard deviation of component correlation coefficients

standard deviation were then averaged over all 27 local samples. These mean coefficients ($\bar{x}_E$) and their standard deviations ($\bar{s}_E$) were ranked like their analogs in the previously discussed correlation analysis. Table 8 summarizes the findings of the principal component analysis. Again rostral width is estimated to be the most conservative variable measured. The rank orders of relative conservatism derived from the correlation and from the principal component analyses are almost identical; compare Tables 7 and 8.

The significant negative correlation between $\bar{x}_r$ and $\bar{s}_r$ ($r = -.686$, $df = 12$, $P < .01$) and $\bar{x}_E$ and $\bar{s}_E$ ($r = -.786$, $df = 12$, $P < .001$) may indicate the relative degree of coadaptation among the 14 morphometric variables recorded. The general prediction that follows from this relationship is that the more highly correlated a character is the less likely it is to change during the course of evolution; also see predictions of Kluge and Kerfoot (1973).

SIMILARITIES BASED ON SIZE AND SHAPE.—The problem of selecting the "best" independent (X) morphometric variable must be dealt with before I proceed with the study of similarities based on size and shape. There is such a problem because of the considerable variation among even closely related species of reptiles in their size at hatching, differential growth rate and maximum size attained. In order to eliminate the effect of these differences, when individuals of different absolute sizes are compared in terms of a morphometric character, the character states are usually expressed as percentages of some other size-related variable. In almost all reptile studies the character "snout-to-vent length" is employed as the denominator in such transformations and it tends to correct for differences due to absolute size. Similarly, snout-to-vent length is often used as the independent variable when the relative growth of different species is determined. While explicit reasons are never given for why the snout-to-vent length character is selected from among other possibilities it seems reasonable to assume that the best variable is one that (1) increases linearly with age, (2) can be accurately recorded (repeatable), and (3) is conservative in evolution. When an independent variable fits these assumptions, one can consider that he has done the best he can in referring the contribution of differences observed among samples to the dependent variable.

In the present morphometric data set the first criterion listed above (1) does not appear to be an issue because log transformations of the raw data in the 27 local populations do not significantly improve the correlation coefficients. In any event all morphometric variables were log transformed in the regression analyses. With the possible exception of RLV all characters are equally accurately recorded (criterion 2; see Table 2), and both criteria 2 and 3 appear to be estimated by the correlation and principal component analyses described immediately above. If I adhere strictly to these two criteria and to the predictions of the two statistical analyses, I must select RW as the best independent variable among the 14 recorded. However, there is yet another solution to the selection of best independent variable. In most animals there is usually a high positive correlation of many body parts in ontogeny, and pygopodids are no exception to this generalization; see Table 3. Since this correlation is due primarily to the common factor of increasing size (Gould, 1966), the first principal component's axis has been interpreted as a general growth descriptor (Jolicoeur and Mosimann, 1960). Further, Matsuda and Rohlf (1961) have successfully employed the individual projections from that first axis as the reference or independent dimension (X) for regressions with body parts. I believe that this methodology provides the best independent variable and I have used it in the present study; see Matsuda and Rohlf (1961) for statistical details. The first component accounted for an average of 74.0% (range 58.7-85.2%) of the total variance in the 25 species samples analyzed. The following species were excluded because they were represented by few individuals: *Aclys concinna, Aprasia rostrata, A. smithi, Delma elegans, Ophidiocephalus taeniatus.* The species samples almost certainly consist of individuals from populations with different adaptive optima and it seems certain that a higher percentage of the total variance would have been accounted for if the species samples were truly local biological samples.

The trends and relationships based on size and shape were evaluated by a combination of linear regression, correlation and principal component statistics and Prim Network cluster analysis. The first step in the evaluation consisted of calculating relative growth (b_{YX}) and initial growth index (a_{YX}) from a linear regression Model I type of analysis for each of the 15 dependent characters (Y) in all those species samples represented by more than four individuals. The relative growth and initial growth index and their standard errors are listed for each character in the individual species accounts (pp. 50-154). The independent variable consisted of the projections from the first principal component; see paragraph above. The four assumptions of Model I regression analysis (Sokal and Rohlf, 1969:408-10) are met, or at least closely approximated, in my choice of independent and dependent variables.

Table 9 summarizes the correlation between a character's relative growth and initial growth index. The correlation is negative and with the exception of four characters (SVL, RD, RLD, MD) the relation-

TABLE 9

CORRELATION BETWEEN A CHARACTER'S RELATIVE GROWTH AND INITIAL GROWTH INDEX IN PYGOPODIDS

SVL	-.288	RW	-.579
HL	-.766	RLD	.199
SL	-.678	RLV	-.549
EW	-.573	MD	-.221
PL	-.796	MW	-.509
HW	-.664	ML	-.547
HD	-.671	TL	-.579
RD	.008		

df = 21; $P < .05$ @ $r \leqslant 413$; $P < .01$ @ $r \leqslant .526$

ship is significant ($P < .05$). The findings presented in Table 9 argue against the use of relative growth and initial growth index as independent variables in the analysis of species relationships to follow; but see Baird and Eckardt (1972) for the opposite opinion. Table 10 suggests that relative growth varies significantly and positively among all morphometric dimensions measured except RLD. The peculiar relationship between RLD and all other variables does not appear to be attributable to observational or computational error; see Table 2 and the individual species accounts.

The phenetic similarity among pygopodids based on the relative growth of the 15 morphometric characters was initially studied by principal component analysis and the results are presented in Fig. 9. Fig. 9 consists of two-dimensional graphs of component I plotted against II and III. The two graphs viewed together define a three-dimensional space. I decided against using single illustrations of three dimensions throughout this paper because too many points tended to overlap, resulting in the apparent loss or misinterpretation of information. The following species were excluded from the present principal component analysis because they were represented by less than 10 individuals: *Aclys concinna, Aprasia rostrata, Aprasia smithi, Delma elegans, D. torquata, Ophidiocephalus taeniatus, Paradelma orientalis.* The initial growth index values were not included because of their significantly high correlation with relative growth. The biological meaning of relative growth is much easier to identify than that of the initial growth index, which is the value of Y when X = 0. The first three components in the analysis account for 89.9% of the total variance in the data set (Table 11). The II and III component correlation coefficients are not obviously interpretable. The uniformly strong correlation of all variables except RLD (also see Table 10) on component I suggests that the principal axis corresponds to a general relative growth index. The species relationships shown in the Prim Network analysis of the same standardized set of data (Fig. 10) are similar to those illustrated in the three-dimensional space defined by principal components I-III. The fact that the relationships expressed by the principal component analysis and the Prim Network are similar suggests that the two-dimensional hierarchic structure delimited by the latter method is present in the data set. Comparing the relationships illustrated in Figs. 13-14, I conclude that species considered phenetically similar on other grounds, and perhaps phylogenetically closely related, as inferred from Fig. 15, may have evolved different relative growth indexes. For example, *Pygopus nigriceps* is much more similar to *Lialis burtonis* in its relative growth than it is to its supposed congener *P. lepidopodus.*

There is a wide range of adult size among pygopodids as estimated by the largest values recorded for SVL; see Table 12. *Pletholax gracilis* reaches the smallest maximum size at 71 mm (♂), whereas *Lialis jicari* is the largest at 314 mm (♀). The two species of

TABLE 10

CORRELATION AMONG RELATIVE GROWTH INDEXES IN PYGOPODIDS

	SVL	HL	SL	EW	PL	HW	HD	RD	RW	RLD	RLV	MD	MW	ML
HL	0.879													
SL	0.899	0.981												
EW	0.804	0.808	0.813											
PL	0.684	0.888	0.830	0.666										
HW	0.915	0.917	0.928	0.840	0.785									
HD	0.860	0.864	0.858	0.793	0.753	0.937								
RD	0.759	0.771	0.760	0.809	0.639	0.830	0.840							
RW	0.883	0.885	0.886	0.846	0.709	0.893	0.874	0.902						
RLD	-.003	-.062	-.013	-.026	-.318	-.096	-.228	0.123	0.086					
RLV	0.727	0.838	0.796	0.661	0.780	0.823	0.832	0.791	0.802	-.214				
MD	0.556	0.586	0.572	0.681	0.545	0.757	0.831	0.814	0.718	-.193	0.679			
MW	0.900	0.901	0.913	0.836	0.756	0.945	0.923	0.872	0.950	0.008	0.815	0.736		
ML	0.643	0.706	0.696	0.756	0.596	0.753	0.763	0.749	0.825	-.120	0.775	0.784	0.782	
TL	0.948	0.816	0.830	0.764	0.699	0.870	0.808	0.727	0.813	-.120	0.757	0.535	0.822	0.588

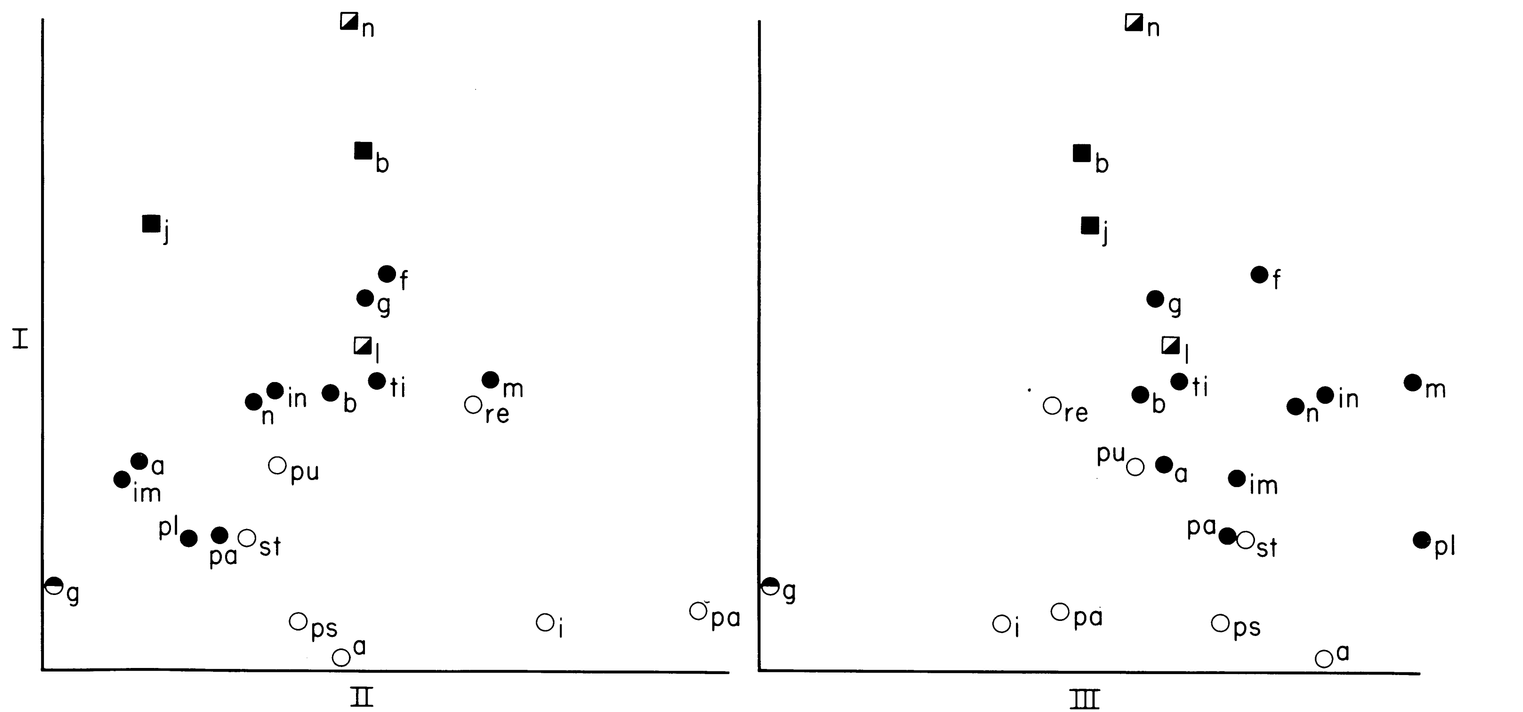

Fig. 9. Principal component I plotted against II and III. The data consist of 23 species described by the relative growth of 15 morphometric characters; see pages 27-8. Table 11 lists the eigenvalues and the component correlation coefficients of this analysis. The results of the Prim Network cluster analysis applied to the same data set are illustrated in Fig. 10. The taxa whose relationships are illustrated here, and in Figs. 10-15, are defined by the following combination of symbols (genus) and letters (species): (☆) *Aclys*–(c) *concinna*; (○) *Aprasia*–(a) *aurita*, (i) *inaurita*, (pa) *parapulchella*, (ps) *pseudopulchella*, (pu) *pulchella*, (re) *repens*, (ro) *rostrata*, (sm) *smithi*, (st) *striolata*; (●) *Delma*–(a) *australis*, (b) *borea*, (e) *elegans*, (f) *fraseri*, (g) *grayii*, (im) *impar*, (in) *inornata*, (m) *molleri*, (n) *nasuta*, (pa) *pax*, (pl) *plebeia*, (ti) *tincta*, (to) *torquata*; (■) *Lialis*–(b) *burtonis*, (j) *jicari*; (□) *Ophidiocephalus*–(t) *taeniatus*; (▲) *Paradelma*–(o) *orientalis*; (◓) *Pletholax*–(g) *gracilis*; (◪) *Pygopus*–(l) *lepidopodus*, (n) *nigriceps*.

TABLE 11

RESULTS OF PRINCIPAL COMPONENT ANALYSIS OF RELATIVE GROWTH OF 15 CHARACTERS SCORED IN 23 SPECIES OF PYGOPODIDS (*see Fig. 9*)

Component	I	II	III
Eigenvalue	11.4	1.2	0.9
% total variance	75.7	84.0	89.9
Independence	250.3	196.8	146.2
df	104	90	77
Significance	0.0	0.0	0.0
SVL	-.9	-.1	-.3
HL	-.9	-.0	-.2
SL	-.9	-.1	-.3
EW	-.9	-.1	0.1
PL	-.8	0.3	-.3
HW	-1.0	0.0	-.1
HD	-.9	0.1	0.1
RD	-.9	-.2	0.3
RW	-1.0	-.2	0.1
RLD	0.1	-1.0	0.0
RLV	-.9	0.2	0.0
MD	-.8	0.1	0.6
MW	-1.0	-.1	0.0
ML	-.8	0.1	0.5
TL	-.9	0.0	-.3

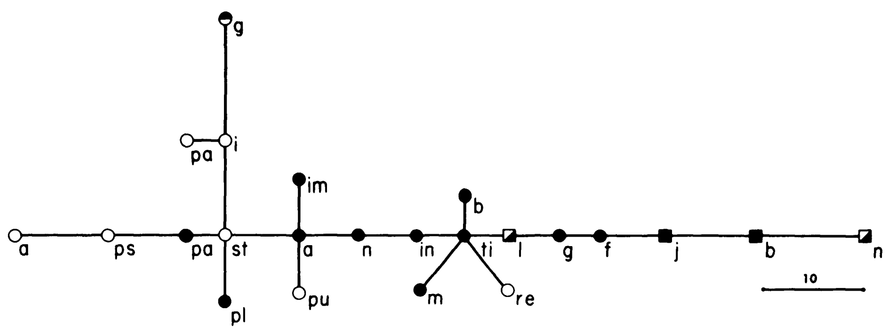

Fig. 10. Prim Network cluster analysis of 23 species described by the relative growth of 15 morphometric characters; see pages 27-8. The characters were standardized. The results of the principal component analysis applied to the same data set are illustrated in Fig. 9. The symbols and letters in the Network refer to the 23 taxa and they are defined in the legend of Fig. 9. The angles of the Network are arbitrary, and the interval lengths are proportionate to the sum of the standardized unit character differences between adjacent species.

TABLE 12

SEXUAL DIMORPHISM IN MAXIMUM AND RELATIVE VALUES OF SVL, TL, HW AND EW IN PYGOPODIDS

Species	N (♂,♀)	Maximum SVL ♂	Maximum SVL ♀	Largest SVL ♂ with complete tail: Total length	SVL	TL	% TL of total length	Largest SVL ♀ with complete tail: Total length	SVL	TL	% TL of total length	Maximum HW	Maximum HW as % of maximum SVL	Maximum EW	Maximum EW as % of maximum SVL
Aclys concinna	(2,0)	78.2	–	416.4	78.2	338.2	81.2	–	–	–	–	5.8	7.4	1.3	1.7
Aprasia aurita	(7,8)	104.0	116.5	165.0	102.0	63.0	38.2	184.5	112.3	72.2	39.1	3.5	3.0	0.8	0.7
Aprasia inaurita	(10,11)	118.8	136.0	163.5	98.0	65.5	40.1	190.7	119.5	71.2	37.3	3.5	2.6	1.0	0.7
Aprasia parapulchella	(8,14)	117.0	141.0	195.6	117.0	78.6	40.2	190.9	117.0	73.9	38.7	3.6	2.6	1.0	0.7
Aprasia pseudopulchella	(11,7)	129.0	143.5	207.0	124.0	83.0	40.1	229.5	143.5	86.0	37.5	3.6	2.5	0.9	0.6
Aprasia pulchella	(23,16)	102.3	121.2	178.5	99.0	79.5	44.5	196.0	114.0	82.0	41.8	3.4	2.8	1.0	0.8
Aprasia repens	(80,89)	116.0	126.0	179.2	115.0	64.2	35.8	180.5	124.0	56.5	31.3	3.5	2.8	0.9	0.7
Aprasia rostrata	(1,0)	94.0	–	–	–	–	–	–	–	–	–	2.1	2.2	0.6	0.6
Aprasia smithi	(3,0)	110.5	–	157.5	91.5	66.0	41.9	–	–	–	–	3.8	3.4	1.1	1.0
Aprasia striolata	(49,43)	131.8	127.8	175.5	110.5	65.0	37.0	196.8	127.8	69.0	35.1	3.6	2.7	1.0	0.8

Delma australis	(37,39)	78.5	87.8	219.3	69.8	149.5	68.2	213.4	76.5	136.9	64.2	5.9	6.7	1.4	1.6
Delma borea	(34,34)	79.8	86.3	327.0	76.0	251.0	76.8	289.0	81.0	208.0	72.0	5.7	6.6	1.5	1.7
Delma elegans	(2,1)	81.5	91.0	396.0	81.5	314.5	79.4	424.2	91.0	333.2	78.6	6.2	6.8	1.6	1.8
Delma fraseri	(71,70)	120.0	128.0	489.6	115.0	374.6	76.5	501.7	121.7	380.0	75.7	8.7	6.8	2.0	1.6
Delma grayii	(13,19)	99.5	120.5	437.6	93.1	344.5	78.7	489.2	104.2	385.0	78.7	7.6	6.3	1.7	1.4
Delma impar	(13,24)	89.1	101.0	239.0	75.5	163.5	68.4	275.8	97.8	178.0	64.5	6.5	6.4	1.5	1.5
Delma inornata	(43,38)	114.5	133.0	423.6	103.7	319.9	75.5	453.0	120.0	333.0	73.5	7.6	5.7	1.7	1.3
Delma molleri	(16,12)	89.0	111.2	314.5	85.5	229.0	72.8	355.3	101.3	254.0	71.5	6.9	6.2	1.7	1.5
Delma nasuta	(56,63)	104.2	102.5	354.0	89.0	265.0	74.9	444.5	93.0	351.5	79.1	6.7	6.4	1.9	1.8
Delma pax	(8,8)	81.6	95.0	296.0	76.0	220.0	74.3	373.2	95.0	278.2	74.6	6.1	6.4	1.5	1.6
Delma plebeia	(17,19)	102.5	122.0	370.0	98.0	272.0	73.5	412.5	116.5	296.0	71.8	6.7	5.5	1.6	1.3
Delma tincta	(44,53)	81.2	89.0	320.0	75.0	245.0	76.6	355.5	89.0	266.5	75.0	5.5	6.2	1.3	1.5
Delma torquata	(2,4)	44.0	63.3	68.0	28.0	40.0	58.8*	–	–	–	–	3.9	6.2	1.1	1.8
Lialis burtonis	(71,115)	213.5	291.0	491.6	213.0	278.6	56.7	548.2	238.2	310.0	56.6	12.1	4.2	2.5	0.9
Lialis jicari	(29,61)	281.5	314.0	702.1	261.0	441.1	62.8	734.1	283.0	451.1	61.5	10.0	3.2	2.7	0.9
Ophidiocephalus taeniatus	(1,0)	102.0	–	–	–	–	–	–	–	–	–	4.3	4.2	0.7	0.7
Paradelma orientalis	(3,2)	185.0	197.5	–	–	–	–	375.8	154.0	221.8	59.0	8.2	4.2	2.2	1.1
Pletholax gracilis	(14,8)	70.5	83.7	269.5	70.5	199.0	73.8	319.7	83.7	236.0	73.8	3.6	4.3	1.1	1.3
Pygopus lepidopodus	(76,73)	248.0	274.8	810.4	229.0	581.4	71.7	635.6	198.2	437.4	68.8	13.0	4.7	2.5	0.9
Pygopus nigriceps	(65,50)	190.5	206.0	427.6	179.5	248.1	58.0	422.6	189.5	233.1	55.2	11.6	5.6	2.5	1.2

*Estimate of actual condition; probably inaccurate because of extremely small SVL.

TABLE 13

SEXUAL DIMORPHISM IN INITIAL GROWTH INDEX AND RELATIVE GROWTH IN SVL AND TL IN SELECTED SPECIES OF PYGOPODIDS

		Y = SVL*					Y = TL*				
Species	Sex	N	a_{yx}	$SE_{a_{yx}}$	b_{yx}	$SE_{b_{yx}}$	N	a_{yx}	$SE_{a_{yx}}$	b_{yx}	$SE_{b_{yx}}$
Aprasia	♂	80	4.44	0.009	-.14	0.009	50	3.85	0.018	-.19	0.017
repens	♀	89	4.51	0.009	-.21	0.009	52	3.80	0.017	-.21	0.016
Delma	♂	71	4.45	0.008	-.23	0.008	33	5.58	0.017	-.34	0.017
fraseri	♀	70	4.50	0.008	-.26	0.009	40	5.56	0.022	-.35	0.020
Lialis	♂	71	5.07	0.009	-.22	0.009	30	5.30	0.030	-.31	0.027
burtonis	♀	115	5.27	0.007	-.23	0.007	36	5.40	0.031	-.31	0.028
Pygopus	♂	65	4.84	0.015	-.31	0.015	32	5.07	0.040	-.43	0.034
nigriceps	♀	50	4.96	0.016	-.32	0.016	18	5.24	0.049	-.47	0.040

*X = general size index (see p. 27).

Pygopus are nearly as large as *Lialis,* whereas all others are considerably smaller. Table 12 also demonstrates that the female of a given species almost always attains a larger size than the male; this correlates with the fact that number of ventral scales is often significantly greater in females than males. Moreover, tail length (TL) as a percentage of total length is almost always greater in the male of the species. Table 13 does not indicate obviously significant differences in relative growth or initial growth index that would help to explain the observed sexual dimorphisms. The same sexual dimorphisms in SVL and TL occur in most snakes and they are usually interpreted, if somewhat vaguely, as related to the fact that the female body bears the eggs or young and the male possesses the postanally located hemipenes.

To conclude my use of morphometric data, I have attempted to discern the presence of broad adaptive types among pygopodids from an analysis of absolute and relative values. From our much greater knowledge of snakes certain measurements, such as snout-to-vent length, tail length, body diameter and eye width, are known to be reasonably good predictors of kind and place of locomotion and principal mode of prey location, by sight as opposed to some other sensory modality. Snakes with long slender bodies and tails and with large eyes tend to be fast moving, visually oriented predators which inhabit more open terrestrial environments (e.g., *Coluber, Masticophis*). At the other adaptive extreme, robust short-tailed and small-eyed species tend to move more slowly, may be fossorial, and hunt by some mechanism other than sight (e.g., *Eryx, Crotalus*). Characterization of such adaptive types may provide evidence of independent evolutionary trends leading to a snake-like morphology in the Pygopodidae. Snakes and pygopodids may not be strictly comparable in all four morphometric characters because they differ significantly in two ways: (1) the tail is usually much longer than the SVL in pygopodids but almost always shorter in snakes, and (2) the tail is always autotomous in pygopodids but rarely so in snakes.

I have used the following four morphometric variables to delimit the adaptive types suggested above: largest snout-to-vent length (SVL) and head width (HW) and eye width (EW) as a percentage of the largest individual, and tail length (TL) as a percentage of the largest adult male, except in *Paradelma orientalis* where females were used because the three known males lack tails. Head width has been chosen to estimate body diameter rather than body width itself because the former measure appears to be much less subject to distortion due to preservation. Food in the digestive tract also contributes to significant deviation from normal body width. Twenty-seven species were characterized by these four variables; *Aprasia rostrata* and *Ophidiocephalus taeniatus* were not included because the known specimens lacked tails. The relative tail length value of the only *Delma torquata* with a complete tail may not be representative of the species because it was taken from a juvenile and for that reason this species was also excluded from the analysis.

Table 14 illustrates the high degree of correlation among the values of SVL, TL, HW and EW in the 27 species sampled. Of particular interest is the fact that relative eye width is negatively related to size, either absolute or relative. Relatively small eyes are found in the diurnal-nocturnal, above ground dwelling predator *Lialis* as well as the myrmecophagous fossorial *Aprasia.* Littlejohn and Rawlinson (1971) concluded that *Aprasia* species are truly burrowing pygopodids and although *Delma, Lialis* and *Pygopus* utilize subterranean microenvironments for shelter, they feed above ground. Bustard (1970) stated that activity occurs exclusively during the day in *Aprasia* kept in the laboratory. Cogger (1967) concluded that *Delma* and *Pygopus* species are almost strictly nocturnal.

Principal component analysis of the 27 species characterized by the four variables is shown in Table 15 and Fig. 11. The first component accounts for 74.9% of the total variance in the data set. Given that the three relative measures, TL, HW, and EW, all correlate very strongly with component I, while SVL does much less so, the

TABLE 14

CORRELATION BETWEEN SVL, TL, HW AND EW SCORED IN 27 SPECIES OF PYGOPODIDS

TL	0.903		
HW	0.878	0.954	
EW	-.955	-.982	-.973
	SVL	TL	HW

TABLE 15

RESULTS OF PRINCIPAL COMPONENT ANALYSIS OF SVL, TL, HW AND EW SCORED IN 27 SPECIES OF PYGOPODIDS (*see Fig. 11*)

Component	I	II	III	IV
Eigenvalue	3.0	0.9	0.1	0.0
% total variance	74.9	96.9	99.1	100.0
Independence	60.1	3.9		
df	5	2		
Significance	0.0	0.2		
SVL	0.5	0.9	0.1	0.0
TL	-.9	0.3	-.2	0.0
HW	-1.0	0.1	0.1	0.1
EW	-1.0	0.0	0.1	-.1

principal axis would appear to be most accurately interpreted as a relative size factor; *Aprasia* and *Lialis* possess relatively shorter tails and narrower heads and eyes than *Aclys* and *Delma. Pletholax* is very similar to *Delma,* and *Pygopus* and *Paradelma* are more like *Aprasia* and *Lialis* in these aspects. Component II accounts for almost all of the remaining variance, an accumulated 96.9%. SVL correlates very strongly with II, and TL moderately so, and the relationships of these two variables suggest that the second axis is a general size dimension; *Aprasia* are the smallest, in the sense of total length, and *Lialis* the largest. The third component accounts for only an additional 2% of the total variance and it is difficult to interpret; only *Pletholax gracilis* and *Pygopus nigriceps* are effectively discriminated from the others by this dimension.

The Prim Network shown in Fig. 12 is based on the same standardized data set used immediately above, and the hierarchic structure that it depicts is very similar to that shown in the principal component analysis (Fig. 11). The *Aprasia* group of species form a well-defined cluster as does *Aclys, Delma* and *Pletholax. Paradelma orientalis* and the two species of *Lialis* and the two of *Pygopus* are very different from each other and they form a large cluster of their own between that of *Aprasia* and *Delma.*

Aprasia consists of species of medium SVL (102-144 mm) and relatively very short tails (37-45%), narrow heads (2.2-3.4%) and small eyes (0.6-1.0%). The *Aclys, Delma* and *Pletholax* cluster consists of small to medium size species (84-133 mm) with relatively long to very long tails (68-81%), wide heads (4.3-7.4%) and large eyes (1.3-1.8%). The *Lialis, Paradelma* and *Pygopus* cluster consists of very large species (185-314 mm), with medium to long tails (57-72%) and head (3.2-5.6%) and eyes (0.9-1.2%) of medium width. The cluster analysis based on the four morphometric variables (Fig. 12)

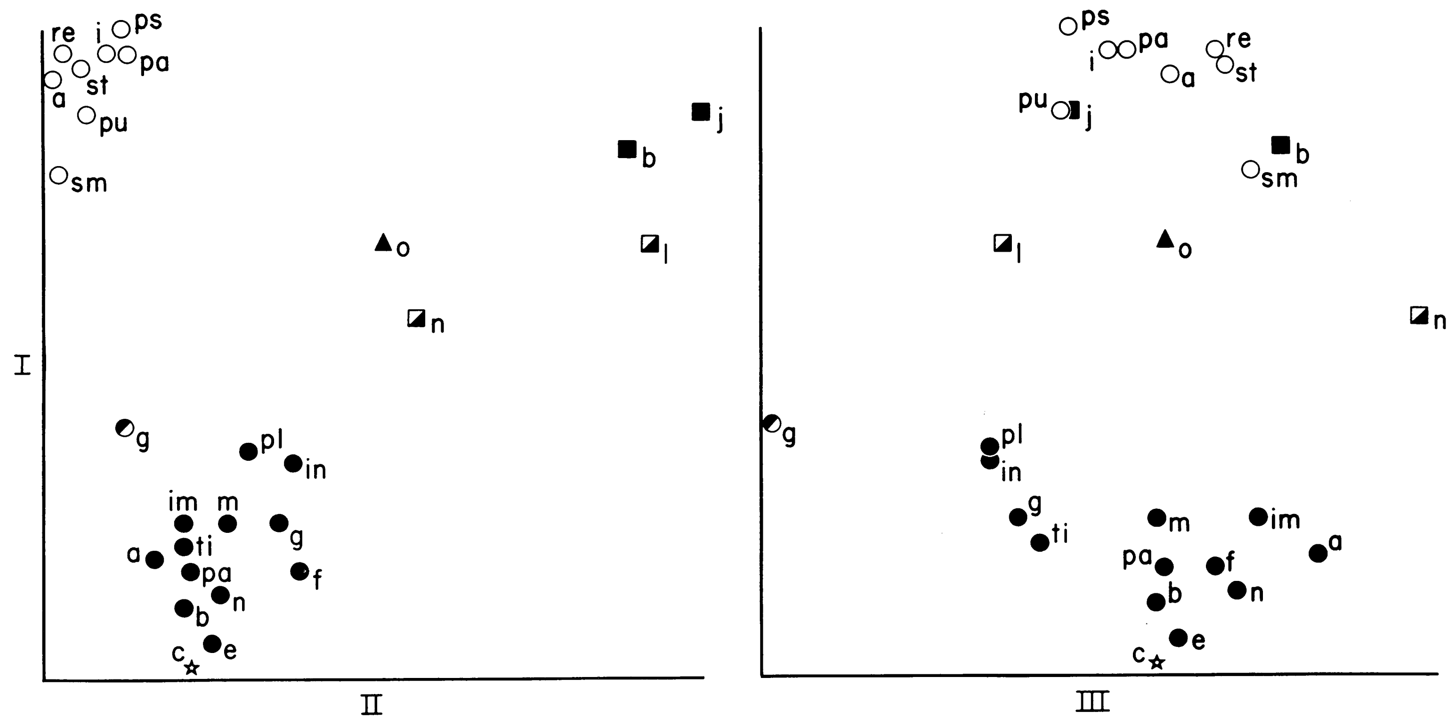

Fig. 11. Principal component I plotted against II and III. The data consist of 27 species described by four characters, largest SVL, largest HW and EW as a percentage of the largest individual, and TL as a percentage of the largest adult male (except in *Paradelma orientalis* where the largest adult female was employed; see pages 34-8).. Table 15 lists the eigenvalues and the component correlation coefficients of this analysis. The results of the Prim Network cluster analysis applied to the same data set are illustrated in Fig. 12. The symbols and letters in the graphs refer to the 27 taxa and they are defined in the legend of Fig. 9.

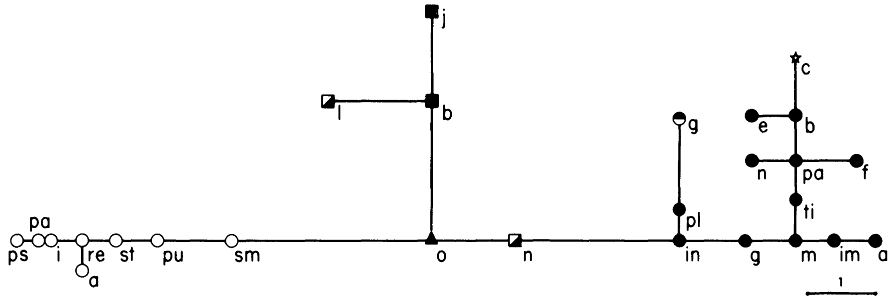

Fig. 12. Prim Network cluster analysis of 27 species described by four characters, largest SVL, largest HW and EW as a percentage of the largest individual, and TL as a percentage of the largest adult male (except in *Paradelma orientalis* where the largest adult female was employed; see pages 34-8). The characters were standardized. The results of the principal component analysis applied to the same data set are illustrated in Fig. 11. The symbols and letters in the Network refer to the 27 taxa and they are defined in the legend of Fig. 9. The angles of the Network are arbitrary, and the interval lengths are proportionate to the sum of the standardized unit character differences between adjacent species.

does not appear to delimit groups that correlate with distinctive "adaptive types" in so far as the meager information of time and place of activity and food habits indicates; see individual species accounts and Bustard (1970) and Cogger (1967). For example, *Lialis burtonis* and *Pygopus nigriceps* occupy nearby points in the Network. *Lialis burtonis* is an aggressive predator of other lizards, primarily skinks (occasionally it will eat arthropods and small snakes), and it hunts above ground in grassy or more open environments at any time of the day or night. On the other hand *Pygopus nigriceps* is a nocturnal form which moves slowly on the ground in and between small shrubs and grass clumps (*Triodia*) in search of large arthropods. *Pletholax gracilis* and *Aprasia repens* do not cluster closely and yet both appear to spend much of the time below the surface of sand or soft soil. *Pletholax* is an extremely rapid sand swimmer while *Aprasia* is much less mobile. It is important to note that at least the species-group relationships differ significantly from those based on scale and color pattern variables; compare Figs. 12 and 14. These differences suggest that the morphometric dimensions have an adaptive role very different from scales and color pattern. Perhaps the cluster analysis based on morphometrics will acquire some meaning and interpretative value when more detailed and extensive knowledge of the species biology is acquired.

INTERSPECIFIC SIMILARITY AND CLASSIFICATION

The purposes of this part of my study are to discover by objective methods the most realistic set of interspecific relationships possible, phenetic and evolutionary, and to use these relationships as a basis for deciding upon classificatory categories above the level of species. I have not attempted a phylogenetic hypothesis of relationships (cladistic and patristic) in the family because the ancestral state of the kinds of characters that I have studied herein is very difficult to decide upon in any rigorous and convincing manner. A phylogenetic hypothesis will be derived later from more readily interpretable osteologic characters.

PHENETIC RELATIONSHIPS.—Again I have used principal component and Prim Network statistics to describe the degree of phenetic similarity among the 30 species of pygopodids that I have recognized. Both methods were applied to a 30 species by 42 characters data matrix. The characters were the 31 scale and 11 color pattern variables defined on pages 6-14, and their states were species means. Because characters IPS and IGS are logically dependent on the existence of preanal pores, character PP, they were not included in the data set. The sexual dimorphism that occurs among pygopodids (see individual species accounts) was not recognized in my use of species means. It was not considered significant in this portion of my study because of the multivariate nature of the analysis, its limited extent among species and characters, and the fact that males and females were usually represented by approximately equal numbers. The morphometric data were excluded because they were extremely highly correlated among themselves and therefore redundant, at least statistically. Two species, *rostrata* and *taeniatus*, are represented by single specimens and their character states are the individual observations. These species' relationships should not be taken too confidently because of their small sample sizes and the likelihood of some sampling error. Each character in the data matrix was standardized (Sokal and Sneath, 1963:295) in order to eliminate differential weighting.

The first three axes of the principal component analysis account for 71.8% of the total variance in the data set and 94.9% is accounted for by the first 10; see Table 16. Almost all scale characters (25 of 31) correlate strongly with the principal axis while the color pattern characters usually do not (only 3 of 11 do so). There is an obvious shift of scale and color pattern correlations on the next axis extracted, component II; 18 of 31 scale characters correlate relatively strongly as do 10 of 11 color pattern characters. The relative influence of scale versus color pattern characters is further accentuated in their relationships to the third principal axis; 14 of 31 scale characters correlate strongly with component III as do 9 of 11 color pattern characters. The reciprocal trend between scale and color pattern character relationships to principal components changes abruptly with axis V; I-IV account for 77.6% of the total variance. This trend suggests that the larger clusters are based on scale

TABLE 16

RESULTS OF PRINCIPAL COMPONENT ANALYSIS OF 31 SCALE AND 11 COLOR PATTERN CHARACTERS SCORED IN 30 SPECIES OF PYGOPODIDS (*see Fig. 13*)

Component	I	II	III	IV	V
Eigenvalue	16.5	9.4	4.3	2.5	2.2
% total variance	39.2	61.6	71.8	77.6	82.9
PNS	−.7	0.6	−.4	0.1	0.2
SNS	−.8	0.5	−.3	0.0	0.1
INS	−.8	0.6	−.2	0.1	0.1
RP	0.7	0.5	0.1	0.3	0.0
LS	−.9	0.3	−.1	0.0	0.2
AOS	−1.0	0.1	−.1	−.1	0.0
PRS	−.9	−.4	0.0	−.1	0.2
SLS	−.8	0.5	−.2	0.0	0.2
FS	−.9	0.3	−.2	0.1	0.1
IOS	−.9	0.2	0.2	0.2	0.0
POS	−.9	0.1	0.1	0.0	0.1
OS	−.9	−.4	0.1	0.0	0.0
SOS	−1.0	0.0	0.0	0.1	0.1
PS	−.3	−.8	0.4	0.1	−.1
NS	−.9	0.0	−.1	−.1	0.0
EAM	0.7	0.5	−.3	−.1	−.1
PM	−.5	0.8	−.2	0.0	−.1
ILS	−.9	0.4	−.1	0.0	0.1
GS	−.8	−.5	0.1	−.1	−.1
DSK	−.1	0.1	0.6	0.6	−.3
VSK	0.1	0.1	0.5	0.7	0.0
VS	0.4	0.7	−.3	−.2	−.3
PVS	−.2	−.3	−.6	−.5	0.0
MS	−.8	−.1	0.3	0.0	−.3
VBS	−.5	−.7	0.0	−.2	0.0
PP	−.6	0.1	0.1	−.2	−.7
PAS	−.2	−.1	0.1	0.1	0.6
PCS	−.7	−.2	0.4	−.2	0.1
HLS	−.4	−.6	0.6	−.2	−.2
CS	−.7	0.1	0.4	−.1	−.4
SCS	−.2	0.2	0.5	0.2	0.1
DSP	−.5	0.6	0.0	−.1	−.3
DIP	0.0	−.6	−.5	0.4	0.1
DPP	−.1	−.6	−.5	0.4	0.1
DNP	−.1	−.7	−.5	0.3	−.2
PNB	−.1	−.6	−.5	0.4	−.1
LHP	−.1	0.7	0.2	0.2	−.1
LLP	−.3	−.7	−.4	0.2	−.1
TP	−.4	0.2	−.5	0.3	−.1
DBP	0.1	0.7	0.2	0.1	0.0
VBP	−.5	0.5	−.2	0.3	0.0
VP	0.2	−.5	0.2	−.1	0.7

differences and that color pattern differences only influence relationships within clusters.

Fig. 13 illustrates species relationships on the basis of the first three principal axes, components I-III. Five clouds of points (each point is a species) are particularly conspicuous; they are Group One—*aurita, inaurita, parapulchella, pseudopulchella, pulchella, repens, rostrata, smithi* and *striolata* (all previously described species have been referred to the genus *Aprasia*), Group Two—*australis, borea, elegans, fraseri, grayii, impar, inornata, molleri, nasuta, orientalis, pax, plebeia, tincta* and *torquata* (all previously described species have been referred to the genus *Delma* except *orientalis* which is almost always placed in a monotypic genus, *Paradelma*), Group Three—*concinna* and *gracilis*, Group Four—*lepidopodus* and *nigriceps* (previously referred to the genus *Pygopus*), and Group Five—*burtonis* and *jicari* (previously referred to the genus *Lialis*). One species, *taeniatus*, is located between the well circumscribed Groups One and Two and it does not appear to belong to either. *Gracilis* has always been placed in a monotypic genus (*Pletholax*) as has *taeniatus* (*Ophidiocephalus*). The species *concinna* is described as new in this paper.

The hierarchic structure depicted by the Prim Network (Fig. 14) corresponds closely to that illustrated by principal components I-III (Fig. 13) except for the placement of *orientalis* and perhaps *gracilis*. *Orientalis* is located well within the cluster of *Delma* species in Fig. 13 while outside it in Fig. 14. In Fig. 13 *gracilis* appears to be much closer to *Ophidiocephalus taeniatus*, and perhaps to *Delma impar*, than to the *Aprasia* group where it is located in Fig. 14. In general, the two-dimensional hierarchic structure extracted from the data set by the Prim Network appears to be present in the n-dimensional space where structure is not necessarily imposed (Fig. 13).

Note that the degree of interspecific similarity varies greatly among the Groups discerned in Fig. 14. For example, the average interval length in Group One is 7.6 ($s = 2.198$) and 10.7 ($s = 4.618$) in Group Two. The single interval lengths in Groups Four and Five are 27.5 and 33.9, respectively. The mean and coefficient of variation of the interval lengths of Groups One and Two do not appear to be significantly different statistically; however, the single values for Groups Four and Five are significantly different from both of them.

EVOLUTIONARY RELATIONSHIPS.—The methods employed in this section are identical to those used in my analysis of PHENETIC RELATIONSHIPS. The only difference between the two sections is how, and for what reason, I transformed the data. In the previous analysis the data were standardized and each character had a mean of 0 and a standard deviation of ± 1, whereas in this section I have divided each character by its average within-population standard deviation; see Table 6 for transformation values, $\bar{s}$. It may be recalled

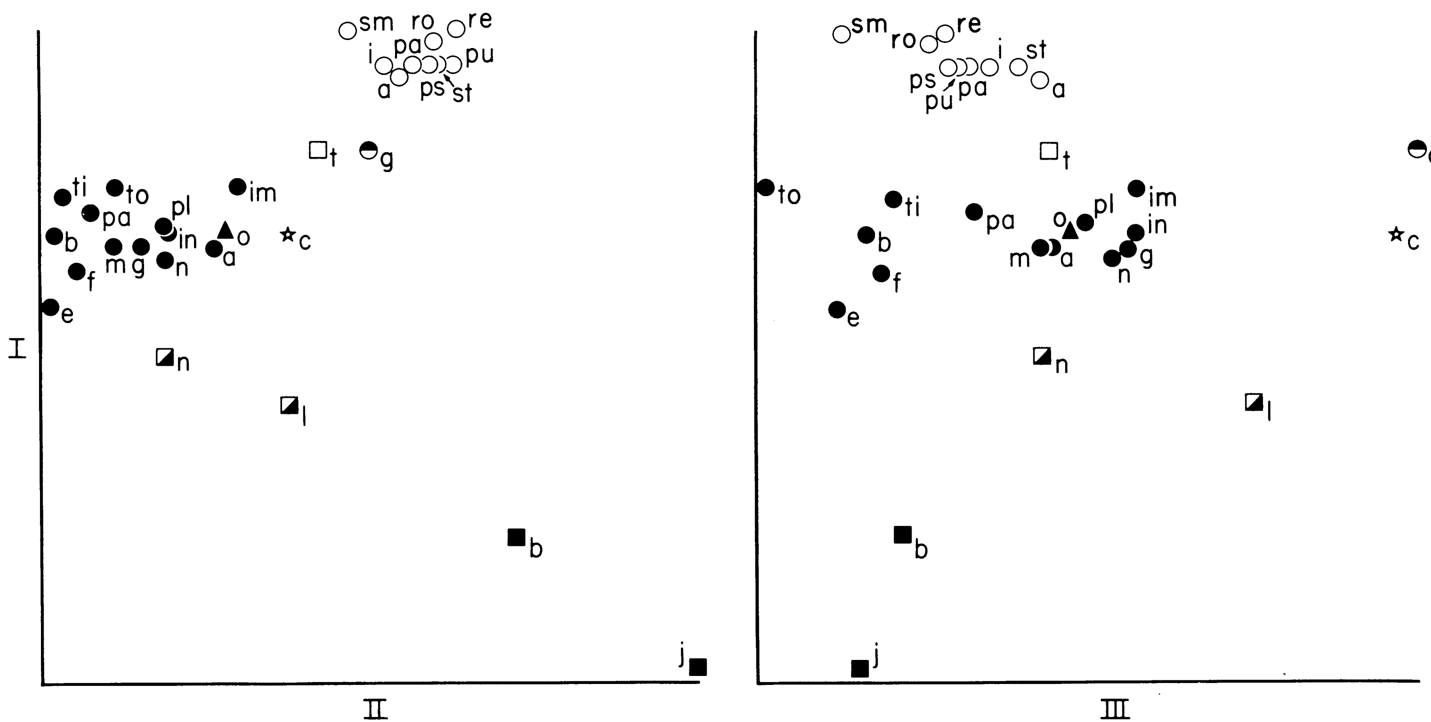

Fig. 13. Principal component I plotted against II and III. The data consist of 30 species described by 31 scale and 11 color pattern characters; see pages 38-41. Table 16 lists the eigenvalues and the component correlation coefficients of this analysis. The results of the Prim Network cluster analysis applied to the same data set are illustrated in Fig. 14. The symbols and letters in the graphs refer to the 30 taxa and they are defined in the legend of Fig. 9.

that I established that the rate at which characters have evolved in pygopodids is related to their average within-population variation (pp. 20-24; also see Kluge and Kerfoot, 1973), and therefore the latter transformation is effectively differentially weighting on a continuous scale in favor of more conservative variables (Farris, 1966).

Again, the same major Groups of species have been delimited by the Prim Network; compare Figs. 14 and 15. The only major effect that weighting has on species relationships concerns the placement of *gracilis.* In the standardized Prim Network (Fig. 14) it clusters with Group One while in the weighted analysis it branches off from *concinna,* which in turn is associated with Group Two. The relatively minor differences among *aurita, inaurita* and *striolata* are almost

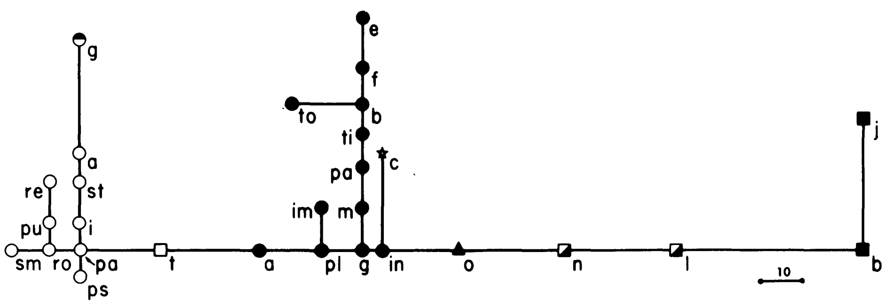

Fig. 14. Prim Network cluster analysis of 30 species described by 31 scale and 11 color pattern characters; see pages 38-41. The characters were standardized. The results of the principal component analysis applied to the same data set are illustrated in Fig. 13. The symbols and letters in the Network refer to the 30 taxa and they are defined in the legend of Fig. 9. The angles of the Network are arbitrary, and the interval lengths are proportionate to the sum of the standardized unit character differences between adjacent species.

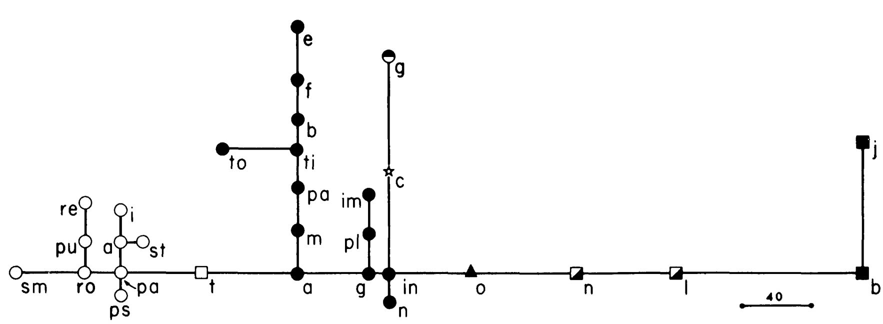

Fig. 15. Prim Network cluster analysis of 30 species described by 31 scale and 11 color pattern characters; see pages 38-44. Each character was transformed by dividing by its $\bar{s}$ value listed in Table 6. The results of the Prim Network cluster analysis applied to a standardized version of the same data set are illustrated in Fig. 14. The symbols and letters in the Network refer to the 30 taxa and they are defined in the legend of Fig. 9. The angles of the Network are arbitrary, and the interval lengths are proportionate to the sum of the standardized unit character differences between adjacent species.

certainly due to the removal of *gracilis* from Group One. The rather numerous, but still relatively minor, differences in relationships among Group Two species do not appear to be due to the placement of *gracilis.* I predict that the cladistic relationships among the major Groups of species described by the weighted Prim Network analysis will be confirmed when highly conservative osteologic characters are employed. These predictions are summarized as follows: (1) Group One is more closely related to Two than it is to any other major Group; (2) *taeniatus* is intermediate between Groups One and Two; (3) *concinna* and *gracilis* are more closely related to Group Two than either is to any other major Group; (4) *orientalis* is intermediate between Groups Two and Four; (5) Group Five is more closely related to Four than it is to any other. The evolutionary relationships estimated in Fig. 14 do not support the general conclusions of Stephenson (1962) nor do they suggest that pygopodids have evolved orthogenetically.

The pattern of degree of interspecific relationships illustrated by the phenetic analysis is encountered again in the weighted Prim Network. I predict that other data sets, even those consisting of much more conservative osteologic characters, will generate the same pattern. Specifically, (1) Group One will consist of a tighter cluster of species than Two, (2) the two species of either Group Four or Five will differ much more than the average among the species of Group Two, and (3) the average among the species of Group Two will differ more than the average in One. These conclusions follow from the fact that within any taxonomic group there appears to be a highly significant positive correlation between within-population variation in a character and degree of character divergence; see pp. 20-24 and Kluge and Kerfoot (1973).

CLASSIFICATION.—In the more formal taxonomic revision which follows this section, I have described 12 new species. The cluster analyses shown in Figs. 14 and 15 indicate that four of these new forms, *aurita, inaurita, parapulchella* and *pseudopulchella,* are members of Group One, and seven, *australis, borea, elegans, inornata, nasuta, pax* and *torquata,* belong to Group Two. On the basis of within and between cluster variation I have chosen to recognize all members of Group One as belonging to the genus *Aprasia,* type species *pulchella,* and all those of Group Two, except *orientalis,* as belonging to the genus *Delma,* type species *fraseri.* As I mentioned earlier, *taeniatus* and *gracilis* have been referred to monotypic genera by previous investigators and this action is supported by the considerable distances by which they are linked to other taxa in the Prim Networks. Similarly, the remaining new species, *concinna,* is linked to other taxa by relatively great distances and it too is referred to a monotypic genus, *Aclys* gen. nov. The pair of species in each of Groups Four and Five are referred to their own generic categories, *Pygopus* and *Lialis,* respectively. In both genera the degree of difference between the species is very great; however, I leave the refinement of employing subgeneric categories to other studies. The classification of *orientalis* is highly problematical. The principal component analysis (Fig. 13) places it within Group Two, the *Delma* cluster, while the Prim Networks (Figs. 14-15) place it in a position intermediate between that Group and Group Four, the *Pygopus* cluster. The resolution of how to represent *orientalis* most accurately must come from future studies of other data; in the interest of taxonomic stability, I have tentatively referred it to its own genus, *Paradelma*, as is customarily done. The generic classification is summarized in Table 1. Supergeneric categories are not well defined in Figs. 13-15 and their recognition must await the study of other data.

NOMENCLATURE AND TAXONOMIC DESCRIPTIONS

Pygopodidae Boulenger

1841. Pygopidae Gray, Ann. Mag. nat. Hist., 7:86. Type genus: *Pygopus* Merrem (1820).
1841. Lialisidae Gray, Ann. Mag. nat. Hist., 7:86. Type genus: *Lialis* Gray (1835).
1841. Aprasiadae Gray, Ann. Mag. nat. Hist., 7:86. Type genus: *Aprasia* Gray (1839).
1843. Pygopoda Fitzinger, Systema Reptilium, p. 23. Emendation of Pygopidae Gray (1841a).
1884. Pygopodidae Boulenger, Ann. Mag. nat. Hist., 14:119. Emendation of Pygopidae Gray (1841a).
1887. Pygopodida Strauch, Zap. imp. Akad. Nauk, 7:11. Emendation of Pygopidae Gray (1841a).
1901. Ophiopsisepidae Jensen, Vidensk. Meddr. dansk. naturh. Foren., 1900:325. Type genus: *Ophiopsiseps* Boulenger (1887).

GEOGRAPHIC RANGE.—Aru Islands, New Britain, New Guinea and Australia, excluding Tasmania.

DIAGNOSIS.—Pygopodidae differs from all other families of lizards in possessing the following combination of character states: a) front limbs absent, b) hind limbs present, c) individual digits of hind limb not obvious externally, completely encased in single scaled flap of skin near vent, d) eye well-developed, e) eyelid immobile, eye covered by spectacle, f) pupil vertical, oval or slit-like in shape, g) body scales imbricate, h) postanal sacs and associated cloacal bones present, i) premaxilla single, j) median ventral process of premaxilla absent, k) postorbital bone absent, l) temporal arch absent, m) parietal foramen absent, n) palatal teeth absent, o) osteoderms absent, p) vertebrae procoelous, q) vertebra with median constriction, r) vertebra with prominent subcentral foramina, s) tail autotomous, t) free intercentral chevron bones present, u) *Rectus superficialis* present, v) clutch consists of two elongate parchment-shelled eggs, w) vocalization consists of squeak or buzz-like sounds.

REMARKS.—Boulenger's (1884) emended family name Pygopodidae is accepted over Gray's (1841a) original spelling, Pygopidae, because the ending podidae is the correct latinized term for the Greek *pod-os* which is the genitive singular of *pous* (International Congress of Zoology, 1961:136). According to Agassiz (1845), the suffix *pus* of the type genus *Pygopus* means foot and in Greek is *pous* in the nominative singular (Brown, 1956). Furthermore, the family name Pygopidae is now applied to a terebratulid brachiopod, type genus *Pygope* Link.

The Pygopoda of Fitzinger (1843) and Pygopodida of Strauch (1887) were names used to describe family and tribe categories of nomenclature, respectively. Since Fürbringer's (1900) Pygopodomorpha and Camp's (1923) Pygopodoidea are superfamilial names they have not been included in the above synonomy. Obvious mispellings of accepted family names, such as Kinghorn's (1926a) Ophidiosepsidae, have also been excluded.

Aclys gen. nov.

TYPE OF GENUS.—*Aclys concinna* sp. nov., by original designation.

DIAGNOSIS.—*Aclys* differs from all other pygopodid genera in possessing the following combination of character states: a) two or more pairs of enlarged scales cover parietal and neck regions, b) rostral projects posteriorly on dorsal midline and separates anteriormost pair of nasal scales, c) nostril bordered by two scales, d) external auditory meatus large, e) scales smooth, f) 20 midbody scale rows, g) ventral body scales not distinctly larger than adjacent lateral body scalation, h) 14 caudal scale rows, i) preanal pores absent, j) 5 subcaudal scale rows, k) snout obviously long and pointed, 1) five hind limb scales, m) dorsal and lateral body and tail stripes present.

Aclys concinna sp. nov.

Figs. 4, 6, 16-7, 32, 121-2.

HOLOTYPE.—WAM R17312, adult male with complete tail. Collected at Sorrento (a suburb of Perth), 11 mi NW Perth, Western Australia by A. E. Boyd, on Dec. 6, 1962.

PARATYPE.—WAM R41156.

ETYMOLOGY.—*Aclys*, of feminine gender, is Latin for short javelin, and *concinna* means beautiful in Latin. The combination of the two terms refers to this species' spear-like appearance and beautiful gray ground color and dark stripes.

GEOGRAPHIC RANGE.—Known only from two localities on the coastal sand plain between Perth and 30° S Lat, Western Australia (Fig. 32).

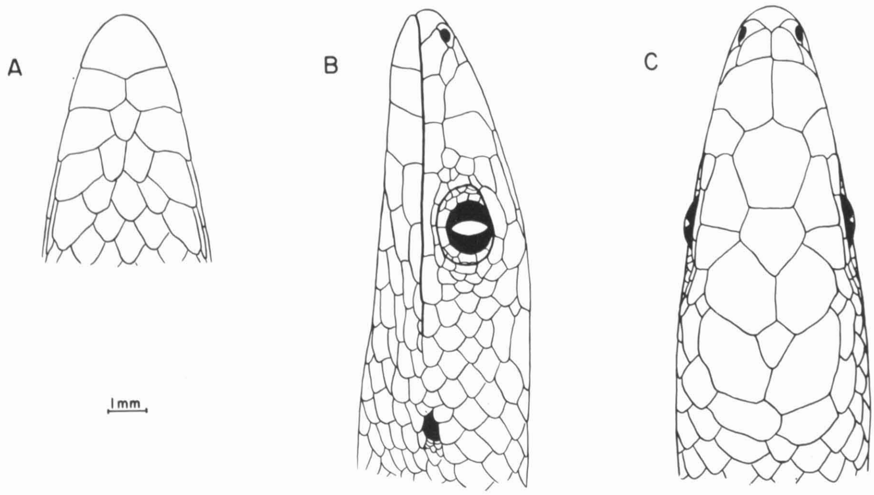

Fig. 16. Head region of holotype of *Aclys concinna* (WAM R17312; male; Sorrento, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

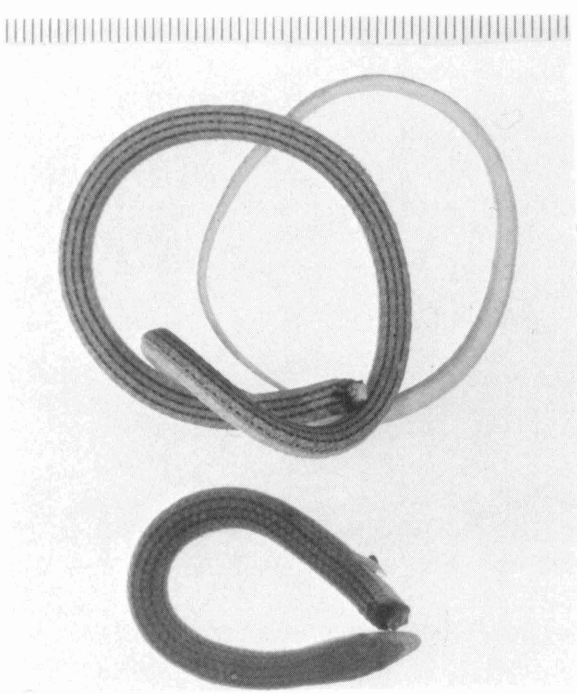

Fig. 17. Predominantly dorsal view of holotype of *Aclys concinna* (WAM R17312; male; Sorrento, Western Australia). SVL = 70.5 mm. Note that tail is separated from body.

DIAGNOSIS.—See generic diagnosis.

DESCRIPTION.—(n = 2) SVL 70.5-78.2, HL 7.9-9.0, SL 4.3-4.8, EW 1.2-1.3, PL 1.7-2.2, HW 4.9-5.8, HD 4.1-4.9, RD 1.0-1.1, RW 1.8-1.9, RLD 0.6-0.7, RLV 1.0-1.1, MD 1.0-1.2, MW 2.4-2.6, ML 1.6-1.7, TL 300.6-338.2, PNS 1.0, SNS 0.0, INS 2.0, RP 1.0, LS 6-7, AOS 2.0, PRS 5.0, SLS 6-7, FS 4.0, IOS 5.0, POS 6.0, OS 13.0, SOS 1.0, PS 1.0, NS 12-13, EAM 0.0, PM 2.0, ILS 6-7, GS 15-16, DSK 0.0, VSK 0.0, VS 67-69, PVS 0.0, MS 20.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 5-7, HLS 5.0, CS 14.0, SCS 5.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.0, LLP 0.0, TP 0.0, DBP 3.0, VBP 0-1, VP 2.0.

INDIVIDUAL VARIATION.—The two known individuals are males and they exhibit very few differences (see DESCRIPTION).

REMARKS.—The holotype was collected in the backyard of a home located at the crest of Cowper Road, Sorrento (pers. comm. A. E. Boyd). The area is a mixed *Banksia-Eucalyptus* coastal woodland of stationary dunes and protruding limestone ridges (Figs. 121-2). *Pletholax gracilis* is very common in this habitat, and *Aprasia repens, Delma grayii* and *Lialis burtonis* are also known from the immediate area. The second specimen was collected approximately 8 miles north of the turnoff to Jurien Bay on the Dongara to Eneabba road by Michael Brooker and John Estbergs on Oct. 20, 1971. It was found on the surface in a shallow sandy valley between low flat-topped gravel ridges. It was lying near the base of the shrub *Vertiacortia; Banksia candoleana, B. menziesii, B. verticillata* and *Petrophile linearis* were the more numerous sclerophyllous plants in the area. The general habitat is coastal heath, 1-2 ft in height. The specimen was extremely active when captured, and according to local residents this species is referred to as the "hoop snake" because of the contortions it throws its body into when alarmed. *Concinna, Delma fraseri* and *Pygopus lepidopodus* probably occur in sympatry in the area between Dongara and Eneabba.

Aprasia Gray

1839. *Aprasia* Gray, Ann. Mag. nat. Hist., 2:331. Type of genus: *Aprasia pulchella* Gray (1839), by monotypy.

1873. *Ophioseps* Barboza du Bocage, Jorn. Sci. math. phys. nat., 4:231. Type of genus: *Ophioseps nasutus* Barboza du Bocage (1873a), by monotypy.

1873. *Ophioseps* Barboza du Bocage, J. Zool., Paris, 2:289. Type of genus: *Ophioseps nasutus* Barboza du Bocage (1873a), by monotypy.

1887. *Ophiopsiseps* Boulenger, Catalogue of the lizards in the British Museum (Natural History), 3:436. Substitute name for *Ophioseps* Barboza du Bocage (1873a).

DIAGNOSIS.–*Aprasia* differs from all other pygopodid genera in possessing the following combination of character states: a) head scales very large, few in number, b) parietal scales absent, c) ring of ocular tissue *not* completely separated into distinct scales, d) external auditory meatus absent (small opening present beneath scale in *aurita*), e) scales smooth, f) preanal pores absent, g) almost always one hind limb scale, h) snout very short, i) body diameter very small, j) tail very short.

Aprasia aurita sp. nov.
Figs. 18-20, 31.

HOLOTYPE.–NMV D599, adult male with complete tail. Collected at Ouyen, Victoria, and donated by W. A. Hall in 1912.

PARATYPES.–All other specimens listed under *aurita* in the Specimens Examined section (Appendix II).

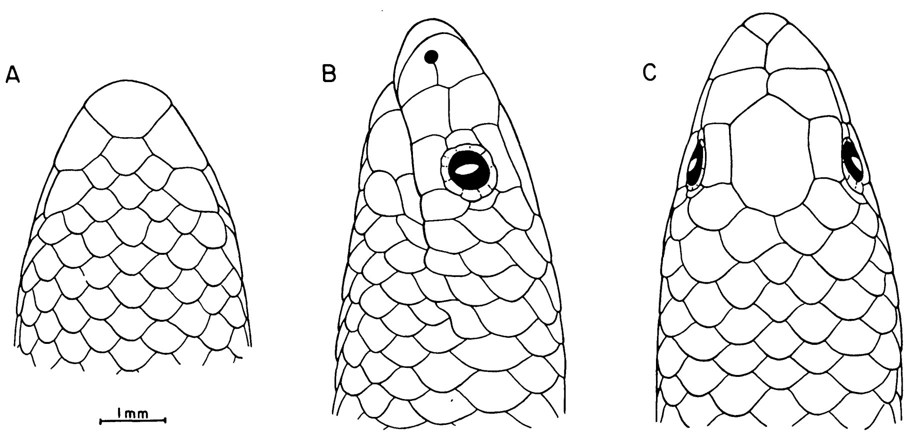

Fig. 18. Head region of *Aprasia aurita* (UMMZ 131225; female; Ouyen, Victoria). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

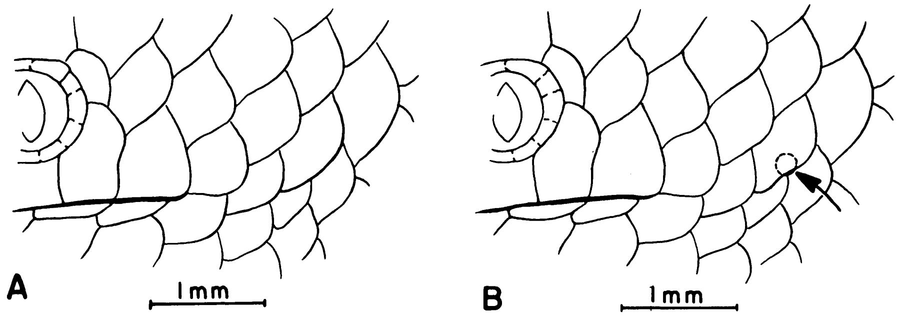

Fig. 19. Left lateral view of cheek region of *Aprasia* illustrating condition of external auditory meatus (EAM, p. 7). A. EAM = 1 (*Aprasia* sp.). B. EAM = 0 (*Aprasia aurita*, CAS-SU 12631). Note in B that external auditory meatus (dashed circle) is almost completely covered by an emarginate scale (see arrow).

ETYMOLOGY.—*Aurita* comes from the Latin *auri'tus* which means eared. The specific name refers to the unique eared condition of this species in *Aprasia.*

GEOGRAPHIC RANGE.—Known only from Ouyen and Woomelang, Victoria (Fig. 31).

DIAGNOSIS.—*Aurita* is unique in the genus *Aprasia* in possessing an external auditory meatus (Fig. 19).

DESCRIPTION.—(n = 15) SVL -.13 (0.015) 4.61 (0.014) 67.0-116.5, HL -.08 (0.007) 1.36 (0.007) 3.1-4.4, SL -.08 (0.009) 0.69 (0.009) 1.6-2.2, EW -.09 (0.014) -.30 (0.013) 0.6-0.8, PL -.10 (0.023) -.16 (0.022) 0.6-1.0, HW -.07 (0.011) 1.13 (0.011) 2.6-3.5, HD -.05 (0.011) 0.84 (0.011) 2.0-2.6, RD -.07 (0.010) 0.32 (0.010) 1.2-1.6, RW -.07 (0.008) 0.19 (0.008) 1.0-1.4, RLD -.15 (0.034) -.45 (0.033) 0.5-0.9, RLV -.07 (0.015) 0.04 (0.015) 0.9-1.2, MD -.06 (0.016) -.18 (0.016) 0.7-0.9, MW -.06 (0.013) 0.47 (0.012) 1.3-1.8, ML -.07 (0.011) -.09 (0.010) 0.8-1.0, TL (n = 7) -.18 (0.017) 4.14 (0.020) 37.0-72.2, PNS 1.0, SNS 0.0, INS 2.0, RP 1.0, LS 3.0, AOS 2.0, PRS 2.0, SLS 5.6 (0.13) 5-6, FS 3.0, IOS 3.0, POS 2.0, OS 0.0, SOS 0.0, PS 0.0, NS 8.6 (0.13) 8-9, EAM 0.0, PM 3.0, ILS 3.7 (0.13) 3-4, GS 9.0, DSK 0.0, VSK 0.0, VS 134.6 (1.10) 128-141, PVS 15.2 (0.38) 13-18, MS 14.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 5.0, HLS 1.0, CS 9.9 (0.07) 9-10, SCS 3.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 1.0, LLP 0.0, TP 0.0, DBP 2.1 (0.07) 2-3, VBP 0.0, VP 1.0.

Fig. 20. Predominantly right lateral view of *Aprasia aurita* (UMMZ 131225; female; Ouyen, Victoria). SVL = 112.8 mm.

INDIVIDUAL VARIATION.–I have recorded the number of ocular scales (OS) as 0 in all species of *Aprasia*. In some individuals the ring of ocular tissue is faintly creased one or more times, which gives the appearance of an irregular series of scales. However, in no *Aprasia* did I observe creases deep enough to suggest the presence of separate ocular scales like those of all other pygopodids; *Ophidiocephalus taeniatus* may be exceptional.

In *aurita,* the nasal and first supralabial scales are distinct posterior to the nostril, and the nasal contacts the second supralabial.

GEOGRAPHIC VARIATION.–The individual from Woomelang (NMV D635) does not differ significantly from the Ouyen series.

SEXUAL DIMORPHISM.–A sample of seven males was compared to one of eight females and no significant differences were observed.

REMARKS.–*Aurita* is sympatric with *A. inaurita* at Ouyen, and morphological intermediates between the species do not exist.

Aprasia inaurita sp. nov.
Figs. 21, 32.

HOLOTYPE.–NMV D11181, adult male with complete tail. Collected at Birthday Tank, Sunset County (N Cowangie), Victoria by A. J. Coventry on Nov. 2, 1965.

PARATYPES.–All other specimens listed under *inaurita* in the Specimens Examined section (Appendix II).

ETYMOLOGY.–*Inaurita* comes from the Latin *inauri'tus* which means earless. The specific name refers to the earless condition which helps to distinguish this species from its close relative *A. aurita.*

GEOGRAPHIC RANGE.–Northwestern Victoria and adjacent South Australia, and the Eyre Peninsula, South Australia to as far west as Eyre (Nurina), Western Australia (Fig. 32). See REMARKS (p. 52) for further discussion.

DIAGNOSIS.–*Inaurita* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales distinct posterior to nostril, b) nasal contacts second supralabial, c) two or three postorbital scales, d) usually 10 nuchal scales, e) ventral scales in males average 149.7, in females 154.6, f) 14 midbody scale rows, g) usually three preanal scales, h) dorsal surfaces of head and body uniformly pigmented, faint lateral head pattern rarely present (Fig. 21).

DESCRIPTION.–(n = 21) SVL -.14 (0.010) 4.65 (0.010) 74.0-136.0, HL -.07 (0.009) 1.30 (0.009) 3.1-4.1, SL -.07 (0.015) 0.56 (0.014) 1.5-2.2, EW -.05 (0.013) -.20 (0.012) 0.7-1.0, PL -.03 (0.044) -.26 (0.043) 0.5-1.0, HW -.09 (0.010) 1.03 (0.010) 2.2-3.5, HD -.09 (0.010) 0.78 (0.010) 1.8-2.6, RD -.09 (0.010) 0.27 (0.010)

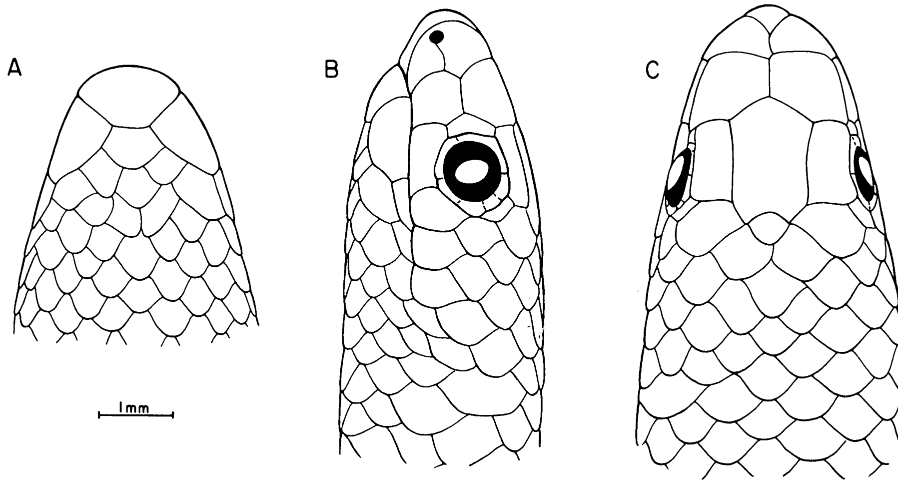

Fig. 21. Head region of *Aprasia inaurita* (UMMZ 131672; male; Mallee, Victoria). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

1.1-1.6, RW -.09 (0.011) -.01 (0.011) 0.8-1.2, RLD -.22 (0.031) -.59 (0.030) 0.3-0.9, RLV -.10 (0.018) -.05 (0.018) 0.7-1.3, MD -.10 (0.018) -.31 (0.018) 0.5-0.9, MW -.09 (0.010) 0.45 (0.009) 1.3-1.9, ML -.10 (0.014) -.15 (0.013) 0.7-1.1, TL (n = 6) -.12 (0.082) 4.15 (0.052) 49.0-71.2, PNS 1.0, SNS 0.0, INS 2.0, RP 1.0, LS 3.0, AOS 2.0, PRS 2.0, SLS 5.7 (0.11) 5-6, FS 3.0, IOS 3.0, POS 2.2 (0.09) 2-3, OS 0.0, SOS 0.0, PS 0.0, NS 9.9 (0.19) 8-11, EAM 1.0, PM 3.0, ILS 3.6 (0.11) 3-4, GS 9.1 (0.05) 9-11, DSK 0.0, VSK 0.0, VS 152.3 (1.23) 145-161, PVS 15.0 (0.29) 13-17, MS 14.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.8 (0.11) 1-3, PCS 4.8 (0.11) 3-5, HLS 1.2 (0.10) 1-2, CS 9.8 (0.13) 8-11, SCS 3.3 (0.16) 3-5, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.05 (0.05) 0-1, LLP 0.0, TP 0.0, DBP 0.0, VBP 0.3 (0.11) 0-1, VP 1.0.

GEOGRAPHIC VARIATION.—Univariate and multivariate trends were not observed. No significant differences were found when a sample representing all of the material from east of the Mount Lofty Ranges, including the Victoria specimens, was compared to one from the Eyre Peninsula. A specimen from Fowlers Bay (NMV D4686) was considered outside the Peninsula and excluded from that sample. I have not examined the 14 midbody scale row individuals listed by Parker (1956:377) from Renmark, South Australia; however, on the basis of that character state they would appear to represent *inaurita*.

SEXUAL DIMORPHISM.—A sample of 10 males was compared to one of 11 females and no significant differences were observed.

REMARKS.—NMV D594 is typical of *inaurita* and I question the accuracy of the locality data associated with it: Brighton, Victoria. Brighton is a beach suburb south-southeast of Melbourne, and it is approximately 250 miles southeast of the nearest part of the better documented geographic range of the species. It is possible that Brighton refers to the Adelaide, South Australia, suburb located at 35° 01′ S Lat, 138° 31′ E Long. At present a specimen (SAM R2808) from Salisbury is the only known record for *inaurita* between the Eyre Peninsula and the region east of the Mount Lofty Ranges. In contrast, *A. striolata* is represented by numerous specimens and localities from this geographically intermediate area and it is difficult to understand why *inaurita* is not as frequently encountered. The large geographic gap between the Eyre Peninsula records and the westernmost outlier of the species (Eyre, Western Australia; WAM R5280) is probably a function of little or no collecting rather than an absence of appropriate habitat.

Inaurita is sympatric with *A. aurita* at Ouyen, Victoria, and the Salisbury and the Renmark (Parker, 1956:377), South Australia records suggest that it is marginally sympatric with *A. striolata*; note their largely allopatric distributions (Figs. 32, 35). No morphological intermediates between these three species are known. *Inaurita* is probably sympatric at different localities with one or more of the following distantly related species: *Delma australis, D. inornatus, D. molleri, Lialis burtonis* and *Pygopus lepidopodus*.

Bustard (1970) states that *A. repens* (probably *inaurita*) from Renmark, South Australia have been collected beneath old mallee stumps.

Aprasia parapulchella sp. nov.

Figs. 22-3, 27, 115-6.

HOLOTYPE.—WAM R41231, adult male with complete tail. Collected at Coppins Crossing, Molonglo R, Australian Capital Territory by R. Barwick, R. Jenkins and A. Kluge on Dec. 20, 1971.

PARATYPES.—All other specimens (except NMV R7056) listed under *parapulchella* in the Specimens Examined section (Appendix II).

ETYMOLOGY.—*Para* is the Greek word for near. I have added this term as a prefix to another species' name, *pulchella,* to emphasize their similarity and probable close evolutionary relationship.

GEOGRAPHIC RANGE.—Known only from Coppins Crossing, Australian Capital Territory and 10 mi NE Tarcutta, New South Wales (Fig. 27).

DIAGNOSIS.—*Parapulchella* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales fused posterior to nostril, b) two or three preorbital scales, c) almost always two postorbital scales, d) usually nine nuchal scales, e) ventral scales in males average 162.3, in females 170.0, f) 14 midbody scale rows, g) three preanal scales, h) lateral head pattern absent (Figs. 22-3).

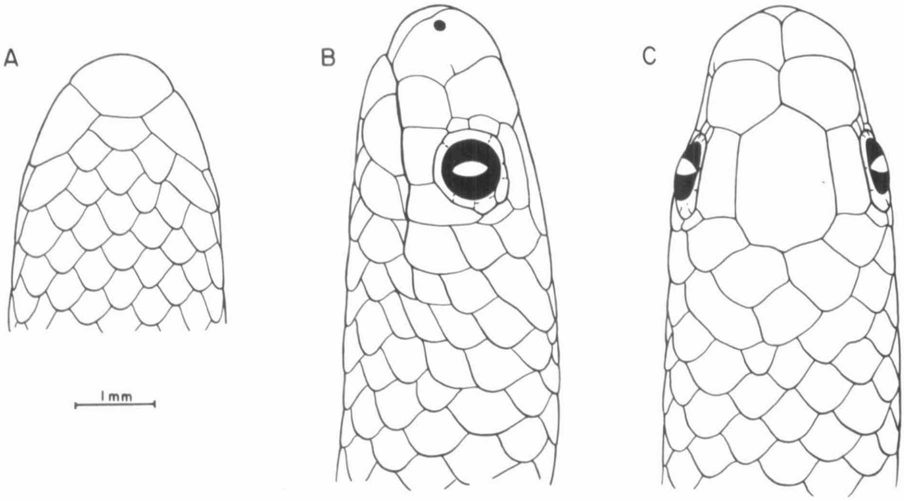

Fig. 22. Head region of *Aprasia parapulchella* (UMMZ 131202; female; Coppins Crossing, Australian Capital Territory). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

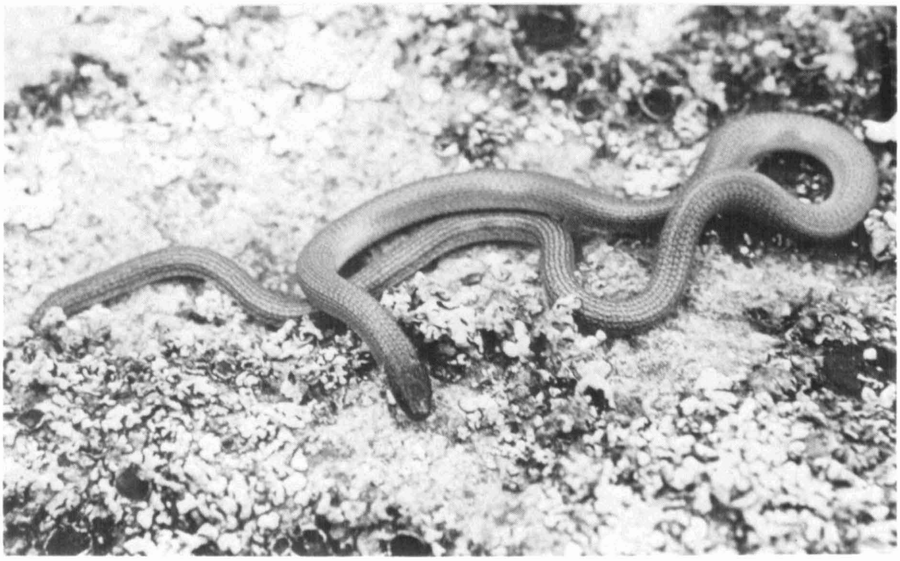

Fig. 23. Predominantly dorsal view of a live *Aprasia parapulchella* (UMMZ 131194; female; Coppins Crossing, Australian Capital Territory). SVL = 131.5 mm.

DESCRIPTION.—(n = 22) SVL -.14 (0.016) 4.70 (0.016) 73.0-141.0, HL -.08 (0.006) 1.28 (0.006) 2.9-4.0, SL -.09 (0.010) 0.46 (0.010) 1.2-1.8, EW -.08 (0.010) -.19 (0.009) 0.7-1.0, PL -.06 (0.025) -.10 (0.025) 0.7-1.4, HW -.08 (0.014) 1.09 (0.014) 2.3-3.6, HD -.07 (0.014) 0.86 (0.013) 2.0-2.9, RD -.12 (0.013) 0.20 (0.013)

0.8-1.4, RW -.11 (0.014) 0.06 (0.013) 0.7-1.2, RLD -.25 (0.049) -1.36 (0.048) 0.1-0.4, RLV -.04 (0.018) -.19 (0.018) 0.7-1.0, MD -.10 (0.017) -.27 (0.016) 0.6-1.0, MW -.08 (0.009) 0.48 (0.008) 1.2-1.8, ML -.08 (0.012) -.11 (0.011) 0.7-1.0, TL (n = 11) -.13 (0.015) 4.28 (0.012) 56.3-81.5, PNS 1.0, SNS 0.0, INS 2.0, RP 0.8 (0.09) 0-1, LS 3.0, AOS 2.0, PRS 2.4 (0.11) 2-3, SLS 5.9 (0.06) 5-6, FS 3.0, IOS 3.0, POS 2.1 (0.05) 2-3, OS 0.0, SOS 0.0, PS 0.0, NS 8.9 (0.12) 8-10, EAM 1.0, PM 3.0, ILS 3.8 (0.08) 3-4, GS 8.9 (0.08) 8-9, DSK 0.0, VSK 0.0, VS 167.2 (1.51) 158-184, PVS 15.3 (0.58) 11-23, MS 14.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 5.0, HLS 1.1 (0.08) 1-2, CS 9.3 (0.15) 8-10, SCS 3.0, DSP 0.1 (0.08) 0-1, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.0, LLP 0.0, TP 0.9 (0.06) 0-1, DBP 2.1 (0.08) 2-3, VBP 1.0, VP 1.1 (0.05) 1-2.

INDIVIDUAL VARIATION.—Six of 21 (29%) individuals were asymmetrical for number of preorbital scales, 3 (14%) were symmetrical with three scales and the remainder (57%) were symmetrical with two. Three of 21 individuals (14%) possessed very short post-nostril creases, i.e., the nasal and first supralabial scales are partially distinct. These creases originated from either the second supralabial or frontal scales.

GEOGRAPHIC VARIATION.—The single female from near Tarcutta, New South Wales (NMV D15389) possessed 184 ventral scales and that character state differs significantly ($P < .05$) from the female sample from Coppins Crossing [168.9 (5.87) 160-176]. No other significant differences were observed.

SEXUAL DIMORPHISM.—A sample of eight males was compared to one of 14 females and no significant differences were discovered.

REMARKS.—The exact type locality at Coppins Crossing is the grazed grassy north-facing slope leading down to the Molonglo River (Fig. 115). Native oaks, *Casuarina cunninghami,* are the most numerous large trees on the slopes. All of the type series were collected under weathered lichen-covered granite rocks (Fig. 116). Small black ants of the genus *Iridomyrmex* (B. Taylor pers. comm.) were invariably found with *parapulchella* at the type locality. When uncovered some *parapulchella* tried to escape into small nearly vertical burrows located beneath the rocks. Sloughed skins were found under some rocks. The shed skins were in one piece, and occasionally tied in a simple knot and split length-wise on the ventral midline. A pair of leathery eggs was laid by each of two captive females; one female laid on Dec. 23, the other on Dec. 26. The eggs had the following individual length by width dimensions (mm): 19.2 × 5.8 and 21.3 × 5.0; 17.5 × 5.6 and 20.2 × 5.3.

The distantly related *Delma impar* and *D. inornata* appear to be the only pygopodids that are likely to be found in sympatry with *parapulchella.*

Aprasia pseudopulchella sp. nov.
Figs. 24, 27.

HOLOTYPE.—SAM R6360, adult female with complete tail. Collected a few miles north of Burra, South Australia by J. Bishop during Nov., 1966.

PARATYPES.—All other specimens listed under *pseudopulchella* in the Specimens Examined section (Appendix II).

ETYMOLOGY.—*Pseudo* is a Greek combining form from the stem *pseudes,* meaning false. I have used it as a prefix to another species' name, *pulchella,* to emphasize their more distant evolutionary relationship relative to that of *parapulchella.*

GEOGRAPHIC RANGE.—Restricted to the Flinders Ranges, South Australia (Fig. 27).

DIAGNOSIS.—*Pseudopulchella* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales fused posterior to nostril, b) usually two postorbital scales, c) usually nine nuchal scales, d) ventral scales in males average 175.4, in females 185.1, e) 14 midbody scale rows, f) three preanal scales, g) faint lateral head pattern often present (Fig. 24).

DESCRIPTION.—(n = 18) SVL -.08 (0.020) 4.75 (0.020) 87.3-143.5, HL -.10 (0.009) 1.28 (0.009) 3.0-4.2, SL -.10 (0.007) 0.50 (0.007) 1.3-1.9, EW -.05 (0.009) -.25 (0.009) 0.7-0.9, PL -.16 (0.029) -.11 (0.028) 0.6-1.2, HW -.09 (0.014) 1.04 (0.014) 2.5-3.6, HD -.07 (0.014) 0.82 (0.013) 1.9-2.6, RD -.09 (0.019) 0.13 (0.019) 0.9-1.4, RW -.06 (0.013) 0.09 (0.013) 0.09-1.3, RLD -.17 (0.103) -1.50 (0.100) 0.1-0.5, RLV -.11 (0.030) -.17 (0.029) 0.7-1.4, MD

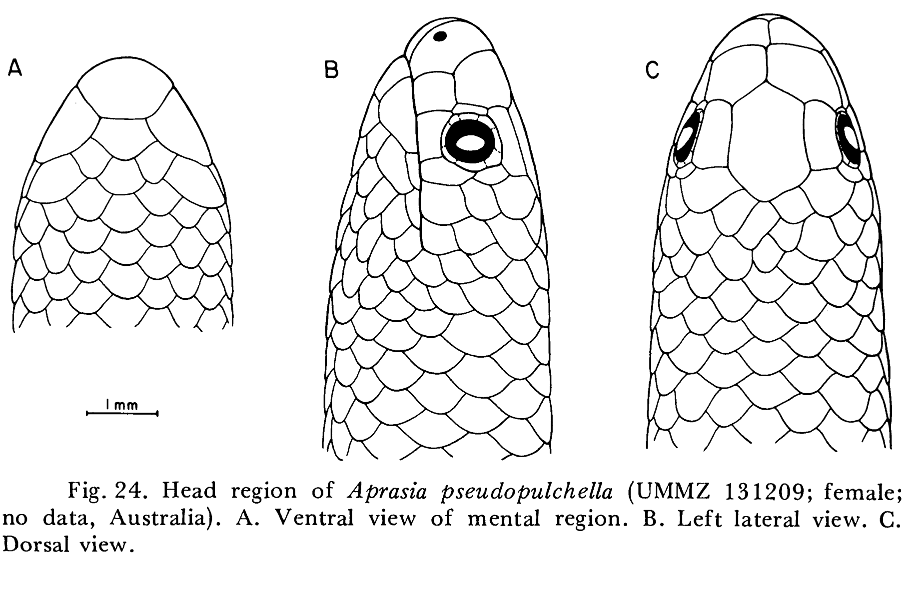

Fig. 24. Head region of *Aprasia pseudopulchella* (UMMZ 131209; female; no data, Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

-.09 (0.018) -.30 (0.017) 0.6-0.9, MW -.07 (0.011) 0.43 (0.010) 1.3-1.9, ML -.07 (0.010) -.13 (0.010) 0.8-1.0, TL (n = 8) -.10 (0.035) 4.30 (0.036) 59.5-86.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.6 (0.12) 0-1, LS 3.0, AOS 2.0, PRS 2.0, SLS 5.5 (0.12) 5-6, FS 3.0, IOS 3.0, POS 2.1 (0.06) 2-3, OS 0.0, SOS 0.0, PS 0.0, NS 8.8 (0.17) 8-10, EAM 1.0, PM 3.0, ILS 3.4 (0.12) 3-4, GS 8.9 (0.10) 8-10, DSK 0.0, VSK 0.0, VS 179.2 (1.88) 166-193, PVS 16.2 (0.68) 12-22, MS 14.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 5.0, HLS 1.0, CS 9.8 (0.13) 9-11, SCS 3.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.3 (0.11) 0-1, LLP 0.0, TP 1.0, DBP 2.2 (0.09) 2-3, VBP 1.0, VP 0.9 (0.06) 0-1.

INDIVIDUAL VARIATION.–Two of 18 individuals (11%) possessed very short postnostril creases, i.e., the nasal and first supralabial scales are partially distinct.

GEOGRAPHIC VARIATION.–Univariate and multivariate trends were not observed. A recently collected male from Yudnamutana (SAM R12510) establishes the existence of *pseudopulchella* in both the North and South Flinders Ranges. The Yudnamutana specimen does not differ significantly from the sample of 10 males from the South Flinders Range in spite of the fact that it is approximately 200 miles from the nearest record.

SEXUAL DIMORPHISM.–A sample of 11 males was compared to one of seven females and no significant differences were observed.

REMARKS.–A specimen from Mylor (SAM R2110) is the only one known from outside the Flinders Ranges and its locality data are probably erroneous. The specimen is one of four tied together; the other three are typical *A. striolata.* The two species in the bundle were almost certainly not preserved together as inferred from their very different states of preservation. From these differences it seems reasonable to assume that they had different geographical origins. *A. striolata* is known from other localities in the vicinity of Mylor.

Delma australis and *Pygopus lepidopodus* are the two most likely species to be found in sympatry with *pseudopulchella.*

Aprasia pulchella Gray
Figs. 5, 25-7, 123.

1839. *Aprasia pulchella* Gray, Ann. Mag. nat. Hist., 2:332. Holotype: BM 1946.8.30.93. Type locality: New Holland.

1873. *Ophioseps nasutus* Barboza du Bocage, Jorn, Sci, math, phys. nat., 4:232. Holotype: MB T73-(439). Type locality: Australia. Collected by Simmonds in 1867.

1873. *Ophioseps nasutus* Barboza du Bocage, J. Zool., Paris, 2:290. Holotype: MB T73-(439). Type locality: Australia. Collected by Simmonds in 1867.

1909. *Aprasia brevirostris* Werner, *In* Michaelsen and Hartmeyer, Die Fauna Südwest-Australiens, 2:266, text-fig. 2a-b. Syntypes: repository unknown. Type locality: Lion Mill and Donnybrook, Western Australia.

GEOGRAPHIC RANGE.—Restricted to southwestern Western Australia from the vicinity of Perth to near Albany. Within this area it does not appear to occur in the dense jarrah forest (Serventy and Whittell, 1962; Fig. 27).

DIAGNOSIS.—*Pulchella* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales fused posterior to nostril, b) two preorbital scales, c) usually two postorbital scales, d) usually 11 nuchal scales, e) ventral scales in males average 151.6, in females 159.9, f) 14 midbody scale rows, g) two preanal scales, h) dorsal snout pattern usually present, i) lateral head pattern often present (Figs. 5, 25-6).

DESCRIPTION.—(n = 39) SVL -.20 (0.017) 4.53 (0.017) 46.0-121.0, HL -.09 (0.008) 1.28 (0.008) 2.7-4.3, SL -.11 (0.010) 0.48 (0.010) 1.1-2.0, EW -.09 (0.008) -.17 (0.008) 0.7-1.0, PL -.11 (0.020) -.09 (0.020) 0.6-1.2, HW -.14 (0.007) 1.05 (0.007) 1.8-3.4, HD -.12 (0.008) 0.75 (0.008) 1.5-2.6, RD -.10 (0.021) 0.21 (0.020) 0.6-1.6, RW -.10 (0.007) 0.03 (0.007) 0.7-1.2, RLD -.13 (0.028) -.90 (0.028) 0.3-0.6, RLV -.10 (0.011) -.10 (0.011) 0.7-1.1, MD -.13 (0.019) -.42 (0.019) 0.5-0.9, MW -.10 (0.012) 0.33 (0.011) 1.0-1.8, ML -.11 (0.013) -.19 (0.013) 0.5-1.0, TL (n = 19) -.31 (0.027) 4.21 (0.033) 23.3-82.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.9 (0.04) 0-1, LS 3.0, AOS 2.0, PRS 2.0, SLS 5.6 (0.08) 5-6, FS 3.0, IOS 3.0, POS 2.1 (0.04) 2-3, OS 0.0, SOS 0.0, PS 0.0, NS 10.7 (0.09) 9-11, EAM 1.0, PM 3.0, ILS 3.9 (0.07) 3-5, GS 9.0 (0.04) 8-10, DSK 0.0, VSK 0.0, VS 155.0 (0.96) 144-166, PVS 13.5 (0.23) 10-16, MS 14.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.0, PCS 4.1 (0.06) 4-6, HLS 1.1 (0.04) 1-2, CS 10.0 (0.06) 9-10, SCS 3.0, DSP 0.7 (0.07) 0-1, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.4 (0.11) 0-2, LLP 0.0, TP 0.8 (0.06) 0-1, DBP 2.2 (0.06) 2-3, VBP 1.0 (0.06) 0-3, VP 0.9 (0.04) 0-1.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were detected. The geographically exceptional specimens from Geraldton (see remarks below) do not differ significantly in any character from the remainder of the *pulchella* sampled.

SEXUAL DIMORPHISM.—A sample of 23 males was compared to one of 16 females. The sexes only differ significantly in the number of ventral scales [males 151.6 (0.96) 144-162, females 159.9 (0.99) 152-166].

REMARKS.—Gray (1839) appears to have used a single specimen, type locality listed as New Holland, in his original description

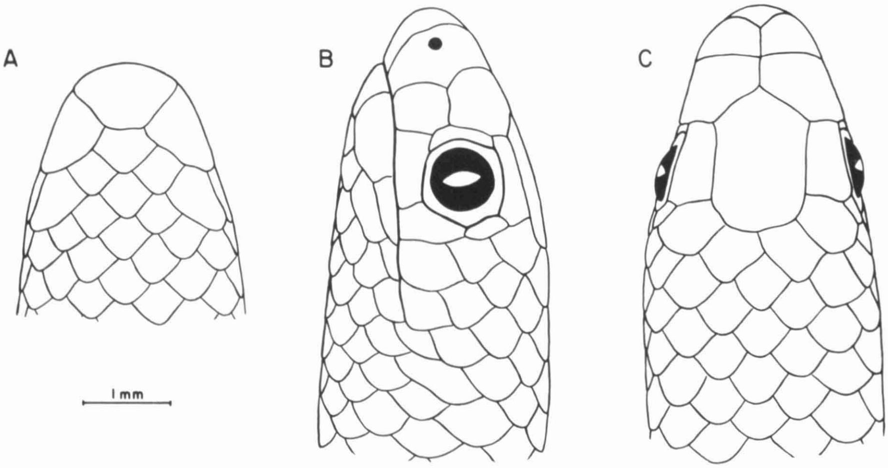

Fig. 25. Head region of *Aprasia pulchella* (UMMZ 129986; male; Guildford, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

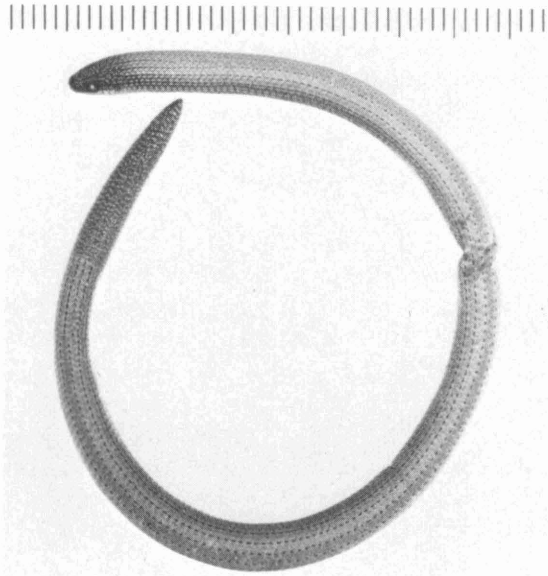

Fig. 26. Predominantly dorsal view of *Aprasia pulchella* (WAM R22773; female; 6 mi E Kalamunda, Western Australia). SVL = 107.5 mm.

of *pulchella*. One specimen is inferred from the fact that no range of variation is given or even alluded to by Gray. In 1845[a], Gray (p. 68) listed the British Museum holdings of *pulchella* as three specimens from "W. Australia," two of which came from Buchanan's collection and one from Turner's. It seems reasonable to assume that the single Turner specimen is the holotype. Later, Boulenger (1885a) listed only two adults as "types." Parker (1956) considered one of these, BM 1946.8.30.93, to be the holotype. Measurements and the color pattern of the head of BM 1946.8.30.93 closely resemble those conditions cited and figured by Gray in his original description. I take this opportunity to restrict the type locality of *pulchella* to Kalamunda National Park, 13 miles east of Perth, Western Australia. *Pulchella* has been collected in this area (WAM R16889, R22773).

Barboza du Bocage described both the genus and species *Ophioseps nasutus* in two journals in the same year (1873a,b). I have not been able to establish which article was published first, and I have therefore made my choice between the two coincident with that of Barboza du Bocage's subsequent paper (1881:11-2).

I have not examined the poorly preserved holotype of *O. nasutus* [MB T73-(439)], but Parker's arguments (1956:380) lead me to the conclusion that it should be treated as a synonym of *pulchella.* The low number of ventral scales in the holotype of *O. nasutus,* inferred from the vertebral count given by Parker, is very different from the condition in *A. parapulchella* and *A. pseudopulchella.*

I have not been able to locate the two individuals which made up the type series of Werner's (1909) *A. brevirostris.* Werner recognized two species in the 1909 paper, and his descriptions clearly indicate that the individuals he called *pulchella* were in fact the species *A. repens* described in 1914 by Fry and that those of *A. brevirostris* were *pulchella.* Apparently, when Werner misidentified *A. repens* as *pulchella* he was led to believe that his second species was new.

There are two locality records for *pulchella* which must be questioned. AM 5168 is said to have come from Rockhampton, no state recorded. Rockhampton, Queensland is certainly an error (Fig. 27). Perhaps, Rockhampton is a misspelling of Rockingham, Western Australia, a locality within the known geographic range of *pulchella.* The other questionable record for *pulchella* is that of Geraldton, Western Australia (MCZ 24467-8). These specimens were catalogued in the Museum of Comparative Zoology on or about the same day as two *A. repens* (MCZ 24458-9) and whose locality is also given as Geraldton. Perhaps, the locality information for the *pulchella* was assumed to be the same as that for *A. repens.* Geraldton is over 200 miles north of the nearest well-documented locality of *pulchella* and it must be confirmed by additional material before it is generally accepted; see GEOGRAPHIC VARIATION section above.

Pulchella is regularly collected under lateritic boulders and pieces of granite where the soil is slightly moist (Loveridge, 1934; Fig. 123). It is almost certainly sympatric at different localities with either *A. repens, A. striolata, Delma australis, D. fraseri, D. grayii, Lialis burtonis* or *Pygopus lepidopodus*; *Aclys concinna* and *Pletholax gracilis* are probable candidates as well.

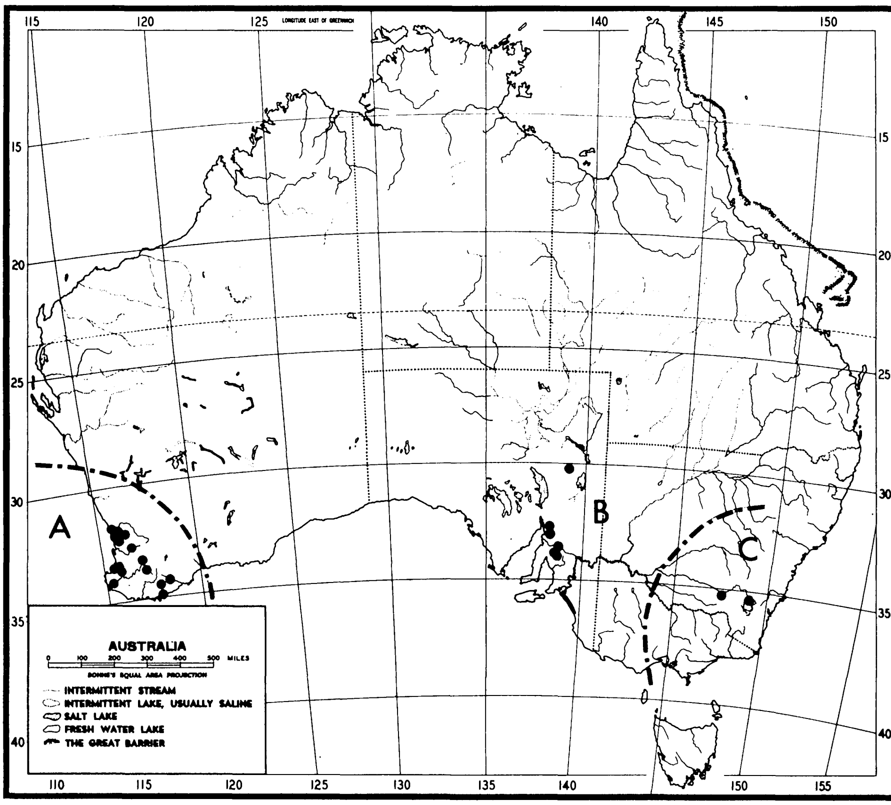

Fig. 27. Geographic distribution of (A) *Aprasia pulchella,* (B) *Aprasia pseudopulchella,* and (C) *Aprasia parapulchella* based on specimens examined; see pages 189-90.

Aprasia repens (Fry)
Figs. 7, 28-9, 31, 120-23.

1914. *Ophioseps repens* Fry, Rec. West. Aust. Mus., 1:178, text-figs. 2-3. Holotype: WAM R364. Type locality: Western Australia. Collector unknown; accessioned Sept., 1914.

GEOGRAPHIC RANGE.—Restricted to the southwestern portion of Western Australia. It extends from Newmarracarra in the north to Oldfield River in the southeast. Within this area it does not appear to occur in the dense jarrah forest (Serventy and Whittell, 1962; Fig. 31).

DIAGNOSIS.—*Repens* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales distinct posterior to nostril, b) nasal almost never contacts second supralabial, c) one postorbital scale, d) usually eight nuchal scales, e) usually seven gular scales, f) ventral scales in males average 139.4, in females 147.9, g) almost always 12 midbody scale rows, h) usually two preanal scales, i) lateral head pattern usually present (Figs. 7, 28-9).

DESCRIPTION.—(n = 169) SVL -.18 (0.007) 4.48 (0.007) 48.0-126.0, HL -.13 (0.003) 1.16 (0.003) 2.2-4.2, SL -.15 (0.004) 0.49 (0.004) 1.0-2.2, EW -.12 (0.005) -.39 (0.005) 0.5-0.9, PL -.10 (0.014) -.43 (0.014) 0.4-1.0, HW -.14 (0.004) 0.87 (0.004) 1.6-3.5, HD -.14 (0.004) 0.65 (0.004) 1.3-2.4, RD -.14 (0.005) 0.06 (0.005) 0.7-1.4, RW -.13 (0.004) -.06 (0.004) 0.6-1.3, RLD -.18 (0.013) -.69 (0.013) 0.2-0.8, RLV -.13 (0.004) 0.06 (0.004) 0.7-1.4, MD -.12 (0.012) 0.44 (0.012) 0.2-0.9, MW -.12 (0.004) 0.26 (0.004) 0.9-1.7, ML 0.12 (0.004) -.26 (0.004) 0.5-1.0, TL (n = 102) -.20 (0.012) 3.82 (0.013) 19.2-74.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.9 (0.02) 0-1, LS 3.0, AOS 2.0, PRS 2.0, SLS 5.4 (0.04) 5-6, FS 3.0 (0.06) 2-3, IOS 3.0, POS 1.0, OS 0.0, SOS 0.0, PS 0.0, NS 8.3 (0.04) 8-9, EAM 1.0, PM 3.0, ILS 3.8 (0.04) 3-5, GS 7.0 (0.02) 5-8, DSK 0.0, VSK 0.0, VS 143.9 (0.68) 126-171, PVS 13.3 (0.10) 10-17, MS 12.0 (0.01) 11-13, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 1.5 (0.04) 1-2, PCS 3.4 (0.04) 2-4, HLS 1.0, CS 7.9 (0.03) 6-9, SCS 3.0, DSP 0.3 (0.03) 0-1, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.8 (0.04) 0-2, LLP 0.0, TP 0.05 (0.02) 0-1, DBP 2.0 (0.02) 0-3, VBP 0.9 (0.07) 0-3, VP 0.9 (0.02) 0-1.

INDIVIDUAL VARIATION.—A separate postorbital like that of *A. pulchella* and related species was present on one side of WAM R28157; all other *repens* examined lacked that scale. The nasal contacts the second supralabial in about 15% of the specimens examined.

GEOGRAPHIC VARIATION.—Univariate and multivariate geographic trends were not detected in *repens*. However, Parker (1956) observed a significant positive correlation between mean number of presacral vertebrae and mean December temperature in this species. It is not surprising that I have also been able to find a similar relationship (r = .845, P < .01, df 11) between that environmental parameter and the mean number of ventral scales because vertebral number and ventral scales are themselves significantly and positively correlated in many lizards (Kerfoot, 1970). There is almost zero correlation in *repens* when individual scale counts and mean December temperature are compared. Two local samples of males from Perth and near Darlington have ranges of variation in ventral scales, 126-152 and 129-145, respectively, that nearly encompass the known extremes of the species (126-158). No other scale or color pattern variables in this species appear to be correlated with mean December temperature. The causal relationship between mean December temperature and mean vertebral and ventral scale number, if any, remains to be established. The functional relationship between vertebral number and ventral scale number has been considered in detail by Kerfoot (1970).

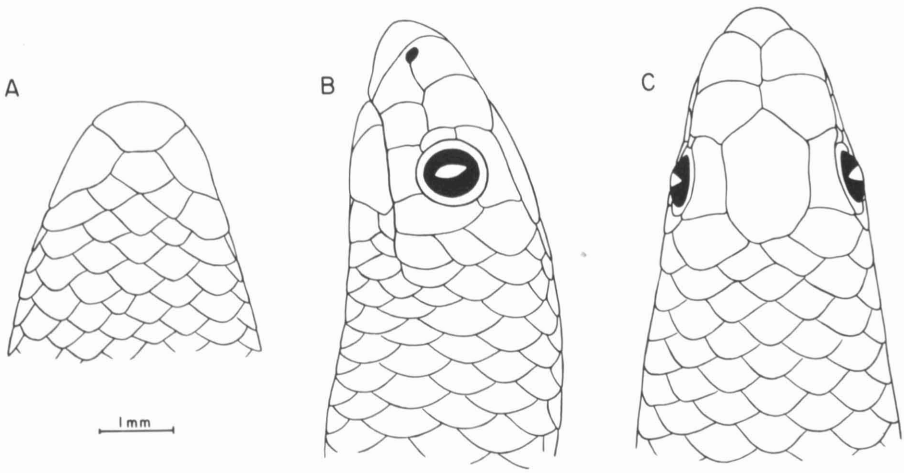

Fig. 28. Head region of *Aprasia repens* (UMMZ 129988; female; Darlington, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

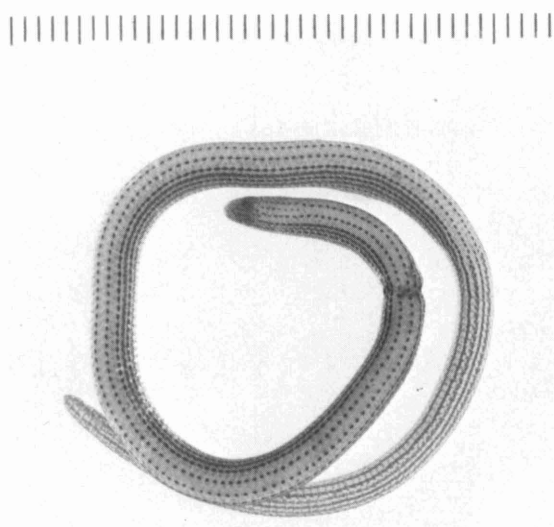

Fig. 29. Dorsal view of *Aprasia repens* (UMMZ 129987; female; Darlington, Western Australia). SVL = 91.9 mm.

The number of midbody scale rows is invariant within all species of *Aprasia*, except *repens*. In my sample of 169 *repens*, the number of midbody scale rows is 12, with the following exceptions: 11 was recorded from three females (WAM R16892, Melville; WAM R21216, Swanbourne Beach; WAM R32369, Morley Park) and 13 from one female (NMV D5438, Cannington). Parker (1956) noted 14 in a male *repens* from Eradu (WAM R5064). This count has been confirmed by A. Grandison and N. Arnold (pers. comm.) of the British Museum, where that specimen is now deposited. The deviations from the usual 12 midbody scale rows are so rare in *repens* that no geographic pattern, e.g., latitudinal cline, is demonstrable. The absence of any such pattern of variation is important in determining the status of the closely related *A. rostrata*; see p. 66.

SEXUAL DIMORPHISM.—A sample of 80 males was compared to one of 88 females. The sexes only differ significantly in the number of ventral scales [males 139.4 (0.81) 126-158, females 147 (0.86) 128-171].

REMARKS.—In the absence of a specific type locality for *repens* (Fry, 1914), I take this opportunity to restrict it to Swan View National Park, 35° 51′ S Lat, 116° 03′ E Long, Western Australia. The species is known to occur in the Park (MCZ 33027).

NMV D14906 is from the Kalgoorlie District according to the catalogue entry. Kalgoorlie District, even broadly interpreted, is far to the east of all other *repens* localities and it is of sufficiently different habitat to be considered in error. Werner's reference (1909:266) to a Shark Bay specimen of *Aprasia pulchella* in the "Coll. Mus. Perth" suggests that *repens'* range may be extended northward (Parker, 1956:382). Werner's description of the color pattern of the Shark Bay individual indicates that it cannot be *A. smithi*.

Repens is extremely abundant in some microenvironments. For example, in the Darlington area, before the ground dries in the spring-summer, it can be found under most of the plentiful small slabs and chips of exfoliated granite (Fig. 123). *Repens* appears to be much less abundant in sand dunes, e.g., 1 m N Marmion (Fig. 121). It is probably sympatric at different localities with one or more of the following species: *Aclys concinna, Aprasia pulchella, A. striolata, Delma australis, D. fraseri, D. grayii, Lialis burtonis, Pletholax gracilis* and *Pygopus lepidopodus.*

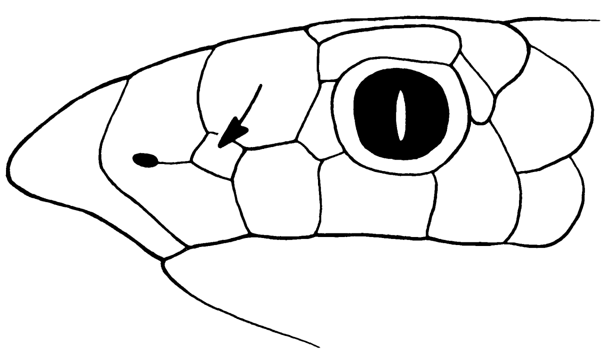

Fig. 30. Left lateral view of head of holotype of *Aprasia rostrata* (WAM R13861; male; Hermite Is, Monte Bello Group, Western Australia). SL = 1.5 mm. Arrow indicates extra postnostril scale.

Aprasia rostrata Parker
Figs. 30-31.

1956. *Aprasia repens rostrata* Parker, Bull. Br. Mus. nat. Hist., Zool., 3:384, text-fig. 7 (allotype). Holotype: WAM R13861. Type locality: Hermite Is, Monte Bello Group, Western Australia. Collected by F. L. Hill, on 17.viii.52.

GEOGRAPHIC RANGE.—Known only from Hermite Island, Monte Bello Group, Western Australia (Fig. 31).

DIAGNOSIS.—*Rostrata* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales distinct posterior to nostril, b) one or two postorbital scales, c) nine gular scales, d) ventral scales in male 174, e) 11 preventral scales, f) 14 midbody scale rows, g) two preanal scales, h) four precloacal scales, i) lateral head pattern absent, j) throat pattern present (Fig. 30).

DESCRIPTION.—(n = 1) SVL 94.0, HL 2.6, SL 1.5, EW 0.6, PL 0.3, HW 2.1, HD 1.7, RD 1.2, RW 0.7, RLD 0.8, RLV 0.8, MD 0.5, MW 1.1, ML 0.5, PNS 1, SNS 0, INS 2, RP 1, LS 4, AOS 2, PRS 2,

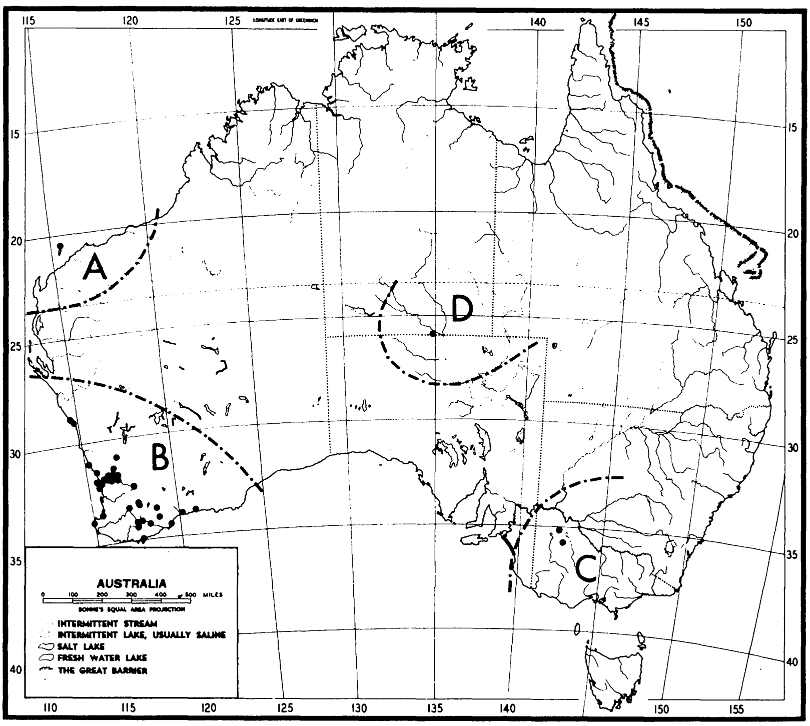

Fig. 31. Geographic distribution of (A) *Aprasia rostrata,* (B) *Aprasia repens,* (C) *Aprasia aurita,* and (D) *Ophidiocephalus taeniatus* based on specimens examined; see pages 189-90, 201.

SLS 5, FS 3, IOS 3, POS 2, OS 0, SOS 0, PS 0, NS 9, EAM 1, PM 3, ILS 4, GS 9, DSK 0, VSK 0, VS 174, PVS 11, MS 14, VBS 0, PP 0, IPS 0, IGS 0, PAS 2, PCS 4, HLS 1, CS 8, SCS 3, DSP 0, DIP 0, DPP 0, DNP 0, PNB 0, LHP 0, LLP 0, TP 1, DBP 2, VBP 1, VP 1.

INDIVIDUAL VARIATION.—The holotype of *rostrata* possesses an extra postnasal scale (Fig. 30), a condition not observed in any other *Aprasia.* It is bilaterally symmetrical in the holotype but absent altogether from the paratype and only other known specimen of *rostrata* (A. Grandison, pers. comm.). The holotype also differs from the paratype in possessing a small postorbital scale (Fig. 30). The presence of postnostril and postorbital scales was not mentioned by Parker (1956) in the original description of *rostrata.* Further, Grandison (pers. comm.) noted that there is a small area of contact between the "prefrontal" and the first upper labial on the left hand side of the allotype whereas on the right hand side the scales meet at a point as described by Parker.

GEOGRAPHIC VARIATION.—Parker (1956) appears to have based his subspecific association of *rostrata* with *A. repens* on the likelihood that the number of midbody scale rows in the latter species is clinal latitudinally. Aside from the peculiar variation in number of extra postnasal and postocular scales, *rostrata* differs markedly from *A. repens* in many characters, GS, VS, PVS, MS, PAS, PCS. Owing to the many differences between *rostrata* and *A. repens* it seems reasonable to treat them as distinct species.

REMARKS.—*Rostrata* is sympatric on Hermite Island with *Delma borea, D. nasuta* and *Lialis burtonis. D. tincta* is known from nearby Barrow Island and it too may be found in sympatry with *rostrata.*

The Hermite Island record for *rostrata* clearly indicates that the genus *Aprasia* once had a much wider continuous geographic distribution.

Aprasia smithi Storr
Figs. 33-5.

1970. *Aprasia smithi* Storr, West. Aust. Nat., 11:141. Holotype: WAM R34325. Type locality: Kalbarri townsite (27° 43′ S Lat, 114° 10′ E Long), Western Australia. Collected by W. J. March on July 13, 1969.

GEOGRAPHIC RANGE.—Known only from the vicinity of Kalbarri townsite, Western Australia (Fig. 35).

DIAGNOSIS.—*Smithi* is unique in the genus *Aprasia* in possessing a jet black head (including the throat) and tail-tip (Fig. 34).

DESCRIPTION.—(n = 3) SVL 91.5-110.5, HL 3.5-5.0, SL 1.7-2.7, EW 0.8-1.1, PL 0.7-1.0, HW 2.6-3.8, HD 2.3-2.9, RD

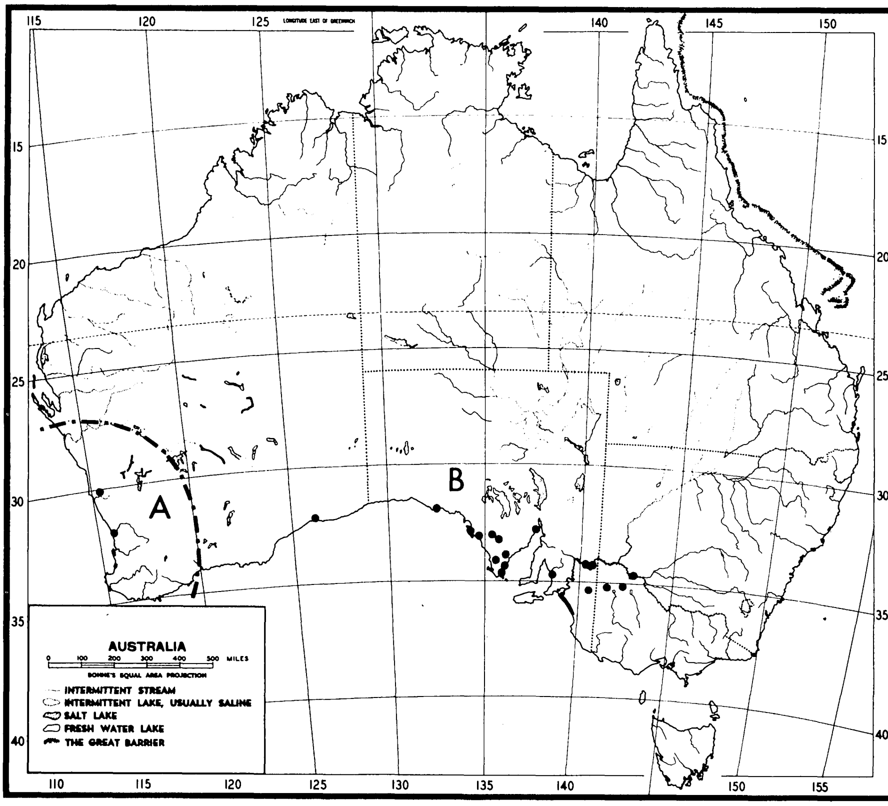

Fig. 32. Geographic distribution of (A) *Aclys concinna* and (B) *Aprasia inaurita* based on specimens examined; see page 189.

1.3-1.6, RW 1.0-1.5, RLD 0.8-1.1, RLV 1.1-1.7, MD 0.7-0.9, MW 1.6-2.1, ML 0.9-1.1, TL (n = 1) 66.0, PNS 1.0, SNS 0.0, INS 2.0, RP 1.0, LS 3.0, AOS 2.0, PRS 2.0, SLS 5.0, FS 3.0, IOS 3.0, POS 1.0, OS 0.0, SOS 0.0, PS 0.0, NS 8.0, EAM 1.0, PM 3.0, ILS 4.0, GS 6.3 (0.67) 5-7, DSK 0.0, VSK 0.0, VS 129.3 (0.88) 128-131, PVS 11.7 (1.45) 9-14, MS 12, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.0, PCS 4.0, HLS 1.0, CS 8.0, SCS 3.0, DSP 0.0, DIP 1.0, DPP 1.0, DNP 1.0, PNB 0.0, LHP 0.0, LLP 2.0, TP 1.0, DBP 2.0, VBP 0.0, VP 1.0.

INDIVIDUAL VARIATION.—All three specimens in the *smithi* sample are males and they exhibit very little if any variation in the characters scored. This species is like *A. repens* in that a) the nasal and first supralabial scales are distinct posterior to the nostril, b) the nasal does not contact the second supralabial and c) there is but one postorbital scale (Fig. 33). The distinctive jet black condition of the tail-tip occurs in both unregenerated and regenerated tails. Black pigmentation is also concentrated around the vent.

REMARKS.—The holotype of *smithi* was collected in a backyard approximately two hundred yards east of a tidal estuary formed by

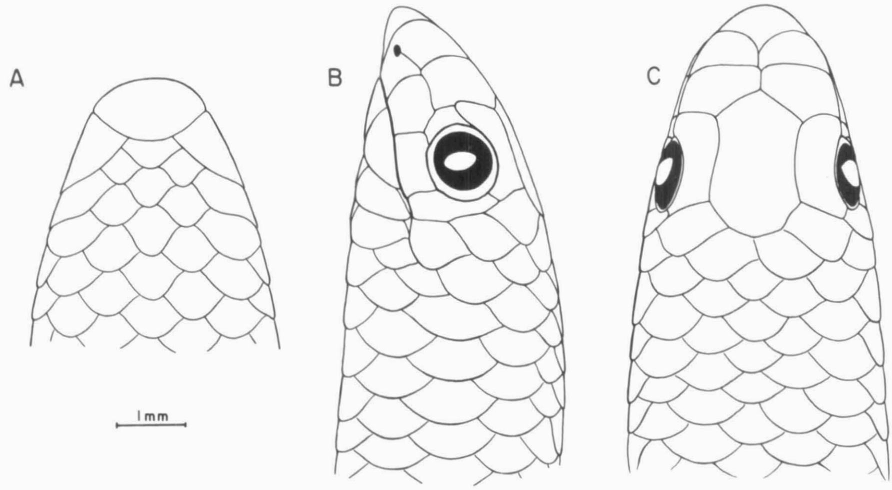

Fig. 33. Head region of *Aprasia smithi* (WAM R38994; male; Kalbarri, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

Fig. 34. Left lateral view of *Aprasia smithi* (WAM R38994; male; Kalbarri, Western Australia). SVL = 108.5 mm.

the Murchison River. The holotype was dug from very dry and moderately hard ground. The surface soil at the type locality tends to be black and powdery.

Smithi is probably sympatric with *Delma grayii, D. tincta, Lialis burtonis* and *Pygopus lepidopodus.*

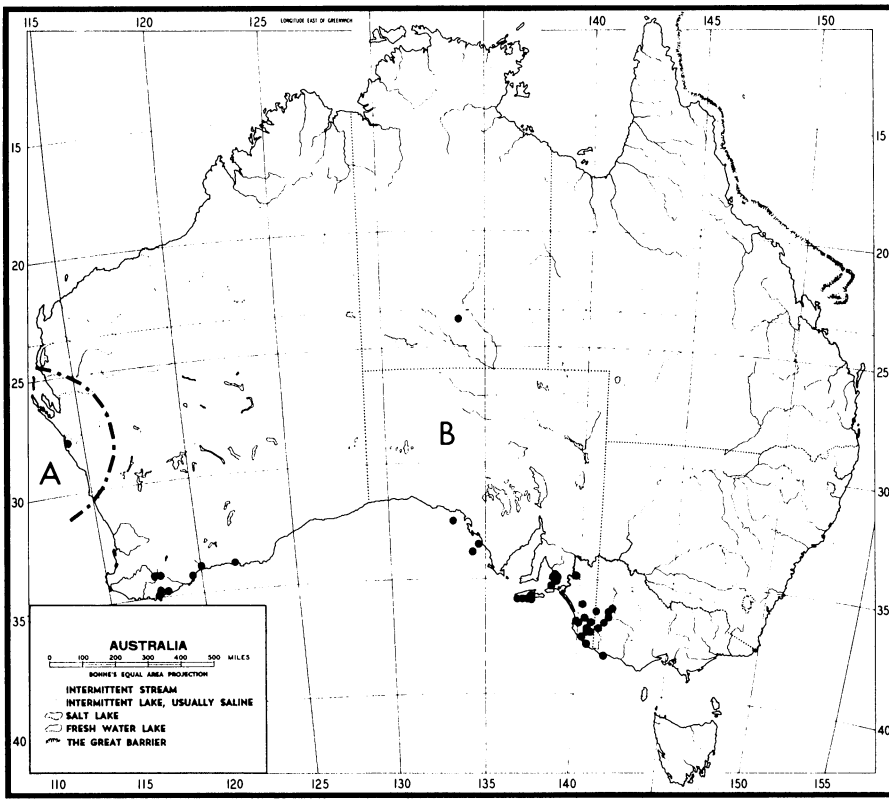

Fig. 35. Geographic distribution of (A) *Aprasia smithi* and (B) *Aprasia striolata* based on specimens examined; see pages 190-91.

Aprasia striolata Lütken

Figs. 35-9, 118.

1863. *Aprasia pulchella* var. *striolata* Lütken, Vidensk. Meddr dansk. naturh. Foren., 1862:300, pls. 1-2, figs. 3a-d. Holotype: UZMK R.3505 (formerly 6). Type locality: Unknown. Collected by Möller.

1863. *Aprasia pulchella* var. *lineolata* Lütken, Vidensk. Meddr dansk. naturh. Foren., 1862:300. Holotype: UZMK R.3504 (formerly 5). Type locality: Unknown. Collected by Möller.

1864. *Aprasia octolineata* W. Peters, Mber. dt. Akad. Wiss. Berl., 1863:233. Syntypes: ZMB 4720a-b. Type locality: Buchsfelde, nr Adelaide, South Australia. Donated by R. von Schomburgk.

1956. *Aprasia striolata glauerti* Parker, Bull. Br. Mus. nat. Hist., Zool., 3:378, text-fig. 3a. Holotype: WAM R10949. Type locality: Albany, Western Australia. Collected by F. R. Bradshaw; accessioned in Nov., 1953.

GEOGRAPHIC RANGE.—Southwestern Victoria and adjacent South Australia, Kangaroo Island and smaller islands west of the Eyre Peninsula, southwestern Western Australia and Mt. Buring, Northern Territory (Fig. 35).

DIAGNOSIS.—*Striolata* differs from all other species in the genus *Aprasia* in possessing the following combination of character states: a) nasal and first supralabial scales distinct posterior to nostril, b) nasal almost always contacts second supralabial, c) almost always two postorbital scales, d) usually 10 or 11 nuchal scales, e) ventrals in males average 143.8, in females 145.0, f) 12 midbody scale rows, g) almost always three preanal scales, h) except for Western Australia and Kangaroo Island populations, very conspicuous head, body and tail stripes present (Figs. 36-9).

DESCRIPTION.—(n = 92) SVL -.16 (0.010) 4.61 (0.010) 51.0-131.8, HL -.10 (0.006) 1.30 (0.006) 2.3-4.6, SL -.12 (0.007) 0.59 (0.007) 1.1-2.4, EW -.06 (0.006) -.25 (0.006) 0.6-1.0, PL -.11 (0.017) -.22 (0.017) 0.4-1.2, HW -.12 (0.007) 1.06 (0.007) 1.9-3.6, HD -.10 (0.006) 0.80 (0.006) 1.5-2.8, RD -.09 (0.006) 0.27 (0.006) 1.0-1.7, RW -.10 (0.006) -.07 (0.006) 0.7-1.2, RLD -.12 (0.019) -.67 (0.019) 0.3-0.9, RLV -.11 (0.007) -.05 (0.007) 0.6-1.2, MD -.10 (0.010) -.35 (0.010) 0.5-1.0, MW -.10 (0.006) 0.41 (0.006) 1.2-1.9, ML -.08 (0.008) -.19 (0.008) 0.6-1.1, TL (n = 54) -.20 (0.018) 3.98 (0.020) 22.0-80.0, PNS 1.0, SNS 0.0, INS 2.0, RP 1.0 (0.02) 0-1, LS 3.0, AOS 2.0 (0.02) 2-3, PRS 2.1 (0.03) 2-3, SLS 5.6 (0.05) 5-6, FS 3.0 (0.01) 2-3, IOS 3.0, POS 2.1 (0.02) 2-3, OS 0.0, SOS 0.0, PS 0.0, NS 10.4 (0.08) 8-11, EAM 1.0, PM 3.0 (0.01) 3-4, ILS 3.6 (0.05) 3-4, GS 8.9 (0.04) 8-10, DSK 0.0, VSK 0.0, VS 144.4 (1.11) 125-174, PVS 16.9 (0.17) 14-22, MS 12.0, VBS 0.0, PP 0.0,

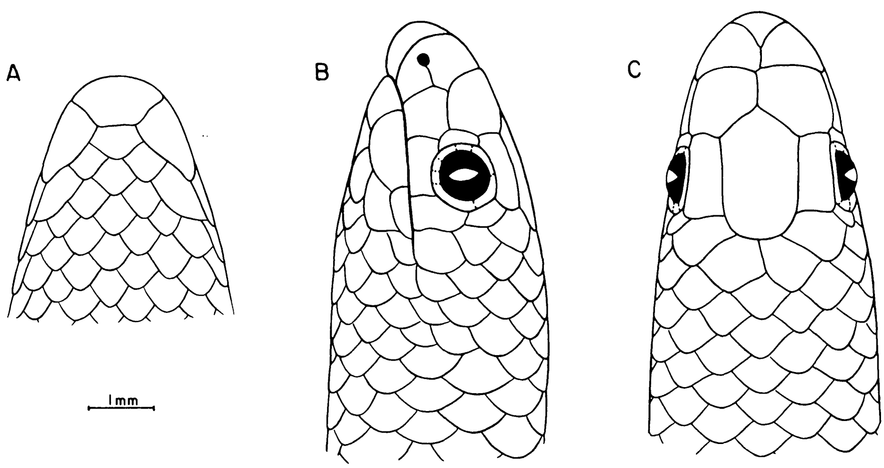

Fig. 36. Head region of *Aprasia striolata* (SAM R1478; male; Henley Beach, South Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

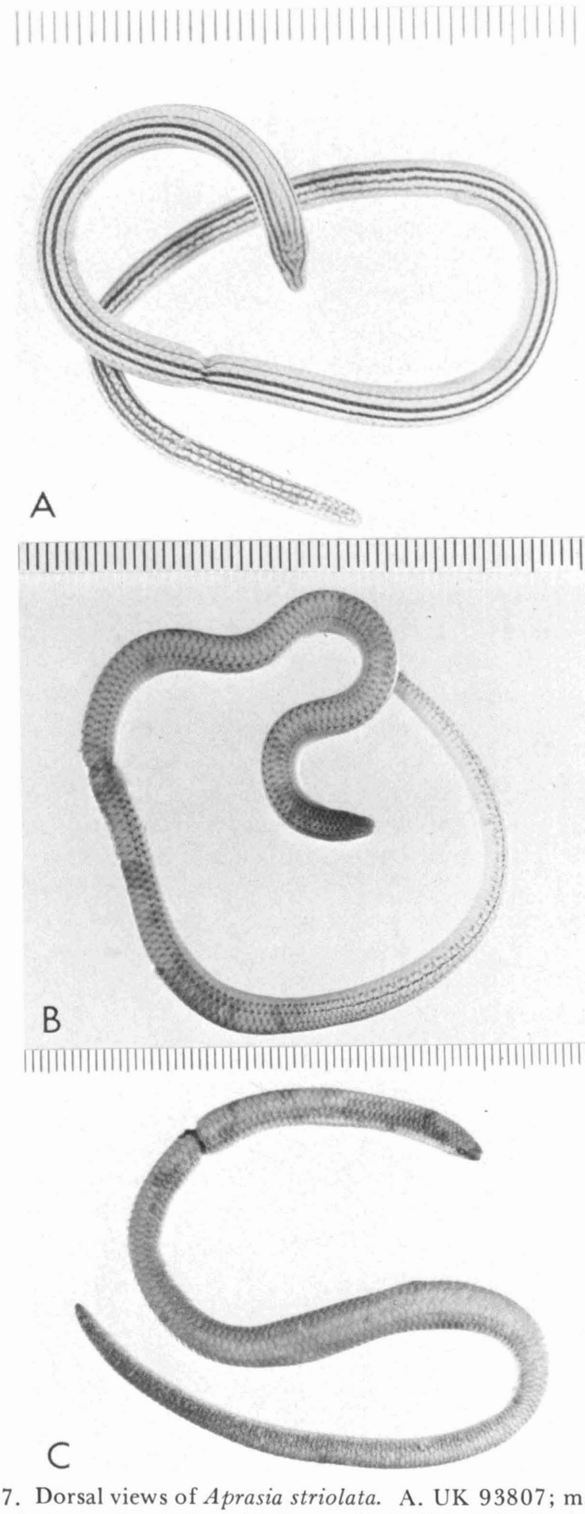

Fig. 37. Dorsal views of *Aprasia striolata*. A. UK 93807; male; Mount Lofty Ranges, South Australia; SVL = 99.5 mm. B. WAM R19046; female; Esperance, Western Australia; SVL = 110.2 mm. C. SAM R4048; female; Kelly Hill Caves, Kangaroo Is, South Australia; SVL = 118.0 mm.

IPS 0.0, IGS 0.0, PAS 3.0 (0.02) 1-3, PCS 5.0 (0.04) 3-7, HLS 1.1 (0.04) 1-2, CS 9.9 (0.04) 9-11, SCS 3.4 (0.08) 3-5, DSP 0.7 (0.07) 0-2, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 1.0 (0.02) 0-1, LLP 0.0, TP 0.02 (0.02) 0-1, DBP 2.1 (0.13) 0-3, VBP 0.1 (0.04) 0-1, VP 1.0 (0.04) 0-2.

INDIVIDUAL VARIATION.—One specimen possessed a prenostril crease—the nasal and first supralabial were not fused along their zone of contact. Parker (1956) listed *striolata* with both 12 and 14 midbody scale rows. I do not believe that this is evidence of intraspecific variation; rather, it is likely that his sample included two species, *striolata* (12) and *A. inaurita* (14). The fact that Parker listed both 12 and 14 midbody scale row individuals (BM 1902.7.30.8, 1902.5.30.10-13) from Renmark, South Australia also suggests that the two species are sympatric there.

GEOGRAPHIC VARIATION.—The geographic range of *striolata* is exceptional in the Pygopodidae in the degree to which it is discontinuous (Fig. 35). The degree of similarity among these isolates does not conform closely to their geographic proximity or probable historical route of migration. Both univariate (Fig. 39) and multivariate (Fig. 40; Table 17) analyses exemplify the irregularity of the pattern of similarity. The Western Australia isolate (sample A of Fig. 39), to which Parker (1956) applied the subspecific name *striolata glauerti,* is very similar to the Kangaroo Island and southeastern South Australia and southwestern Victoria samples and yet very different from the more geographically intermediate ones. Once this obviously complicated history of migration and/or convergent evolution is better understood (see immediately below) it may be useful to reinstitute subspecific nomenclature.

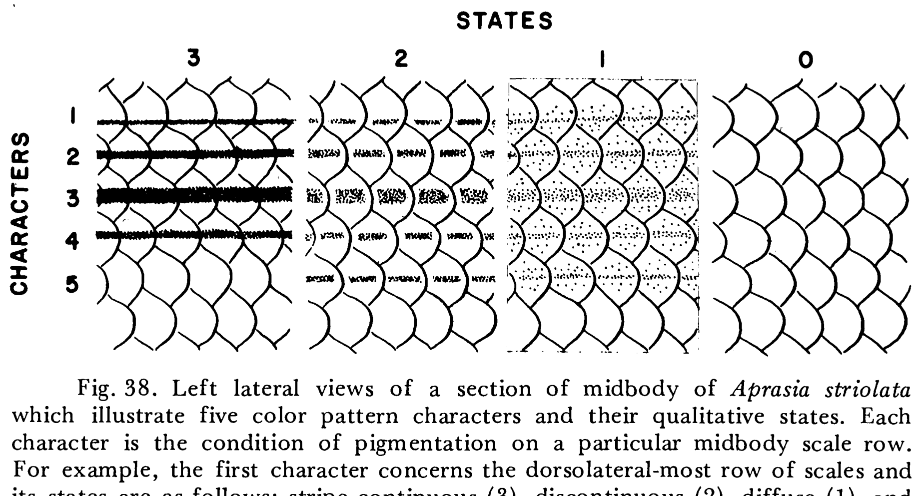

Fig. 38. Left lateral views of a section of midbody of *Aprasia striolata* which illustrate five color pattern characters and their qualitative states. Each character is the condition of pigmentation on a particular midbody scale row. For example, the first character concerns the dorsolateral-most row of scales and its states are as follows: stripe continuous (3), discontinuous (2), diffuse (1), and absent (0). Note that a continuous stripe was never observed in character 5.

TABLE 17

RESULTS OF PRINCIPAL COMPONENT ANALYSIS OF 13 SCALE AND 6 COLOR PATTERN CHARACTERS SCORED IN 11 SAMPLES OF *APRASIA STRIOLATA*

Component	I	II	III
Eigenvalue	6.2	4.0	2.5
% total variance	32.5	53.4	66.4
RP	0.4	-.1	-.3
PRS	0.7	-.4	-.2
SLS	0.6	0.6	0.0
POS	0.1	0.4	0.2
NS	0.8	-.1	0.2
ILS	0.8	0.4	0.4
GS	0.5	0.4	0.7
VS	-.9	-.1	0.1
PVS	0.2	0.9	-.1
PCS	0.3	-.3	0.8
HLS	-.2	-.9	0.1
CS	-.6	-.1	-.1
SCS	-.5	-.7	0.4
DSP	-.8	0.2	0.2
LHP	-.6	0.4	0.2
TP	-.2	0.3	0.5
DBP	-.7	0.2	0.1
VBP	-.2	0.4	0.6
VP	0.5	-.4	-.2

Parker (1956) observed the same positive correlation between the mean number of presacral vertebrae and mean December temperature in *striolata* that he had in *A. repens.* However, in this case his findings must be questioned because the samples analyzed contained two species, *A. inaurita* and *striolata.* Nevertheless, the geographic pattern of ventral scale variation, a variable correlated with vertebral number (see p. 62), in *striolata,* as I have diagnosed that species (Fig. 39), appears to corroborate Parker's conclusion. For example, the Western Australia (A), Kangaroo Island (D) and southeastern South Australia and adjacent Victoria (F) samples have low mean numbers, and the general area from which the specimens were collected are characterized by relatively low mean December temperatures, while the Adelaide sample (E) has higher numbers and comes from an area of higher temperatures. The three Northern Territory specimens (sample B) suggest an even higher mean number of ventrals and that locality is certain to exhibit a higher temperature than that of the Adelaide region. If a strong ecophenotypic effect does exist, then the relatively larger variances observed in samples E and F (Fig. 39) may be due to the fact that they include specimens taken from more climatologically variable areas than the other areas sampled. It is clear

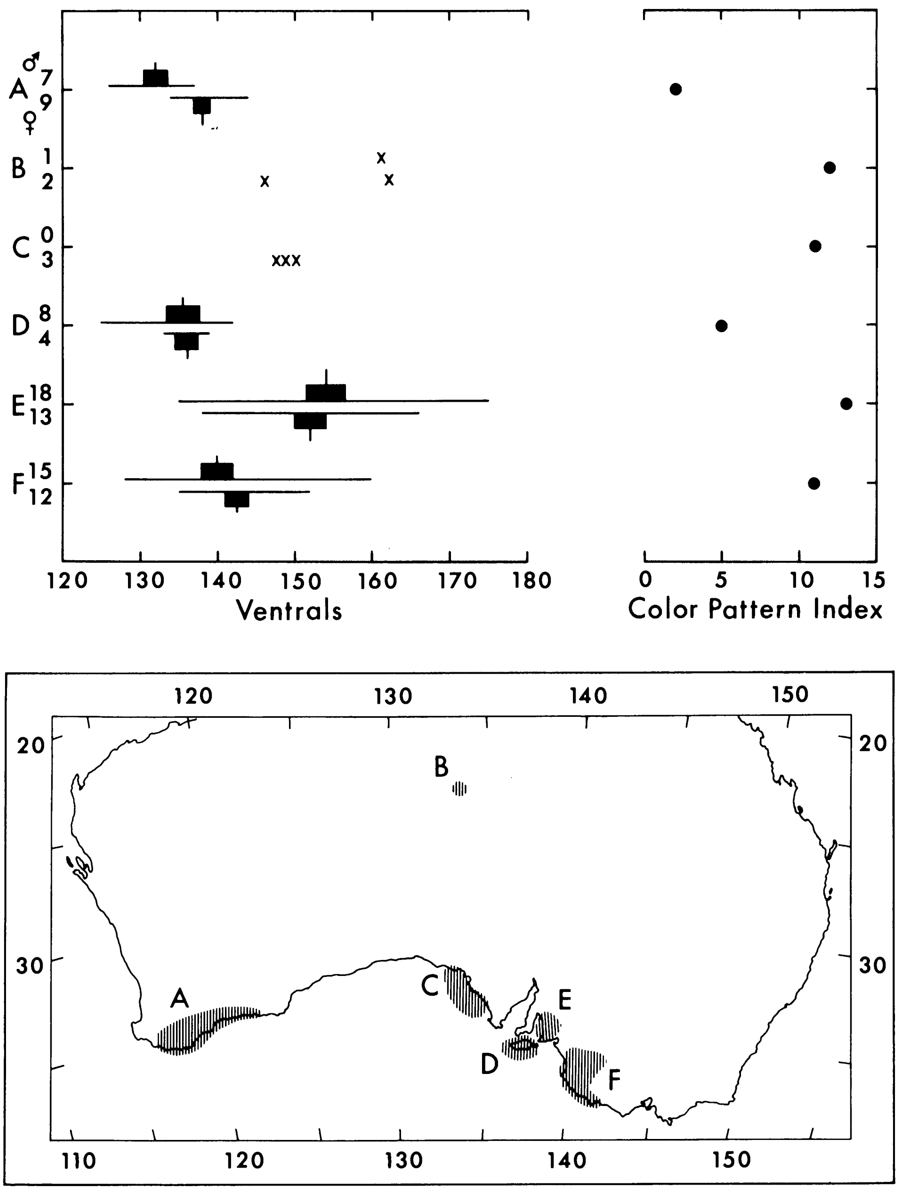

Fig. 39. Six sets (A-F; the map indicates their geographic origin) of individuals divided into male and female subsets are compared in terms of number of ventral scales (VS) and color pattern. The sample size of each subset is listed on the left vertical axis. The horizontal line characterizes the observed range of variation of VS in each subset, the vertical line the mean and the solid rectangle one standard error of the mean on each side of the mean. Individual VS states are indicated by an X. The color pattern index was calculated for an individual as the sum of the character states of the five body color pattern characters illustrated in Fig. 38. The solid circles are average color pattern indexes.

that the color pattern index (Fig. 39) and the multivariate analysis (Fig. 40) show the same basic geographic pattern as number of ventral scales. It seems unlikely that so many qualitatively different and uncorrelated variables should be affected by mean December temperature. As in most studies involving environmental correlation, probable causation has yet to be demonstrated.

SEXUAL DIMORPHISM.—A sample of 18 males was compared to one of 13 females (area E of Fig. 39) and no significant differences were observed. Similarly, sexual dimorphism was not observed in the area of southeastern South Australia and southwestern Victoria (sample F of Fig. 39).

REMARKS.—The holotypes of *Delma molleri* and *striolata* were collected by a Captain Möller from an unknown Australian locality (Lütken, 1863). The two specimens were probably collected together and since the known geographic ranges of the species include only one major port, Adelaide, South Australia (Figs. 35 and 69) it seems reasonable to assume that both types came from or near that early settlement. Since both *striolata* and *D. molleri* have been collected in the Adelaide area from 1 mile northeast of Tea Tree Gully, I take this opportunity to restrict their type localities to that place.

Parker (1956:367) examined the specimen that Jensen (1901) used in his redescription of *Ophioseps nasutus.* I concur with Parker's conclusion that Jensen actually had a juvenile *striolata* before him

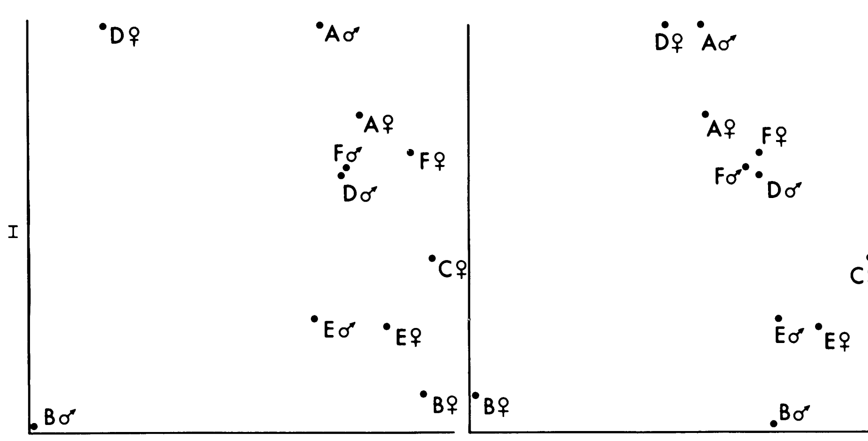

Fig. 40. Principal component I plotted against II and III (see Table 17). The data consist of the following 11 samples illustrated in Fig. 39: (A, males and females) Western Australia, (B, male and females) Northern Territory, (C, females) Eyre Peninsula islands, (D, males and females) Kangaroo Island, (E, males and females) Adelaide, and (F, males and females) southwestern South Australia and adjacent Victoria. The samples were described by the means of all those characters (RP, PRS, SLS, POS, NS, ILS, GS, VS, PVS, PCS, HLS, CS, SCS, DSP, LHP, TP, DBP, VBP, VP) that were significantly different between one or more of the larger samples, A, D, E and F. Samples consisting of single specimens were described by individual observations.

(SVL 55 mm) and not an *O. nasutus* (= *A. pulchella*; see p. 60) as he thought. The few osteological differences that Jensen cited and which he and others have used to justify the recognition of the Ophiopsisepidae, and *Ophioseps* as distinct from *Aprasia* within that family (McDowell and Bogert, 1954), are due to the fact that his material is a juvenile with incomplete ossification.

Lütken (1863) recognized *A. lineolata* as distinct from *striolata* on the basis of a slightly different color pattern and the presence of a "hindlimb papilla." The papilla is almost certainly the protruding cloacal bone of males, and the color pattern condition cited by Lütken falls within the range of variation now known to exist in *striolata* (Fig. 38). I conclude that there is no basis for distinguishing *A. lineolata* from *striolata* and I believe that the former name should be placed in the synonomy of the latter. Similarly, W. Peter's (1864) *A. octolineata* is based on one of the many color pattern variations exhibited by *striolata* and it too should be considered a synonym of that species. My reasons for placing Parker's *A. striolata glauerti* in the synonomy of *striolata* are discussed above under GEOGRAPHIC VARIATION.

Little is known of the habitat preference of *striolata* (Fig. 118); however, its wide geographic range suggests that it must be varied. Specimens from Lake Wallace, Victoria were turned up in a ploughed field (McCoy, 1888). The Northern Territory locality record must represent a relict population. *Striolata* is almost certainly sympatric at different localities with either *A. inaurita, A. pulchella, A. repens, Delma australis, D. fraseri, D. impar, D. inornata, D. molleri, D. nasuta, Lialis burtonis* or *Pygopus lepidopodus*. Why *striolata* should be the only pygopodid to occupy Kangaroo Island is impossible to answer. At least one species, *P. lepidopodus,* occupies the mainland adjacent to Kangaroo Island.

Delma Gray

1831. *Delma* Gray, Zoological Miscellany, p. 14. Type of genus: *Delma fraseri* Gray (1831a), by monotypy.
1867. *Nisara* Gray, The lizards of Australia and New Zealand in the collection of the British Museum, p. 3. Type of genus: *Delma grayii* A. Smith (1849), by original designation.
1882. *Pseudodelma* Fischer, Arch. Naturgesch., 48:286. Type of genus: *Pseudodelma impar* Fischer (1882), by original designation.

DIAGNOSIS.–*Delma* differs from all other pygopodid genera in possessing the following combination of character states: a) one pair of enlarged scales cover parietal region, b) anteriormost pair of nasal scales almost always meet on midline, c) nostril bordered by more than two scales (*D. impar* exceptional), d) external auditory meatus large, e) almost always 18 or less midbody scale rows, f) scales smooth, g) preanal pores absent, h) 13 or less caudal scale rows, i) almost always three subcaudal scale rows.

Delma australis sp. nov.
Figs. 4, 6, 41-3, 120.

HOLOTYPE.—WAM R27359, adult male with complete tail. Collected at Port Lincoln, South Australia by G. M. Storr on Oct. 19, 1966.

PARATYPES.—I have selected as paratypes all those individuals examined by me from the Eyre Peninsula, south of the Gawler Ranges, South Australia (NMV D8857-8, D15440,56; SAM R380, R3852, R4301, R5375, R9189, R9213, R9224, R10374, R10376, R12454-5, R12481, R12669, R12751; WAM R24528).

ETYMOLOGY.—*Australis* is the Latin Word for southern. I have chosen the specific name to emphasize the fact that the species has the most widespread southern geographic distribution in the genus *Delma*.

GEOGRAPHIC RANGE.—Widespread throughout southern Australia. It has been collected in northwestern Victoria, most of South Australia, southern Northern Territory and southwestern Western Australia as far north as Rat Island. It does not appear to be present in the extreme southwestern corner of Western Australia (Fig. 43).

DIAGNOSIS.—*Australis* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) usually four loreal scales, b) four frontal scales, c) fourth supralabial almost always located below orbit, d) ventral scales in males average 82.5, females 88.5, e) usually 18 midbody scale rows, f) ventral body scales usually not enlarged, g) usually three preanal scales, h) dorsal head bands absent, i) lateral lip pattern almost always present, j) throat usually completely covered with dark pigmentation or reticulation, k) ventral body surface usually completely covered with dark pigmentation or reticulation (Figs. 4, 6, 41-2).

DESCRIPTION.—(n = 76) SVL -.17 (0.009) 4.19 (0.009) 31.5-87.8, HL -.12 (0.005) 1.65 (0.005) 3.0-6.5, SL -.12 (0.006) 0.90 (0.006) 1.4-3.0, EW -.09 (0.007) 0.18 (0.007) 0.9-1.4, PL -.15 (0.012) 0.32 (0.011) 0.6-1.9, HW -.13 (0.005) 1.52 (0.005) 2.7-5.9, HD -.13 (0.007) 1.15 (0.007) 1.8-4.2, RD -.10 (0.007) 0.09 (0.007) 0.7-1.3, RW -.11 (0.005) 0.52 (0.005) 1.1-2.1, RLD -.09 (0.018) -.53 (0.018) 0.3-0.8, RLV -.11 (0.011) -.41 (0.011) 0.4-0.9, MD -.12 (0.011) -.05 (0.011) 0.5-1.4, MW -.10 (0.007) 0.71 (0.007) 1.4-2.6, ML -.11 (0.011) 0.29 (0.011) 1.0-1.8, TL (n = 22) -.23 (0.019) 4.91 (0.022) 46.0-154.5, PNS 1.0, SNS 0.0, INS 2.0, RP 0.6 (0.06) 0-1, LS 4.1 (0.05) 3-5, AOS 4.2 (0.07) 3-6, PRS 5.8 (0.11)

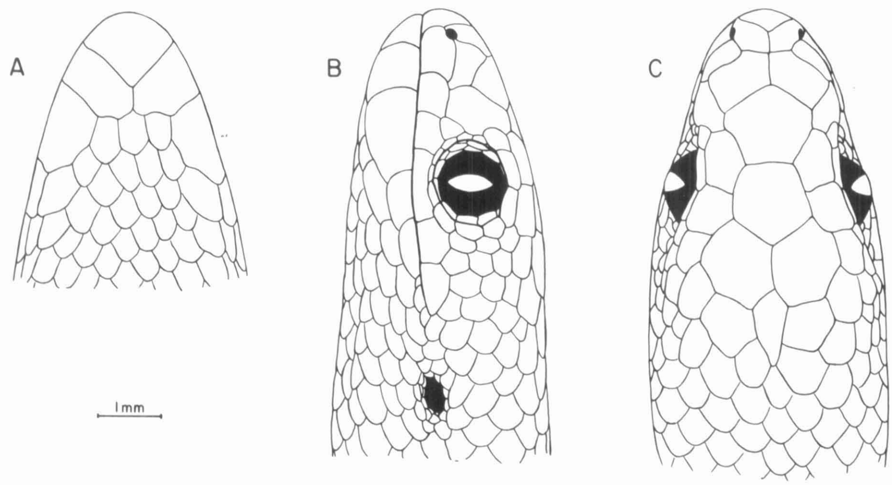

Fig. 41. Head region of *Delma australis* (UMMZ 129998; male; 76 mi E Norseman, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

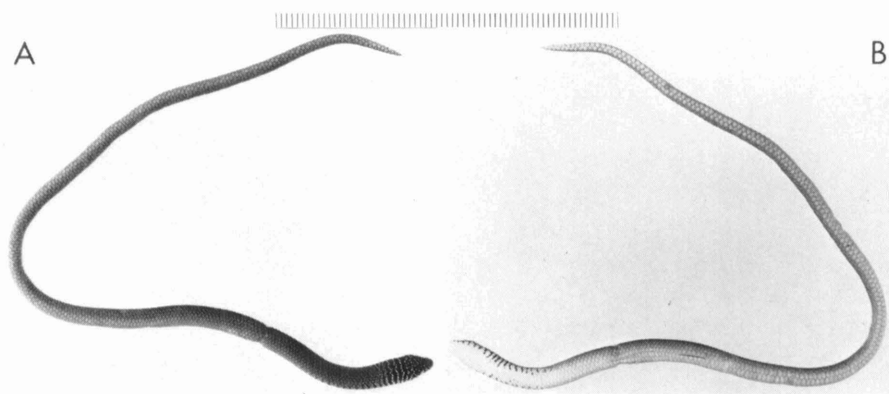

Fig. 42. Dorsal (A) and ventral (B) views of *Delma australis* (SAM R10375; male; nr Kokatha, South Australia). SVL = 55.0 mm.

4-8, SLS 6.0 (0.03) 5-7, FS 4.0, IOS 5.0, POS 4.5 (0.06) 3-6, OS 12.7 (0.14) 10-15, SOS 1.0, PS 1.0, NS 12.3 (0.10) 10-15, EAM 0.0, PM 2.0, ILS 5.5 (0.06) 4-6, GS 15.0 (0.10) 13-18, DSK 0.0, VSK 0.0, VS 85.4 (0.50) 77-95, PVS 18.6 (0.20) 14-25, MS 18.2 (0.07) 16-20, VBS 0.5 (0.10) 0-2, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.8 (0.05) 2-4, PCS 6.0 (0.11) 4-7, HLS 3.4 (0.08) 2-5, CS 11.3 (0.10) 10-13, SCS 3.4 (0.09) 3-5, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.0, LLP 3.8 (0.07) 0-4, TP 1.8 (0.06) 0-2, DBP 0.2 (0.04) 0-1, VBP 1.4 (0.06) 0-2, VP 0.7 (0.07) 0-1.

INDIVIDUAL VARIATION.–Approximately 25% (9 of 37) of the *australis* examined exhibit a row of small scales between the large dorsolateral plates of the snout and the supralabials; in some individuals this condition is present on one side but not on the other. Fifty percent of the Rat Island series possess the row of small scales while only 17% of the mainland Western Australia individuals do. Three of 37 specimens examined had the third supralabial scale in a suborbital position, two of these were asymmetrical; the fourth is usually located below the eye.

GEOGRAPHIC VARIATION.—A plot of principal component I against latitude and longitude in *australis* suggested a moderate amount of regionally correlated differentiation in a few characters. To identify more precisely these differences, I compared the following three samples of males: southwestern Western Australia (south of 32° 30′ S Lat and west of 120° E Long; n = 7), Eyre Peninsula, South Australia (south of 32° S Lat; n = 8) and Victoria (n = 12). Six characters, PRS, PAS, HLS, CS, TP and VP, exhibited significant mean differences between at least two of the three samples and they were used to calculate linear discriminant functions and Mahalanobis D^2 statistics. The D^2 values reveal (Table 18) that all pairwise comparisons are significantly different. All individuals were classified correctly according to sample except for one from Western Australia, classified as Victorian, posterior probability 0.96, and one from the Eyre Peninsula, classified as Victorian, posterior probability 0.99. The posterior probabilities for correctly classified individuals range from 0.97-1.0 in the Western Australia sample, 0.90-0.99 in the Eyre Peninsula sample and 0.98-1.0 in the Victoria sample. There is no obvious explanation for the two misclassified individuals. I was not able to study regional differentiation in females because of their smaller sample sizes.

Single character trends were not as conspicuous in *australis* as they were in the multivariate analysis, except possibly in the number of ventral scales. In Western Australia, specimens from the southwestern corner of the state usually have fewer ventrals than those from the more interior regions, Rat Island included. The number of ventrals in the Eyre Peninsula sample is approximately the same as that exemplified by the interior Western Australia group but fewer than the Victoria series (Fig. 43). The ventral scale differences are not highly significantly different.

TABLE 18

COMPARISON OF MALE *DELMA AUSTRALIS* FROM WESTERN AUSTRALIA (WA), SOUTH AUSTRALIA (SA) AND VICTORIA (V)*

Samples Compared	D^2	F-statistic	Significance
WA-SA	14.0	6.9	0.001
WA-V	23.1	13.5	0.000
SA-V	8.8	5.5	0.002

*See p. 79.

SEXUAL DIMORPHISM.—A sample of 37 males was compared to one of 39 females. The sexes only differ significantly in the number of ventral scales [males 82.5 (0.56) 77-88, females 88.1 (0.51) 81-95].

REMARKS.—An Alice Springs specimen (SAM R2240) is an old record and it must be confirmed with additional material. It is important to note that *australis* is not present in the Northern Territory Museum collection which appears to represent a reasonably good survey of the herpetofauna of the Alice Springs area.

Australis inhabits an extremely wide variety of structural environments. It has been collected under coral slabs (Rat Island series) and logs, in unoccupied termite mounds and road-grader spoils and it has even been burned out of clumps of porcupine grass (*Triodia*). It is probably sympatric at different localities with one or more of the following pygopodids: *Aprasia aurita, A. inaurita, A. pseudopulchella, A. pulchella, A. repens, A. striolata, Delma fraseri, D. inornata, D. molleri, D. nasuta, Lialis burtonis, Pygopus lepidopodus* and *P. nigriceps.*

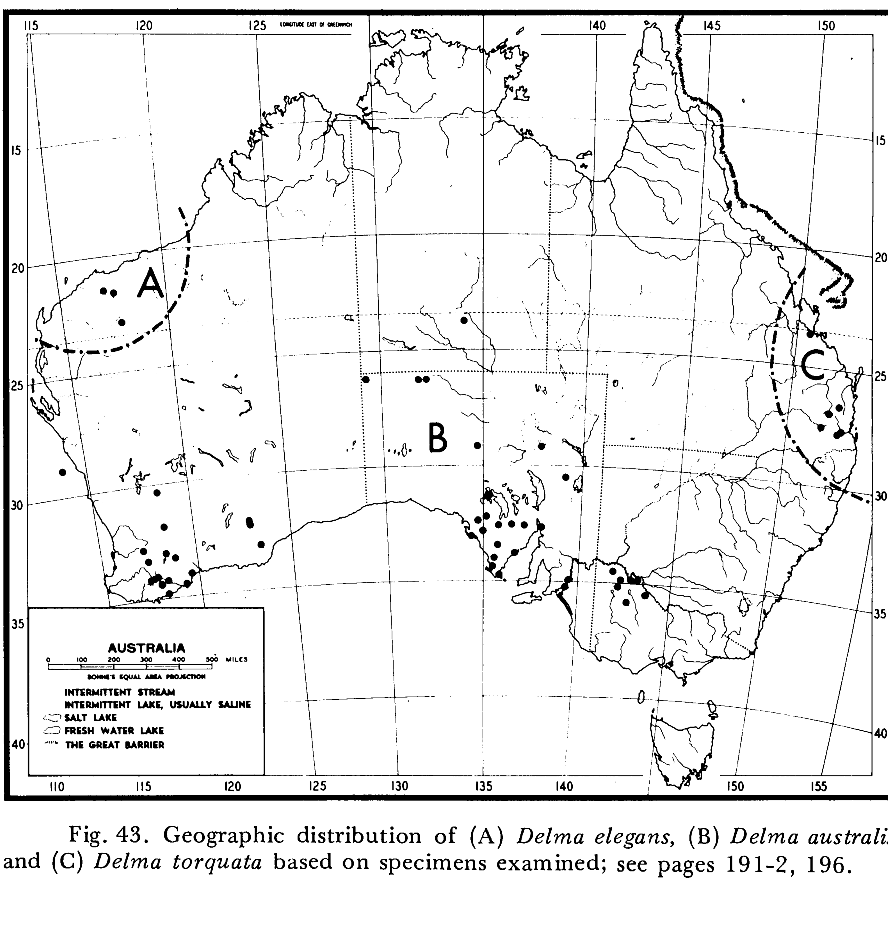

Fig. 43. Geographic distribution of (A) *Delma elegans,* (B) *Delma australis,* and (C) *Delma torquata* based on specimens examined; see pages 191-2, 196.

Delma borea sp. nov.
Figs. 44-7, 124.

HOLOTYPE.—WAM R37131, adult female with complete tail. Collected 48 miles south of Darwin, Northern Territory by P. J. Fuller on June 25, 1970.

PARATYPES.—All other specimens listed under *borea* in the Specimens Examined section (Appendix II) whose place of collection is north of 20° S Lat.

ETYMOLOGY.—*Borea* comes from the Greek word *boreas* which means north. The specific name emphasizes the fact that this species exhibits a generally northern distribution.

GEOGRAPHIC RANGE.—Widespread throughout the northern and central regions of the continent. It has been collected in Western Australia, Northern Territory, South Australia and Queensland (Fig. 47).

DIAGNOSIS.—*Borea* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal usually narrowly separated from nostril, b) usually five loreal scales, c) four anterior orbital scales, d) five frontal scales, e) fourth supralabial almost always located below orbit, f) ventral scales in males average 72.9, in females 74.5, g) usually 16 midbody scale rows, h) one pair of ventral body scales enlarged, i) almost always three preanal scales, j) dorsal head bands almost always present, k) throat region almost always without dark pigmentation (Figs. 44-6).

DESCRIPTION.—(n = 68) SVL -.21 (0.008) 4.16 (0.008) 33.5-86.3, HL -.14 (0.006) 1.77 (0.006) 4.0-8.9, SL -.15 (0.006)

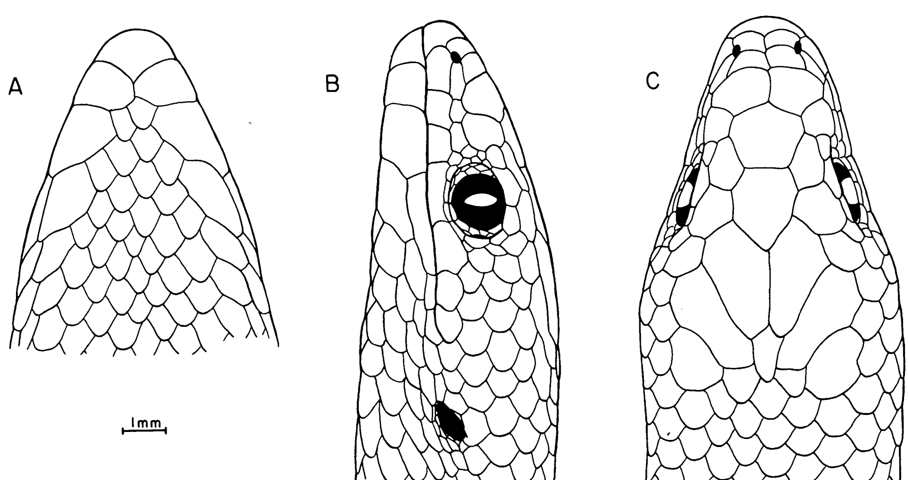

Fig. 44. Head region of *Delma borea* (UMMZ 131239; male; 16° 06′ S Lat, 128° 44′ E Long, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

1.02 (0.006) 1.7-3.8, EW -.09 (0.006) 0.17 (0.006) 0.9-1.5, PL -.14 (0.012) 0.51 (0.012) 1.1-2.6, HW -.16 (0.006) 1.47 (0.006) 2.9-5.7, HD -.16 (0.007) 1.18 (0.007) 2.1-4.5, RD -.14 (0.006) -.01 (0.006) 0.7-1.4, RW -.11 (0.005) 0.57 (0.005) 1.3-2.3, RLD -.15 (0.028) -.60 (0.028) 0.4-2.8, RLV -.13 (0.011) -.22 (0.011) 0.5-1.1, MD -.15 (0.012) -.13 (0.012) 0.5-1.3, MW -.11 (0.005) 0.70 (0.005) 1.4-2.7, ML -.09 (0.009) 0.26 (0.009) 1.0-1.7, TL (n = 19) -.27 (0.029) 5.22 (0.026) 103.2-257.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.02 (0.02) 0-1, LS 5.2 (0.05) 5-6, AOS 4.0, PRS 5.7 (0.09) 4-7, SLS 6.6 (0.07) 5-7, FS 5.0, IOS 5.0, POS 4.1 (0.05) 3-5, OS 13.8 (0.16) 11-17, SOS 1.0, PS 1.0, NS 12.2 (0.07) 11-14, EAM 0.0, PM 2.0, ILS 4.5 (0.07) 4-6, GS 14.3 (0.17) 11-18, DSK 0.0, VSK 0.0, VS 73.7 (0.42) 66-84, PVS 18.4 (0.19) 15-22, MS 15.8 (0.07) 14-16, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0 (0.02) 2-3, PCS 5.4 (0.10) 4-7, HLS 2.3 (0.06) 2-3, CS 9.9 (0.05) 8-11, SCS 3.0, DSP 0.0, DIP 0.9 (0.04) 0-1, DPP 2.5 (0.11) 0-3, DNP 2.8 (0.09) 0-3, PNB 0.8 (0.05) 0-1, LHP 0.0, LLP 3.7 (0.08) 1-4, TP 0.03 (0.03) 0-2, DBP 0.02 (0.02) 0-1, VBP 0.9 (0.04) 0-1, VP 1.6 (0.06) 0-2.

INDIVIDUAL VARIATION.—In approximately 7% of the individuals examined the third supralabial was located in a suborbital position. One specimen (NMV D8494) had only two preanal scales, and in three of 30 specimens the anteriormost pair of nasal scales were separated on the midline by the rostral. The second pair of nasal scales are usually only narrowly separated from the nostril, rarely do they border it.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were observed in *borea.*

SEXUAL DIMORPHISM.—A sample of 34 males was compared to one of 34 females and no significant differences were observed.

REMARKS.—*Borea* has been collected from disturbed microenvironments, such as trash heaps, as well as from among natural areas of grass and rocks. This species is most frequently encountered in regions of stony, hard soil and porcupine grass (*Triodia*). It does not appear to occupy porcupine grass clumps located on sandplains. *Borea* and *D. tincta* are often encountered in the same clump of porcupine grass. It is probably locally sympatric with one or more of the following other pygopodids as well: *Aprasia striolata, Delma australis, D. elegans, D. nasuta, D. pax, Lialis burtonis* and *Pygopus nigriceps.*

Delma elegans sp. nov.
Figs. 43, 48-50, 124.

HOLOTYPE.—WAM R20070, adult male with complete tail. Collected on the top of Mount Herbert (Fig. 124), northern foothills

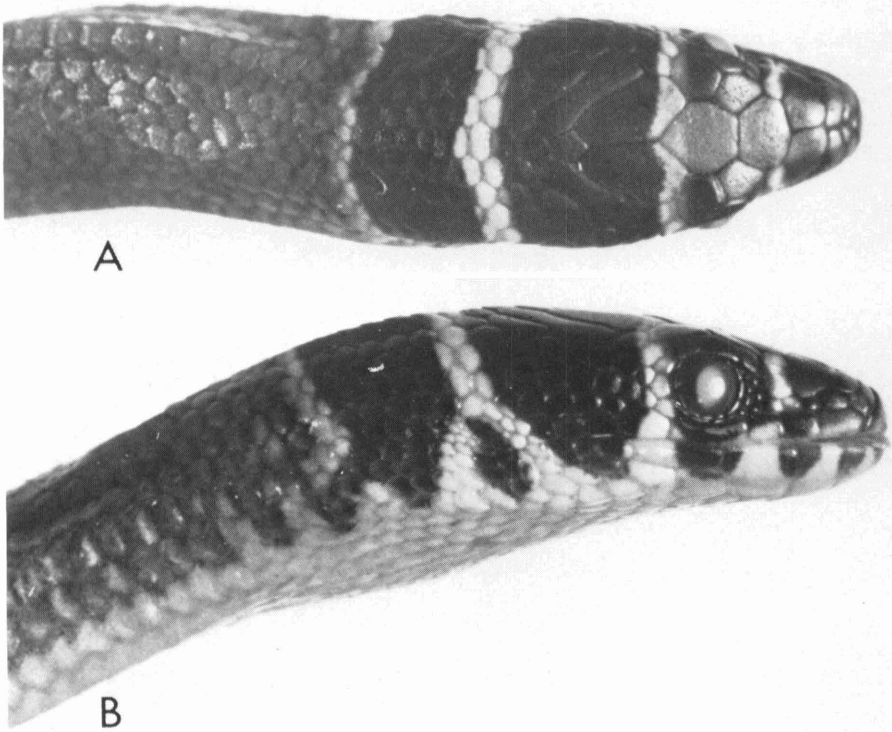

Fig. 45. Dorsal (A) and right lateral (B) views of head region of *Delma borea* (WAM R34333; juvenile male; Cockatoo Is, Western Australia). SVL = 36.3 mm.

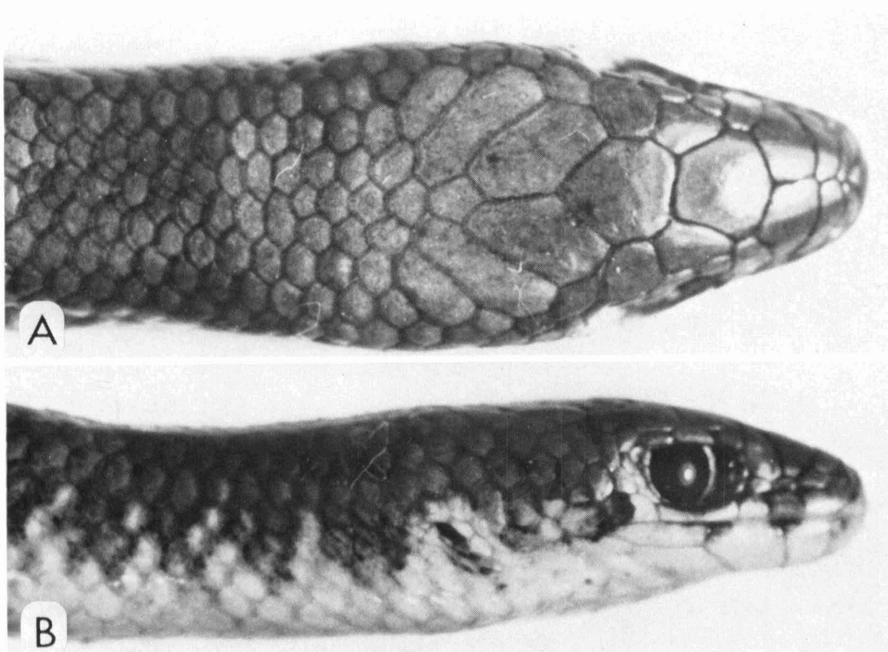

Fig. 46. Dorsal (A) and right lateral (B) views of head region of *Delma borea* (WAM R32142; male; Saint George Range, Western Australia). SVL = 74.0 mm.

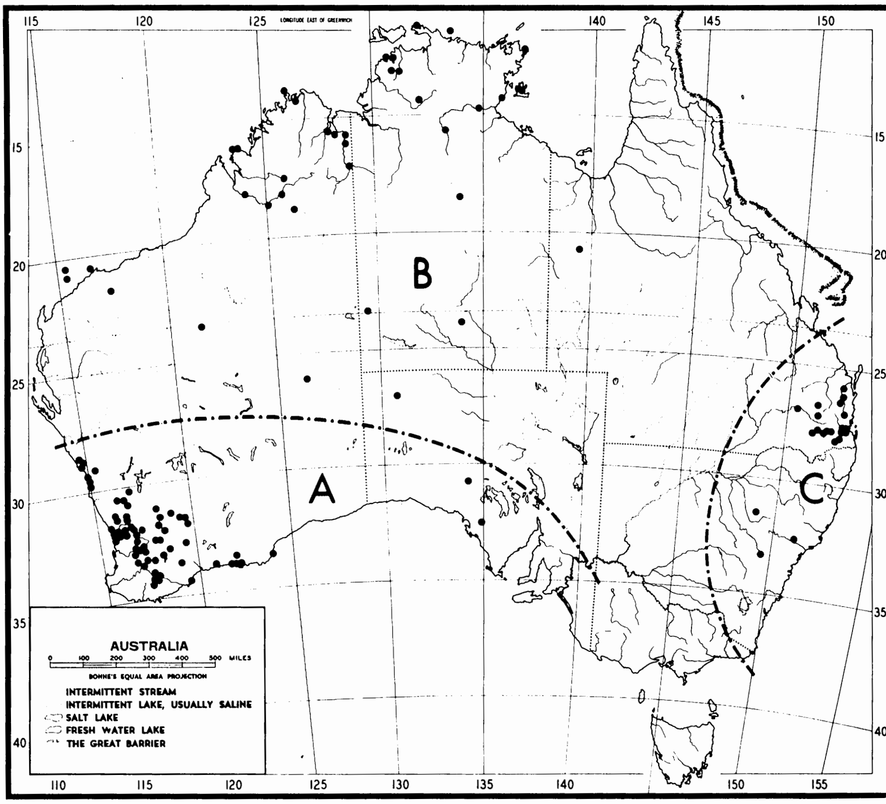

Fig. 47. Geographic distribution of (A) *Delma fraseri,* (B) *Delma borea,* and (C) *Delma plebeia* based on specimens examined; see pages 192-3, 195.

of Hamersley Range, Western Australia by the Western Australia-South Australia Museum Hamersley Expedition (Field no. 437) on August 4, 1958.

PARATYPES.—All other specimens listed under *elegans* in the Specimens Examined section (Appendix II).

ETYMOLOGY.—*Elegans* is the Latin word for choice or fine in the sense of beautiful. I have chosen this name to emphasize this species' beautiful head color and pattern.

GEOGRAPHIC RANGE.—Known only from three locations in the vicinity of the Hamersley Range (Fig. 43).

DIAGNOSIS.—*Elegans* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal borders nostril, b) six loreal scales, c) six anterior orbital scales, d) five frontal scales, e) fourth supralabial located below orbit, f) 18 gular scales, g) ventral scales in males average 78.5, 82 in female, h) usually 18 midbody scale rows, i) one pair of ventral body scales enlarged, j) three preanal scales, k) dorsal head bands

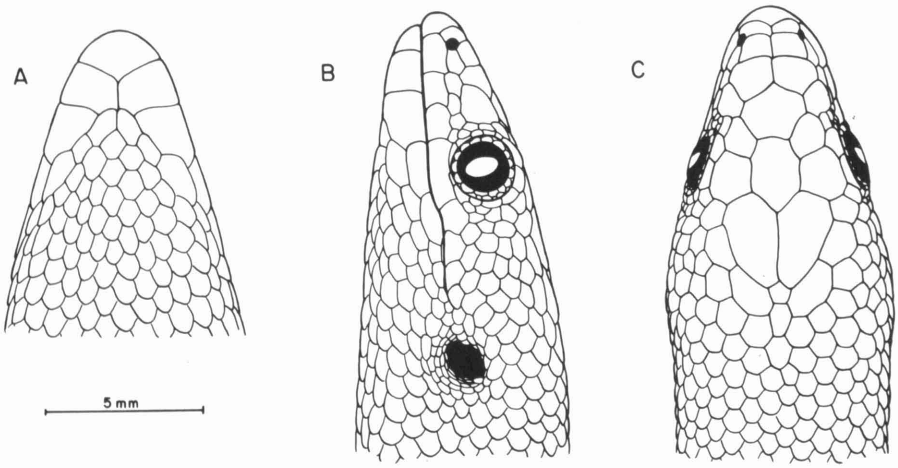

Fig. 48. Head region of *Delma elegans* (WAM R31051; female; Mt Tom Price townsite, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

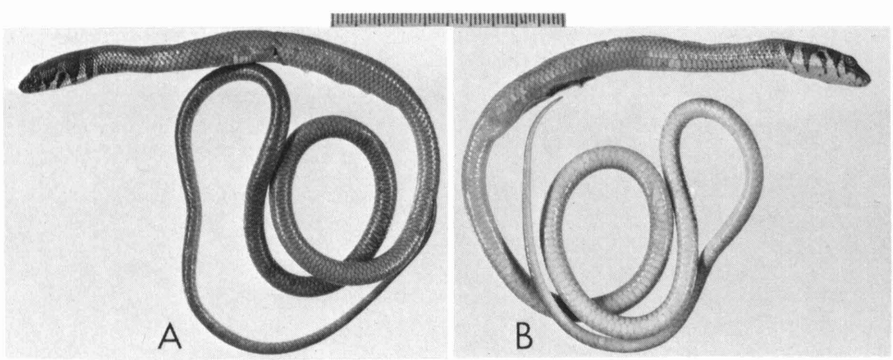

Fig. 49. Predominantly left lateral (A) and ventral (B) views of *Delma elegans* (WAM R31051; female; Mt Tom Price townsite, Western Australia). SVL = 91.0 mm.

present, l) two postparietal bands present, m) reticulation present on throat, n) dorsal and ventral body scales usually possess dark margins (Figs. 48-50).

DESCRIPTION.—(n = 3) SVL 81.5-91.0, HL 7.1-8.2, SL 3.7-4.0, EW 1.4-1.6, PL 1.6-2.2, HW 5.4-6.2, HD 4.1-4.4, RD 1.0-1.1, RW 2.0-2.2, RLD 0.7-0.8, RLV 0.8-0.9, MD 0.8-1.4, MW 2.4-2.6, ML 1.5-1.6, TL (n = 2) 314.5-333.2, PNS 1.0, SNS 0.0, INS 2.0, RP 0.0, LS 6.0, AOS 6.0, PRS 7.7 (0.67) 7-9, SLS 7.0, FS 5.0, IOS 5.0, POS 4.7 (0.33) 4-5, OS 15.0 (1.00) 13-16, SOS 1.0, PS 1.0, NS 16.0 (1.00) 14-17, EAM 0.0, PM 2.0, ILS 6.3 (0.33) 6-7, GS 18.0, DSK 0.0, VSK 0.0, VS 79.7 (1.45) 77-82, PVS 23.0 (1.00) 22-25, MS 17.7 (0.33) 17-18, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0,

PAS 3.0, PCS 6.3 (0.67) 5-7, HLS 4.0, CS 10.0, SCS 3.0, DSP 0.0, DIP 0.7 (0.33) 0-1, DPP 3.0, DNP 3.0, PNB 0.7 (0.33) 0-1, LHP 0.0, LLP 4.0, TP 2.0, DBP 0.7 (0.33) 0-1, VBP 1.7 (0.33) 1-2, VP 1.7 (0.33) 1-2.

INDIVIDUAL VARIATION.–Two of the three known specimens are males. There is very little variation present in the sample; see above DESCRIPTION.

REMARKS.–On Feb. 26, 1972 the author and Bob Humphries found a nearly complete skin slough of *elegans* inside a deserted and somewhat broken-down termite mound. The mound was located approximately 50 feet below the top of Mount Herbert on its northwest-facing slope (Fig. 124). *Elegans* is almost certainly locally sympatric with *Delma borea, D. nasuta* and *Lialis burtonis. Delma pax, D. tincta* and *Pygopus nigriceps* occur in the vicinity of the range of *elegans* and they too may be found in sympatry with it.

Delma fraseri Gray
Figs. 4, 47, 51-5, 120-21, 123.

1831. *Delma fraseri* Gray, Zoological Miscellany, p. 14. Syntypes: BM 1946.8.26.98-9. Type locality: New Holland; restricted to Western Australia (Gray, 1845a). Presented by J. Hunter.

GEOGRAPHIC RANGE.–Restricted to southwestern Western Australia and south-central South Australia. The two South Australia localities probably represent disjunct far eastern relicts. *Fraseri* does not appear to be distributed in the dense jarrah forest of the southwest (Serventy and Whittell, 1962; Fig. 47).

DIAGNOSIS.–*Fraseri* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal often borders nostril, b) usually six loreal scales, c) usually five anterior orbital scales, d) almost always five frontal scales, e) fourth supralabial almost always below orbit, f) usually 16 gular scales, g) ventral scales in males average 72.5, in females 73.2, h) usually 16 midbody scale rows, i) one pair of ventral body scales enlarged, j) almost always three preanal scales, k) dorsal head bands present (may be obscure in exceptionally large individuals), l) reticulation almost always present on throat, m) dorsal body scales rarely possess dark margins, n) ventral body scales usually possess dark margins (Figs. 4, 51-5).

DESCRIPTION.–(n = 141) SVL -.25 (0.006) 4.47 (0.006) 46.2-128.0, HL -.17 (0.003) 2.07 (0.003) 5.1-11.6, SL -.17 (0.006) 1.33 (0.006) 2.3-5.9, EW -.12 (0.004) 0.36 (0.004) 1.0-2.0, PL -.20 (0.008) 0.83 (0.008) 1.2-3.9, HW -.16 (0.003) 1.78 (0.003) 4.0-8.7, HD -.17 (0.004) 1.47 (0.004) 2.6-6.6, RD -.16 (0.004) 0.27 (0.004) 0.8-1.8, RW -.15 (0.003) 0.85 (0.003) 1.6-3.2, RLD -.16 (0.011) -.33 (0.011) 0.4-1.1, RLV -.16 (0.007) 0.04 (0.007) 0.7-1.5, MD

-.13 (0.008) 0.21 (0.008) 0.7-1.7, MW -.14 (0.004) 0.98 (0.004) 1.9-3.6, ML -.11 (0.005) 0.53 (0.005) 1.1-2.6, TL (n = 73) -.35 (0.014) 5.57 (0.015) 112.0-394.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.03 (0.01) 0-1, LS 5.8 (0.05) 4-7, AOS 5.2 (0.09) 4-8, PRS 6.2 (0.08) 4-9, SLS 6.7 (0.04) 5-8, FS 5.0 (0.01) 4-5, IOS 5.0, POS 5.1

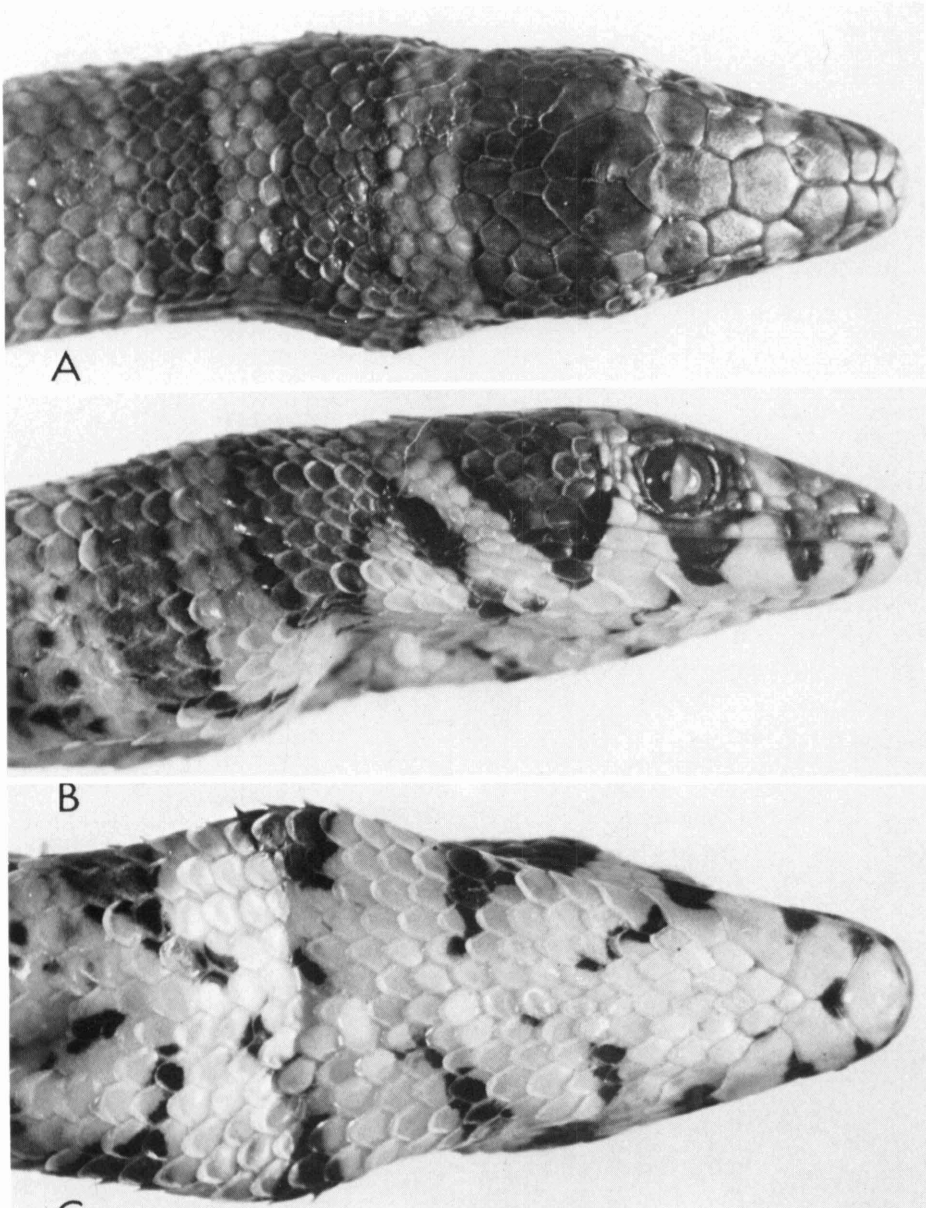

Fig. 50. Dorsal (A), right lateral (B), and ventral (C) views of head region of holotype of *Delma elegans* (WAM R20070; male; Mt Herbert, Western Australia). SVL = 81.5 mm.

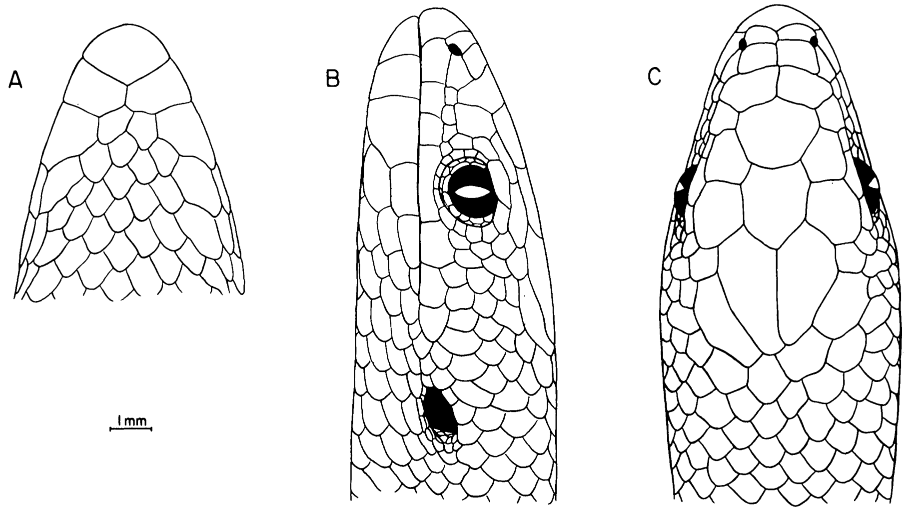

Fig. 51. Head region of *Delma fraseri* (WAM R10556; female; York, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

(0.04) 4-6, OS 15.5 (0.13) 12-19, SOS 1.0, PS 1.0, NS 13.5 (0.09) 12-16, EAM 0.0, PM 2.1 (0.02) 2-3, ILS 6.3 (0.04) 4-7, GS 15.5 (0.09) 13-18, DSK 0.0, VSK 0.0, VS 72.8 (0.23) 67-81, PVS 17.6 (0.12) 13-21, MS 16.0 (0.02) 15-17, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0 (0.01) 2-3, PCS 5.1 (0.03) 4-7, HLS 3.6 (0.05) 2-5, CS 10.3 (0.04) 9-12, SCS 3.0, DSP 0.0, DIP 0.8 (0.03) 0-1, DPP 1.0 (0.05) 0-3, DNP 2.7 (0.07) 0-3, PNB 0.8 (0.04) 0-1, LHP 0.0, LLP 3.4 (0.08) 1-4, TP 1.8 (0.06) 0-2, DBP 0.04 (0.02) 0-2, VBP 0.9 (0.04) 0-2, VP 1.5 (0.04) 1-2.

INDIVIDUAL VARIATION.—In approximately 34% of the specimens examined the posterior nasal borders the nostril, in about 45% they are narrowly separated, in 16% moderately separated and in 5% they are widely separated. In 6% of the specimens examined the rostral separates on the midline the first of the two pairs of nasals. Only one of the many specimens examined possessed one pair of nasals and it was asymmetrical with the typical condition of two on the opposite side. Only one specimen was found with the third supralabial in a suborbital position. About 3% of the individuals examined tended towards an immaculate throat region. The absence of pigmentation in these few specimens may be a function of their preservation.

GEOGRAPHIC VARIATION.—Northern and interior *fraseri* tend to have slightly more ventral scales than do those from the coastal and southwestern portion of the species' range. Unfortunately, samples are not sufficiently numerous or geographically well enough placed to be able to test for correlation with environmental variables

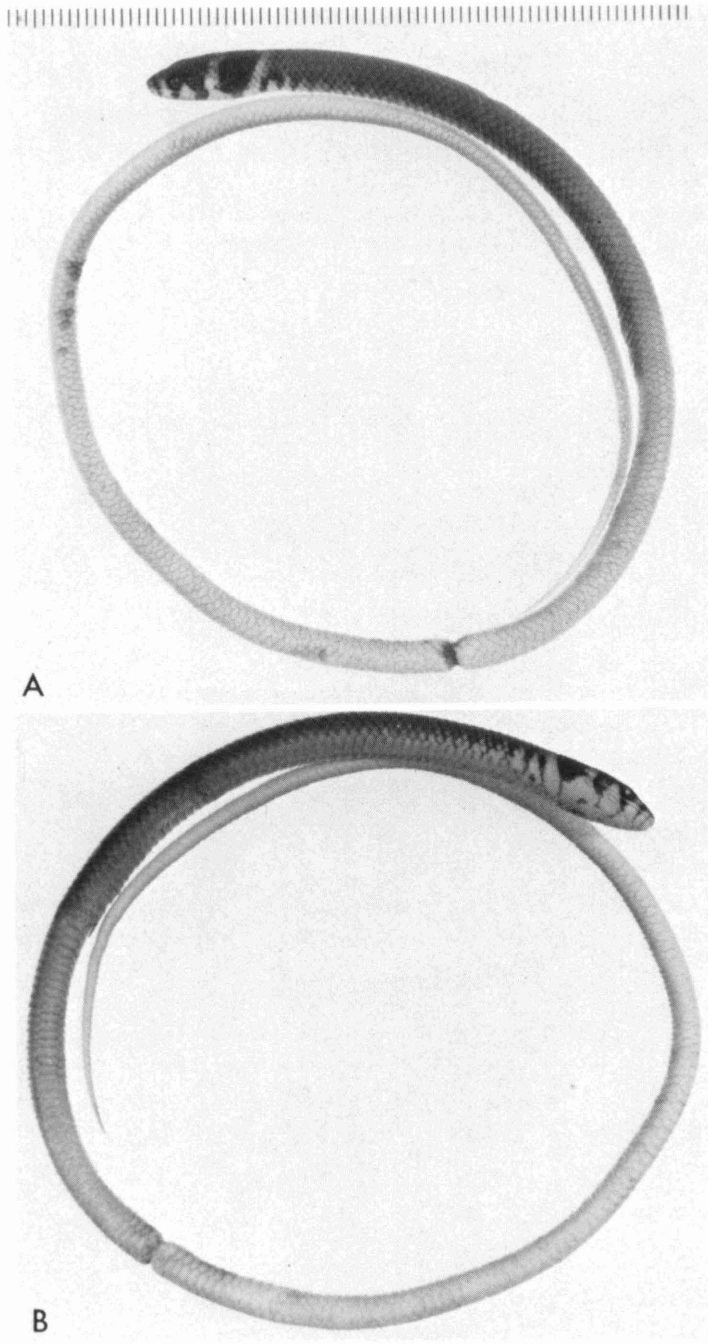

Fig. 52. Predominantly left dorsolateral (A) and right ventrolateral (B) views of *Delma fraseri* (WAM R10556; female; York, Western Australia). SVL = 78.0 mm.

such as mean December temperature (see *Aprasia repens* and *A. striolata*; Parker, 1956). No multivariate or univariate trends, other than ventral scales, were evident in *fraseri.*

Three specimens from South Australia appear to be referable to *fraseri.* They (SAM R3583, R10586) are not significantly different in any character from the Western Australia sample. The fact that their head banding is absent or indistinct is probably only a function of their large individual sizes (SVL 118.0, 121.7). In Western Australia

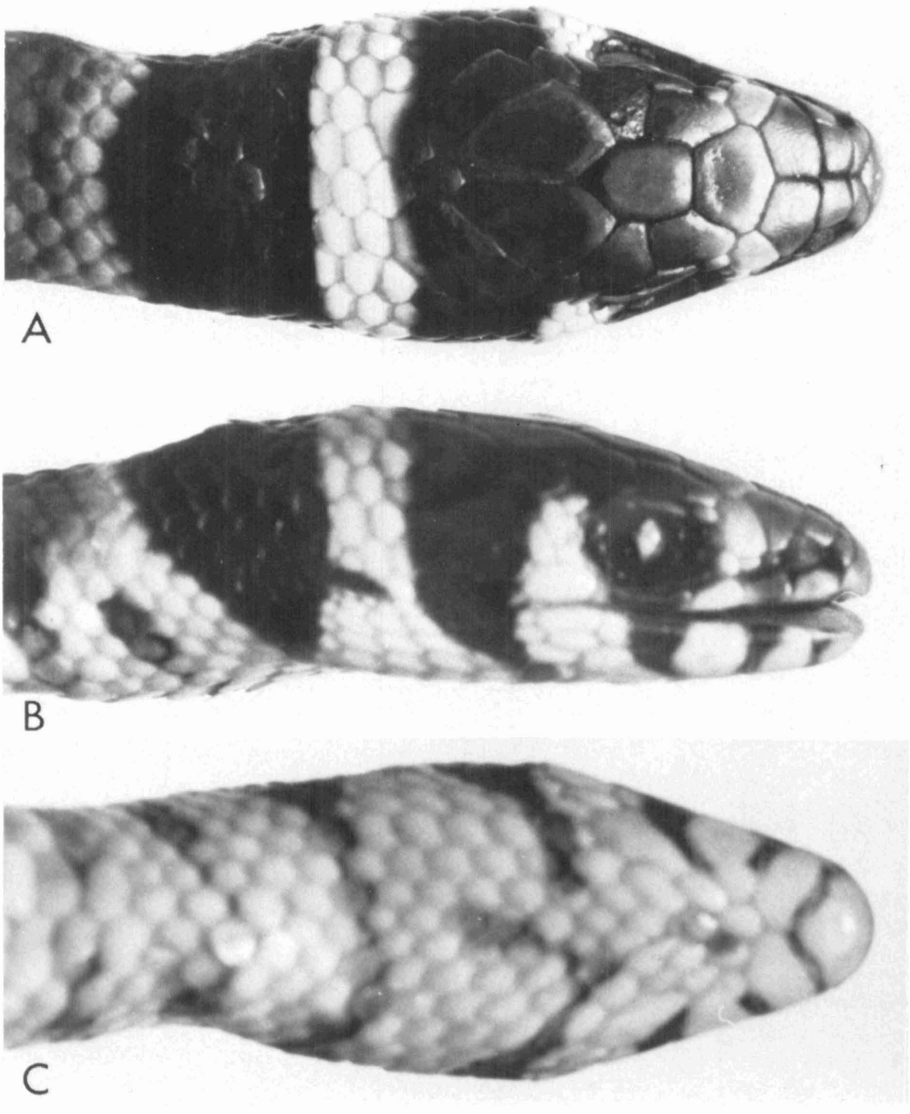

Fig. 53. Dorsal (A), right lateral (B), and ventral (C) views of head region of *Delma fraseri* (WAM R13654; juvenile male; Merredin, Western Australia). SVL = 57.0 mm.

fraseri there appears to be an inverse relationship between size (= age) and distinctness of head bands.

SEXUAL DIMORPHISM.—A sample of 71 males was compared to one of 70 females and no significant differences were observed.

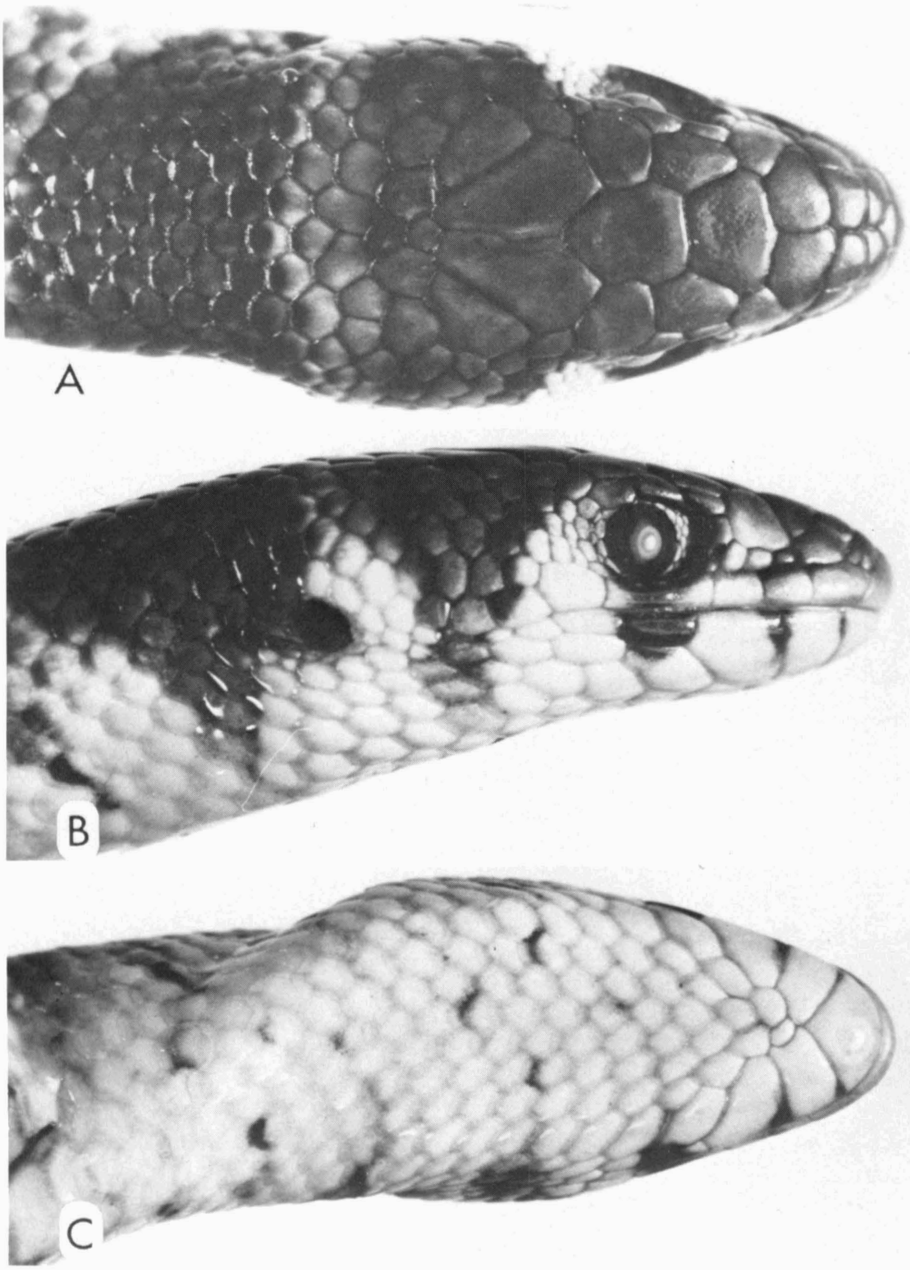

Fig. 54. Dorsal (A), right lateral (B), and ventral (C) views of head region of *Delma fraseri* (WAM R36474; male; Beverley, Western Australia). SVL = 92.0 mm.

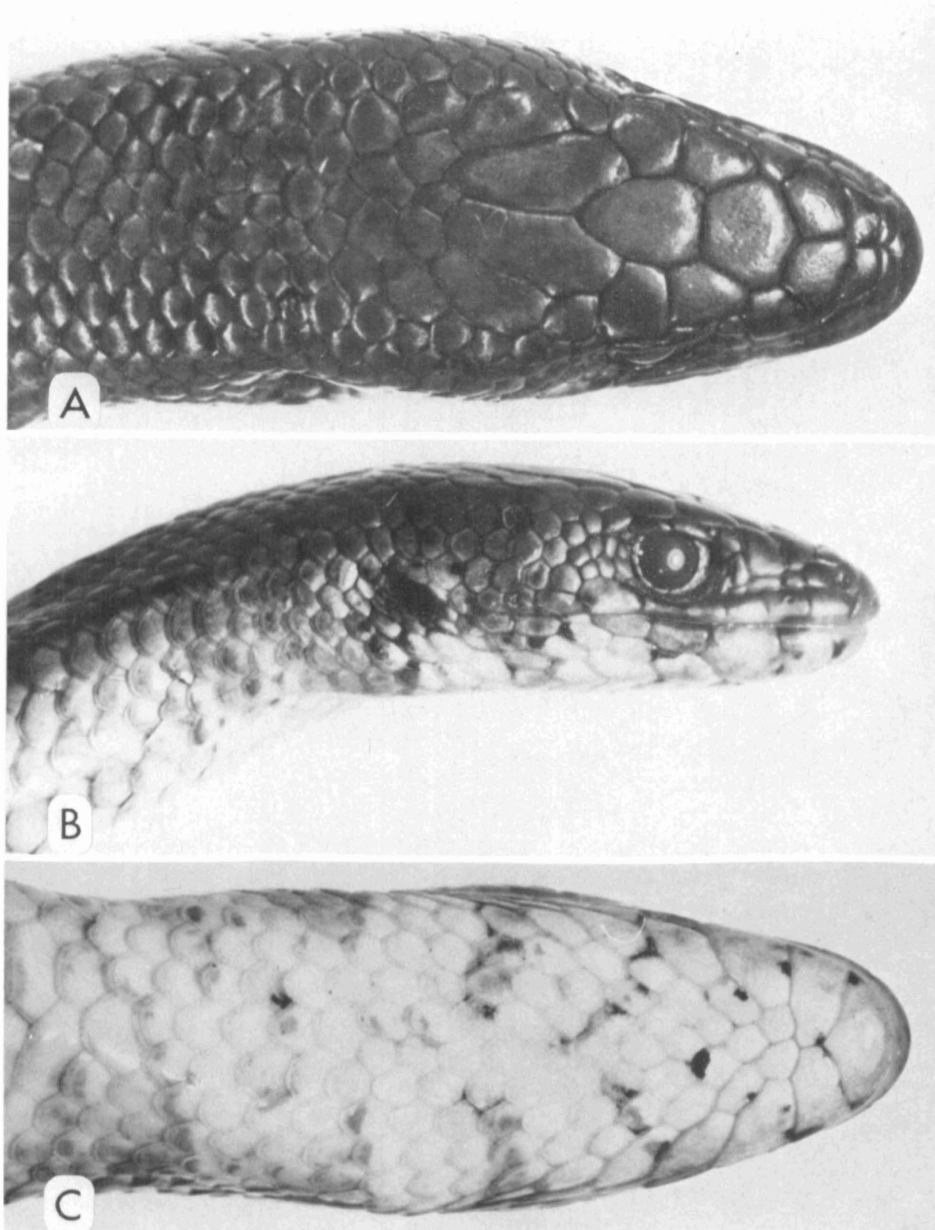

Fig. 55. Dorsal (A), right lateral (B), and ventral (C) views of head region of *Delma fraseri* (WAM R40039; female; Tarin Rock Reserve, Western Australia). SVL = 115.5 mm.

REMARKS.—There is considerable confusion regarding the earliest date of publication of the names *Delma* and *fraseri*, type species of *Delma*, and to whom they should be credited. Neave (1939) and Sherborn (1922) give 1830 as the date of publication for *Delma* and the source as J. E. Gray's "A synopsis of the species of the class Reptilia," *In* Griffith and Pidgeon, Animal Kingdom, vol. 9, while Schulze (1926) and Scudder (1882) list 1831 and the Zoological Miscellany. Cowan (pers. comm.; also see Cowan, 1969) has suggested that the former group of nomenclators took their 1830 date from the "Oct. 1830" which was printed at the bottom of page 1 of Gray's "Synopsis." However, this date is not a printer's mark, and perhaps it only documents when Gray finished or submitted the paper for publication. Since Gray's "Synopsis" followed part 27 of volume 9, which is known to have been printed in 1831, probably March, the "Oct. 1830" reference must be considered incorrect (Cowan, 1969). The description of *Delma,* and *fraseri,* that was published in the Zoological Miscellany (Feb., 1831) seems to have appeared one or more months earlier than the "Synopsis" and it must be considered the place of first usage. However, further complicating this issue is the fact that it can not be stated with certainty that J. E. Gray was the author of the Zoological Miscellany paper, since no name is listed; it is only generally assumed that Gray wrote all of the unauthored papers in the Zoological Miscellany (Kluge, 1971b). Until evidence to the contrary is presented, it seems reasonable to recognize 1831[a], Zoological Miscellany, as the earliest date and place of publication of *Delma,* type species *fraseri,* and the author as J. E. Gray.

I have not examined the specimens in the British Museum which are listed as the syntypes of *fraseri* (BM 1946.8.26.98-9). However, the fact that the original descriptions noted the presence of two pairs of nasals, three preanals and a banded head and neck (and a reticulate throat and a suborbital fourth supralabial; see Gray, 1841b, pl. 4, fig. 3) makes the name *fraseri* applicable only to the southwestern species of *Delma.*

Apparently, Gray (1831a) had only a single specimen of *fraseri* before him when he described that species, an adult from New Holland presented by James Hunter. In the 1845 British Museum catalogue of lizards Gray listed Hunter's specimen and one collected by J. Gilbert under the name *fraseri.* Gray gave Western Australia as the locality for the former individual. Boulenger (1885a:244) listed two juvenile syntypes of *fraseri* from "W. Australia," both presented by "J. Hunter." Resolution of these minor inconsistencies is impossible at this time. From a detailed comparison of the supposed syntypes with the original description one should be able to suggest which one Gray actually used and must therefore be considered the holotype.

I propose that the type locality be further restricted to the John Forrest National Park, approximately 17 miles east of Perth, Western Australia. While I know of no specimen that comes from within the Park boundary, the species is common in the same habitat nearby.

Fraseri is known to occupy a wide variety of structural habitats, some of which are extremely disturbed situations, e.g., trash heaps.

This species has been collected under fallen *Eucalyptus* bark, *Xanthorrhoea* logs and stones. *Fraseri* occupies damp flats, sand hills and plains and country with harder and more stony soils. A specimen was collected in sandy soil deep among the roots of a stump. One (WAM R40829) was found swimming in a tide-pool at Yanchep Beach. *Fraseri* has been, or will almost certainly be, found in sympatry at different localities with one or more of the following pygopodids: *Aclys concinna, Aprasia pulchella, A. repens, A. striolata, Delma australis, D. grayii, D. nasuta, D. tincta, Lialis burtonis, Pletholax gracilis, Pygopus lepidopodus. Pygopus nigriceps* and *fraseri* geographic ranges do not overlap; however, they are sufficiently close to anticipate their sympatry as well.

Delma grayii A. Smith
Figs. 56-8, 121-3.

1849. *Delma grayii* A. Smith, Illustrations of the Zoology of South Africa, pl. 76, figs. 2-2a-c (and associated unnumbered pages of text). Holotype: BM 1946.8.30.81. Type locality: Interior of southern Africa. Presented by A. Smith.

GEOGRAPHIC RANGE.—Restricted to southwestern Western Australia (Fig. 58). It has been found along the coast between 27° 44′ S Lat, 114° 08′ E Long (Wittecarra Gully) and 32° 17′ S Long, 115° 43′ E Long (Rockingham) and as far inland as 30° 50′ S Lat, 117° 29′ E Long (Koorda). It may be present on West Wallabi Island.

DIAGNOSIS.—*Grayii* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal almost always widely separated from nostril, b) usually six loreal scales, c) usually five anterior orbital scales, d) almost always five frontal scales, e) fourth supralabial almost always below orbit, f) usually 15 gular scales, g) ventral scales in males and females average 68.5, h) usually 16 midbody scale rows, i) one pair of ventral body scales enlarged, j) three preanal scales, k) dorsal head bands absent, l) lateral lip pattern almost always present and conspicuous, m) dorsal body scales sometimes possess dark margins, n) throat and ventral body surfaces immaculate (Figs. 56-7).

DESCRIPTION.—(n = 32) SVL -.23 (0.010) 4.46 (0.010) 45.5-120.5, HL -.16 (0.007) 2.07 (0.007) 5.2-10.4, SL -.16 (0.009) 1.35 (0.009) 2.5-4.9, EW -.10 (0.008) 0.35 (0.008) 1.0-1.7, PL -.17 (0.015) 0.76 (0.014) 1.2-2.9, HW -.16 (0.009) 1.70 (0.009) 3.5-7.6, HD -.16 (0.011) 1.51 (0.011) 2.8-6.2, RD -.16 (0.008) 0.31 (0.008) 0.9-1.8, RW -.15 (0.008) 0.85 (0.008) 1.7-3.1, RLD -.16 (0.025) -.26 (0.025) 0.4-1.0, RLV -.19 (0.014) 0.13 (0.014) 0.7-1.6, MD -.15 (0.018) 0.25 (0.017) 0.7-1.7, MW -.13 (0.008) 0.96 (0.007) 2.0-3.4, ML -.11 (0.015) 0.56 (0.015) 1.3-2.1, TL (n = 13) -.36 (0.034) 5.76 (0.037) 110.2-422.5, PNS 1.0, SNS 0.0, INS 2.0, RP

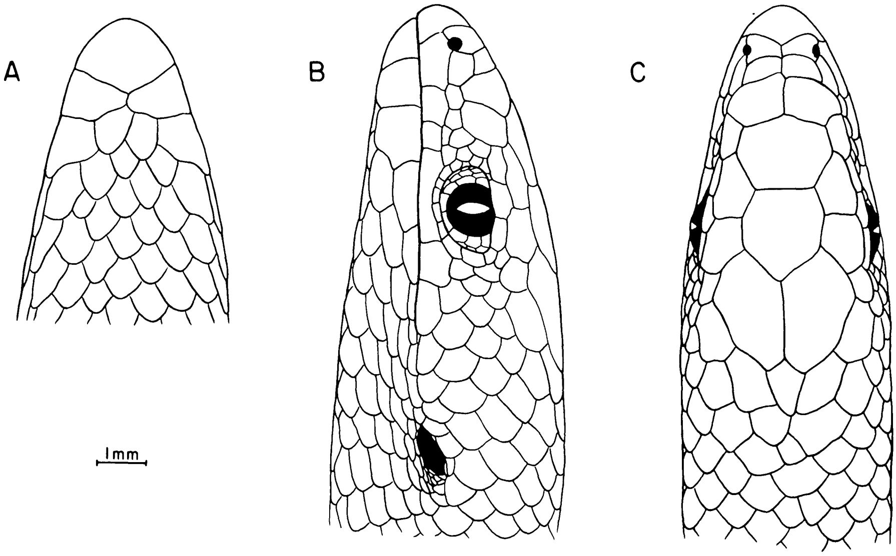

Fig. 56. Head region of *Delma grayii* (WAM R19756; female; Beagle Pt, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

0.03 (0.03) 0-1, LS 5.9 (0.11) 5-8, AOS 5.2 (0.19) 4-7, PRS 6.2 (0.19) 5-8, SLS 6.6 (0.09) 6-7, FS 5.0 (0.03) 4-5, IOS 5.0, POS 4.7 (0.10) 3-5, OS 14.6 (0.30) 11-19, SOS 1.0, PS 1.0, NS 12.7 (0.18) 12-16, EAM 0.0, PM 2.3 (0.08) 2-3, ILS 6.1 (0.08) 5-7, GS 14.9 (0.18) 13-17, DSK 0.0, VSK 0.0, VS 68.5 (0.39) 63-74, PVS 17.5 (0.20) 16-20, MS 16.1 (0.09) 15-18, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 6.9 (0.09) 5-7, HLS 4.4 (0.11) 4-6, CS 10.1 (0.06) 10-11, SCS 3.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.0, LLP 2.5 (0.22) 0-4, TP 0.0, DBP 0.4 (0.09) 0-1, VBP 0.0, VP 2.0.

INDIVIDUAL VARIATION.—WAM R7260, R4401 and SAM R3889 exhibit the atypical condition of one pair of nasals; the latter two specimens are asymmetrical in that they possess two nasals on one side. In those specimens with two pairs of nasals, the second scale is widely separated from the nostril in all but 8% where it is only narrowly separated. Only one specimen had the third supralabial in a suborbital position; the fourth supralabial was in that position on its opposite side.

I have examined the holotype of *grayii* (BM 1946.8.30.81) and it is exceptional among all of the other individuals referred to this species in lacking a row of small scales between the supralabials and the much larger dorsal and dorsolateral plates of the snout, viz., the number of anterior orbital scales is four in the holotype whereas it is six in all other individuals. Gray (1867) emphasized this condition when he diagnosed the genus *Nisara,* type species *grayii* A. Smith, as distinct from *Delma.* This peculiar head scalation appears to be an extreme individual variant and I can see no other reason to continue to recognize both *Nisara* and *Delma* since the holotype of *grayii* does not differ significantly in any other character.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were evident in the *grayii* data set. The individuals from Kukerin (SAM R3889), Sandstone (AMNH 102387), Wittecarra Gully (WAM R33892) and West Wallabi Island (WAM R185) are relatively far outside the main portion of the species' range defined by the remainder of the known material. The exceptional specimens were compared individually to a sample made up of the more geographically typical material and no significant differences were observed.

SEXUAL DIMORPHISM.—A sample of 13 males was compared to one of 19 females and no significant differences were observed.

REMARKS.—According to Waterhouse (1880), A. Smith's plate no. 76 and associated text which formed the original description of *grayii* was published in 1848 as usually cited. Grandison (pers. comm.) indicated that no data accompany the holotype of *grayii* (BM 1946.8.30.81); however, in 1867 Gray restricted its type locality to "Australia." In his South African publication, A. Smith (1849, Appendix, p. 15) described a second species of lizard, *Pholeophilus capensis*, without locality data and which is now considered to be an Australian endemic. This species of skink has been placed in the synonomy of the Western Australia *Lerista praepedita* (Storr, 1971). It is interesting to note that both of A. Smith's Australian species have relatively restricted and very similar geographic ranges and it seems likely that they were collected by the same person in the same area. Given the likelihood that the holotype of *grayii* was collected by that person in or near Perth, the major port and the center of commerce in Western Australia at the time of collection, I take this opportunity to restrict its type locality to Kalamunda National Park, 13 miles east of Perth, Western Australia. *Grayii* has been collected at Kalamunda and at nearby Gooseberry Hill.

Storr (pers. comm.) has suggested that the locality data accompanying WAM R185, West Wallabi Island, might be in error. More recent collections from that particular island have failed to yield additional *grayii* (Storr, 1965). While it is certain that the collector, W. B. Alexander, obtained a *Delma* from the Abrolhos (Alexander, 1922), he probably mixed specimens from different islands, according to the Western Australian Museum catalogue. This may mean that *grayii* is resident on one of the other islands in the Abrolhos group. It seems very likely that the Sandstone record (AMNH 102387) is also in error since that area differs considerably from the usual habitat of the species. Furthermore, I doubt the authenticity of the Kukerin locality (SAM R3889). It too is far removed to the southeast of the nearest part of the species range and *grayii* was not collected in nearby Tarin Rock Reserve surveys which recorded both *Delma fraseri* and *D. australis.*

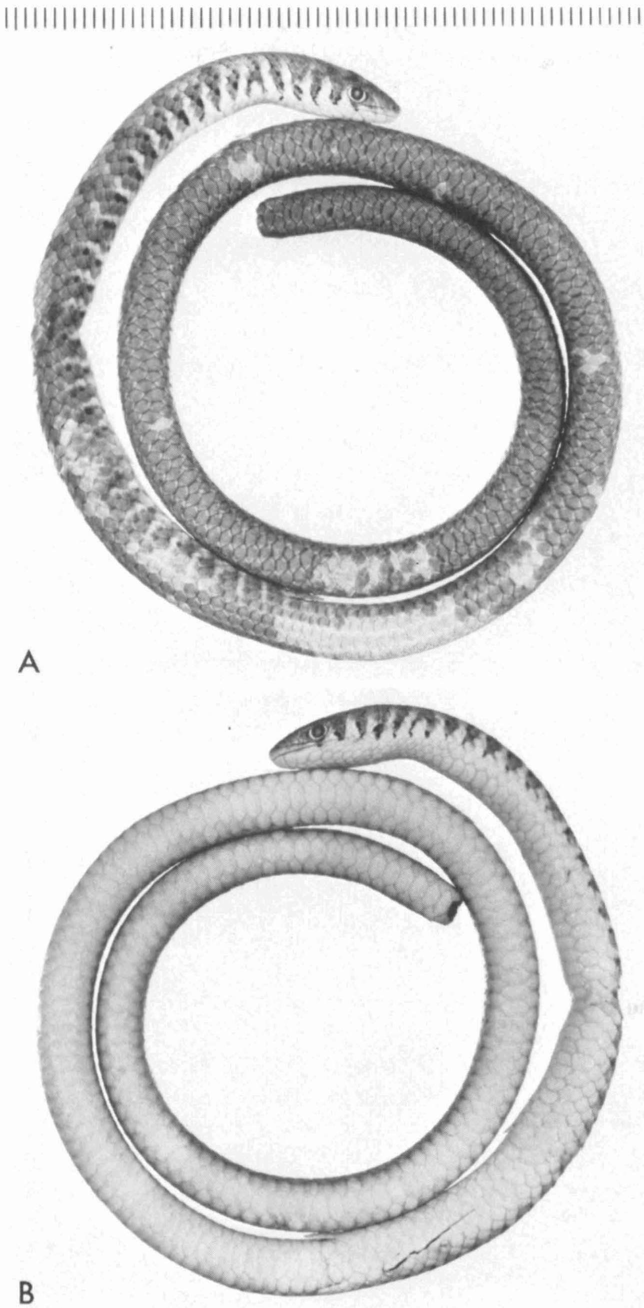

Fig. 57. Predominantly dorsal (A) and ventral (B) views of *Delma grayii* (WAM R19756; female; Beagle Pt, Western Australia). SVL = 94.0 mm.

Grayii inhabits at least two distinctly different substrate types within its small geographic range. It is known from both sand and hard clay soils. In the former it has been collected within 100 yards of the ocean and under fallen *Banksia* logs. One specimen (WAM

R33892) was caught in a Sherman mammal trap. A captive specimen did not burrow into the sandy substrate provided but preferred the seclusion of surface debris, such as wood, bark and pieces of termite mound. One or more of the following pygopodids have been collected either with *grayii* at different localities or sufficiently close to it to be considered as occurring in sympatry: *Aclys concinna, Aprasia pulchella, A. repens, Delma fraseri, Lialis burtonis, Pletholax gracilis* and *Pygopus lepidopodus.* Additional collecting will probably reveal that *Aprasia smithi, Delma tincta* and *Pygopus nigriceps* also occur with *grayii.*

Delmar impar (Fischer)
Figs. 7, 59-61.

1882. *Pseudodelma impar* Fischer, Arch. Naturgesch., 48:287, pl. 16, figs. 1-4. Holotype: KZMD D158. Type locality: Melbourne, Victoria. Collected by Semper in 1881.

1905. *Delma lineata* Rosén, Ann. Mag. nat. Hist., 16:131, pl. 8, fig. 1, text-fig. 2a-c. Holotype: ZML (number unknown). Type locality: Victoria.

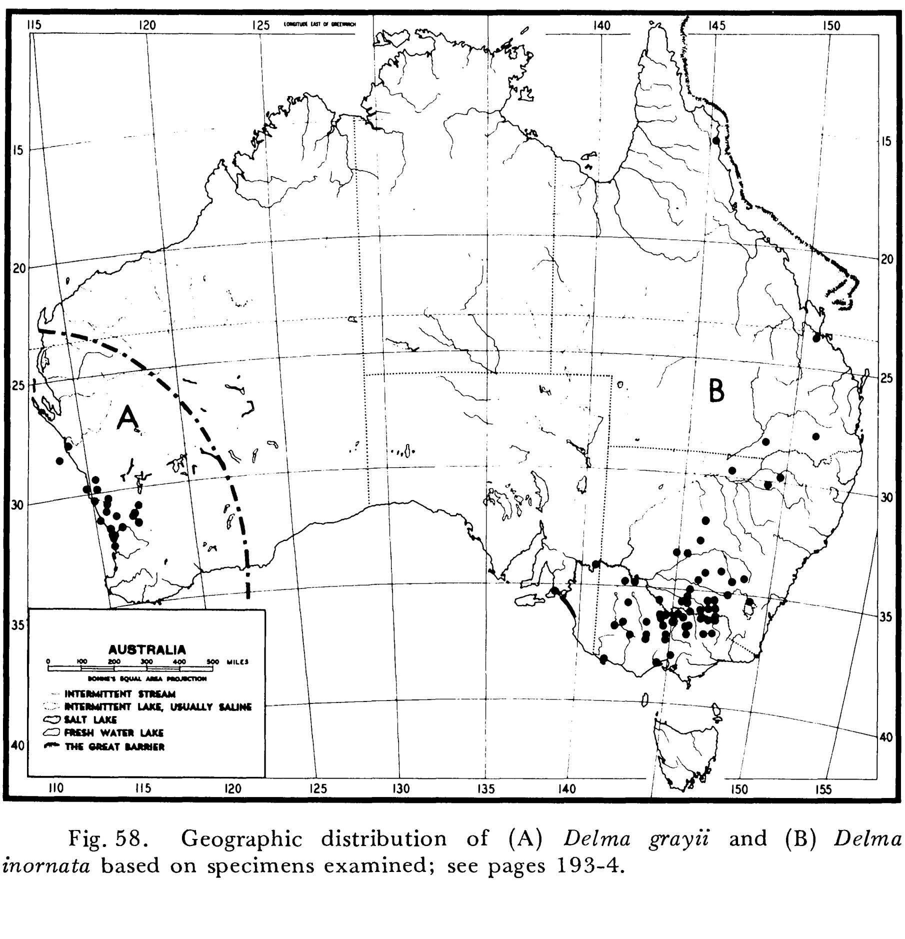

Fig. 58. Geographic distribution of (A) *Delma grayii* and (B) *Delma inornata* based on specimens examined; see pages 193-4.

GEOGRAPHIC RANGE.—Restricted to southeastern Australia. It has been collected in southeastern South Australia, central and western Victoria, except in the northwestern mallee associations, and in the Australian Capital Territory and surrounding area of New South Wales (Fig. 61).

DIAGNOSIS.—*Impar* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) nasal and first supralabial fused anterior to nostril, b) usually five or six loreal scales, c) usually five anterior orbital scales, d) almost always four frontal scales, e) fourth supralabial below orbit, f) usually 10 nuchal scales, g) usually 12 gular scales, h) ventral scales in males average 65.7, in females 70.5, i) usually 14 or 16 midbody scale rows, j) one pair of ventral body scales almost always enlarged, k) two preanal scales, l) dorsal head bands absent, m) throat and ventral body surfaces immaculate, n) conspicuous stripes almost always present on dorsal body surfaces (Figs. 7, 59-60).

DESCRIPTION.—(n = 37) SVL -.18 (0.014) 4.36 (0.014) 41.8-101.0, HL -.13 (0.007) 1.91 (0.007) 4.5-8.3, SL -.13 (0.010) 1.20 (0.009) 2.1-4.1, EW -.08 (0.010) 0.15 (0.010) 1.0-1.5, PL -.17 (0.016) 0.64 (0.016) 1.1-3.2, HW -.13 (0.009) 1.67 (0.009) 3.4-6.5, HD -.14 (0.010) 1.47 (0.010) 2.6-5.9, RD -.09 (0.008) 0.21 (0.008) 1.0-1.6, RW -.10 (0.007) 0.82 (0.007) 1.7-2.9, RLD -.09 (0.021) -.55 (0.021) 0.4-0.8, RLV -.09 (0.017) 0.02 (0.017) 0.8-1.3, MD -.12 (0.013) 0.13 (0.013) 0.8-1.5, MW -.11 (0.009) 0.96 (0.009) 2.0-3.2, ML -.09 (0.008) 0.37 (0.008) 1.1-1.8, TL (n = 21) -.17 (0.021) 4.98 (0.025) 75.0-178.5, PNS 1.0, SNS 0.0, INS 2.0, RP 0.0, LS 5.5 (0.11) 5-7, AOS 4.6 (0.14) 4-7, PRS 5.3 (0.14) 3-7, SLS 6.4 (0.10) 5-8, FS 4.0 (0.04) 3-5, IOS 5.0, POS 3.9 (0.10) 3-6, OS 12.6 (0.21) 10-15, SOS 1.0, PS 1.0, NS 10.0 (0.06) 9-11, EAM 0.0, PM 2.1 (0.04) 2-3, ILS 5.0 (0.07) 4-6, GS 12.1 (0.16) 10-14, DSK 0.0, VSK 0.0, VS 68.8 (0.57) 61-76, PVS 14.9 (0.21) 13-18, MS 14.7 (0.10) 13-16, VBS 2.0 (0.05) 0-2, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.0, PCS 5.2 (0.16) 4-6, HLS 3.0 (0.09) 2-4, CS 10.2 (0.09) 10-12, SCS 3.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.6 (0.13) 0-2, LLP 0.03 (0.03) 0-1, TP 0.0, DBP 2.7 (0.16) 0-3, VBP 0.0, VP 2.0 (0.03) 1-2.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were evident in *impar.* Three females from New South Wales and Australian Capital Territory (Fig. 61) were compared to a sample of 20 females taken from the remainder of the species' range and no significant differences were observed.

SEXUAL DIMORPHISM.—A sample of 13 males was compared to one of 24 females. The sexes only differ significantly in the number of ventral scales [males 65.7 (0.62) 61-69, females 70.5 (0.57) 66-76].

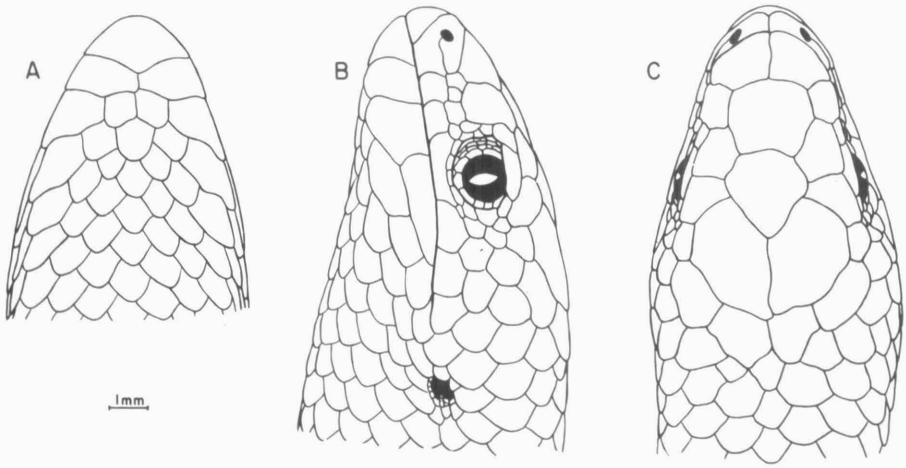

Fig. 59. Head region of *Delma impar* (AK 1079; male; no data, Victoria). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

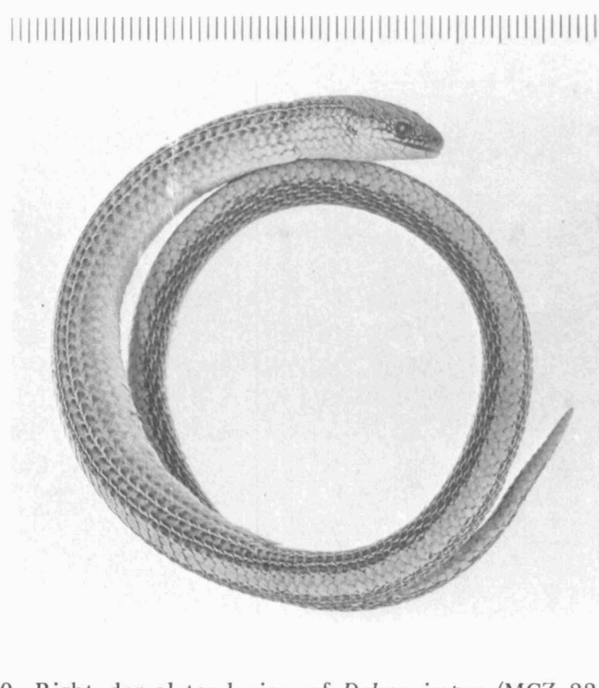

Fig. 60. Right dorsolateral view of *Delma impar* (MCZ 22159; female; no data, Victoria). SVL = 97.6 mm.

REMARKS.–F. J. Obst (pers. comm.) has informed me that the holotype of *impar* was probably deposited in the Königlich Zoologischen Museums, Dresden, now the Staatliches Museum für Tierkunde, Dresden, and that the specimen was very likely destroyed in the bombing of Dresden during World War II. It can not be determined which of the Semper brothers, Karl Gottfried or Georg, collected the holotype. NMV R10883 is designated the neotype of *impar* in the absence of the original name bearer. It is a subadult male with a complete tail, collected at Hamilton, Victoria, 37° 45′ S Lat, 142° 02′ E Long, and donated by F. P. Spry on October 12, 1904.

I have not examined the holotype of *D. lineata*; however, Rosén's description (1905) leaves little doubt that it is conspecific with *impar.* He (*op. cit.*:133) stated that his species was allied to *impar* but differed from it in having 16 midbody rows of scales and three scales in contact with the mental. These conditions are frequently observed in *impar* and they cannot be considered diagnostic of *D. lineata.* Rosén also noted the existence of coloration differences (he did not specify them, however) and observed that *D. lineata* was unique among the *Delma* in having the anterior part of the nasal fused with the first supralabial. The fusion is now recognized as the usual, if not invariant, circumstance in *impar.* While the fused state was not mentioned by Fischer (1882) in his description of the holotype of *impar* the separation of the nasal and first supralabial is clearly shown in the accompanying figure. It is very easy to mistake a concentration of pigmentation and/or fold of skin in poorly preserved specimens for separate nasal and supralabial scales anterior to the nostril. It seems likely that Fischer's illustration of the holotype of *impar* is in error.

Fischer (1882) stated that his new genus *Pseudodelma* (type species *impar*) differed from *Delma* in that it exhibited an odd number of midbody scale rows (15), broad palatine groove and absence of supranasals. I have compared the skull of *impar* to that of *fraseri,* type species of *Delma*, and the region of their palatine bones is not obviously different. The two scale differences that Fischer cited are known in other species of *Delma.* In the absence of several diagnostic character states, *Pseudodelma* is referred to the synonomy of *Delma.*

In spite of the fact that *impar* occurs in one of the two most populated regions of Australia and that it has been collected in large numbers, almost nothing is known about its biology. It has been collected under stones (McCoy, 1888), and it appears to be sympatric at different localities with either *Aprasia inaurita, A. parapulchella, Delma inornata,* or *Pygopus lepidopodus. Impar* may be one of the very few pygopodids which does not coexist with *Lialis burtonis.*

Delma inornata sp. nov.

Figs. 58, 62-4.

HOLOTYPE.—NMV D3492, adult male with complete tail. Collected at Kewell, Victoria, by J. A. Kershaw in Sept., 1896.

PARATYPES.—All other specimens listed under *inornata* in the Specimens Examined section (Appendix II) which come from south of 31° S Lat.

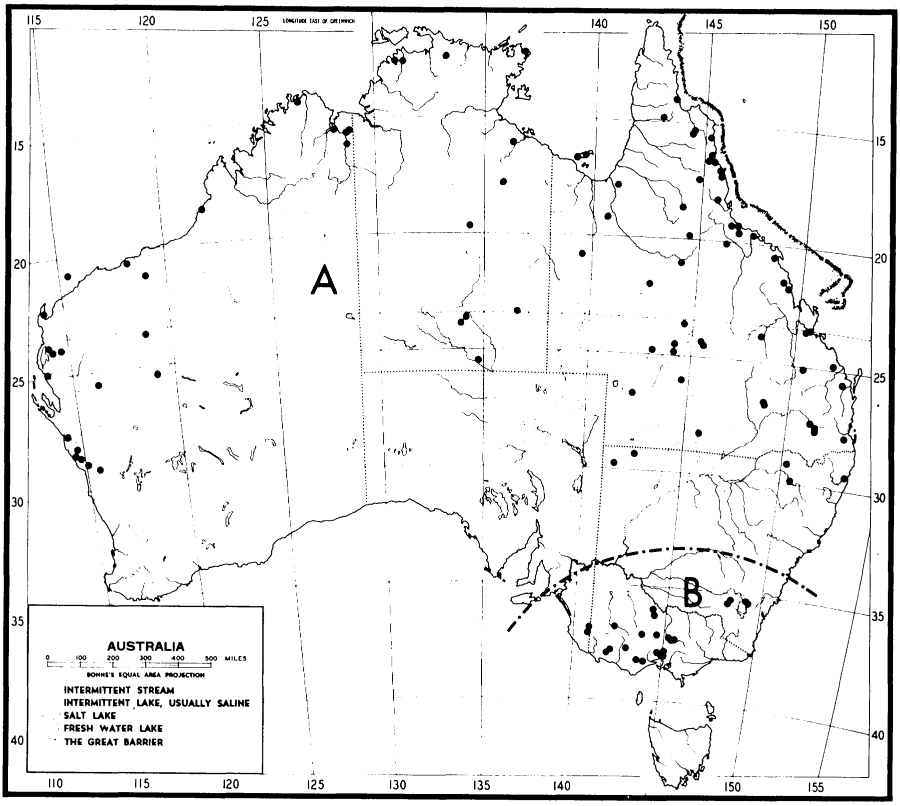

Fig. 61. Geographic distribution of (A) *Delma tincta* and (B) *Delma impar* based on specimens examined; see pages 193, 195-6.

ETYMOLOGY.—*Inornata* is the Latin word for unadorned. This specific name emphasizes the absence of the dorsal head and neck bands which are so characteristic of most species in the genus *Delma.*

GEOGRAPHIC RANGE.—Eastern Australia. It has been collected in South Australia along the Murray River, throughout most of Victoria, except the more arid western and mesic eastern sections of the state, much of New South Wales west of the Great Dividing Range, and from widely scattered localities in eastern Queensland (Fig. 58).

DIAGNOSIS.—*Inornata* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal widely separated from nostril, b) usually six loreal scales, c) usually five anterior orbital scales, d) usually five frontal scales, e) fourth supralabial usually below orbit, f) usually 14 gular scales, g) ventral scales in males average 72.6, in females 73.1, h) usually 16 midbody scale rows, i) one pair of ventral body scales enlarged, j) almost always three preanal scales, k) dorsal head bands absent, l) throat and ventral body surfaces immaculate, m) lateral lip pattern almost always absent, never conspicuous, n) dorsal body scales may or may not possess dark margins (Figs. 62-3).

DESCRIPTION.–(n = 81) SVL -.22 (0.007) 4.52 (0.007) 48.5-133.0, HL -.14 (0.005) 2.08 (0.005) 5.3-9.9, SL -.14 (0.006) 1.34 (0.006) 2.6-4.8, EW -.08 (0.006) 0.32 (0.006) 1.1-1.7, PL -.18 (0.009) 0.82 (0.009) 1.3-3.1, HW -.13 (0.005) 1.75 (0.005) 4.0-7.6, HD -.14 (0.006) 1.55 (0.006) 3.2-6.2, RD -.13 (0.005) 0.31 (0.005) 0.9-1.7, RW -.13 (0.005) 0.90 (0.005) 1.8-3.2, RLD -.13 (0.013) -.44 (0.013) 0.4-1.0, RLV -.16 (0.008) 0.16 (0.008) 0.8-1.6, MD -.10 (0.008) 0.27 (0.008) 0.9-1.7, MW -.12 (0.007) 1.02 (0.007) 2.0-3.6, ML -.10 (0.008) 0.53 (0.008) 1.3-2.3, TL (n = 39) -.31 (0.017) 5.55 (0.018) 100.0-333.0, PNS 1.0, SNS 0.0, INS 2.0 (0.01) 2-3, RP 0.0, LS 6.3 (0.07) 5-8, AOS 5.1 (0.12) 4-8, PRS 6.6 (0.10) 5-9, SLS 6.7 (0.07) 5-8, FS 4.9 (0.03) 4-5, IOS 5.0, POS 4.7 (0.08) 4-7, OS 14.5 (0.17) 11-19, SOS 1.0 (0.01) 0-1, PS 1.0, NS 13.1 (0.11) 11-16, EAM 0.0, PM 2.2 (0.04) 2-3, ILS 6.1 (0.05) 5-7, GS 14.3 (0.12) 12-17, DSK 0.0, VSK 0.0, VS 72.8 (0.27) 68-78, PVS 17.0 (0.15) 14-21, MS 16.0 (0.03) 15-18, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0 (0.01) 2-3, PCS 5.8 (0.11) 4-7, HLS 4.1 (0.07) 3-5, CS 10.3 (0.05) 9-11, SCS 3.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.0, LLP 0.4 (0.02) 0-1, TP 0.0, DBP 0.3 (0.05) 0-1, VBP 0.0, VP 2.0.

INDIVIDUAL VARIATION.–Approximately 10% of the *inornata* examined possessed one pair of nasals instead of the usual two. Three individuals (NMV R10830, D15450 and D15455) exhibited two nasals on one side and one on the other. A fourth specimen (AM R679) possessed a large typical second nasal on the left side but only a very small and atypically formed one on the right. These few observations suggest that the acquisition or loss of the second pair of nasals has occurred by selection for or against suture lines between scales rather than by a decrease or increase in scale size, and that the posterior nasal area is that which is affected by the change. About 10% of the *inornata* examined had the fifth supralabial located in a suborbital position, while about 5% had the third in that position; typically it is the fourth.

GEOGRAPHIC VARIATION.–There is no evidence of univariate or multivariate trends in *inornata*. Moreover, the South Australia, northern New South Wales and Queensland specimens, which represent obvious geographic outliers, do not differ significantly from the sample representing the main body of the range of the species.

SEXUAL DIMORPHISM.–A sample of 43 males was compared to one of 38 females and no significant differences were observed.

REMARKS.–*Inornata* is very abundant in certain areas in Victoria and New South Wales; however, it has been rarely encountered in Queensland. The reason for the conspicuous difference in density is not apparent. A specimen was collected a few miles

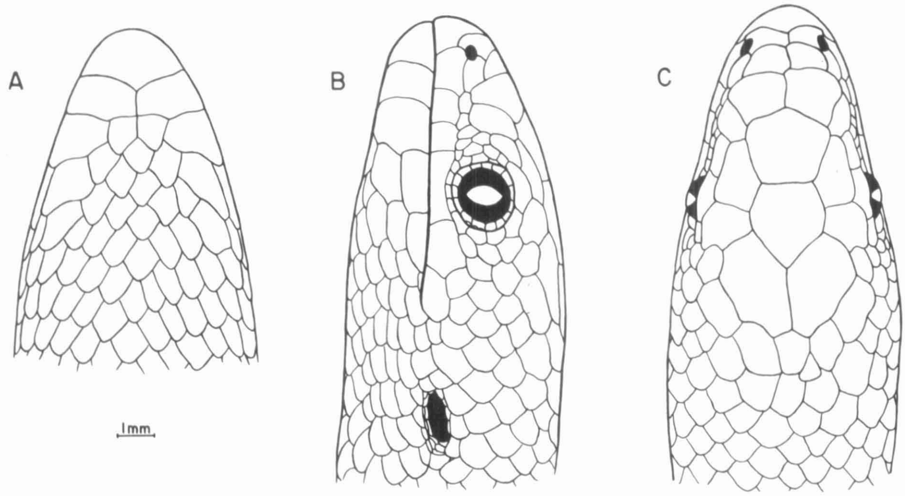

Fig. 62. Head region of *Delma inornata* (UMMZ 130000; male; Benalla, Victoria). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

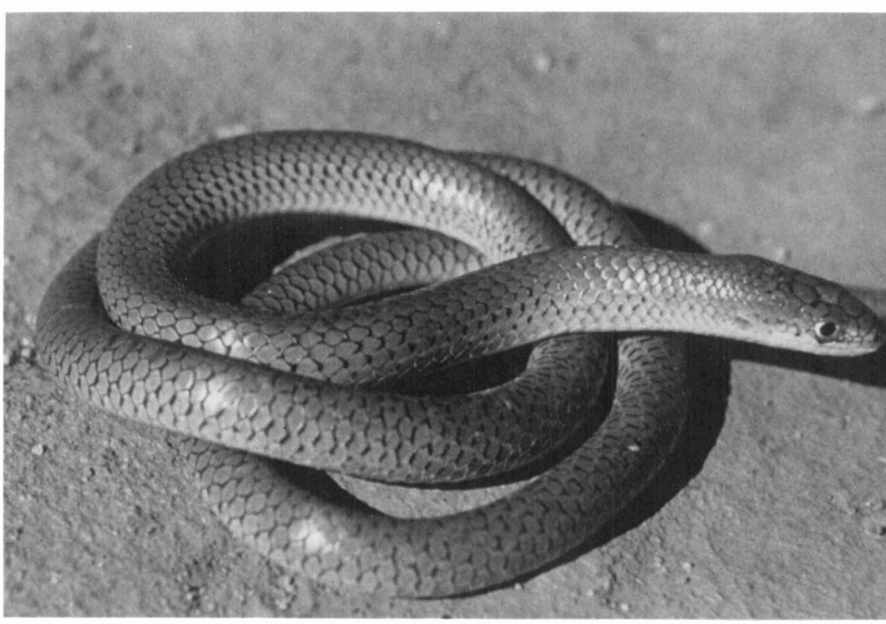

Fig. 63. Predominantly right dorsolateral view of a live *Delma inornata* (UMMZ 131155; female; Numurkah, Victoria). SVL = 125.4 mm.

south of Townsville, Queensland after a bush fire. *Delma tincta* is relatively common in this area. Two of the three Numurkah, Victoria specimens were collected under logs while the third was dug out of a bank. *Inornata* is sympatric at different localities with either *Aprasia aurita, A inaurita, A. parapulchella, A. striolata, Delma australis, D.*

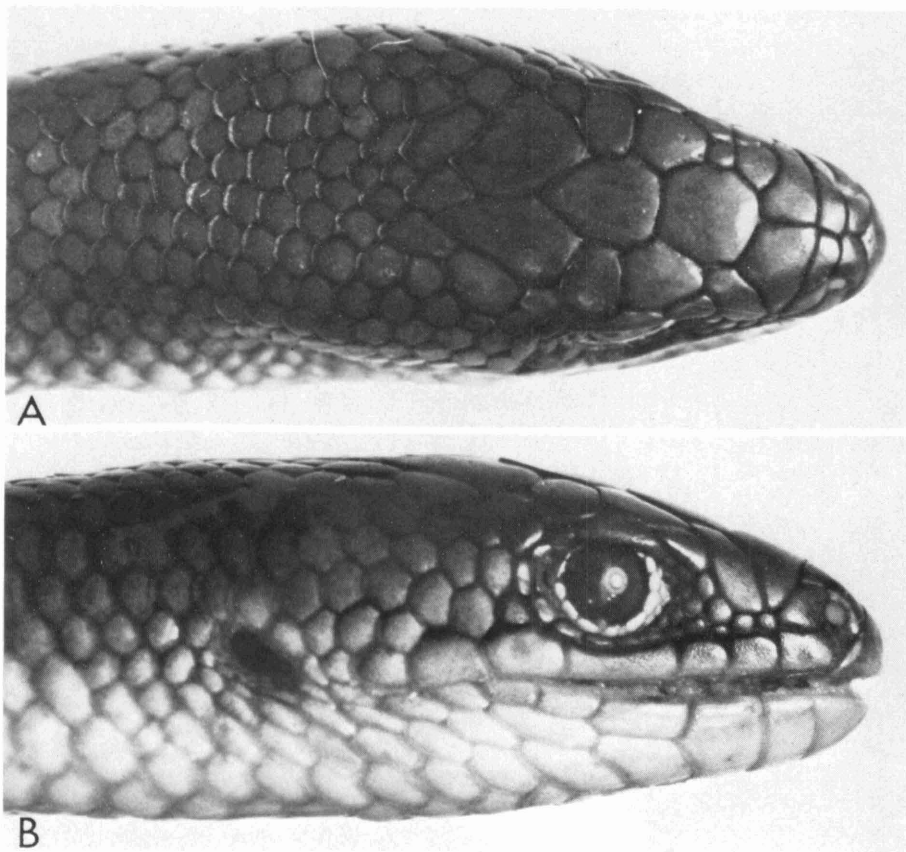

Fig. 64. Dorsal (A) and right lateral (B) views of *Delma inornata* (SAM R11095; male; 20 mi N Walla Walla, New South Wales). SVL = 96.5 mm.

impar, D. tincta, Lialis burtonis, Pygopus lepidopodus or *P. nigriceps*. Given their close geographic proximity, *D. nasuta, D. plebeia* and *D. torquata* may yet be found with *inornata*.

Delma molleri Lütken
Figs. 65-9.

1863. *Delma Mölleri* Lütken, Vidensk. Meddr dansk. naturh. Foren., 1862:296, pl. 1/2, fig. 2a-c. Holotype: UZMK R.3503 (formerly 4). Type locality: Unknown. Collected by Möller.

GEOGRAPHIC RANGE.–Known only from South Australia in the region between Spencer Gulf and the Murray River (Fig. 69).

DIAGNOSIS.–*Molleri* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) usually five loreal scales, b) usually five anterior orbital scales, c) almost always four frontal scales, d) fourth supralabial below orbit, e) usually 14 gular scales, f) ventral scales in males average 72.7, in females 76.1, g) usually 18 midbody scale rows, h) one pair of ventral body scales enlarged, i) three preanal scales, j) dorsal head bands almost always present, k) throat immaculate, l) dorsal and ventral body pattern usually absent (Figs. 65-8).

DESCRIPTION.—(n = 28) SVL -.26 (0.017) 4.27 (0.017) 43.0-111.2, HL -.15 (0.009) 1.91 (0.009) 4.9-8.5, SL -.17 (0.009)

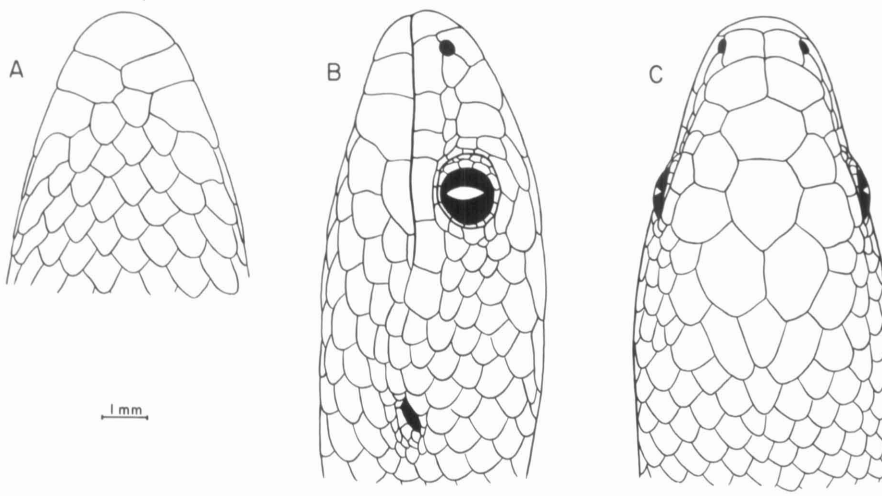

Fig. 65. Head region of *Delma molleri* (SAM R6368; female; few mi N Burra, South Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

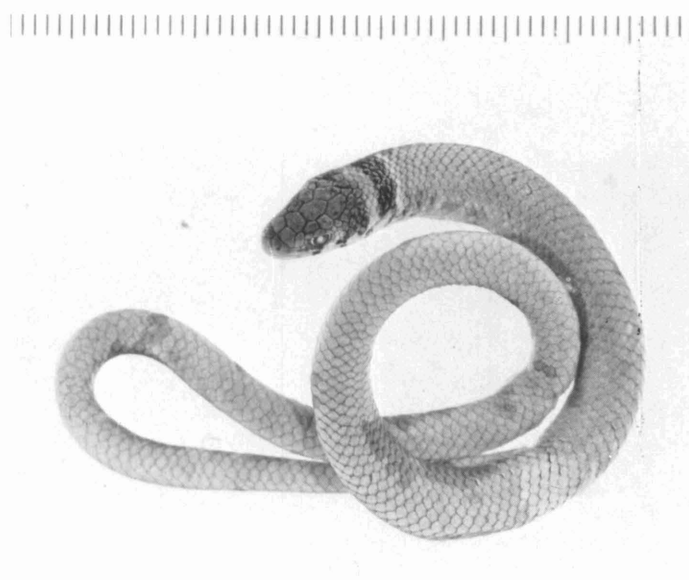

Fig. 66. Dorsal view of *Delma molleri* (AMNH 24848; female; no data, Australia).

1.15 (0.009) 2.3-4.4, EW -.11 (0.010) 0.22 (0.009) 0.9-1.7, PL -.14 (0.013) 0.70 (0.013) 1.5-2.6, HW -.15 (0.008) 1.64 (0.008) 3.7-6.9, HD -.14 (0.013) 1.39 (0.013) 2.9-5.0, RD -.13 (0.008) 0.18 (0.008) 0.9-1.6, RW -.12 (0.006) 0.78 (0.006) 1.8-3.0, RLD -.18 (0.026) -.49 (0.025) 0.4-1.1, RLV -.11 (0.017) -.04 (0.016) 0.7-1.4, MD -.10 (0.016) 0.13 (0.015) 0.9-1.5, MW -.13 (0.007) 0.94 (0.007) 2.0-3.5, ML -.08 (0.011) 0.49 (0.011) 1.4-2.0, TL (n = 14) -.34 (0.037) 5.16 (0.042) 89.0-257.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.0, LS 5.4 (0.12) 4-6, AOS 4.9 (0.20) 4-7, PRS 5.9 (0.18) 4-8, SLS 6.6 (0.11) 5-7, FS 4.0 (0.04) 4-5, IOS 5.0, POS 4.3 (0.13) 3-6, OS 14.0 (0.26) 11-17, SOS 1.0, PS 1.0, NS 12.9 (0.18) 12-15, EAM 0.0, PM 2.3 (0.08) 2-3, ILS 5.4 (0.11) 4-6, GS 14.0 (0.15) 13-15, DSK 0.0, VSK 0.0, VS 74.1 (0.63) 69-84, PVS 16.3 (0.24) 14-19, MS 17.7 (0.11) 16-18, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 6.7 (0.14) 5-7, HLS 3.2 (0.08) 3-4, CS 10.8 (0.10) 10-12, SCS 3.0, DSP 0.0, DIP 0.4 (0.09) 0-1, DPP 0.9 (0.21) 0-3, DNP 1.9 (0.27) 0-3, PNB 0.2 (0.08) 0-1, LHP 0.0, LLP 1.9 (0.14) 1-4, TP 0.0, DBP 0.1 (0.09) 0-2, VBP 0.6 (0.09) 0-1, VP 2.0.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were observed in *molleri.*

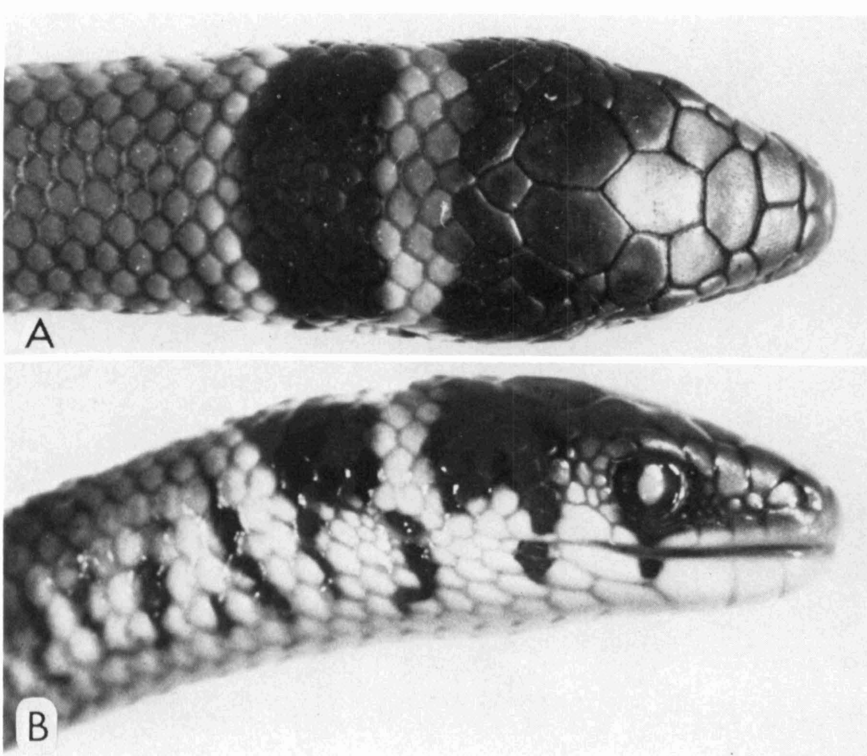

Fig. 67. Dorsal (A) and right lateral (B) views of *Delma molleri* (SAM R11187; juvenile male; 1 mi NE Tea Tree Gully, South Australia). SVL = 47.5 mm.

SEXUAL DIMORPHISM.—A sample of 16 males was compared to one of 12 females and no significant differences were observed.

REMARKS.—I have not examined the holotype of *molleri*; however, H. Cogger was able to do so and he has kindly allowed me to use his detailed notes. Cogger's information coupled with an English translation of Lütken's original description provided by F. Braestrup leaves little doubt that the name *molleri* applies to the South Australian endemic species of *Delma*. The holotype of *molleri* has one pair of nasals, the fourth supralabial in a suborbital position, 17 midbody rows of scales, three preanal scales and faint head and neck bands. I restrict the type locality of this species to 1 mile northeast of Tea Tree Gully; see p. 75 for discussion. *Molleri* is probably sympatric at different localities with either *Aprasia inaurita, A. pseudopulchella, A. striolata, Delma australis, Lialis burtonis, Pygopus lepidopodus* or *P. nigriceps*. The geographic ranges of *molleri* and *D. inornata* and *D. nasuta* are sufficiently close to suggest that they too will be found in sympatry.

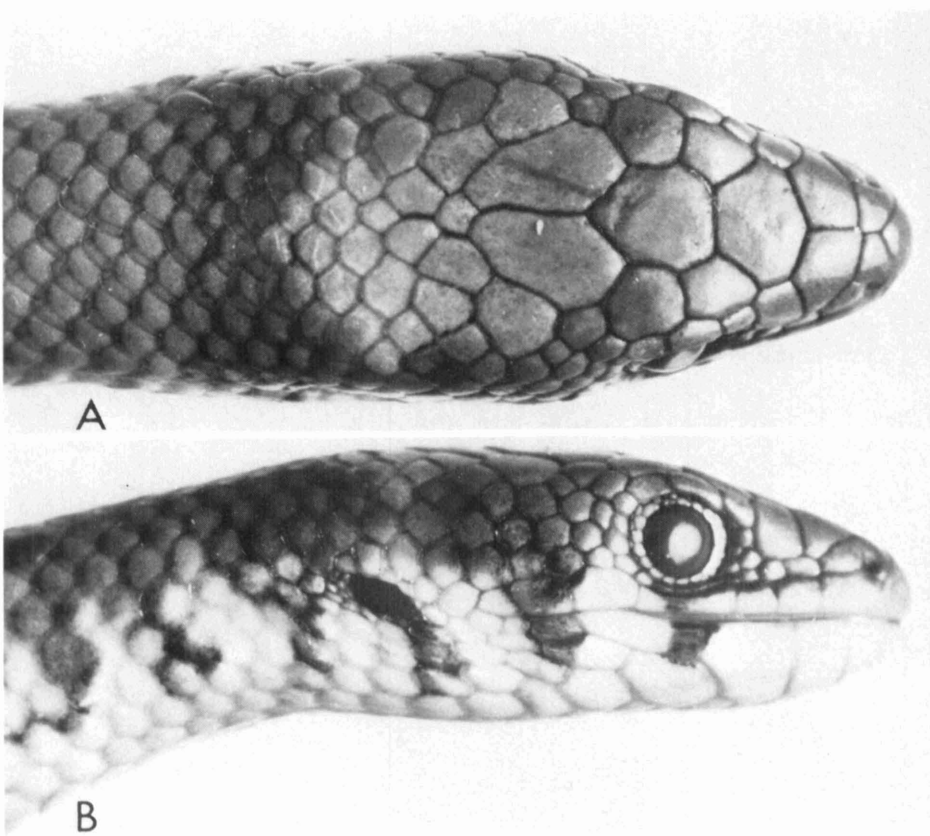

Fig. 68. Dorsal (A) and right lateral (B) views of *Delma molleri* (SAM R12918; male; Mambray Ck, South Australia). SVL = 77.0 mm.

Delma nasuta sp. nov.
Figs. 70-73, 124.

HOLOTYPE.—WAM R40178, adult female with complete tail. Collected at Pollock Hills, 144 miles west of Sandy Blight Junction, Western Australia, by J. Dell and G. Chapman on May 25, 1971.

PARATYPES.—All other specimens listed under *nasuta* in the Specimens Examined section (Appendix II) whose place of collection is between 20° and 25° S Lat and west of 121° E Long.

ETYMOLOGY.—*Nasuta* comes from the Latin word *nasutus* which means large-nosed. The specific name emphasizes the relatively long snout and sharp *canthus rostralis* of this species in the genus *Delma*.

GEOGRAPHIC RANGE.—Widespread throughout the more arid regions of the western two-thirds of the continent. It has been collected from most of Western Australia, except the western and southwestern margins of the state, the southern half of the Northern Territory, South Australia and far western Queensland (Fig. 73).

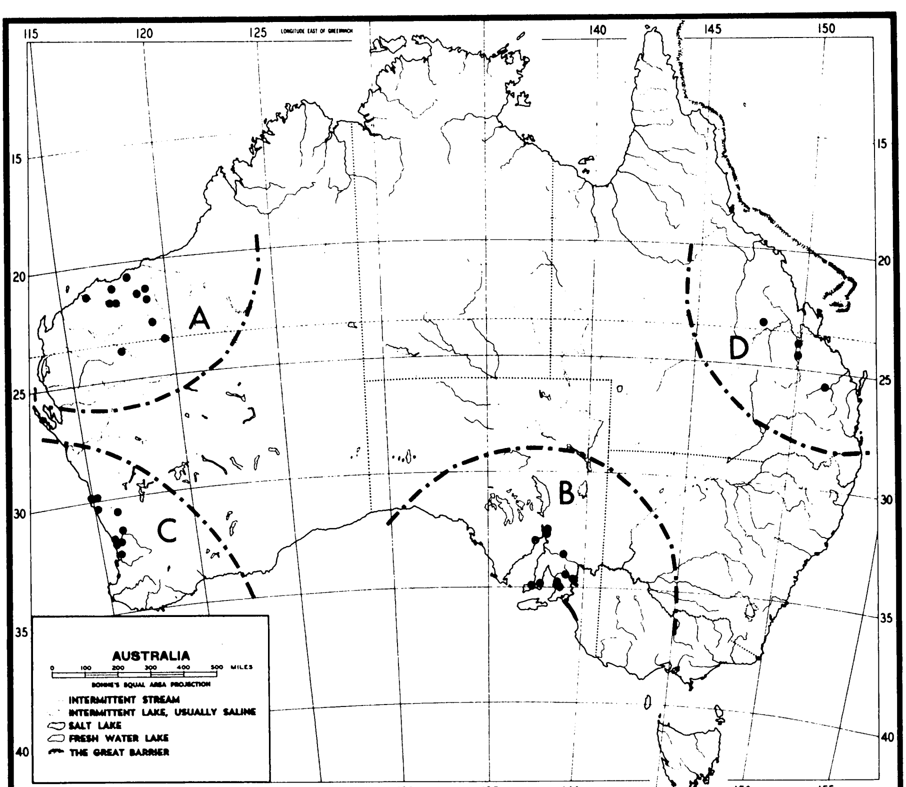

Fig. 69. Geographic distribution of (A) *Delma pax*, (B) *Delma molleri*, (C) *Pletholax gracilis*, and (D) *Paradelma orientalis* based on specimens examined; see pages 194-5, 202.

DIAGNOSIS.—*Nasuta* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal usually borders nostril or is only narrowly separated from it, b) usually seven loreal scales, c) usually five anterior orbital scales, d) usually five frontal scales, e) fourth supralabial almost always below orbit, f) usually 17 gular scales, g) ventral scales in males average 66.9, in females 70.2, h) almost always 16 midbody scale rows, i) one pair of ventral body scales enlarged, j) almost always three preanal scales, k) dorsal head bands almost always absent, l) throat almost always immaculate, m) dorsal and ventral body scales often possess dark margins (Figs. 70-72).

DESCRIPTION.—(n = 119) SVL -.19 (0.007) 4.36 (0.007) 43.0-104.2, HL -.16 (0.006) 2.08 (0.006) 5.0-11.2, SL -.17 (0.008) 1.33 (0.008) 2.2-5.4, EW -.09 (0.006) 0.38 (0.006) 1.1-1.9, PL -.17 (0.010) 0.77 (0.010) 1.1-3.2, HW -.13 (0.005) 1.70 (0.005) 3.5-6.7, HD -.14 (0.007) 1.49 (0.007) 2.3-6.1, RD -.10 (0.008) 0.16 (0.008) 0.7-1.5, RW -.12 (0.006) 0.69 (0.006) 1.3-2.7, RLD -.13 (0.017) -.58 (0.017) 0.2-0.9, RLV -.14 (0.010) -.05 (0.010) 0.6-1.3, MD -.11 (0.009) 0.10 (0.009) 0.7-1.5, MW -.11 (0.006) 0.87 (0.006) 1.7-3.1, ML -.11 (0.006) 0.47 (0.006) 1.0-2.1, TL (n = 36) -.24 (0.024) 5.49 (0.030) 106.2-351.5, PNS 1.0, SNS 0.0, INS 2.0 (0.01) 2-3, RP 0.02 (0.01) 0-1, LS 6.9 (0.10) 5-9, AOS 4.8 (0.09) 2-7, PRS 7.9 (0.12) 4-11, SLS 7.0 (0.05) 6-8, FS 5.0 (0.02) 4-6, IOS 5.0, POS 5.1 (0.06) 4-7, OS 14.1 (0.13) 11-17, SOS 1.0 (0.12) 0-1, PS 1.0, NS 15.5 (0.14) 12-19, EAM 0.0, PM 2.1 (0.03) 2-3, ILS 6.3 (0.05) 5-8, GS 16.8 (0.12) 13-20, DSK 0.0, VSK 0.0, VS 68.6 (0.33) 61-78, PVS 19.4 (0.15) 12-24, MS 16.1 (0.05) 14-18, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0 (0.01) 2-3, PCS 5.8 (0.09) 4-7, HLS 4.0 (0.06) 2-6, CS 10.0 (0.03) 9-11, SCS 3.0, DSP 0.0, DIP 0.03 (0.01) 0-1, DPP 0.03 (0.01) 0-1, DNP 0.08 (0.04) 0-3, PNB 0.03 (0.01) 0-1, LHP 0.0, LLP 0.6 (0.11) 0-4, TP 0.01 (0.01) 0-1, DBP 0.6 (0.05) 0-2, VBP 0.6 (0.09) 0-3, VP 2.0 (0.01) 1-2.

INDIVIDUAL VARIATION.—The second nasal broadly contacts the nostril in approximately 60% of the specimens examined; it is narrowly separated from the nostril in 30% and widely separated in the remainder. Six percent of the specimens examined had the fifth supralabial in a suborbital position rather than the usual fourth labial.

GEOGRAPHIC VARIATION.—My intuitive impression is that specimens from more southern localities have a shorter snout and less sharply defined *canthus rostralis.* These two geographic trends appear to be gradual and uninterrupted and they correspond to the pattern of ventral scale variation. Ventrals tend to increase towards southern Western Australia and they reach their greatest numbers in the vicinity of the Eyre Peninsula. No other univariate or multivariate trends were detected in *nasuta*.

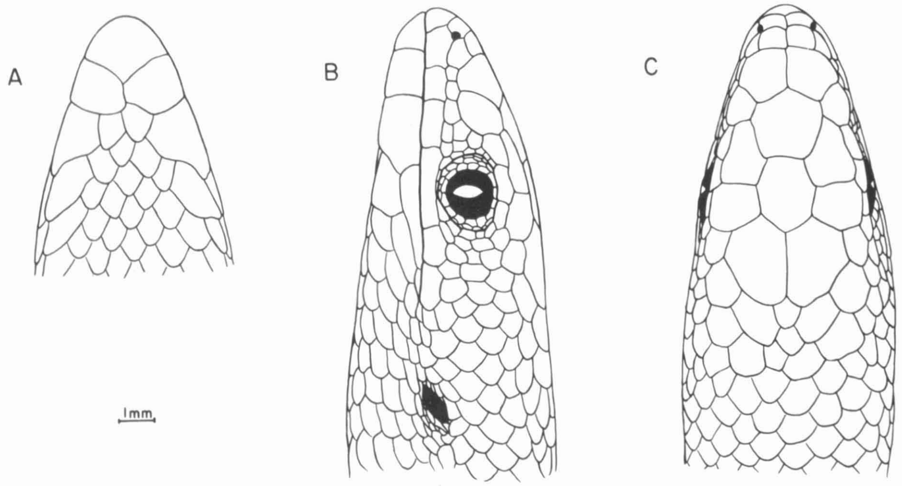

Fig. 70. Head region of *Delma nasuta* (UMMZ 129999; female; 7 mi SSW Learmonth, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

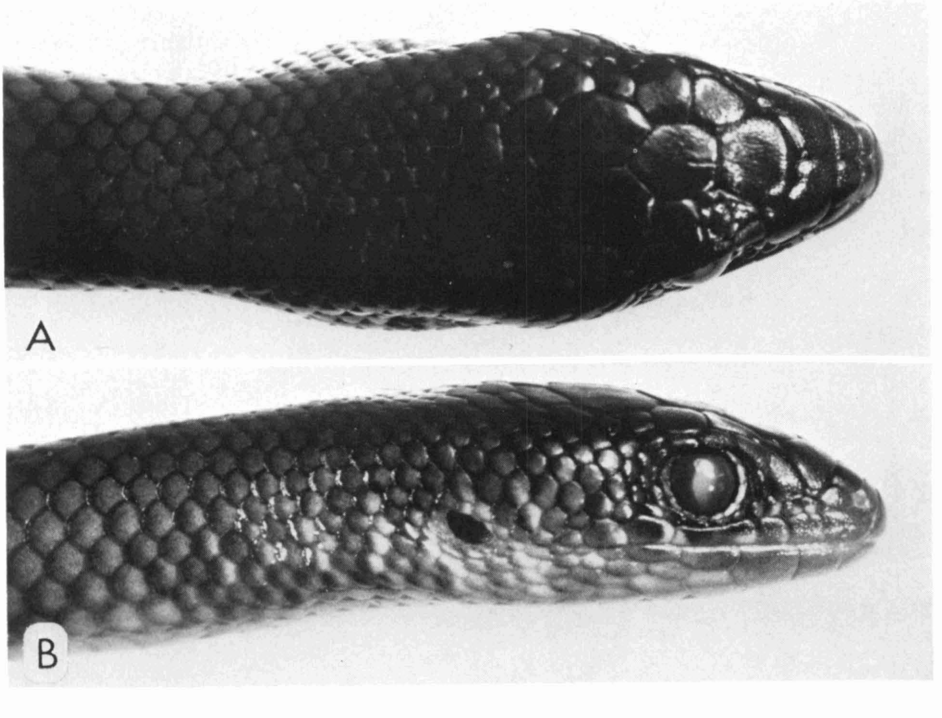

Fig. 71. Dorsal (A) and right lateral (B) views of head region of *Delma nasuta* (WAM R36649; juvenile female; 27 mi NE Maralinga, South Australia). SVL = 44.0 mm.

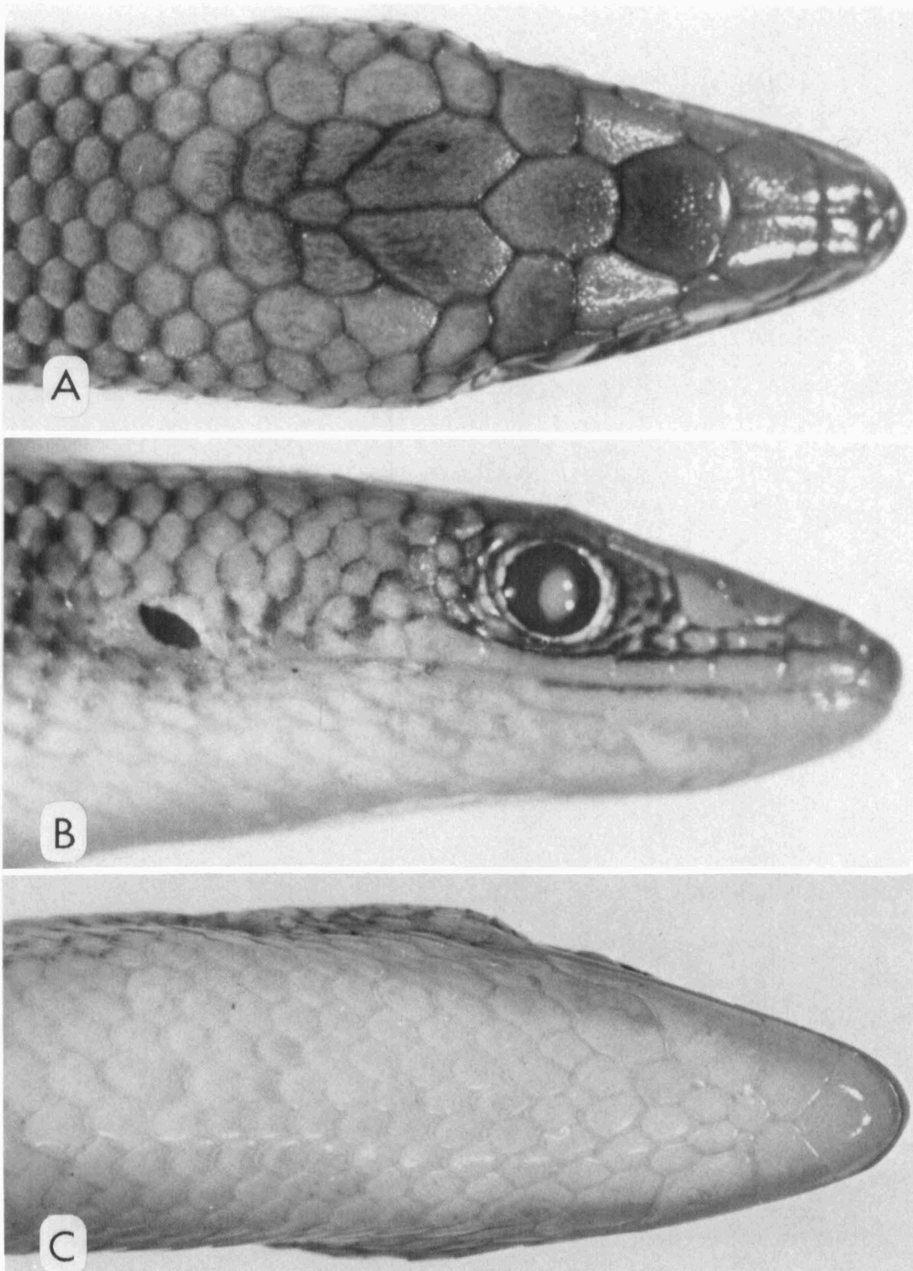

Fig. 72. Dorsal (A), right lateral (B), and ventral (C) views of head region of *Delma nasuta* (WAM R13195; female; Yardie Ck, Western Australia). SVL = 87.0 mm.

SEXUAL DIMORPHISM.—A sample of 56 males was compared to one of 63 females. The sexes only differ significantly in the number of ventral scales [males 66.9 (0.40) 61-74, females 70.2 (0.43) 65-78].

REMARKS.—All of the many field observations available to me personally suggest that *nasuta* is restricted to various species of porcupine grass, genus *Triodia*. It has been most frequently collected as it tries to escape from burning clumps of *Triodia*. Unlike *D. borea*, *nasuta* appears to be most common in the northwestern part of its range in areas of sand, such as sand plains, dunes and river beds. Only a few specimens have been collected in *Triodia* on clay flats, which is the usual habitat of *D. borea*, or stony ground (Fig. 124). Pianka (1969) states that *nasuta*, incorrectly identified by him as *D. fraseri*, commonly inhabits a mixed *Acacia-Eucalyptus-Triodia*, mulga and porcupine grass habitat, association on desert loams in the more interior part of its geographic range. Pianka (1968) also identified the remains of this species, incorrectly identified as *D. fraseri*, in the stomach of *Varanus eremius*.

The Waikerie (SAM R54) and Darwin (NMV R11132-6) records are far removed from the main portion of the geographic range of *nasuta* (Fig. 73). The Waikerie specimen was collected many years ago but there appears to be no reason to question its associated locality data (T. Houston, pers. comm.). Other reptile material from Waikerie was catalogued at the same time as the *nasuta*. The Darwin locality could be a shipping point and it must be confirmed with well documented specimens of precise origin.

Nasuta probably occurs sympatrically at different localities with one or more other pygopodids. They are *Aprasia inaurita*, *A. pseudopulchella*, *A. rostrata*, *A. striolata*, *Delma australis*, *D. elegans*, *D. fraseri*, *D. pax*, *D. tincta*, *Lialis burtonis*, (?) *Ophidiocephalus taeniatus*, *Pygopus lepidopodus* and *P. nigriceps*.

Delma pax sp. nov.

Figs. 69, 74-7.

HOLOTYPE.—WAM R14804, adult female with complete tail. Collected at the Jones River, 21 miles southeast of Roeburne, 20° 58′ S Lat, 117° 23′ E Long, Western Australia, by G. M. Storr on May 21, 1961.

PARATYPES.—All other specimens listed under *pax* in the Specimens Examined section (Appendix II).

ETYMOLOGY.—*Pax* is the Latin word for peace.

GEOGRAPHIC RANGE.—Restricted to the region of the Hamersley Plateau, Western Australia (Fig. 69).

DIAGNOSIS.—*Pax* differs from all other species in the genus *Delma* in possessing the following combination of character states: a)

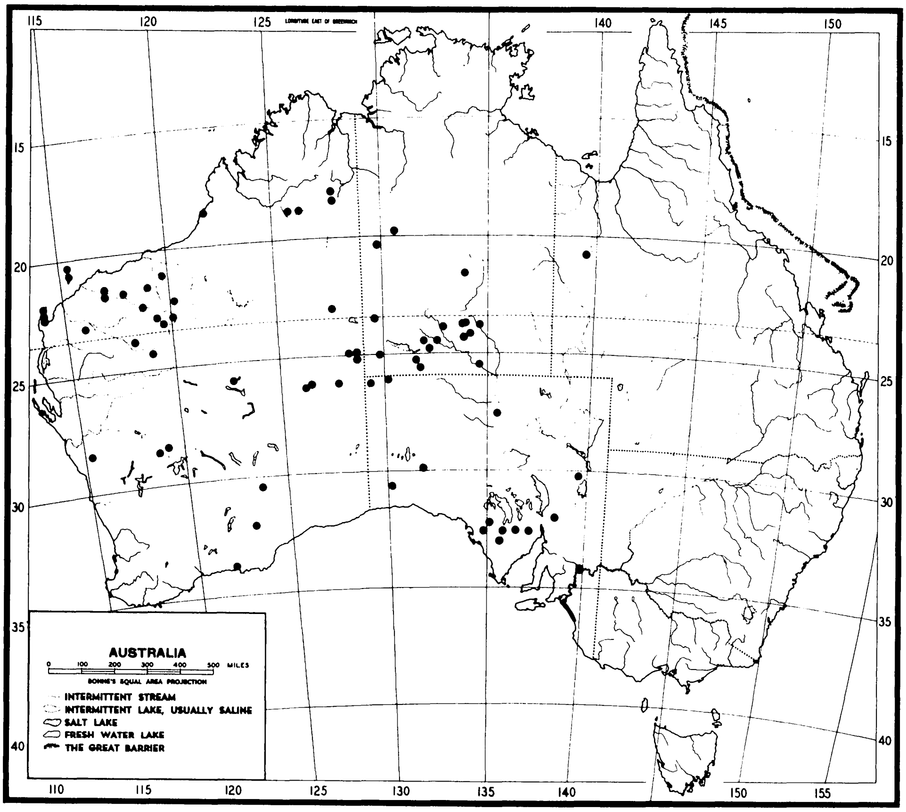

Fig. 73. Geographic distribution of *Delma nasuta* based on specimens examined; see pages 194-5.

posterior nasal in contact with nostril or only narrowly separated from it, b) usually five loreal scales, c) four anterior orbital scales, d) five frontal scales, e) third supralabial almost always below orbit, f) usually 14 gular scales, g) ventral scales in males average 73.9, in females 76.1, h) almost always 16 midbody scale rows, i) one pair of ventral body scales enlarged, j) three preanal scales, k) dorsal head bands usually present, although often obscure, l) throat and ventral body surfaces immaculate, m) dorsal body scales rarely possess dark margins (Figs. 74-7).

DESCRIPTION.–(n = 16) SVL -.14 (0.017) 4.35 (0.016) 51.5-95.0, HL -.11 (0.009) 1.90 (0.009) 5.3-7.6, SL -.10 (0.009) 1.17 (0.009) 2.5-3.7, EW -.07 (0.012) 0.26 (0.011) 1.2-1.5, PL -.15 (0.019) 0.70 (0.018) 1.4-2.6, HW -.11 (0.015) 1.65 (0.014) 3.6-6.1, HD -.10 (0.010) 1.43 (0.010) 3.3-4.7, RD -.11 (0.010) 0.18 (0.009) 0.9-1.4, RW -.09 (0.011) 0.74 (0.011) 1.8-2.5, RLD -.12 (0.030) -.45 (0.029) 0.5-1.0, RLV -.12 (0.017) 0.03 (0.017) 0.8-1.3, MD -.10 (0.020) 0.07 (0.019) 0.9-1.4, MW -.09 (0.008) 0.85 (0.008) 1.9-2.6, ML -.07 (0.013) 0.45 (0.013) 1.3-1.8, TL (n = 9) -.18

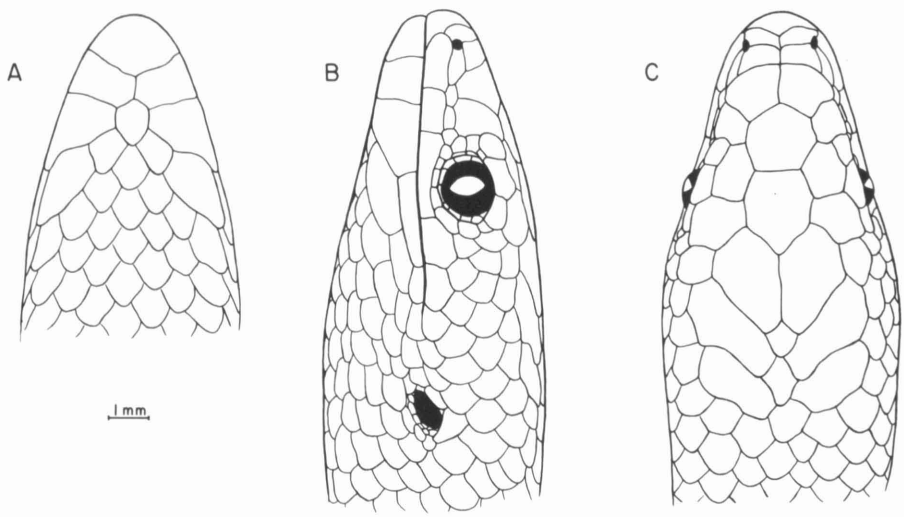

Fig. 74. Head region of *Delma pax* (UMMZ 129889; female; Mundabullangana, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

Fig. 75. Right dorsolateral view of *Delma pax* (UMMZ 129889; female; Mundabullangana, Western Australia). SVL = 92.4 mm.

(0.032) 5.39 (0.038) 85.6-278.2, PNS 1.0, SNS 0.1 (0.09) 0-1, INS 2.0, RP 0.0, LS 4.9 (0.09) 4-5, AOS 4.0, PRS 5.3 (0.17) 4-7, SLS 5.4 (0.16) 5-7, FS 5.0, IOS 5.0, POS 3.9 (0.06) 3-4, OS 13.6 (0.27) 12-16, SOS 1.0, PS 1.0, NS 12.1 (0.13) 12-14, EAM 0.0, PM 2.0, ILS 4.4 (0.13) 4-5, GS 13.4 (0.16) 13-15, DSK 0.0, VSK 0.0, VS

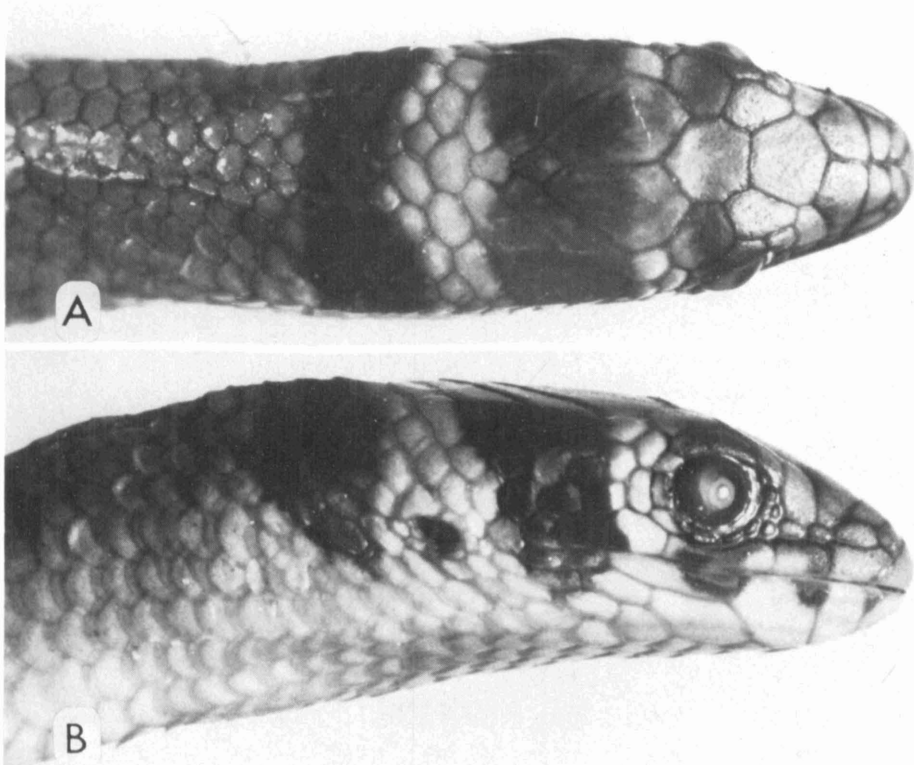

Fig. 76. Dorsal (A) and right lateral (B) views of head region of *Delma pax* (SAM R3445; juvenile male; Pilgangoora Well, Western Australia). SVL = 51.5 mm.

75.0 (0.65) 71-79, PVS 18.7 (0.29) 17-21, MS 15.9 (0.06) 15-16, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 5.0, HLS 3.4 (0.13) 3-4, CS 10.0, SCS 3.0, DSP 0.0, DIP 0.8 (0.10) 0-1, DPP 1.9 (0.32) 0-3, DNP 2.4 (0.30) 0-3, PNB 0.0, LHP 0.0, LLP 2.0 (0.30) 0-4, TP 0.0, DBP 0.3 (0.11) 0-1, VBP 0.0, VP 2.0.

INDIVIDUAL VARIATION.–All of the specimens examined had the third supralabial located below the orbit except SAM R3445 where the fourth labial occupied that position on one side.

GEOGRAPHIC VARIATION.–No univariate or multivariate trends were detected.

SEXUAL DIMORPHISM.–A sample of eight males was compared to one of eight females and no significant differences were observed.

REMARKS.–The holotype (WAM R14804) was collected during the daytime in damp litter beside a pool of the Jones River. Another specimen (WAM R14803) was also collected in leaf litter along another stream course.

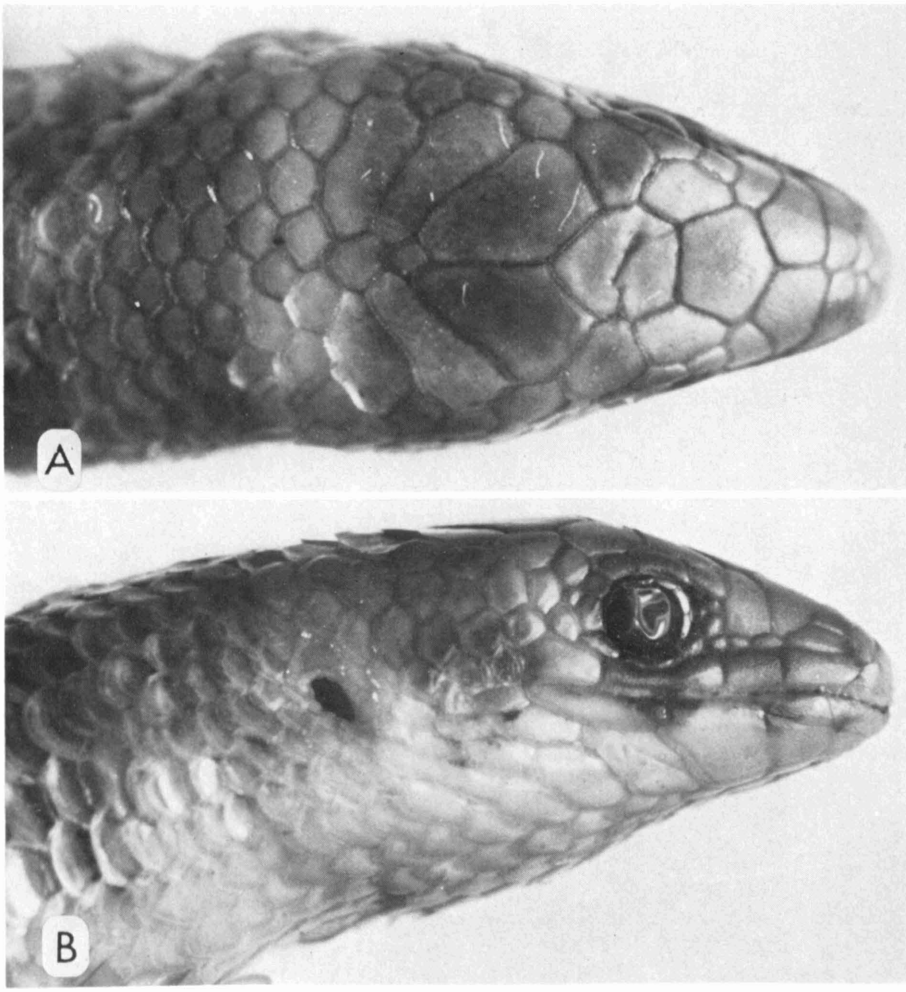

Fig. 77. Dorsal (A) and right lateral (B) views of head region of *Delma pax* (SAM R4514; female; Tambrey, Western Australia). SVL = 88.2 mm.

Pax appears to be sympatric at different localities with either *Delma borea, D. elegans, D. nasuta, D. tincta, Lialis burtonis* or *Pygopus nigriceps.*

Delma plebeia De Vis
Figs. 47, 78-80.

1888. *Delma plebeia* De Vis, Proc. Linn. Soc. N.S.W., 2:825. Syntypes: QM J254, Brisbane, and J12768-70, Brisbane or Gympie, Queensland.

GEOGRAPHIC RANGE.—Restricted to southeastern Queensland south of 25° S Lat and east of 150° E Long. Specimens from eastern New South Wales are tentatively referred to *plebeia* (Fig. 47).

DIAGNOSIS.—*Plebeia* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) posterior nasal usually in contact with nostril, or only narrowly separated from it, b) usually five or six loreal scales, c) usually four or five anterior orbital scales, d) almost always five frontal scales, e) fourth supralabial almost always below orbit, f) usually 13 gular scales, g) ventral scales in males average 68.4, in females 70.9, h) usually 16 midbody scale rows, i) one pair of ventral body scales enlarged, j) almost always two preanal scales, k) dorsal head bands absent, l) throat usually immaculate, m) dorsal and ventral body scales usually without dark margins (Figs. 78-80).

DESCRIPTION.—(n = 36) SVL -.19 (0.010) 4.51 (0.010) 47.1-122.0, HL -.12 (0.005) 2.04 (0.005) 5.5-9.2, SL -.12 (0.008) 1.31 (0.008) 2.7-4.7, EW -.08 (0.008) 0.29 (0.008) 1.1-1.6, PL -.13 (0.017) 0.83 (0.017) 1.5-3.0, HW -.11 (0.007) 1.73 (0.007) 4.1-6.7, HD -.11 (0.008) 1.52 (0.008) 3.0-5.5, RD -.08 (0.007) 0.25 (0.007) 1.0-1.5, RW -.09 (0.007) 0.90 (0.007) 2.0-2.9, RLD -.10 (0.026) -.50 (0.025) 0.4-0.8, RLV -.10 (0.014) 0.14 (0.014) 0.9-1.5, MD -.08 (0.016) 0.23 (0.016) 1.0-1.6, MW -.08 (0.007) 1.01 (0.007) 2.2-3.5, ML -.07 (0.009) 0.53 (0.09) 1.4-2.0, TL (n = 10) -.27 (0.031) 5.44 (0.043) 84.8-296.0, PNS 1.0, SNS 0.0, INS 2.0 (0.03) 2-3, RP 0.0, LS 5.5 (0.11) 4-7, AOS 4.4 (0.14) 3-7, PRS 5.9 (0.17) 4-9, SLS 6.7 (0.09) 5-7, FS 4.9 (0.06) 4-6, IOS 5.0, POS 4.2 (0.12) 3-6, OS 15.4 (0.24) 12-18, SOS 0.9 (0.04) 0-1, PS 1.0, NS 12.0 (0.10) 10-14, EAM 0.0, PS 2.1 (0.04) 2-3, ILS 5.2 (0.09) 4-6, GS 12.8 (0.19) 10-15, DSK 0.0, VSK 0.0, VS 69.7 (0.46) 65-77, PVS 15.3 (0.19) 13-17, MS 15.7 (0.10) 14-16, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.0 (0.05) 1-3, PCS 5.3 (0.16) 4-7, HLS 3.4 (0.09) 2-4, CS 10.3 (0.07) 10-11, SCS 3.1 (0.06) 3-5, DSP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.0, LLP 3.1 (0.18) 0-4, TP 0.2 (0.11) 0-2, DBP 0.3 (0.08) 0-1, VBP 0.2 (0.10) 0-2, VP 2.0.

INDIVIDUAL VARIATION.—All but four of the *plebeia* that I have examined have two pairs of nasals. QM J12399 (Pittsworth, Queensland) has an extra median "nasal" scale in addition to the usual two pairs; the remaining three exceptional individuals have but one pair. The latter are from widely distributed localities in both Queensland and New South Wales (UMMZ 131183-Geebung; AM R15414-Hebden; AM R14960-Warrumbungle Mountains). Of those individuals with two pairs of nasals, approximately 40% have the posterior pair in broad contact with the nostril, in 30% it is slightly separated, and in the remainder widely separated. UMMZ 131183 (Geebung) has the unusual state of three preanal scales in addition to being characterized by the exceptional single pair of nasals. This specimen is so much like typical *plebeia* in all other characters scored that it must be referred to this species in spite of the absence of two of the "diagnostic states." It is important to note that it was

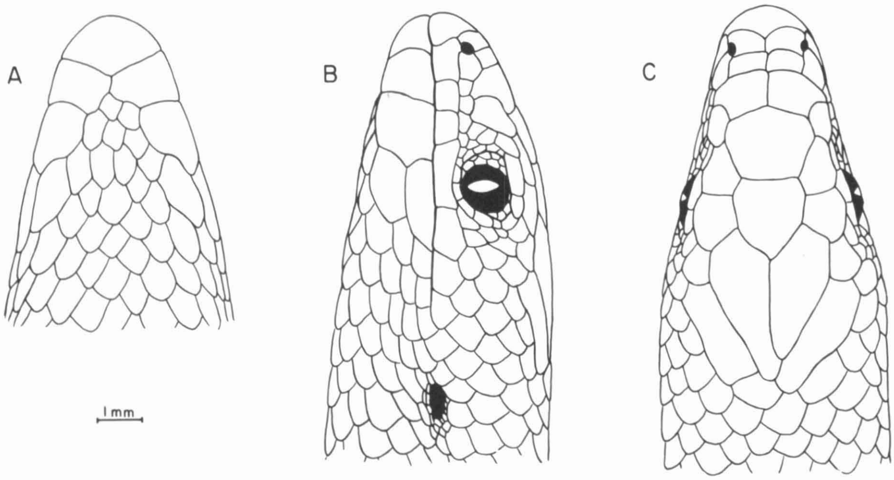

Fig. 78. Head region of *Delma plebeia* (QM J6766; female; Windsor, Queensland). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

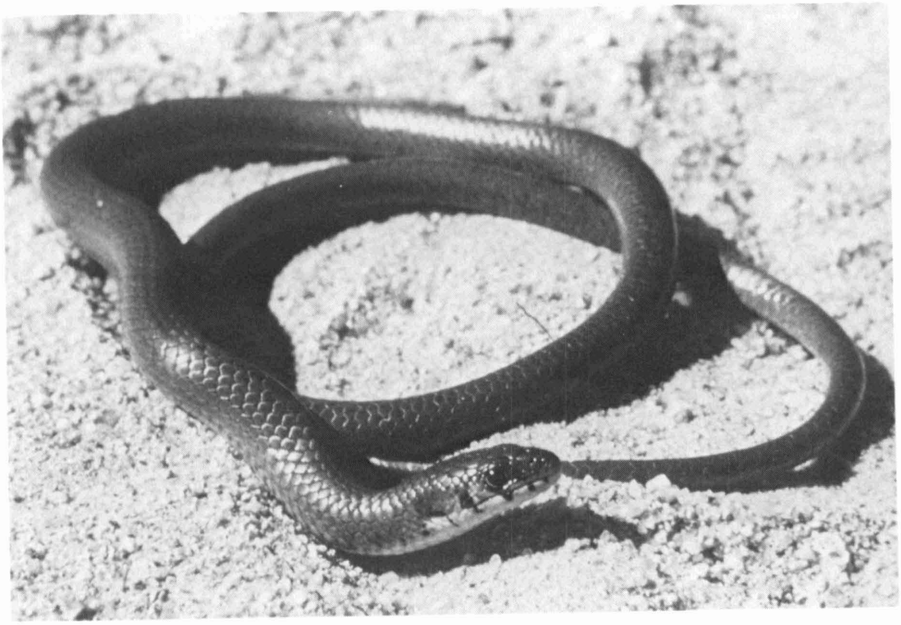

Fig. 79. Predominantly right dorsolateral view of a live *Delma plebeia* (UMMZ 131184; female; Geebung, Queensland). SVL = 116.5 mm.

collected under a board with another individual (UMMZ 131184) which is a typical *plebeia* in all characters. AM R11684 also has three cloacal scales. Only two individuals of the 36 specimens examined have the third supralabial in a subocular position rather than the usual fourth.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were observed. The New South Wales specimens, as a group, do not differ significantly in any character from the Queensland sample.

SEXUAL DIMORPHISM.—A sample of 17 males was compared to one of 19 females and no significant differences were observed.

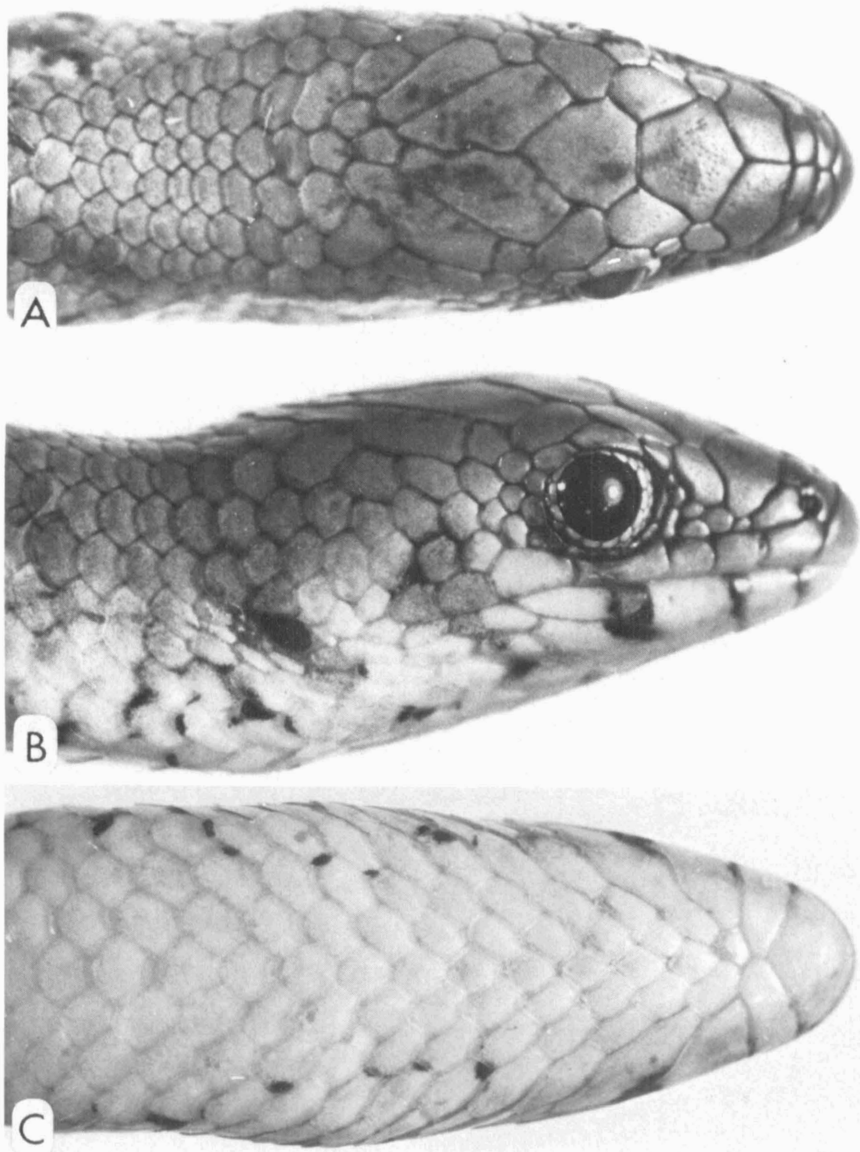

Fig. 80. Dorsal (A), right lateral (B), and ventral (C) views of head region of *Delma plebeia* (QM J21347; male; Brookfield, Queensland). SVL = 96.5 mm.

REMARKS.—According to Covacevich (1971), the catalogue entry for QM J254 reads "Type = selected by De Vis from 12/247." QM 12/247 is now referred to as QM J247. Covacevich also noted that QM J247 has been recatalogued as QM J12768-70 and that the earlier number referred to ten specimens which came from Brisbane and Gympie. It seems that the locality data for the individual specimens became confused when they were recatalogued. I accept QM J254 as the lectotype and Brisbane as the restricted type locality. This species appears to be very abundant in Brisbane and its surrounding suburbs and it has been collected in a wide variety of disturbed and natural situations in that area. It is sympatric at different localities with either *Delma inornata, D. tincta, D. torquata, Lialis burtonis, Pygopus lepidopodus* or *P. nigriceps.*

Delma tincta De Vis
Figs. 61, 81-4, 124.

1888. *Delma tincta* De Vis, Proc. Linn. Soc. N.S.W., 2:824. Syntypes: QM J241. Type locality: Normanton, Gulf of Carpentaria, and Springsure, Queensland. Donated by M. Conley.

1901. *Delma reticulata* Garman, Bull. Mus. comp. Zool. Harv., 39:5, pl. 2, figs. 1-1a-f. Holotype: MCZ 6486. Type locality: Restricted to Cooktown, Queensland (Barbour and Loveridge, 1929). Collected by E. A. C. Olive.

GEOGRAPHIC RANGE.—Widely distributed throughout the northern part of Australia. It has been collected in northern and northwestern Western Australia, Northern Territory, Queensland and northern New South Wales. It probably occurs in South Australia (Fig. 61).

DIAGNOSIS.—*Tincta* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) usually five loreal scales, b) usually four anterior orbital scales, c) four frontal scales, d) third supralabial below orbit, e) usually 13 gular scales, f) ventral scales in males average 68.8, in females 71.9, g) usually 14 midbody scale rows, h) one pair of ventral body scales enlarged, i) almost always three preanal scales, j) dorsal head bands almost always present, k) throat and ventral body surfaces immaculate, l) dorsal body scales without dark margins (Figs. 81-4).

DESCRIPTION.—(n = 97) SVL -.22 (0.008) 4.17 (0.008) 33.0-89.0, HL -.14 (0.004) 1.72 (0.004) 3.6-7.0, SL -.14 (0.004) 0.98 (0.005) 1.8-3.4, EW -.09 (0.006) 0.11 (0.006) 0.8-1.3, PL -.15 (0.012) 0.44 (0.012) 0.7-2.3, HW -.15 (0.005) 1.45 (0.005) 2.6-5.5, HD -.15 (0.006) 1.19 (0.006) 2.1-4.4, RD -.14 (0.005) 0.04 (0.005) 0.7-1.4, RW -.13 (0.004) 0.60 (0.004) 1.2-2.3, RLD -.16 (0.012) -.63 (0.012) 0.3-0.8, RLV -.13 (0.009) -.17 (0.009) 0.5-1.1, MD -.13 (0.009) -.07 (0.008) 0.6-1.3, MW -.11 (0.005) 0.73 (0.005) 1.3-2.6,

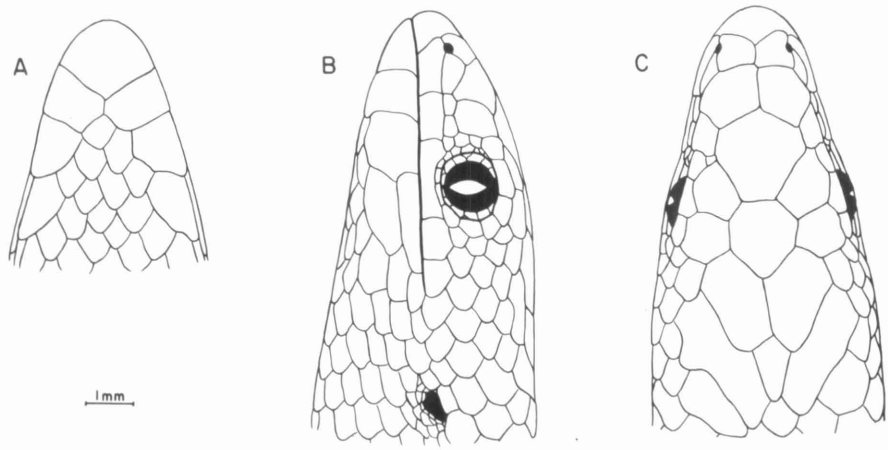

Fig. 81. Head region of *Delma tincta* (AM R12202; female; Winton, Queensland). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

Fig. 82. Dorsal view of *Delma tincta* (FM 97148; female; Woodstock, Queensland). SVL = 76.0 mm.

ML -.10 (0.008) 0.30 (0.008) 1.0-1.8, TL (n = 36) -.28 (0.016) 5.23 (0.016) 90.0-266.5, PNS 1.0, SNS 0.0, INS 2.0, RP 0.02 (0.02) 0-1, LS 5.0 (0.06) 4-7, AOS 4.1 (0.03) 4-6, PRS 5.4 (0.08) 4-7, SLS 5.4 (0.06) 4-7, FS 4.0, IOS 5.0, POS 3.9 (0.05) 3-5, OS 12.9 (0.12) 10-16, SOS 1.0, PS 1.0, NS 11.7 (0.07) 10-13, EAM 0.0, PM 2.0 (0.02) 2-3, ILS 4.2 (0.04) 4-5, GS 12.9 (0.08) 11-16, DSK 0.0, VSK 0.0, VS 70.5 (0.37) 64-81, PVS 16.4 (0.14) 14-21, MS 14.0 (0.03) 12-16, VBS 2.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.9 (0.03) 2-3, PCS 5.1 (0.07) 3-7, HLS 2.1 (0.03) 2-3, CS 9.3 (0.05) 8-10, SCS 3.0, DSP 0.0, DIP 0.9 (0.03) 0-1, DPP 2.5 (0.10) 0-3, DNP 2.8 (0.08) 0-3, PNB 0.7 (0.05) 0-1, LHP 0.0, LLP 2.3 (0.14) 0-4, TP 0.0, DBP 0.0, VBP 0.0, VP 1.7 (0.05) 0-2.

INDIVIDUAL VARIATION.—Only one specimen (WAM R22323) had two nasals and it exhibited the usual condition of one nasal on the opposite side.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were observed. Samples from western Western Australia, vicinity of Alice Springs, Northern Territory, and south central, northern coastal and southern coastal Queensland were compared and no significant differences were detected between them.

SEXUAL DIMORPHISM.—A sample of 44 males was compared to one of 53 females. The sexes only differ significantly in the number of ventral scales [males 68.8 (0.47) 64-79, females 71.9 (0.47) 66-81].

REMARKS.—Both Kinghorn (1926a) and Longman (1916) referred to the "holotype" of *tincta*; however, it is certain that De Vis (1888) described this species from a series. De Vis gave ranges of variation for some characters and he cited two "type localities," Normanton, Gulf of Carpentaria, and Springsure, Central Queensland. Covacevich (1971) stated that the Springsure syntypes cannot be located in the Queensland Museum where they were originally deposited. Measurements of the remaining Normanton specimen (QM J241) fit those given in De Vis' original description of *tincta* and it is here designated the lectotype. I restrict the type locality of this species to Normanton, Queensland.

WAM R13933 was catalogued as Mount Pleasant, Perth, Western Australia and I believe that the reference to Perth is in error. The Perth suburb of Mount Pleasant is over 200 miles south of the nearest record and it is the only specimen of *tincta* recorded from this very well-collected metropolitan area. In this case, Mount Pleasant probably refers to the hill located at 25° 16′ S Lat, 119° 02′ E Long, which is the only such place name within or close to the better documented range of *tincta* in Western Australia.

The early record of *tincta* from the Abrolhos Islands (NMV R867) must also be questioned because this species has not been recollected there. The specimen in question is supposed to have been

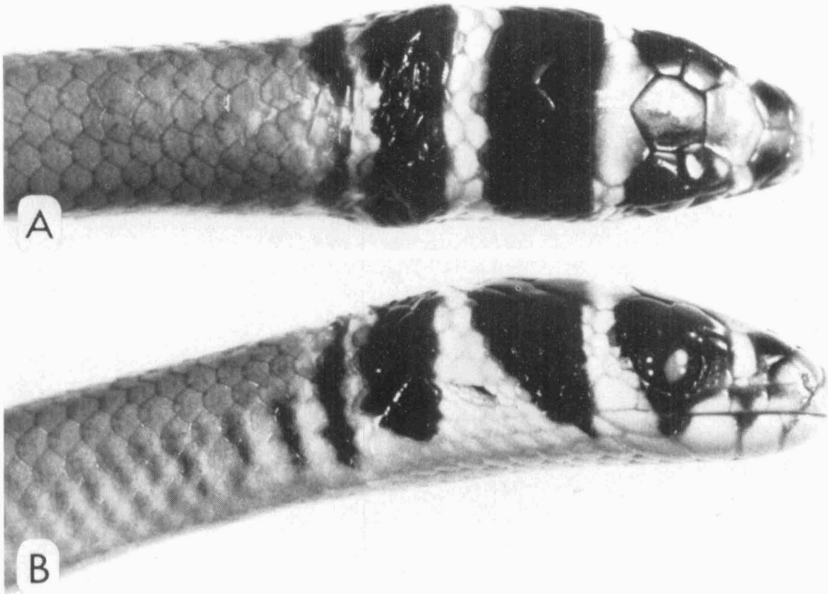

Fig. 83. Dorsal (A) and right lateral (B) views of head region of *Delma tincta* (WAM R30259; juvenile female; Carnarvon, Western Australia). SVL = 37.5 mm.

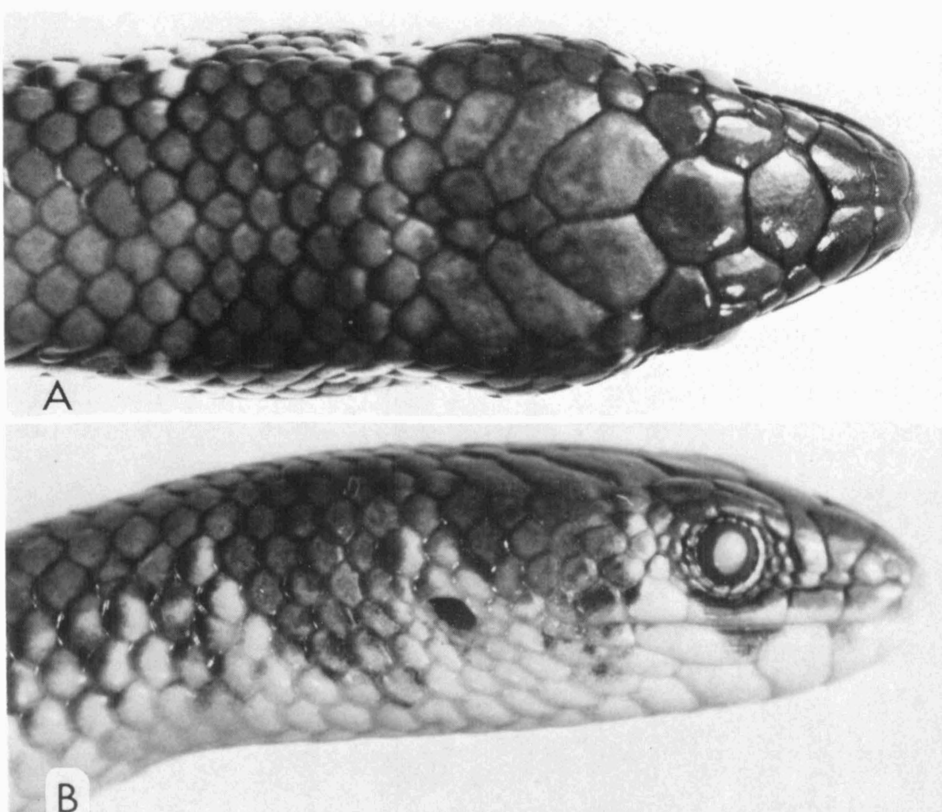

Fig. 84. Dorsal (A) and right lateral (B) views of head region of *Delma tincta* (WAM R24821; male; Binnu, Western Australia). SVL = 70.5 mm.

part of a large exchange between the Western Australian Museum and the National Museum of Victoria. The original list of material received by the National Museum indicates that a "*Delma fraseri*" from the Abrolhos Islands was included (A. Coventry, pers. comm.).

Tincta has been collected under stones, rubbish associated with human habitation and in road-grader spoils. A specimen from Townsville, Queensland, laid two parchment shelled eggs on Sept. 1, 1971. The eggs had the following individual length by width dimensions (mm): 13.8 × 6.0 and 13.5 × 6.6.

Tincta appears to be one of the most excitable species of pygopodids. When an individual is disturbed it twists its body and jumps in a fantastic display of acrobatics. Individuals kept in aquaria under simulated natural conditions for more than two months did not show a decline in the intensity of this behavior. Some of the aquarium-housed specimens from Queensland burrowed very readily in sand or loose gravel. Burrowing was not observed in numerous Western Australia *D. fraseri* and one *D. grayii* kept under similar conditions. *Tincta* enters the substrate by means of a stereotyped series of lateral head thrusts while its snout is pressed firmly against the surface. Individuals were frequently observed in aquaria with only their black and white-banded heads projecting above the substrate. The projecting head is very difficiult to distinguish from a surface of differently colored pebbles and small rocks and it seems likely that the color pattern of the head aids in its concealment. Recently, Bustard (1968c, 1970; also see Hall, 1905 and Waite, 1929) reviewed an alternative explanation of the adaptive significance of head bands in pygopodids, that of mimetic resemblance to venomous snakes.

Tincta occurs in sympatry at different localities with either *Aprasia smithi, Delma borea, D. fraseri, D. inornata, D. nasuta, D. pax, D. plebeia, D. torquata, Lialis burtonis, Paradelma orientalis, Pygopus lepidopodus* or *P. nigriceps*. The geographic ranges of *A. repens, A. rostrata, D. australis, D. elegans, D. grayii,* and *Ophidiocephalus taeniatus* are sufficiently close to that of *tincta* to be considered additional sympatric species.

Delma torquata sp. nov.
Figs. 6, 43, 85-6.

HOLOTYPE.—QM J14365, adult female with incomplete tail. Collected at Upper Brookfield, 15 miles west-northwest of Brisbane, Queensland, by E. J. Neilsen on Nov. 7, 1967.

PARATYPES.—All other specimens listed under *torquata* in the Specimens Examined section (Appendix II).

ETYMOLOGY.—*Torquata* is a Latin word which means to be adorned with a necklace or collar. The specific name emphasizes the fact that this species has the most conspicuously banded head and neck in the genus *Delma*.

GEOGRAPHIC RANGE.—Known only from southeastern Queensland, from Ulam in the north to Kenmore in the south (Fig. 43).

DIAGNOSIS.—*Torquata* differs from all other species in the genus *Delma* in possessing the following combination of character states: a) usually four loreal scales, b) almost always two or three anterior orbital scales, c) four frontal scales, d) third supralabial below orbit, e) usually 13 gular scales, f) ventral scales in males average 76.0, in females 80.8, g) 16 midbody scale rows, h) ventral body scales sometimes enlarged, i) two preanal scales, j) dorsal head bands present, k) coarse reticulation present on throat, l) dorsal body scales do not possess dark margins, m) ventral body scales possess dark margins (Figs. 85-6).

DESCRIPTION.—(n = 6) SVL -.27 (0.062) 3.84 (0.057) 28.0-63.3, HL -.17 (0.014) 1.32 (0.013) 3.0-4.5, SL -.17 (0.016) 0.59 (0.015) 1.5-2.2, EW -.18 (0.040) -.14 (0.037) 0.6-1.1, PL -.13 (0.052) 0.02 (0.005) 0.6-1.2, HW -.17 (0.021) 1.16 (0.019) 2.6-3.9, HD -.12 (0.016) 0.86 (0.015) 2.0-2.7, RD -.16 (0.020) -.14 (0.018) 0.7-1.1, RW -.17 (0.018) 0.32 (0.017) 1.1-1.7, RLD -.10 (0.036) -.70 (0.033) 0.4-0.6, RLV -.20 (0.032) -.49 (0.029) 0.5-0.8, MD -.14 (0.067) -.25 (0.061) 0.6-0.9, MW -.16 (0.025) 0.46 (0.023) 1.3-2.0, ML -.12 (0.068) 0.39 (0.062) 0.8-1.3, TL (n = 1) 40.0, PNS 1.0, SNS 0.0, INS 2.0, RP 0.7 (0.21) 0-1, LS 3.7 (0.21) 3-4, AOS 2.3 (0.33) 2-4, PRS 4.5 (0.22) 4-5, SLS 5.0, FS 4.0, IOS 5.0, POS 3.7 (0.21) 3-4, OS 10.7 (0.33) 10-12, SOS 1.0, PS 1.0, NS 10.8 (0.31) 10-12, EAM 0.0, PM 2.2 (0.17) 2-3, ILS 4.2 (0.17) 4-5, GS 12.7 (0.56) 11-15, DSK 0.0, VSK 0.0, VS 79.2 (1.28) 76-82, PVS 16.3 (0.49) 15-18, MS 16.0, VBS 1.3 (0.42) 0-2, PP 0.0, IPS 0.0, IGS 0.0, PAS 2.0, PCS 4.0, HLS 2.0, CS 10.0, SCS 3.0, DSP 0.0, DIP 1.0, DPP 3.0, DNP 3.0, PNB 1.0, LHP 0.0, LLP 3.3 (0.42) 2-4, TP 2.0, DBP 0.0, VBP 1.0, VP 0.3 (0.21) 0-1.

GEOGRAPHIC VARIATION.—The few specimens of *torquata* differ very little from each other and no univariate or multivariate trends were observed. The hatchling male (?) from Ulam (AM R12611) is over 225 miles north of the nearest other record of the species (Fig. 43). It does not differ significantly from the remainder of the species' sample.

SEXUAL DIMORPHISM.—A sample of two males was compared to one of four females and no significant differences were observed.

REMARKS.—The holotype (QM J14365) was collected 200 yards west of Upper Brookfield State School, Brookfield Road, Upper Brookfield. It was found "6 inches below surface in black basalt soil, while digging a posthole" (J. Covacevich, pers. comm.). The Kenmore specimen (QM J21220) was collected on the "spur of a small grassy hill where cattle had been grazing. Most of the trees

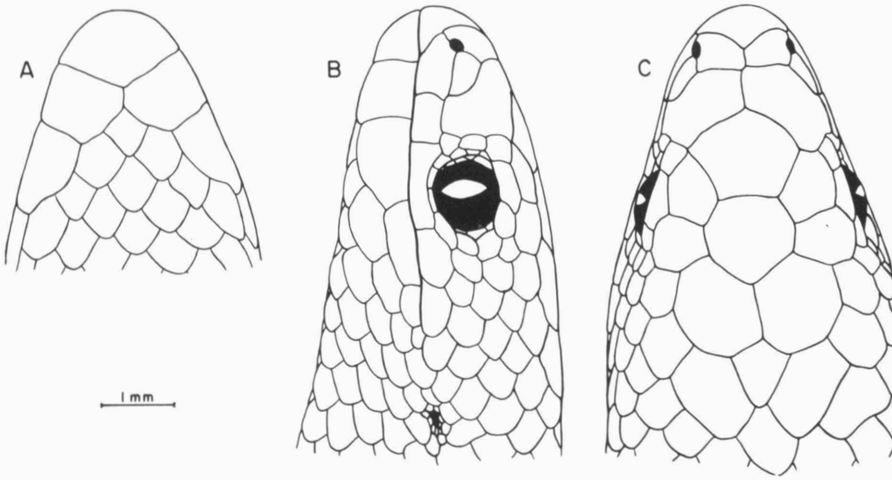

Fig. 85. Head region of *Delma torquata* (QM J5683; female; Crows Nest, Queensland). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

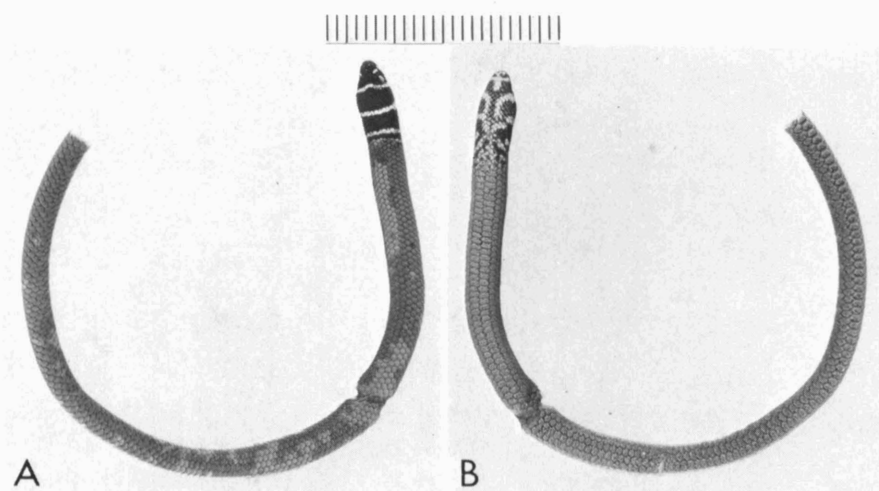

Fig. 86. Dorsal (A) and ventral (B) views of holotype of *Delma torquata* (QM J14365; female; Upper Brookfield, Queensland). SVL = 51.0 mm.

(gums) had been dozed over and heaped. The rock it was under was tightly wedged into the ground amongst other rocks" (T. Low, pers. comm.). A hatchling (AM R12611) had a SVL of 28.0 mm and it was obtained from an egg with the dimensions of 12.8 × 5.9 mm.

Torquata probably occurs sympatrically at different localities with either *Delma inornata, D. plebeia, D. tincta, Lialis burtonis, Pygopus lepidopodus* or *P. nigriceps*.

Lialis Gray

1835. *Lialis* Gray, Proc. zool. Soc. Lond., 1834:134. Type of genus: *Lialis burtonis* Gray (1835), by monotypy.
1843. *Ophiophthalmus* Fitzinger, Systema Reptilium, p. 23. Substitute name for *Lialis* Gray (1835).
1905. *Alopecosaurus* Lindholm, Jb. nassau. Ver. Naturk., 58:230. Type of genus: *Alopecosaurus cuneirostris* Lindholm (1905a), by original designation.

DIAGNOSIS.–*Lialis* differs from all other pygopodid genera in possessing the following combination of character states: a) snout extremely long and pointed, b) head covered with many small scales, large plates absent, c) external auditory meatus present, d) body scales smooth, e) more than 17 midbody scale rows, f) preanal pores present, g) usually one hind limb scale.

Lialis burtonis Gray
Figs. 6, 87-93, 117, 119-24.

1835. *Lialis burtonis* Gray, Proc. zool. Soc. Lond., 1834:134. Holotype: BM (number unknown). Type locality: Novâ Cambria Australia [= New South Wales]. Collected by Mair.
1842. *Lialis bicatenata* Gray, Zoological Miscellany, p. 52. Holotype: BM 1946.8.26.71 (formerly XIV 2c). Type locality: Port Essington, Northern Territory. From J. Gilbert's Collection.
1842. *Lialis punctulata* Gray, Zoological Miscellany, p. 52. Holotype: BM 1946.8.30.89 (formerly XIV 3a). Type locality: Port Essington, Northern Territory. From J. Gilbert's Collection.
1874. *Lialis leptorhyncha* W. Peters, Mber. dt. Akad. Wiss. Berl., 1873:605. Holotype: ZMB 5948. Type locality: Port Mackay, Queensland.
1874. *Lialis burtonii concolor* W. Peters, Mber. dt. Akad. Wiss. Berl., 1873:606. Holotype: ZMB (number unknown). Type locality: Sydney, New South Wales and Swan River, Western Australia.

GEOGRAPHIC RANGE.–*Burtonis* is the most widespread of all pygopodid lizards. It is found on many islands in the Torres Strait and along the south and northeast coasts of New Guinea. Roux (1910) reported typical material from the Aru Islands. In Australia, it appears to be absent from only the southwestern and southeastern margins of the continent, Kangaroo Island and most of the severe deserts, Great Sandy, Gibson, Great Victoria and Simpson (Figs. 92-3).

DIAGNOSIS.–*Burtonis* differs from *L. jicari,* the other species in the genus, in possessing the following combination of character states: a) usually two prenostril scales, b) usually five internostril scales, c) one pair of ventral body scales almost always enlarged, d) almost always four preanal pores, e) almost always one or two interpreanal pore scales (Figs. 6, 87-91).

DESCRIPTION.–(n = 186) SVL -.25 (0.006) 5.19 (0.006) 74.0-291.0, HL -.21 (0.003) 2.78 (0.003) 8.0-25.9, SL -.21 (0.004) 2.14 (0.004) 4.1-14.0, EW -.14 (0.005) 0.56 (0.005) 1.2-2.5, PL -.25 (0.006) 1.66 (0.006) 2.4-8.9, HW -.19 (0.005) 2.04 (0.005) 4.5-12.1, HD -.18 (0.005) 1.78 (0.005) 3.3-9.5, RD -.17 (0.008) -.01 (0.008) 0.6-1.5, RW -.18 (0.006) 0.78 (0.006) 1.2-3.5, RLD -.16 (0.021) -1.67 (0.021) 0.06-0.4, RLV -.18 (0.009) -.07 (0.009) 0.5-1.5, MD -.17 (0.013) -.14 (0.013) 0.3-1.5, MW -.16 (0.007) 0.67 (0.007) 1.2-2.9, ML -.17 (0.006) 0.84 (0.006) 1.3-3.4, TL (n = 66) -.31 (0.023) 5.36 (0.024) 69.0-327.9, PNS 2.1 (0.02) 1-3, SNS 1.6 (0.04) 1-3, INS 5.0 (0.03) 4-6, RP 0.0, LS 16.5 (0.16) 11-21, AOS 11.5 (0.11) 8-17, PRS 7.5 (0.08) 4-11, SLS 16.1 (0.11) 13-21, FS 12.2 (0.10) 9-17, IOS 6.4 (0.05) 5-9, POS 7.3 (0.07) 5-10, OS 17.5 (0.14) 12-24, SOS 2.3 (0.04) 1-3, PS 0.0, NS 22.8 (0.12) 18-27, EAM 0.0, PM 6.2 (0.05) 5-8, ILS 17.0 (0.12) 13-23, GS 15.1 (0.09) 12-18, DSK 0.0, VSK 0.0, VS 98.1 (0.33) 84-109, PVS 13.7 (0.12) 10-18, MS 20.7 (0.06) 18-22, VBS 1.9 (0.03) 0-2, PP 4.0 (0.02) 2-6, IPS 1.3 (0.05) 0-2, IGS 0.1 (0.02) 0-1, PAS 3.0 (0.02) 2-3, PCS 5.0 (0.02) 4-7, HLS 1.0 (0.01) 1-2, CS 12.7 (0.07) 10-14, SCS 3.6 (0.07) 3-5, DSP 0.6 (0.07) 0-3, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.4 (0.04) 0-2, LLP 1.8 (0.14) 0-4, TP 1.5 (0.07) 0-4, DBP 1.1 (0.10) 0-3, VBP 1.8 (0.10) 0-4, VP 0.05 (0.005) 0-1.

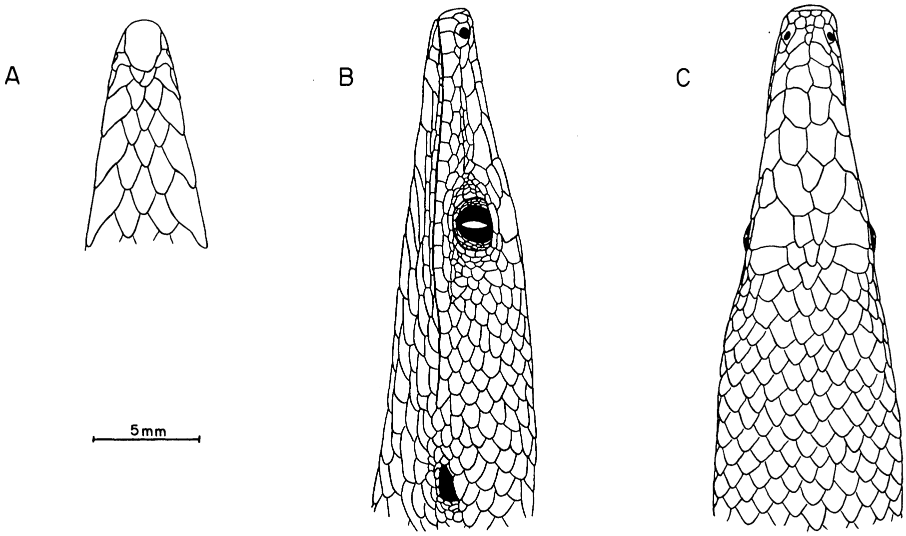

Fig. 87. Head region of *Lialis burtonis* (UMMZ 129994; female; 8 mi NW Learmonth, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

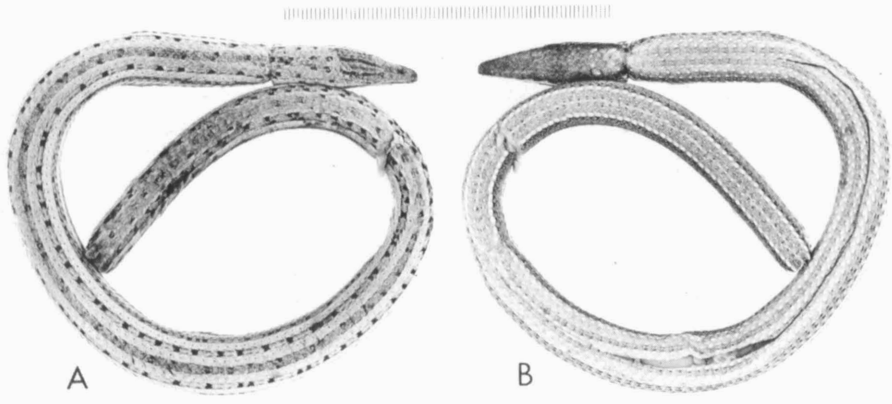

Fig. 88. Dorsal (A) and ventral (B) views of *Lialis burtonis* (EP 9847; female; 19° 18′ S Lat, 121° 23′ E Long, Western Australia). SVL = 222.0 mm.

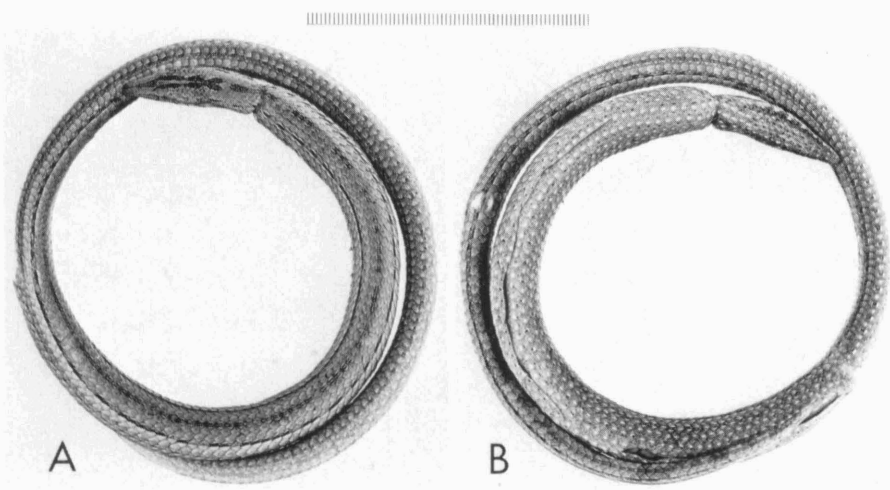

Fig. 89. Dorsal (A) and ventral (B) views of *Lialis burtonis* (EP 10550; female; 28° 27′ S Lat, 119° 05′ E Long, Western Australia). SVL = 164.5 mm.

GEOGRAPHIC VARIATION.—No univariate or multivariate trends were observed. Two samples from New Guinea, two from Queensland, one of which consisted of Torres Strait and Cape York individuals, one from Northern Territory, three from Western Australia and two from South Australia were compared and no significant differences were detected among them. This apparent absence of differentiation is very surprising, considering that approximately 2500 air miles separate the two most distant samples, Perth and Port Moresby, and that the closely related *L. jicari* exhibits considerable differentiation.

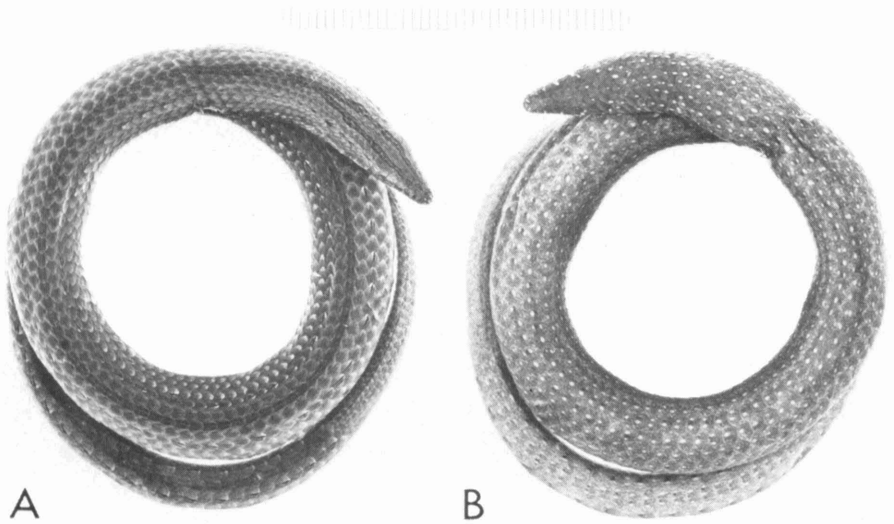

Fig. 90. Dorsal (A) and ventral (B) views of *Lialis burtonis* (UMMZ 129995; female; 2 mi SSE Bakers Hill, Western Australia). SVL = 152.1 mm.

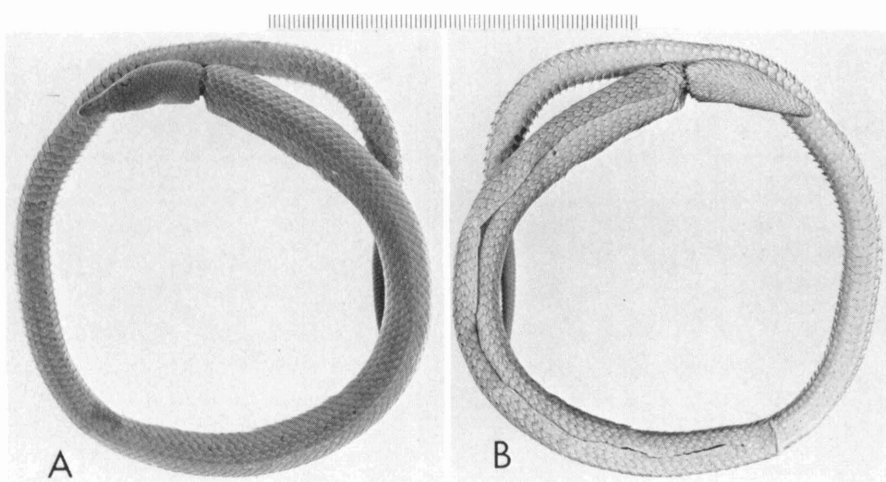

Fig. 91. Dorsal (A) and ventral (B) views of *Lialis burtonis* (EP 10725; male; 28° 28′ S Lat, 122° 50′ E Long, Western Australia). SVL = 166.5 mm.

Many, if not all, color and color-pattern variants (Figs. 88-91) can be found in all of the local samples that I have examined. The genetics and adaptive significance of this extreme case of polymorphism would be an exciting study. The variability of the color pattern of the entire *burtonis* sample (n = 186) was compared to that of its nearest relative, *L. jicari* (n = 90). F tests of the coefficients of variation (Lewontin, 1966) of the variable characters, DSP, LHP, LLP, TP, DBP and VBP, reveal that *burtonis* is highly significantly more variable than *L. jicari* in all but LLP.

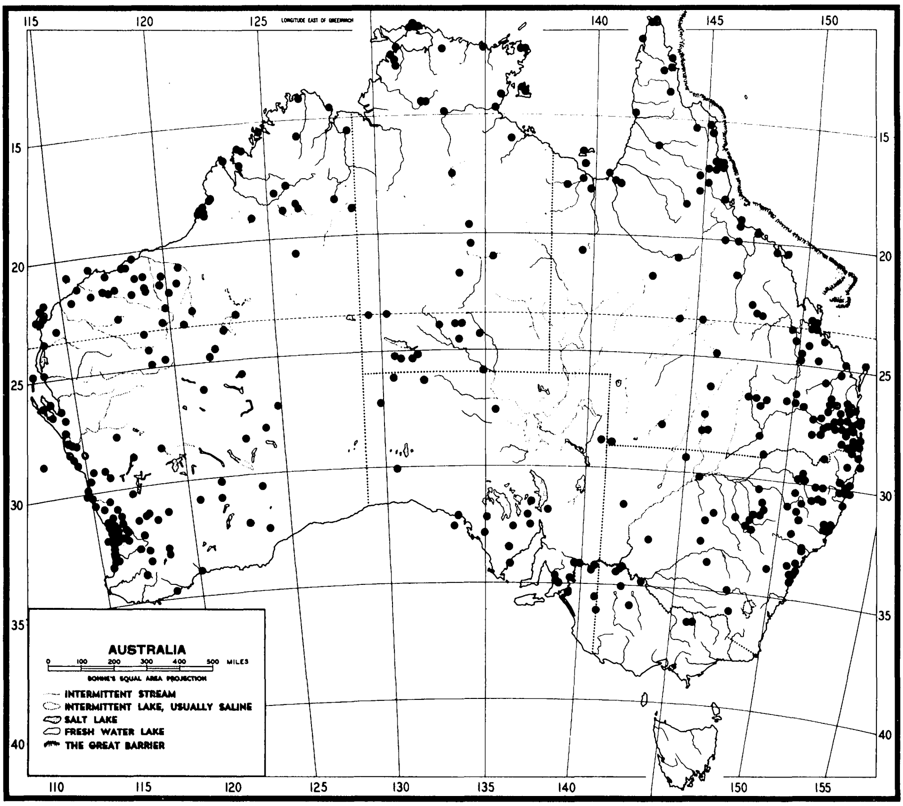

Fig. 92. Geographic distribution of *Lialis burtonis* based on specimens examined; see pages 196-201. See Fig. 93 for distribution of this species in New Guinea.

SEXUAL DIMORPHISM.—A sample of 71 males was compared to one of 115 females. The sexes differ significantly in the number of supralabial scales [males 15.5 (0.15) 13-19, females 16.5 (0.13) 14-21], ventrals [males 94.5 (0.42) 84-102, females 100.2 (0.34) 89-109] and subcaudal scales [males 3.9 (0.12) 3-5, females 3.4 (0.07) 3-5]. Only the number of ventrals was found to be significantly different in a comparison between males and females from the Cape York Peninsula and a comparison between males and females from the south coast of New Guinea.

REMARKS.—A. Grandison (pers. comm.) informed me that she cannot identify which one of the very old examples of *burtonis* in the British Museum is the type of Gray's species. Grandison stated that the Museum possesses a few specimens without precise locality data, only W. Australia. These obviously date from Gray's time as curator at that institution, as inferred from the fact that they bear his style of catalogue number (e.g., XIV). However, there appears to be no way of determining the exact year in which they were

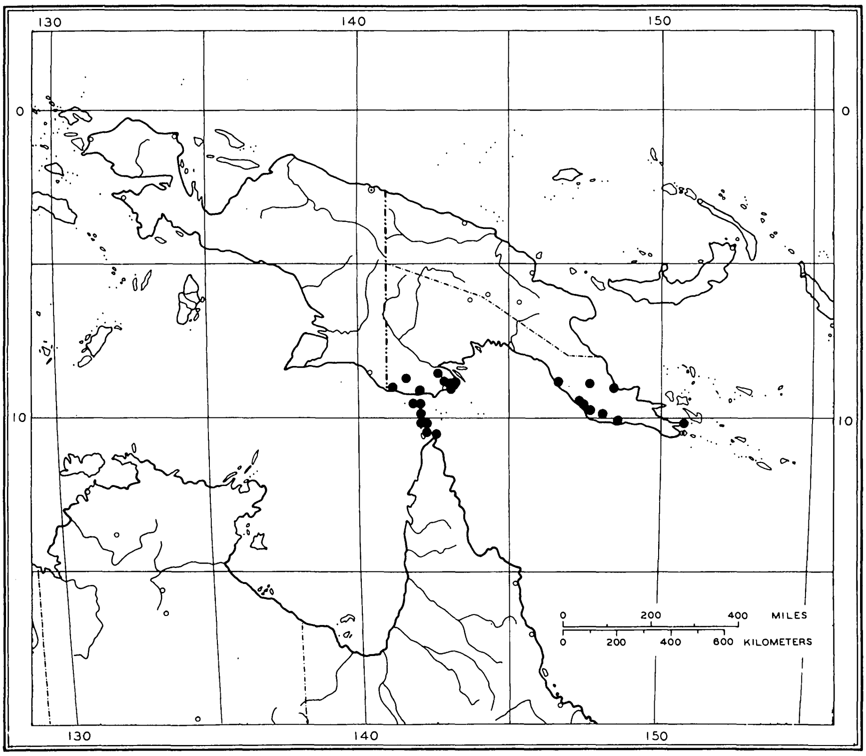

Fig. 93. Geographic distribution of *Lialis burtonis* based on specimens examined; see pages 196-7. See Fig. 92 for distribution of this species in Australia.

accessioned. It may be significant that Boulenger (1885a) did not refer to Gray's holotype, nor do any of the specimens listed by him appear to fit Gray's description of the holotype of *burtonis,* its place of collection and collector. Given that the holotype appears to be lost, I hereby designate AM R27914 as the neotype of *burtonis* and I restrict the type locality to Round Hill Fauna Reserve, 32° 58′ S Lat, 146° 10′ E Long, New South Wales.

G. Peters (pers. comm.) wrote that ZMB 5585, from Rockhampton, Queensland is listed in the Zoologisches Museum, Berlin as the holotype of W. Peter's *leptorhyncha* (1874). The Rockhampton specimen was donated by the "Godeffroy [Museum?]." In the original description of *leptorhyncha,* W. Peters mentioned that a Port Mackay specimen (ZMB 5947) was representative of his species. He did not refer to the Rockhampton locality nor did he cite ZMB 5585 as the holotype of his species. H. Cogger (pers. comm.) found that the catalogue in the Zoologisches Museum, Berlin lists four *leptorhyncha* syntypes, all from Queensland: ZMB 7802 from Port Bowen, ZMB 5947 from Rockhampton and ZMB 5948 from Port Mackay, Poona Ra. Cogger could not locate specimens ZMB 5947 or 5948.

G. Peters (pers. comm.) noted that ZMB 5323 from the Clarence River, New South Wales, donated by J. L. G. Krefft, is listed in the Zoologisches Museum, Berlin as the holotype of *burtonii* var. *concolor.* In the original description of *concolor* W. Peters (1874) stated that the Zoologisches Museum had two representatives from Sydney and two from Swan River. He did not refer to the Clarence River individual as a member of the type series, let alone as the holotype. H. Cogger (pers. comm.) found ZMB 5135 listed as the holotype of *burtonii concolor* in a card file in the Zoologisches Museum; however, the specimen itself could not be located.

Burtonis is an alert and highly mobile predator which feeds primarily on small lizards. I have found the identifiable remains of 26 skinks, three agamids, one gekkonid, one pygopodid and one snake in the stomachs of wild caught adult *burtonis*; also see Bustard (1970). While I have observed captive *burtonis* voluntarily to eat gekkos of the genera *Heteronotia* and *Gehyra* and pygopodids, *Delma* and other *burtonis*, they will invariably attack a skink in preference to these other kinds of lizards. On the contrary, Bustard (1968a) reports that *burtonis* readily eats whole *Gehyra variegata* in the laboratory but only the tails of *Heteronotia binoei* under similar circumstances. Bustard (1970) and Cogger (1967) also conclude that *burtonis* naturally eats insects as well as lizards; the former author states that it never attacks *Diplodactylus elderi*, probably because of the latter's defensive mechanism of squirting viscous [toxic?] fluid from its tail.

When *burtonis* searches for its prey, its head and the anterior portion of its body are raised above the ground at approximately a 30° angle. Most captures involve grabbing the prey by the body. The jaws are then moved towards the chest region where they remain tightly closed until the prey dies, apparently by suffocation. The chest is often held for five or more minutes. Ultimately, the *burtonis* moves its head in short jerky motions towards the prey's snout and then swallows it head first. Swallowing large prey appears to be facilitated when it raises its head and anterior portion of the body above the ground and repeatedly bends the head downward 10°-20° from the horizontal, as if nodding. The skull and lower jaws are not highly kinetic units; the mandibular symphysis and the quadrate do not appear to move. Bustard (1970) concludes from laboratory studies that *burtonis* is active during any hour with a conspicuous peak of movement in the few hours following darkness.

Burtonis has been collected under leaf litter and rocks (Loveridge, 1934). Lucas and Frost (1896) state that *burtonis* burrows "in the ground" and lays two eggs in late summer. The former observation requires confirmation. Neill (1957) described a female of 362 mm SVL from New Guinea that contained two leathery shelled eggs approximately 31 × 10 mm.

The broad geographic range of *burtonis* suggests that it occupies a wide variety of physical environments and that it must encounter a large number of different species of prey, other predators and potential competitors. It has been collected on gray coastal and red inland sandy soils, as well as on hard claypan and stony substrates. It can be found in open country where porcupine grass (*Triodia*; Bustard, 1970) is dominant as well as closed *Acacia* or *Banksia* woodlands (Figs. 119-24; Pianka, 1969). It is common in disturbed environments as well. The only habitats from which it appears to be absent are the moist rainforests of Queensland and New Guinea and the higher and colder altitudes of the Great Dividing Range. Cogger (1967) suggests that it occurs in the lowland rainforests of New Guinea; however, Neill (1957) observes that in New Guinea it is "confined" to the relatively dry savanna association consisting of tall kunai grass, *Eucalyptus* and *Melaleuca*. *Burtonis* is probably sympatric at least at one locality with each species of pygopodid except *Delma impar*.

Lialis jicari Boulenger
Figs. 94-8.

1903. *Lialis jicari* Boulenger, Ann. Mag. nat. Hist., 12:430. Syntypes: BM 1946.8.26.68-70 (formerly 1903.7.10.2-4). Type locality: Fly River, New Guinea. Presented by A. H. Jicar.
1905. *Alopecosaurus cuneirostris* Lindholm, Jb. nassau. Ver. Naturk., 58:231. Syntypes: NMW (four specimens, numbers unknown). Type locality: Bogadjim, Astrolabe Bay, New Guinea. Collected by W. Diehl.
1905. *Alopecosaurus cuneirostris inornata* Lindholm, Jb. nassau. Ver. Naturk., 58:233. Holotype: NMW 328. Type locality: Bogadjim, Astrolabe Bay, New Guinea. Collected by W. Diehl.

GEOGRAPHIC RANGE.—Restricted to New Guinea and offshore islands, and New Britain (Fig. 96).

DIAGNOSIS.—*Jicari* differs from *L. burtonis*, the other species in the genus, in possessing the following combination of character states: a) usually three prenostril scales, b) usually seven internostril scales, c) ventral body scales usually not enlarged, d) almost always six preanal pores, e) interpreanal pore scales almost always absent (Figs. 94-5).

DESCRIPTION.—(n = 90) SVL -.25 (0.005) 5.50 (0.005) 111.0-314.0, HL -.18 (0.004) 2.91 (0.004) 11.3-23.3, SL -.18 (0.004) 2.40 (0.004) 6.8-13.9, EW -.12 (0.005) 0.75 (0.005) 1.5-2.7, PL -.19 (0.008) 1.51 (0.008) 2.6-6.2, HW -.17 (0.005) 2.02 (0.005) 2.7-10.0, HD -.17 (0.005) 1.87 (0.005) 4.3-8.3, RD -.16 (0.012) 0.22 (0.011) 0.6-1.8, RW -.15 (0.006) 0.69 (0.006) 1.4-2.6, RLD -.09 (0.042) -2.21 (0.041) 0.03-0.3, RLV -.21 (0.012) 0.36 (0.012) 0.8-2.0, MD -.15 (0.019) -.12 (0.019) 0.4-1.4, MW -.13 (0.007)

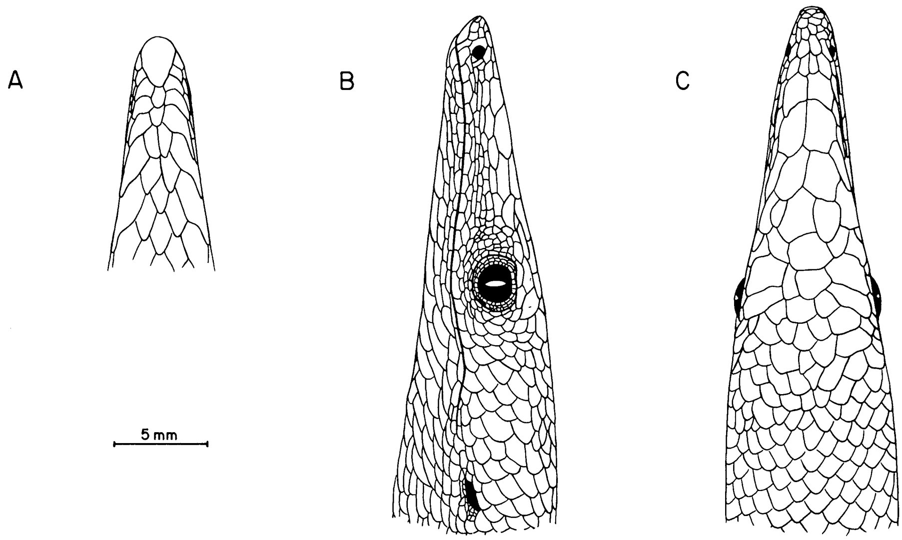

Fig. 94. Head region of *Lialis jicari* (UMMZ 129996; female; Dai, New Guinea). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

0.57 (0.007) 1.3-2.3, ML -.17 (0.008) 0.89 (0.008) 1.5-3.5, TL (n = 25) -.34 (0.015) 5.92 (0.021) 141.0-451.1, PNS 3.0 (0.05) 2-4, SNS 1.8 (0.04) 1-2, INS 6.9 (0.07) 5-8, RP 0.0, LS 20.3 (0.16) 18-25, AOS 12.8 (0.13) 10-16, PRS 9.5 (0.15) 7-13, SLS 19.1 (0.15) 16-22, FS 14.6 (0.13) 12-17, IOS 6.9 (0.11) 5-10, POS 8.2 (0.11) 5-10, OS 22.7 (0.21) 17-28, SOS 3.3 (0.07) 2-5, PS 0.0, NS 19.8 (0.16) 17-23, EAM 0.0, PM 7.1 (0.08) 6-9, ILS 19.6 (0.16) 17-23, GS 17.1 (0.14) 14-21, DSK 0.0, VSK 0.0, VS 122.4 (0.60) 108-134, PVS 17.9 (0.16) 14-22, MS 21.7 (0.05) 21-23, VBS 0.1 (0.04) 0-2, PP 6.2 (0.05) 6-8, IPS 0.02 (0.02) 0-1, IGS 0.7 (0.05) 0-1, PAS 2.9 (0.03) 2-3, PCS 7.0 (0.04) 6-9, HLS 1.6 (0.06) 1-3, CS 13.7 (0.10) 11-16, SCS 3.4 (0.09) 3-5, DSP 1.6 (0.08) 0-3, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 1.1 (0.07) 0-3, LLP 0.09 (0.06) 0-4, TP 2.8 (0.13) 0-4, DBP 2.7 (0.09) 0-3, VBP 3.5 (0.12) 0-4, VP 0.0.

GEOGRAPHIC VARIATION.—Univariate and multivariate analyses of *jicari* clearly indicate that individuals collected north of the main dividing ranges of New Guinea differ markedly from those taken south of the ranges. A northern sample of males and females (n = 35; the New Britain specimen was excluded) was compared to one of southern individuals (n = 54). Significant differences were observed in only SOS [southern 3.0 (0.06) 2-4, northern 3.8 (0.11) 3-5]. Similarly, northern males (n = 9) were compared to those from the south (n = 20) and the sample means differed significantly in SOS [southern 2.9 (0.11) 2-4, northern 3.8 (0.28) 3-5], DSP [southern 0.7 (0.20) 0-2, northern 1-9 (0.11) 1-2], LHP [southern 0.6 (0.11) 0-1, northern 1.4 (0.24) 0-2] and LLP [southern 0, northern 0.9

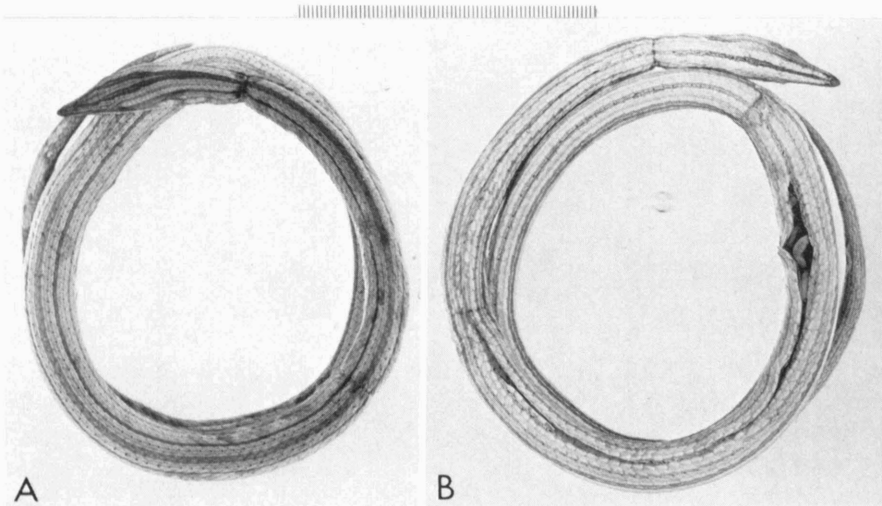

Fig. 95. Dorsal (A) and ventral (B) views of *Lialis jicari* (AMNH 92670; female; Umi R, New Guinea). SVL = 290.0 mm.

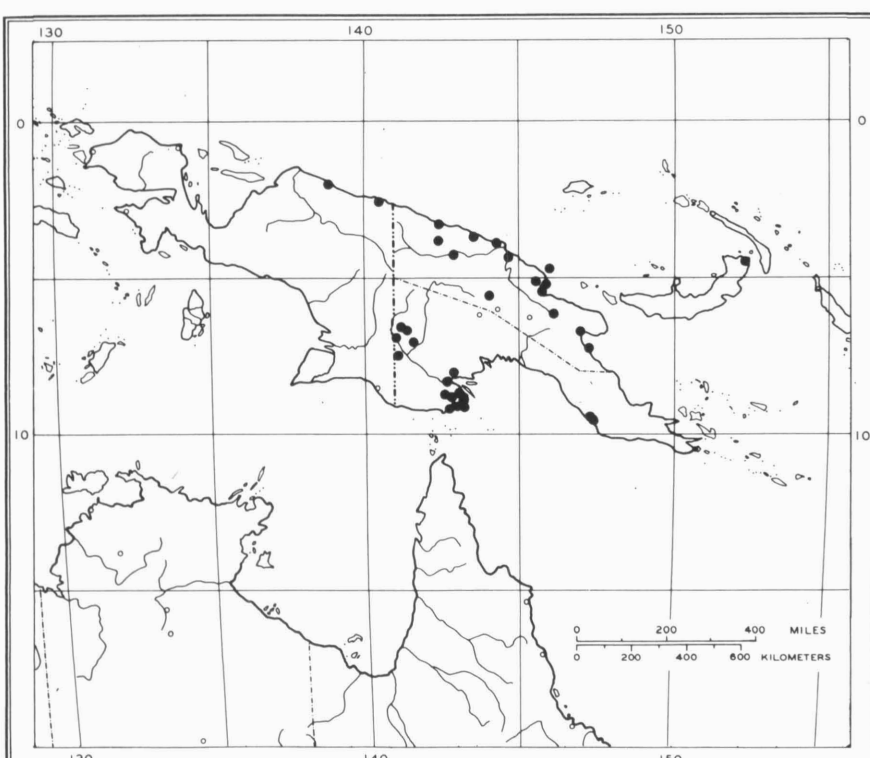

Fig. 96. Geographic distribution of *Lialis jicari* based on specimens examined; see page 201.

(0.59) 0-4]. Females from the north (n = 26) were compared to those from the south (n = 34) and the sample means differed significantly in SLS [southern 18.9 (0.17) 17-21, northern 20.3 (0.18) 18-22], POS [southern 8.1 (0.15) 6-10, northern 8.9 (0.15) 7-10], OS [southern 22.1 (0.29) 19-25, northern 23.9 (0.26) 21-26], SOS [southern 3.0 (0.07) 2-4, northern 3.8 (0.11) 3-5], NS [southern 19.4 (0.17) 18-23, northern 21.3 (0.22) 19-23], PM [southern 7.5 (0.14) 6-9, northern 6.7 (0.11) 6-8], VS [southern 126.8 (0.82) 112-134, northern 120.9 (0.83) 114-128], PP[southern 6.1(0.07) 6-8, northern 6.5 (0.14) 6-8], and LHP [southern 1.0 (0.09) 0-2, northern 1.6 (0.12) 0-3]. The female specimen from Rabaul, New Britain (AM R6990) does not differ significantly from the female sample from northern New Guinea.

Multivariate analyses (Table 19; Figs. 97-8) also illustrate the distinctness of northern and southern *jicari*. Only the first principal component separates a significantly large number of northern males and females from southern males and females; 3 of 29 males and 6 of 61 females are not correctly segregated. Note in Fig. 98 that the individual from Rabaul, New Britain is placed well within the northern cluster.

Stepwise multiple linear discriminant analysis of northern and southern *jicari,* sexes analyzed separately, helps to characterize their degree of divergence. Table 20 summarizes the conclusions. The posterior probabilities of males classified correctly as northern range from 0.84 to 1.0 and as southern from 0.73 to 1.0. No males were misclassified. The posterior probabilities of females classified correctly as northern range from 0.88 to 1.0 and as southern from 0.52 to 1.0. Three northern females misclassify with posterior probabilities of 0.65, 0.73 and 0.99. There is no obvious explanation for the misclassification. The New Britain female classifies with the northern female sample with a posterior probability of 1.0.

I have not recognized the northern and southern samples of *jicari* as different subspecies because so much of New Guinea and New Britain has yet to be sampled. West Irian and extreme southeast Papua are particularly important areas requiring more collecting. Should additional samples support the degree of divergence between northern and southern *jicari* that I have observed, then Lindholm's name *cuneirostris* must be applied to the northern individuals.

Southern and northern samples of *jicari* were compared to New Guinea *L. burtonis* which is primarily southern in distribution (Fig. 93). Character displacement might be inferred from the findings of this comparison because southern *jicari* and the *L. burtonis* sample exhibit a greater difference in all characters than do northern *jicari* and southern *L. burtonis.*

SEXUAL DIMORPHISM.—A sample of 29 males was compared to one of 61 females. The sexes differ significantly in the following characters: AOS [males 13.5 (0.22) 12-16, females 12.5 (0.14)

TABLE 19

RESULTS OF PRINCIPAL COMPONENT ANALYSIS OF INDIVIDUAL *LIALIS JICARI* (*see Figs. 97-8*)*

Component	I (♂)	I (♀)
Eigenvalue	6.2	5.0
% total variance	18.9	16.1
Independence		756.9
df		464
Significance		.0
PNS	0.5	0.0
SNS	0.2	-.1
INS	0.7	-.3
LS	-.4	-.4
AOS	-.4	-.4
PRS	-.5	-.7
SLS	-.2	-.6
FS	0.2	0.0
IOS	-.4	-.4
POS	-.6	-.6
OS	-.6	-.6
SOS	-.6	-.7
NS	-.5	-.8
PM	0.4	0.4
ILS	-.3	-.2
GS	0.0	-.3
VS	0.5	0.4
PVS	0.1	-.1
MS	-.1	-.2
PP	-.2	-.5
IPS	0.4	**
IGS	-.4	0.0
PAS	0.2	-.1
PCS	0.2	-.1
HLS	-.2	-.2
CS	-.2	-.3
SCS	-.6	-.4
DSP	-.8	-.3
LHP	-.8	-.7
LLP	-.5	**
TP	-.3	-.1
DB	-.5	-.3
VB	-.5	-.4

*Males and females were analyzed separately because of the presence of sexual dimorphism in several characters.

**Invariant character among females.

10-15], SLS [males 18.1 (0.25) 16-22, females 19.5 (0.15) 17-22], NS [males 18.8 (0.23) 17-21, females 20.2 (0.18) 18-23], GS [males 16.2 (0.22) 14-20, females 17.5 (0.15) 15-21], VS [males 118.6 (0.83) 108-128, females 124.2 (0.69) 112-134], DSP [males 1.0 (0.18) 0-2, females 1.9 (0.06) 0-3].

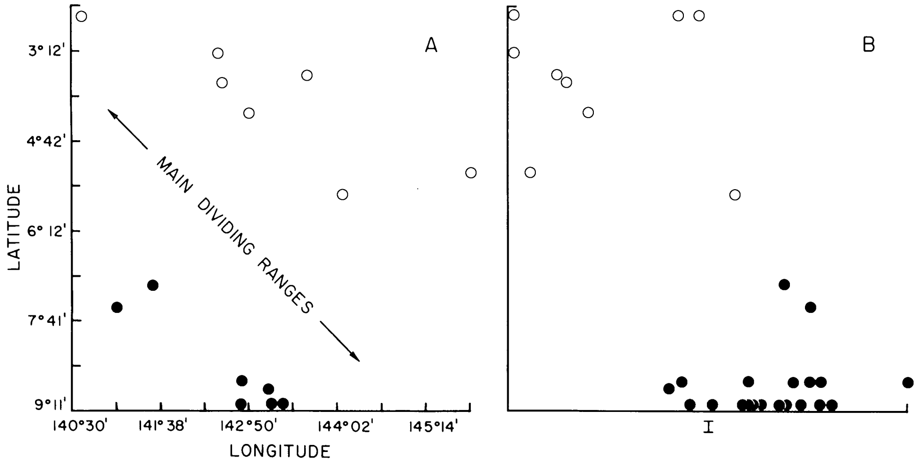

Fig. 97. A. Twenty-nine individual male *Lialis jicari* plotted according to latitude and longitude. Note their position relative to the main dividing ranges of New Guinea. B. The same individual male *L. jicari* plotted according to latitude and principal component I; see Table 19. The males represented by open circles are referred to as the northern sample in the text and the solid circles as the southern sample. Each symbol in A may refer to more than one individual. Table 19 lists the characters used in this analysis and their component correlation coefficients.

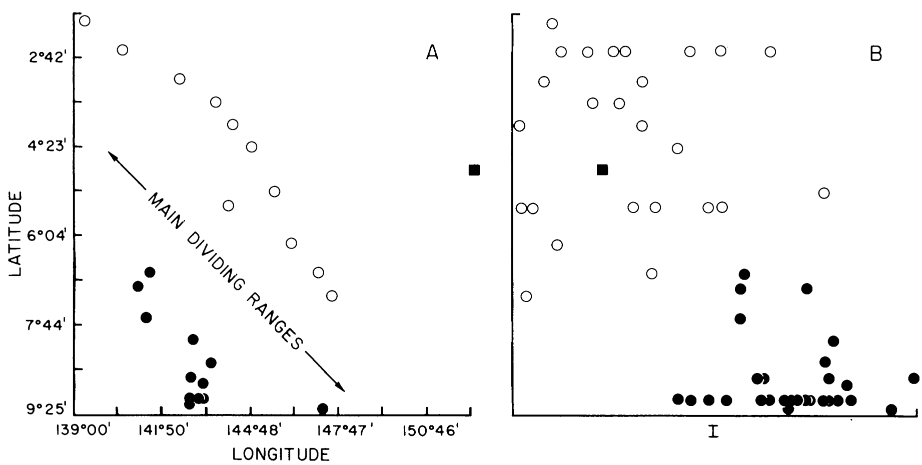

Fig. 98. A. Sixty-one individual female *Lialis jicari* plotted according to latitude and longitude. Note their position relative to the main dividing ranges of New Guinea; also note the location of the New Britain specimen. B. The same individual female *L. jicari* plotted according to latitude and principal component I; see Table 19. The females represented by open circles are referred to as the northern sample in the text and the solid circles as the southern sample. The Rabaul, New Britain specimen is symbolized as a solid box. Each symbol may refer to more than one individual. Table 19 lists the characters used and their component correlation coefficients.

TABLE 20

A FORWARD STEPWISE MULTIPLE LINEAR DISCRIMINANT ANALYSIS OF NORTHERN AND SOUTHERN *LIALIS JICARI* (*see Figs. 97-8*).

Step	Characters separating males	F-statistic	Significance
1	DSP	16.7	0.000
2	VS	11.2	0.003
3	SOS	6.6	0.016
4	SCS	6.3	0.019
5	CS	7.4	0.012
6	DSP	1.8	0.190

n = 9 in northern sample; n = 20 in southern sample.

Step	Characters separating females	F-statistic	Significance
1	NS	46.3	0.000
2	VS	20.3	0.000
3	SOS	17.1	0.000
4	CS	10.8	0.002

n = 27 in northern sample; n = 34 in southern sample.

REMARKS.—I have not examined the four syntypes of *Alopecosaurus cuneirostris* Lindholm nor the holotype of *A. cuneirostris* var. *inornata* Lindholm. However, their detailed descriptions do not appear to differ from typical *jicari*. It appears that, when Lindholm described his two forms (1905a), he simply overlooked Boulenger's original description of *jicari* which had appeared only two years earlier (1903).

I take this opportunity to designate BM 1946.8.26.69, a subadult female without an original tail, as the lectotype of *jicari*. I also restrict the type locality of this species to Wasua, 8° 17′ S Lat, 142° 50′ E Long, a small village on the north bank of the Fly River near its mouth. The species should be abundant there given the numerous localities in this general region from which it has been taken.

Jicari seems to be widespread throughout New Guinea (Fig. 96). Brongersma's (1953) specimens from Ransiki, 1° 34″ S Lat, 134° 11′ E Long, Vogelkop Peninsula is the western-most record. On New Guinea *jicari* ranges from sea level to at least 4900′ at Baiyer River. The species' existence on New Britain seems certain, given Werner's (1900) record from the western end of the island and the Australian Museum specimen (AM R6990) from Rabaul. On the other hand, the Eidsvold, Queensland record (QM J2198) is almost certainly in error.

This species appears to have much the same habitat preference and behavior as the closely related and sympatric *L. burtonis*. Neill (1957) reports that *jicari* is common in the kunai grass association and it can be readily collected in front of slow moving grassland fires.

He further reports that it is probably preyed upon by eagle-kites (*Haliastur indus*). Loveridge (1948) states that the *jicari* from Toem "was secured after bulldozers had cleared jungle growth on moist, loose rather sandy reddish soil." Like *L. burtonis, jicari* is a highly mobile predator of other lizards and it can be found alert and active anytime of the day or night. Six skinks were identified in the stomach contents of wild caught adult *jicari. Jicari* appears to eat lizard eggs (Brongersma, 1953) while *L. burtonis* does not. The detailed comparison of the biology of the two species in an area of sympatry, such as the region of the mouth of the Fly River, would be very interesting. Both species have been collected at Abam, Boze, Porebada, Port Moresby and Wipim. According to F. Parker (pers. comm.) both species are common on Daru Island and the adjacent mainland. *L. burtonis* is widespread throughout the Port Moresby area, while *jicari* is rare and only spasmodic in distribution (R. Mackay, pers. comm.).

Ophidiocephalus Lucas and Frost

1897. *Ophidiocephalus* Lucas and Frost, Proc. R. Soc. Vict., 9:54. Type of genus: *Ophidiocephalus taeniatus* Lucas and Frost (1897), by monotypy.

DIAGNOSIS.—*Ophidiocephalus* differs from all other pygopodid genera in possessing the following combination of character states: a) head scales large, few in number, b) ring of ocular tissue hidden beneath orbital scales, c) parietal scales present, d) six nuchal scales, e) external auditory meatus small, hidden beneath temporal scales, f) body scales smooth, g) preanal pores absent.

Ophidiocephalus taeniatus Lucas and Frost
Figs. 31, 99-100.

1897. *Ophidiocephalus taeniatus* Lucas and Frost, Proc. R. Soc. Vict., 9:54. Holotype: NMV D11761 (formerly 57872). Type locality: Charlotte Waters, Northern Territory. Collected by P. M. Byrne.

GEOGRAPHIC RANGE.—Known only from the male holotype which was collected at Charlotte Waters, Northern Territory (Fig. 31).

DIAGNOSIS.—See generic diagnosis (Figs. 99-100).

DESCRIPTION.—(n = 1) SVL 102.0, HL 5.6, SL 3.4, EW 0.7, PL 1.5, HW 4.3, HD 3.3, RD 1.3, RW 2.3, RLD 0.9, RLV 1.6, MD 1.0, MW 1.9, ML 1.9, TL (broken), PNS 1, SNS 0, INS 2, RP 0, LS 5, AOS 2, PRS 3, SLS 6, FS 4, IOS 3, POS 2, OS 0, SOS 1, PS 1, NS 6, EAM 0, PM 4, ILS 5, GS 11, DSK 0, VSK 0, VS 92, PVS 11, MS 16, VBS 0, PP 0, IPS 0, IGS 0, PAS 3, PCS 5, HLS 3, CS 11,

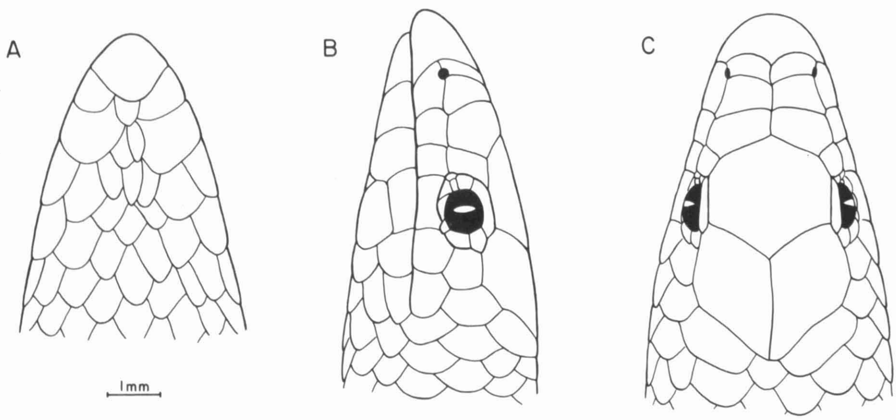

Fig. 99. Head region of holotype of *Ophidiocephalus taeniatus* (NMV D11761; male; Charlotte Waters, Northern Territory). SVL = 102.0 mm. Redrawn from Kinghorn (1926a:57, Fig. 13), Waite (1929:95, Fig. 68) and two photographs provided by A. Coventry. A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

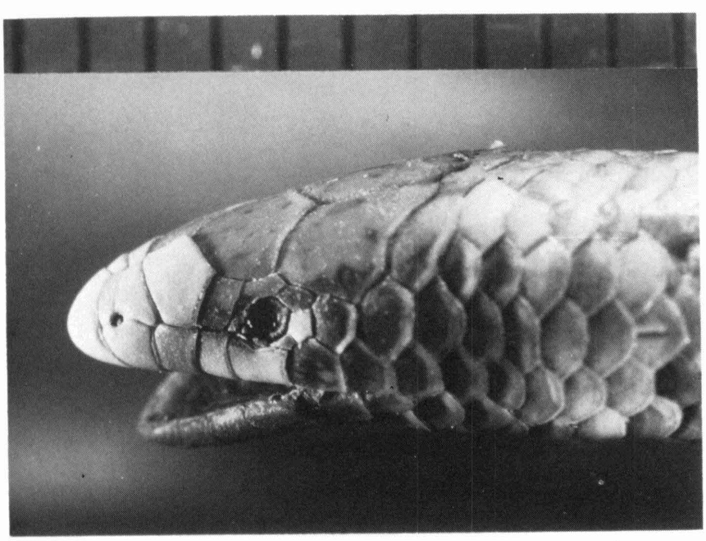

Fig. 100. Left dorsolateral view of head region of holotype of *Ophidiocephalus taeniatus* (NMV D11761; male; Charlotte Waters, Northern Territory). SVL = 102.0 mm.

SCS 3, DSP 0, DIP 0, DPP 0, DNP 0, PNB 0, LHP 0, LLP 0, TP 1, DBP 0, VBP 1, VP 0.

INDIVIDUAL VARIATION.—*Taeniatus* has a unique ocular condition among pygopodid lizards. The eyeball is very small and yet apparently capable of movement. The ring of ocular scales, if present, is hidden beneath the orbital series of scales. The mental region in the holotype is asymmetrical (Fig. 99).

REMARKS.—Certain aspects of this species' head proportions and head and body scalation suggest that it is fossorial, perhaps a "sand swimmer"; see Figs. 11-12. This cryptic mode of life would account for the apparent rarity of the species. The geographic ranges of numerous pygopodids overlap the Charlotte Waters locality of *taeniatus.* These potentially sympatric species are *Delma australis, D. borea, D. nasuta, D. tincta, Lialis burtonis* and *Pygopus nigriceps.*

Paradelma Kinghorn

1926. *Paradelma* Kinghorn, Rec. Aust. Mus., 15:48. Type of genus: *Delma orientalis* Günther (1876), by original designation.

DIAGNOSIS.—*Paradelma* differs from all other pygopodid genera in possessing the following combination of character states: a) four or five loreal scales, b) five anterior orbital scales, c) four frontal scales, d) usually three interorbital scales, e) ventrals in males average 117.3, in females 123.5, f) almost always 18 midbody scale rows, g) body scales smooth, h) four preanal pores, i) two preanal scales, j) postnuchal band conspicuous.

Paradelma orientalis (Günther)
Figs. 69, 101-2.

1876. *Delma orientalis* Günther, J. Mus. Godeffroy, 5:45. Syntypes: BM 1946.8.13.48-9 (formerly 76.3.4.29,31). Type locality: Peak Downs, Queensland. Collected by E. Dämel; purchased from the Godeffroy Museum.

GEOGRAPHIC RANGE.—Known only from four localities east of the Great Dividing Range in Queensland between 23° and 26° S Lat (Fig. 69).

DIAGNOSIS.—See generic diagnosis (Figs. 101-2).

DESCRIPTION.—(n = 5) SVL -.15 (0.033) 5.09 (0.029) 137.5-197.5, HL -.11 (0.022) 2.12 (0.020) 7.3-9.6, SL -.08 (0.022) 1.46 (0.020) 3.8-4.7, EW -.10 (0.051) 0.59 (0.046) 1.6-2.2, PL -.18 (0.008) 0.69 (0.069) 1.4-2.4, HW -.03 (0.024) 2.02 (0.021) 7.1-8.2, HD -.05 (0.039) 1.68 (0.035) 5.1-6.2, RD -.04 (0.022) 0.37 (0.020) 1.4-1.6, RW -.09 (0.016) 1.03 (0.014) 2.5-3.1, RLD 0.07 (0.120) -.49 (0.107) 0.4-0.7, RLV -.04 (0.060) 0.03 (0.054) 0.9-1.2, MD -.09 (0.082) 0.47 (0.074) 1.3-2.0, MW -.10 (0.018) 1.09 (0.016) 2.6-3.3, ML -.08 (0.024) 0.61 (0.021) 1.7-2.0, TL (n = 1) 221.8, PNS 1.0, SNS 0.0, INS 2.0, RP 0.0, LS 4.8 (0.20) 4-5, AOS 5.0, PRS 6.4 (0.25) 6-7, SLS 7.0 (0.32) 6-8, FS 4.0, IOS 3.8 (0.49) 3-5, POS 4.6 (0.25) 4-5, OS 16.0 (0.32) 15-17, SOS 1.0, PS 1.0, NS 10.2 (0.20) 10-11, EAM 0.0, PM 3.0, ILS 6.2 (0.20) 6-7, GS 15.0 (0.32) 14-16, DSK 0.0, VSK 0.0, VS 119.8 (1.63) 116-125, PVS 15.6 (0.51) 14-17, MS 18.2 (0.20) 18-19, VBS 1.6 (0.40) 0-2, PP 4.0, IPS

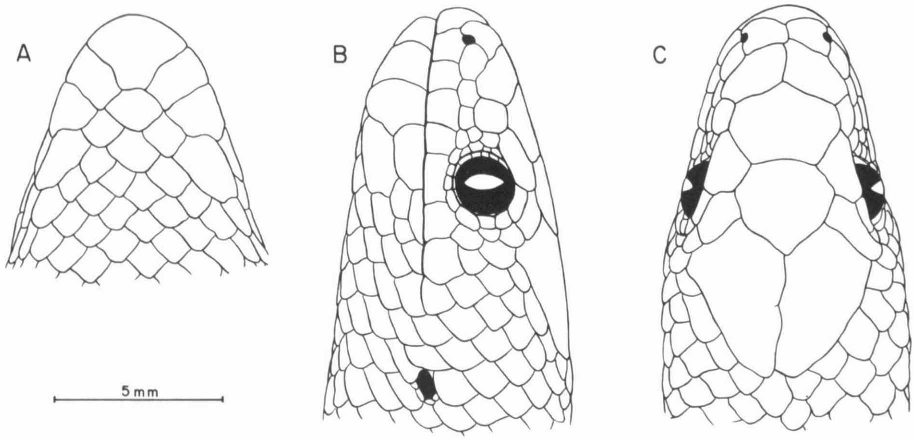

Fig. 101. Head region of *Paradelma orientalis* (CAS 77652; female; 15 mi S Duaringa, Queensland). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

Fig. 102. Left dorsolateral view of *Paradelma orientalis* (CAS 77652; female; 15 mi S Duaringa, Queensland). SVL = 154.0 mm.

0.0, IGS 0.6 (0.40) 0-2, PAS 2.0, PCS 5.6 (0.40) 4-6, HLS 2.8 (0.20) 2-3, CS 13.0 (0.32) 12-14, SCS 3.0, DSP 0.0, DIP 0.0, DPP 0.0, DNP 2.4 (0.60) 0-3, PNB 0.0, LHP 0.4 (0.25) 0-1, LLP 0.6 (0.25) 0-1, TP 0.0, DBP 0.0, VBP 0.0, VP 0.0.

SEXUAL DIMORPHISM.—A sample of three males was compared to one of two females. The sexes only differ significantly in the number of ventral scales [males 117.3 (0.67) 116-118, females 123.5 (1.50) 122-125].

REMARKS.—In the original description of *orientalis,* Günther (1876) mentioned only the Peak Downs record, and it must be considered the type locality. There are two specimens (BM 1946.8.13.48-9) from Peak Downs, Queensland housed in the British Museum which appear to have been used by Günther, and I select BM 1946.8.13.48, an adult male with a complete tail, as the lectotype. Another specimen (BM 1946.8.13.47) from Gayndah, Queensland may have been used in the original description of *orientalis* since it too was collected by E. Dämel and registered on the same day, March 4, 1876, in the British Museum.

Very little is known of the biology of *orientalis.* Unfortunately, the locality records are now well cultivated or grazed areas. It appears to be sympatric at different localities with either *Delma tincta, Lialis burtonis* or perhaps *Pygopus nigriceps.*

Pletholax Cope

1864. *Pletholax* Cope, Proc. Acad. nat. Sci. Philad., 1864:229. Type of genus: *Pygopus gracilis* Schlegel (*In* Cope, 1864), by original designation.

DIAGNOSIS.—*Pletholax* is unique in the Pygopodidae in possessing keeled ventral scales.

Pletholax gracilis (Schlegel)
Figs. 3-6, 69, 103-4, 121-2.

1864. *Pygopus gracilis* Schlegel (*In* Cope), Proc. Acad. nat. Sci. Philad., 1864:229. Holotype: RNHL 3670. Type locality: South West Australia. Collected by J. A. L. Preiss between 1838 and 1842.

GEOGRAPHIC RANGE.—Restricted to a very narrow range in Western Australia between Eneabba in the north and Mandurah in the south (Fig. 69).

DIAGNOSIS.—See generic diagnosis (Fig. 4).

DESCRIPTION.—(n = 22) SVL -.09 (0.019) 4.19 (0.018) 51.0-83.7, HL -.05 (0.009) 1.57 (0.009) 4.3-5.8, SL -.05 (0.011) 0.97 (0.011) 2.2-3.2, EW -.08 (0.022) -.24 (0.021) 0.6-1.1, PL -.09 (0.029) 0.15 (0.028) 0.9-1.7, HW -.08 (0.015) 1.10 (0.014) 2.5-3.6, HD -.12 (0.015) 0.93 (0.015) 1.8-3.2, RD -.12 (0.032) -.08 (0.032) 0.5-1.3, RW -.08 (0.009) 0.43 (0.009) 1.3-1.8, RLD -.07 (0.016) 0.21 (0.016) 1.0-1.6, RLV -.10 (0.010) -.01 (0.010) 0.7-1.2, MD -.16 (0.021) -26 (0.021) 0.5-1.1, MW -.08 (0.011) 0.61 (0.011)

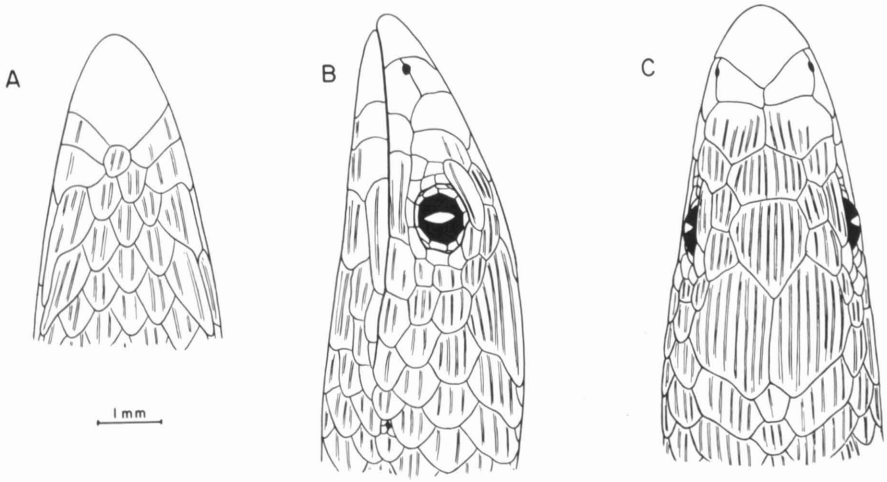

Fig. 103. Head region of *Pletholax gracilis* (UMMZ 129997; female; Applecross, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

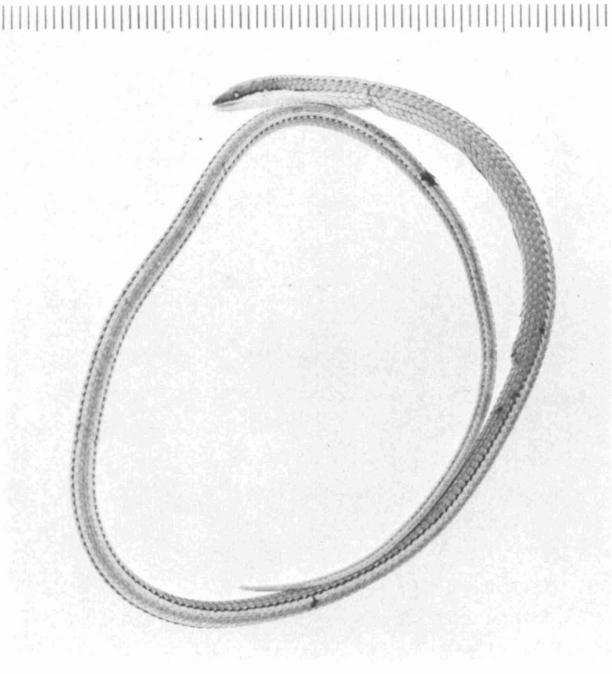

Fig. 104. Left lateral view of *Pletholax gracilis* (MCZ 61166; male; 15 mi N Jurien Bay, Western Australia). SVL = 61.0 mm.

1.5-2.5, ML -.10 (0.014) 0.71 (0.014) 1.6-2.5, TL (n = 17) -.12 (0.022) 5.25 (0.019) 140.0-245.5, PNS 1.0, SNS 0.0, INS 2.0, RP 1.0, LS 4.9 (0.09) 4-6, AOS 2.6 (0.20) 2-4, PRS 3.6 (0.11) 3-4, SLS 5.0, FS 4.0 (0.05) 3-4, IOS 5.0, POS 3.3 (0.10) 3-4, OS 9.7 (0.16) 8-11, SOS 1.0, PS 1.0, NS 8.0 (0.15) 6-9, EAM 0.0, PM 3.1 (0.09)

3-5, ILS 4.1 (0.08) 4-5, GS 9.9 (0.21) 8-11, DSK 2.0, VSK 2.0, VS 66.0 (0.60) 62-73, PVS 0.0, MS 16.0, VBS 0.0, PP 0.0, IPS 0.0, IGS 0.0, PAS 3.0, PCS 5.1 (0.14) 3-7, HLS 2.5 (0.11) 2-3, CS 10.1 (0.05) 10-11, SCS 3.5 (0.18) 3-5, DSP 0.0, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 1.0, LLP 0.0, TP 0.0, DBP 1.9 (0.10) 0-2, VBP 1.2 (0.09) 1-2, VP 1.4 (0.11) 1-2.

GEOGRAPHIC VARIATION.—Univariate and multivariate analyses failed to reveal any obvious trends in *gracilis*. The more inland individuals were not significantly different from the coastal sample.

SEXUAL DIMORPHISM.—A sample of 14 males was compared to one of eight females and no significant differences were observed.

REMARKS.—Cope (1864) explicitly cited Schlegel as the author of the specific name *gracilis* (Dunn and Dunn, 1940). It seems that the original specimen (RNHL 3670) to which Schlegel had applied his name is still located in the Rijksmuseum van Natuurlijke Historie, Leiden where he worked. I regard this individual as the holotype. It was collected by J. A. L. Preiss (M. Boeseman, pers. comm.). Cope gave the type locality of *gracilis* as South West Australia, and Preiss is known to have collected botanical specimens from that region, more specifically the area of the Swan River, from 1838 until January 8, 1842 (Whittell, 1954). I restrict the type locality of *gracilis* to Neerabup National Park, a few miles north of Waneroo, Western Australia which very likely is within the area collected by Preiss. While *gracilis* has not yet been collected in the Park, the habitat appears to be continuous with that of the nearby Sorrento area where the species is common (Figs. 121-2).

Six specimens (UMMZ 131215,22,29,31-32,34) were collected from five sets of combined can traps and drift fences located one mile north of Marmion (Fig. 122). The area is a mixed *Banksia-Eucalyptus* coastal woodland community of stationary dunes and protruding limestone ridges. All of the six specimens were maintained in captivity and they invariably burrowed into sand. The rarity of *gracilis* in collections may be accounted for by its fossorial habits. The Red Hill (WAM R16886) and Coomberdale (WAM R9697) records indicate that the species is not completely restricted to coastal plain vegetation nor to a sandy substrate. *Gracilis* is sympatric at different localities with one or more pygopodids; they are *Aclys concinna, Aprasia pulchella, A. repens, Delma fraseri, D. grayii, Lialis burtonis* and *Pygopus lepidopodus.*

Pygopus Merrem

1820. *Pygopus* Merrem, Versuch eines Systems der Amphibien, p. 77. Type of genus: *bipes lepidopus* [*sic*] Lacépède (1804).

1839. *Hysteropus* A. M. C. Duméril, *In* A. M. C. Duméril and Bibron, Erpétologie générale, 5:826. Type of genus:

Hysteropus novae Hollandiae A. M. C. Duméril and Bibron (1839).

1882. *Cryptodelma* Fischer, Arch. Naturgesch., 48:289. Type of genus: *Cryptodelma nigriceps* Fischer (1882), by original designation.

DIAGNOSIS.—*Pygopus* differs from all other pygopodid genera in possessing the following combination of character states: a) dorsal surface of head covered with large and small scales, b) three to five postmental scales, c) 21 or more midbody scale rows, d) dorsal body scales usually keeled, e) nine or more preanal pores.

Pygopus lepidopodus (Lacépède)
Figs. 1-3, 6-7, 105-8, 118, 120.

1804. *bipes lepidopodus* Lacépède, Annls Mus. natn. Hist. nat. Paris, 4:(193), 209, pl. 55, fig. 1. Holotype: PM 7154. Type locality: Nouvelle-Hollande. Collected by F. Péron and C. A. Le Sueur.

1811. *Sheltopusik novae-hollandiae* Oppel, Die Ordnungen, Familien und Gattungen der Reptilien, p. 40. Type locality: Neu-Holland.

1839. *Hysteropus novae Hollandiae* A. M. C. Duméril and Bibron, Erpétologie générale, 5:828 (pl. 55, fig. 1, *In* A. M. C. Duméril, G. Bibron and A. Duméril, 1854). Substitute name for *Bipes lepidopodus* Lacépède (1804).

1845. *Pygopus squamiceps* Gray, Catalogue of the specimens of lizards in the collection of the British Museum, p. 68. Holotype: BM XII 2a. Type locality: Australia. Presented by Mair.

1882. *Pygopus longicaudatus* Tepper [*nomen oblitum*], Trans. R. Soc. S. Aust., 5:32. Holotype: Unknown. Type locality: near Kangarilla, South Australia. Collected by Bilney.

GEOGRAPHIC RANGE.—With few exceptions, *lepidopodus* occupies the southern margins of the continent. In Western Australia, it occurs as far north as Shark Bay and it extends well inland to the Goldfield Region. It is known from the northern Flinders Ranges, South Australia and to the west of the Great Dividing Range in New South Wales. In the east it has been collected from as far north as Rockhampton, Queensland. It has not been collected in the Northern Territory, and the Tasmania records can not be confirmed (Fig. 108).

DIAGNOSIS.—*Lepidopodus* differs from *P. nigriceps,* the other species in the genus, in possessing the following combination of character states: a) subnostril scale absent, b) ventral scales in males average 95.1, females 100.4, c) usually seven hind limb scales, d) dorsal snout pattern usually present, e) dorsal head bands absent, f) ventral body surfaces usually covered with pigmentation (Figs. 1-3, 6-7, 105-7).

DESCRIPTION.—(n = 149) SVL -.22 (0.006) 5.06 (0.006) 70.0-274.8, HL -.14 (0.004) 2.36 (0.004) 6.5-15.8, SL -.15 (0.005) 1.69 (0.005) 3.3-8.6, EW -.10 (0.005) 0.62 (0.005) 1.3-2.5, PL -.17 (0.010) 0.98 (0.010) 1.2-4.5, HW -.15 (0.004) 2.14 (0.004) 4.6-13.0, HD -.14 (0.004) 1.92 (0.004) 4.3-10.2, RD -.15 (0.005) 0.44 (0.005) 1.0-2.4, RW -.14 (0.004) 1.27 (0.004) 2.4-5.2, RLD -.15 (0.019) -.87 (0.019) 0.2-0.9, RLV -.14 (0.007) 0.41 (0.007) 0.8-2.1, MD -.13 (0.007) 0.61 (0.007) 1.1-3.3, MW -.13 (0.005) 1.32 (0.005) 2.5-5.4, ML -.12 (0.008) 0.74 (0.008) 1.4-3.2, TL (n = 38) -.32 (0.020) 5.73 (0.021) 101.2-581.4, PNS 1.0, SNS 0.0, INS 2.5 (0.05) 2-4, RP 0.0, LS 7.2 (0.07) 5-9, AOS 8.2 (0.09) 6-11, PRS 5.6 (0.08) 3-9, SLS 7.1 (0.05) 6-9, FS 6.2 (0.05) 5-8, IOS 6.7 (0.07) 5-9, POS 5.5 (0.08) 3-8, OS 17.0 (0.15) 13-24, SOS 1.3 (0.04) 1-2, PS 1.0, NS 17.4 (0.11) 14-20, EAM 0.0, PM 3.3 (0.05) 3-5, ILS 7.9 (0.06) 6-10, GS 16.8 (0.08) 14-19, DSK 1.0 (0.02) 0-1, VSK 0.0, VS 97.7 (0.43) 86-110, PVS 15.2 (0.13) 12-20, MS 22.8 (0.09) 21-25, VBS 2.0, PP 13.0 (0.14) 10-18, IPS 0.0, IGS 0.2 (0.03) 0-1, PAS 2.4 (0.04) 2-3, PCS 6.5 (0.08) 4-9, HLS 6.6 (0.07) 5-9, CS 15.6 (0.08) 13-19, SCS 3.3 (0.06) 3-5, DSP 1.5 (0.12) 0-3, DIP 0.0, DPP 0.0, DNP 0.0, PNB 0.0, LHP 0.6 (0.04) 0-2, LLP 1.3 (0.06) 0-2, TP 0.7 (0.08) 0-2, DBP 1.1 (0.08) 0-2, VBP 1.2 (0.05) 0-2, VP 0.03 (0.01) 0-1.

GEOGRAPHIC VARIATION.—East coast *lepidopodus* (Fig. 108) have slightly fewer preanal pores on the average than do those from the interior, southern and western portions of the continent. In addition, east coast individuals almost never exhibit a dorsal body color pattern of continuous or discontinuous stripes (Fig. 107) while both striped (Fig. 106) and unstriped specimens are present in approximately equal numbers in the other areas sampled. All other characters examined singly, and the multivariate analysis as well, do not add further support to the observed differentiation of east coast *lepidopodus*. Much more research will be required to document the exact degree of this character discontinuity. If the east coast populations are recognized subspecifically in the future, Gray's name *Pygopus squamiceps* (1845a) probably should be applied to them.

SEXUAL DIMORPHISM.—A sample of 76 males was compared to one of 73 females. The sexes differ significantly in the number of ventrals [males 95.1 (0.48) 86-105, females 100.4 (0.57) 88-110] and hind limb scales [males 6.8 (0.10) 5-9, females 6.3 (0.09) 5-8].

REMARKS.—The type locality of Lacépède's *lepidopodus* was given as Nouvelle-Hollande (= New Holland) and no additional information appears to be available to further restrict the site. The expedition on which Péron and Le Sueur collected the holotype is known to have landed at King Georges Sound, and since *lepidopodus* is reasonably abundant there, I restrict the type locality to 35° 00′ S Lat, 117° 54′ E Long, the northwest mainland opposite King Georges Sound, Western Australia.

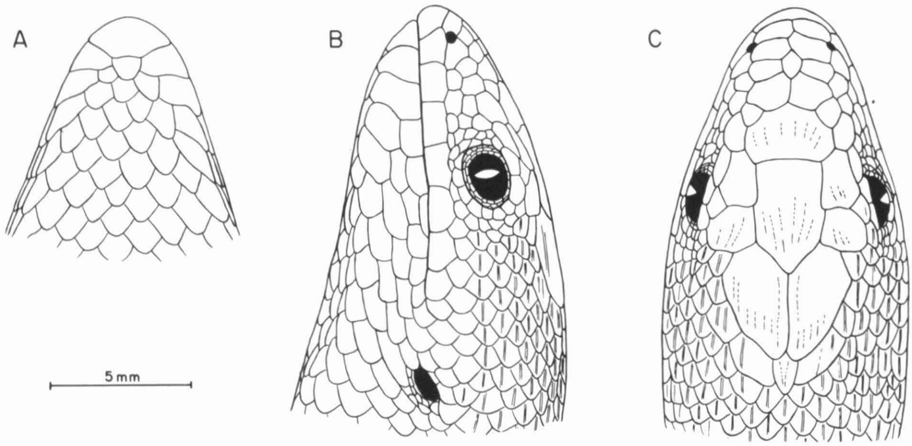

Fig. 105. Head region of *Pygopus lepidopodus* (UMMZ 129991; male; 15 mi N Jurien Bay, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

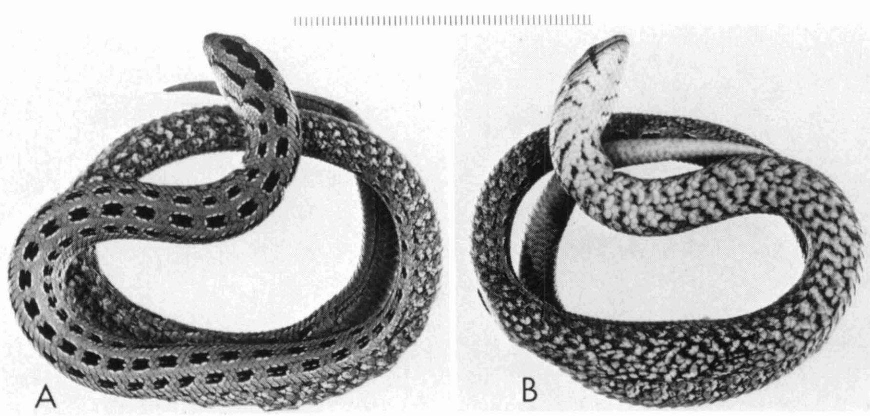

Fig. 106. Dorsal (A) and ventral (B) views of *Pygopus lepidopodus* (UMMZ 129991; male; 15 mi N Jurien Bay, Western Australia). SVL = 165.3 mm.

Gray (1845a) listed his species *P. squamiceps* from New Holland but not from the geographic categories "W. [and] NW Coast of Australia." This suggests that the type was collected at a southern or eastern location (Gray, 1845a:xii).

Shortly after Tepper (1882) described *P. longicaudatus* he became a member of the staff of what is now the South Australia Museum (Musgrave, 1932). It seems likely that he deposited the holotype in that institution; however, the specimen can not be located (T. Houston, pers. comm.). The fact that Tepper's name *longicaudatus* has not appeared in the literature since the original paper requires that it be considered a *nomen oblitum.*

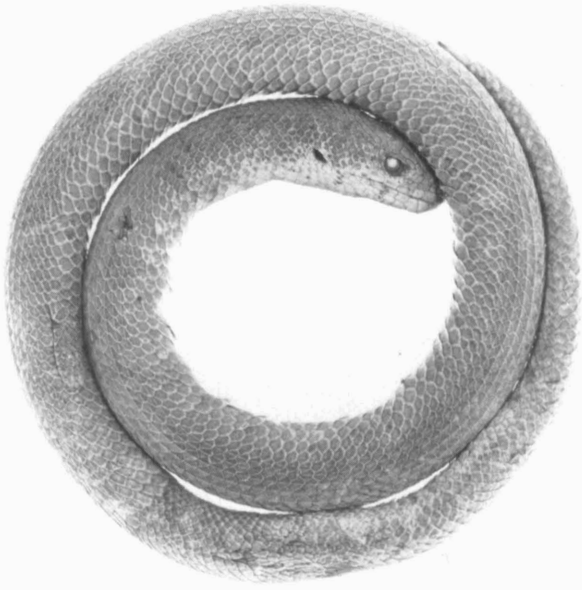

Fig. 107. Right lateral view of *Pygopus lepidopodus* (FM 29112; female; no data, Queensland). SVL = 274.8 mm.

There appear to be at least two records of *lepidopodus* from Tasmania. Both are without exact locality data. One specimen was reported by Boulenger (1885a:242), the other is NMV R10933. The current consensus of opinion among Australian herpetologists and biologists living in Tasmania is that these records are spurious and that the species does not exist on the island. The New Zealand record represents an introduction (Oliver, 1921).

In spite of the fact that *lepidopodus* is wide ranging and occurs in and near many of the most densely populated regions of Australia, very little is known of its biology. Serventy (1951) collected a specimen under a bush within 30 yards of the beach at Israelite Bay, Western Australia, which flattened its neck region when captured, like many Australian elapids. Most of Linton's (1929) observations are so extraordinary that they require confirmation. Although *lepidopodus* possesses a relatively narrow geographic range it is almost certainly sympatric at different localities with all but the following pygopodids: *Aprasia parapulchella, A. rostrata, Delma borea, D. elegans, D. pax, Lialis jicari, Ophidiocephalus taeniatus* and *Paradelma orientalis.*

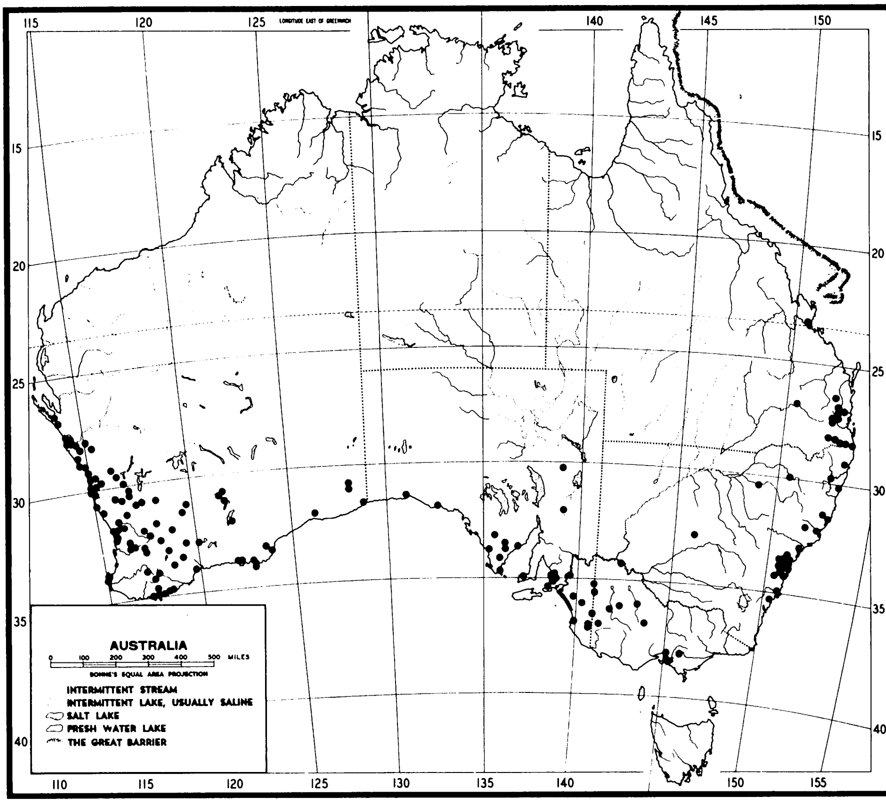

Fig. 108. Geographic distribution of *Pygopus lepidopodus* based on specimens examined; see pages 202-3.

Pygopus nigriceps (Fischer)

Figs. 1, 3, 5, 109-114, 119-20, 124.

1882. *Cryptodelma nigriceps* Fischer, Arch. Naturgesch., 48:290, pl. 16, figs. 5-9. Holotype: KNS 2259. Type locality: Nicol Bay, Western Australia. Presented by F. von Müller.

1897. *Delma* (*Cryptodelma*) *Baileyi* Günther, Ann. Mag. nat. Hist., 19:170, 1 text-fig. Holotype: Unknown. Type locality: near Cue, Western Australia. Collected by H. N. Bailey.

1913. *Pygopus schraderi* Boulenger, Ann. Mag. nat. Hist., 12:564. Holotype: BM 1946.8.27.2 (formerly 1913.7.28.2). Type locality: Milparinha [= Milparinka], New South Wales. Collected by P. Schrader.

GEOGRAPHIC RANGE.—Widely distributed throughout the more xeric parts of Australia. *Nigriceps* is known from Western Australia, Northern Territory, South Australia, New South Wales and Queensland. It appears to be absent only from the more mesic southwestern and southeastern margins of the continent, and from much of the area east of the Great Dividing Range (Fig. 112).

DIAGNOSIS.—*Nigriceps* differs from *P. lepidopodus,* the other species in the genus, in possessing the following combination of character states: a) subnostril scale often present, b) ventral scales in males average 118.6, in females 123.7, c) usually five hind limb scales, d) dorsal snout pattern absent, e) dorsal head bands usually present, f) ventral body surfaces immaculate (Figs. 1, 3, 5, 109-111).

DESCRIPTION.—(n = 115) SVL -.32 (0.011) 4.90 (0.011) 66.4-206.0, HL -.23 (0.004) 2.17 (0.004) 5.0-12.7, SL -.23 (0.004) 1.51 (0.004) 2.6-7.1, EW -.19 (0.007) 0.63 (0.007) 1.2-2.5, PL -.25 (0.012) 0.79 (0.012) 1.2-3.7, HW -.24 (0.006) 1.98 (0.006) 4.0-11.6, HD -.22 (0.005) 1.75 (0.005) 3.1-8.7, RD -.20 (0.006) 0.33 (0.006) 0.8-2.0, RW -.19 (0.005) 1.21 (0.005) 2.0-4.8, RLD -.14 (0.018) -.85 (0.018) 0.2-0.8, RLV -.21 (0.009) 0.35 (0.009) 0.8-2.1, MD -.19 (0.009) 0.54 (0.009) 0.9-3.2, MW -.18 (0.004) 1.21 (0.004) 2.1-4.7, ML -.16 (0.009) 0.81 (0.009) 1.4-3.4, TL (n = 50) -.45 (0.026) 5.14 (0.031) 60.5-268.0, PNS 1.0, SNS 0.6 (0.05) 0-1, INS 2.1 (0.02) 2-3, RP 0.0, LS 6.1 (0.07) 5-8, AOS 7.7 (0.12) 5-11, PRS 5.8 (0.11) 4-9, SLS 6.5 (0.06) 5-8, FS 5.2 (0.05) 5-8, IOS 5.1 (0.03) 5-7, POS 5.2 (0.08) 3-7, OS 18.3 (0.18) 12-22, SOS 1.1 (0.02) 1-2, PS 1.0, NS 17.1 (0.19) 13-22, EAM 0.0, PM 3.7 (0.08) 3-5, ILS 8.3 (0.09) 6-10, GS 18.8 (0.12) 16-23, DSK 0.3 (0.04) 0-1, VSK 0.0, VS 120.8 (1.21) 93-147, PVS 18.5 (0.21) 14-27, MS 23.4 (0.13) 21-28, VBS 2.0, PP 12.1 (0.17) 9-17, IPS 0.0, IGS 0.1 (0.03) 0-1, PAS 2.1 (0.03) 2-3, PCS 5.9 (0.09) 4-8, HLS 4.9 (0.06) 3-7, CS 14.2 (0.11) 12-17, SCS 3.1 (0.04) 3-5, DSP 0.0, DIP 0.6 (0.05) 0-1, DPP 1.7 (0.12) 0-3, DNP 1.9 (0.08) 0-3, PNB 0.2 (0.04) 0-1, LHP 0.0, LLP 1.9 (0.04) 0-4, TP 0.4 (0.03) 0-2, DBP 0.6 (0.05) 0-2, VBP 0.0, VP 0.6 (0.02) 0-1.

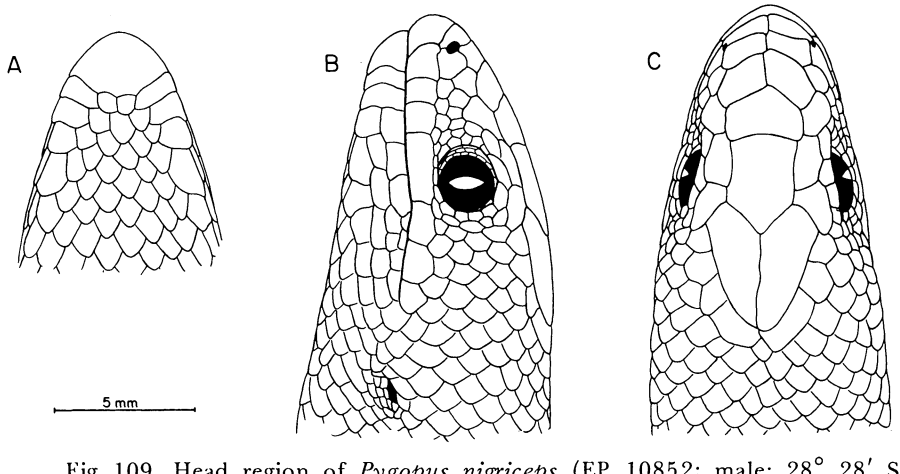

Fig. 109. Head region of *Pygopus nigriceps* (EP 10852; male; 28° 28′ S Lat, 122° 50′ E Long, Western Australia). A. Ventral view of mental region. B. Left lateral view. C. Dorsal view.

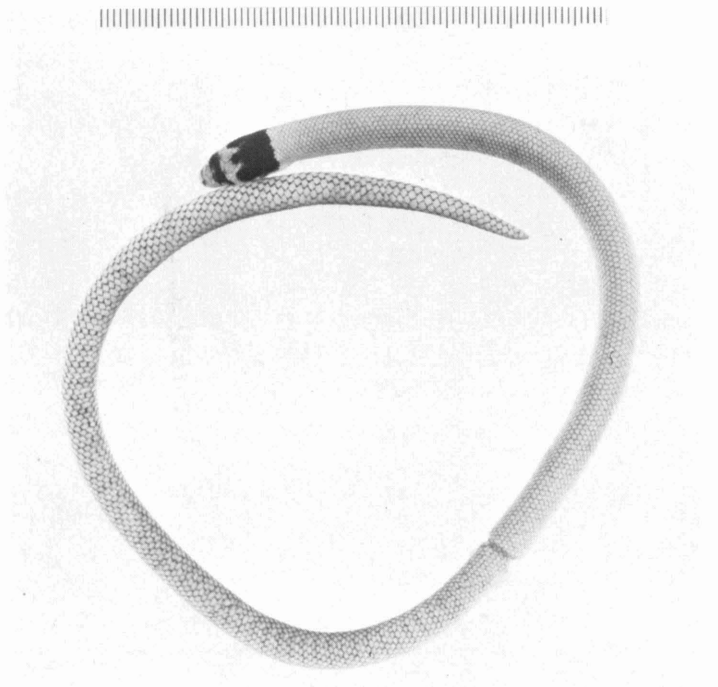

Fig. 110. Dorsal view of *Pygopus nigriceps* (EP 13415; male; 28° 28′ S Lat, 122° 51′ E Long, Western Australia). SVL = 127.8 mm.

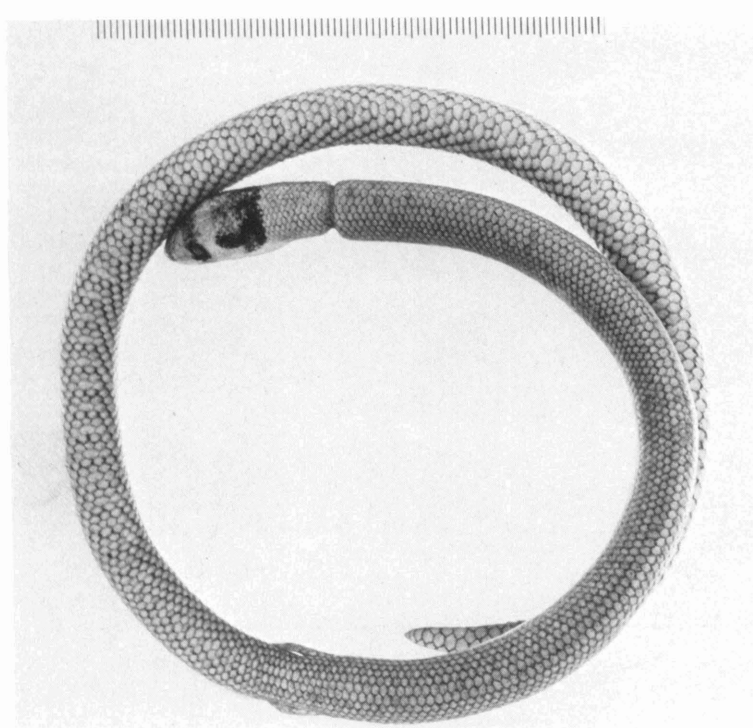

Fig. 111. Dorsal view of *Pygopus nigriceps* (EP 10811; male; 28° 28′ S Lat, 122° 50′ E Long, Western Australia). SVL = 175.8 mm.

INDIVIDUAL VARIATION.—AM R8974 is a juvenile (SVL = 84.0) male (?) from near Hughenden, Queensland. The striped head and body color pattern and well developed nature of the keel on the dorsal body scales are reminiscent of *P. lepidopodus* and unlike *nigriceps.* The fact that the specimen is badly preserved may account for the keeled scales. It has 115 ventral scales which is not significantly different from eastern male *nigriceps,* the species to which it is tentatively referred, but that number is well beyond the upper extreme for ventrals even in female *P. lepidopodus* (110).

GEOGRAPHIC VARIATION.—Univariate and multivariate analyses reveal considerable divergence between western and eastern *nigriceps* (Figs. 112-4). The most obvious region of character discontinuity is a narrow zone located along approximately 135° E Long (Fig. 112). Individuals north of 18° S Lat in Western Australia and Northern Territory are not sufficiently numerous to be able to identify the northern extension of the character discontinuity and

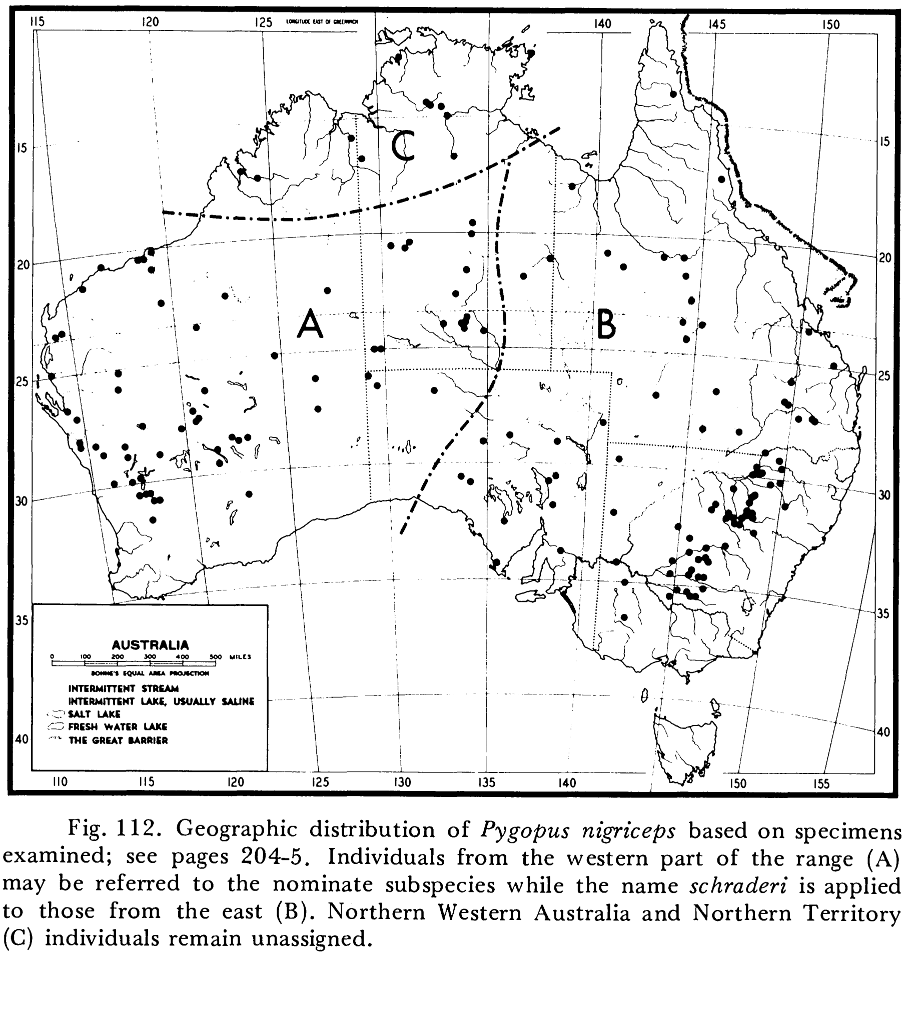

Fig. 112. Geographic distribution of *Pygopus nigriceps* based on specimens examined; see pages 204-5. Individuals from the western part of the range (A) may be referred to the nominate subspecies while the name *schraderi* is applied to those from the east (B). Northern Western Australia and Northern Territory (C) individuals remain unassigned.

therefore they are treated as a taxonomically separate problematical set at this time. In recognition of the degree of divergence in *nigriceps* it appears to be useful to recognize two subspecies. Individuals approximately to the west of 135° E Long (A of Fig. 112) are referred to the nominate subspecies while the name *schraderi* is applied to those from the east (B of Fig. 112). The few northern individuals available to me (C of Fig. 112) tend to be more like *n. schraderi* than *n. nigriceps* (Fig. 113; Table 21). Fig. 114, number of ventral scales plotted against longitude, most clearly exemplifies the tendency of more western *n. nigriceps* to converge towards *n. schraderi*. Note that the greatest difference between *n. nigriceps* and *n. schraderi* occurs where they approach each other in central Australia and thus the degree of the character discontinuity is relatively greater there.

Stepwise multiple linear discriminant analysis of *n. nigriceps* and *n. schraderi* (sexes analyzed separately, and the taxonomically unassigned individuals excluded) helps to characterize their degree of divergence. Table 22 summarizes the conclusions. The posterior probabilities of males classified correctly as *n. nigriceps* range from 0.85 to 1.0 and as *n. schraderi* from 0.99 to 1.0. The posterior probabilities of females classified as *n. nigriceps* range from 0.99 to 1.0 and as *n. schraderi* from 0.98 to 1.0 with the exception of QM J4570. This exceptional female is from Bollon, Queensland and its posterior probability of classifying with *n. nigriceps* is 0.74 and 0.26 with *n. schraderi*. There is no obvious explanation for its misclassification.

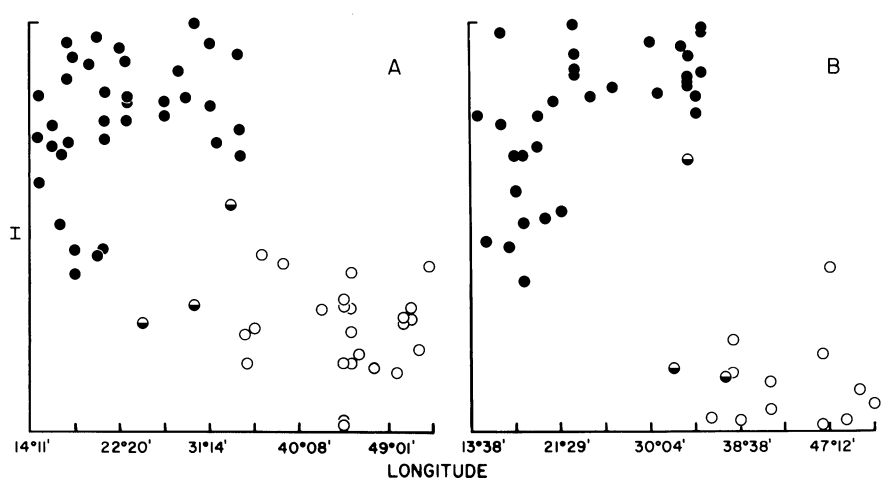

Fig. 113. Male (A) and female (B) *Pygopus nigriceps* plotted according to longitude and principal component I. Individuals represented by closed circles are referred to the nominate subspecies, *n. nigriceps*, while the name *n. schraderi* is applied to those characterized by open circles. The half open circles are not obviously assignable to either subspecies (see Fig. 112). Table 21 lists the characters used in this analysis and their component correlation coefficients.

TABLE 21

RESULTS OF PRINCIPAL COMPONENT ANALYSIS OF INDIVIDUAL *PYGOPUS NIGRICEPS* (*see Fig. 113*)*

Component	I (♂)	I (♀)
Eigenvalue	7.6	6.9
% total variance	22.3	20.8
Independence	804.8	792.6
df	560	527
Significance	0.0	0.0
SNS	0.9	0.8
INS	-.3	-.2
LS	0.1	0.3
AOS	0.4	0.1
PRS	0.7	0.5
SLS	0.1	0.0
FS	-.3	-.2
IOS	-.3	0.0
POS	0.7	0.4
OS	0.7	0.2
SOS	-.2	0.2
NS	-.7	-.7
PM	-.3	-.8
ILS	0.6	0.6
GS	-.3	-.3
DSK	-.7	-.9
VS	0.8	0.7
PVS	0.3	0.2
MS	-.6	-.6
PP	-.8	-.7
IGS	0.2	0.2
PAS	0.2	-.3
PCS	0.3	0.4
HLS	-.1	-.2
CS	-.6	-.6
SCS	-.1	-.3
DIP	0.7	0.5
DPP	0.7	0.5
DNP	-.2	-.3
PNB	-.2	-.2
LLP	0.3	-.3
TP	-.3	**
DB	-.1	-.2
VP	-.3	-.3

*Males and females were analyzed separately because of the presence of sexual dimorphism in several characters.
**Invariant character among females.

The two subspecies differ significantly in 14 scale and color pattern characters. Only the individuals referred to sections A (*n. nigriceps*) and B (*n. schraderi*) of Fig. 112 were compared. The significant differences between the subspecies are as follows:

TABLE 22

A FORWARD STEPWISE MULTIPLE LINEAR DISCRIMINANT ANALYSIS OF *PYGOPUS N. NIGRICEPS* AND *P. N. SCHRADERI* (*see Fig. 112*)

Step	Characters separating males	F-statistic	Significance
1	SNS	113.8	0.000
2	NS	33.3	0.000
3	DSK	13.9	0.000
4	PP	11.5	0.001
5	MS	4.4	0.040

n = 38 in *n. nigriceps*; n = 24 in *n. schraderi.*

Step	Characters separating females	F-statistic	Significance
1	DSK	106.0	0.000
2	NS	23.3	0.000
3	PP	12.3	0.001
4	IGS	8.1	0.007

n = 34 in *n. nigriceps*; n = 13 in *n. schraderi.*

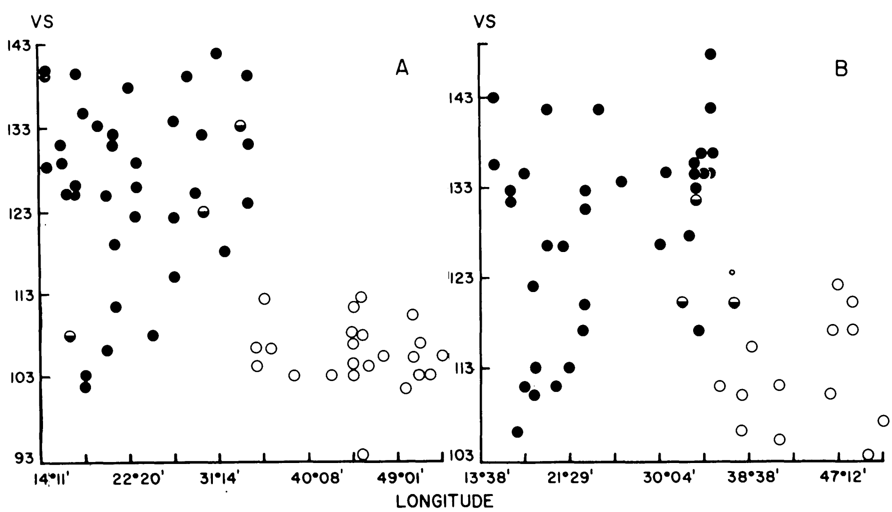

Fig. 114. Male (A) and female (B) *Pygopus nigriceps* plotted according to longitude and number of ventral scales. The symbols are explained in the legend of Fig. 113. Note that the lower number of ventrals in *n. nigriceps* (closed circles) occurs in the more western part of its range.

n. nigriceps (n = 72) SNS 0.9 (0.04) 0-1, PRS 6.1 (0.14) 4-9, POS 5.4 (0.09) 4-7, OS 18.9 (0.21) 15-22, NS 16.0 (0.15) 13-19, PM 3.5 (0.06) 3-4, ILS 8.7 (0.10) 7-10, DSK 0.04 (0.02) 0-1, VS 127.4 (1.25) 102-147, MS 22.7 (0.11) 22-24, PP 11.0 (0.12) 9-14, CS 13.7 (0.10) 12-16, DIP 0.8 (0.04) 0-1, DPP 2.2 (0.13) 0-3.

n. schraderi (n = 37) SNS 0.03 (0.03) 0-1, PRS 5.1 (0.15) 4-7, POS 4.7 (0.12) 3-7, OS 17.2 (0.33) 12-21, NS 19.2 (0.24) 16-22, PM 4.1 (0.11) 3-5, ILS 7.8 (0.13) 6-9, DSK 0.8 (0.07) 0-1, VS 107.7 (0.93) 93-122, MS 24.4 (0.25) 21-28, PP 14.0 (0.23) 12-17, CS 15.2 (0.15) 13-17, DIP 0.3 (0.08) 0-1, DPP 0.8 (0.18) 0-3.

SEXUAL DIMORPHISM.—A sample of 65 males was compared to one of 50 females and no significant differences were observed.

REMARKS.—A. Grandison (pers. comm.) has informed me that "apparently neither the type of *Delma (Cryptodelma) baileyi* nor the *Varanus caudolineatus* which is also mentioned in Günther's description of *baileyi* came to this Museum [British Museum (Natural History)] and the collector's name, H. N. Bailey, does not appear in our records. Other species described by Günther about that time did not come to the B.M. At one time we thought these types might have been deposited at Tring or in a private collection maintained perhaps by Günther, but inquiries that we have made of the Tring Museum and of Günther's grandson suggest that this did not happen." These comments suggest that the holotype of *P. baileyi,* which was collected near Cue, Western Australia, is lost. The original description is very detailed, however, and from its comparison to *nigriceps* there can be little doubt that the two are conspecific (Mertens, 1966b). Günther (1897:170) emphasized the smaller number of "longitudinal series of scales" (=MS) as the major difference between his *P. baileyi* (MS = 22) and *nigriceps* (MS = 26 or 28). The range of variation now known to exist in *nigriceps* is much greater than that described by Günther and 22 is not significantly different from the species' mean (23.4). Moreover, the difference between the holotype of *P. baileyi* and *nigriceps* is even less when the comparison is made between it and the western *n. nigriceps* (22.7).

The record of *nigriceps* from Sydney (AM R5221) seems to be erroneous since all of the many other New South Wales localities are west of the Great Dividing Range. There is nothing associated with the specimen or in the catalogue to indicate its true provenance (H. Cogger, pers. comm.). The coastal Currumbin, Queensland (QM J6079) record is doubtful as well and here too there is nothing in the catalogue or associated with the specimen that would suggest its correct place of origin (J. Covacevich, pers. comm.). *P. lepidopodus* (QM J6650) has been collected at Currumbin.

Nigriceps appears to be very abundant on sandy soils and particularly in areas of porcupine grass (*Triodia*). Three specimens of *n. schraderi* were collected on a red sand hill at night. The air temperature and humidity were high and the specimens were found moving slowly within and between small clumps of *Triodia.* Pianka (1969) reports that western *n. nigriceps* inhabit desert sandhill and sandridge associations; large eucalypt trees, porcupine grass and sandridge perennials. He also notes that this subspecies occurs in *Triodia* and scattered bush communities that have a eucalpyt canopy.

Bustard (1968c) described "defensive display behavior" in an individual *nigriceps* from Coen, Queensland. He interpreted the head raising, neck flattening and striking behavior as mimetic to elapid snakes; also see Bustard (1970), Hall (1905), Longman (1916) and Serventy (1951). Three specimens were collected by me near Innamincka, South Australia but they did not exhibit the defensive display described by Bustard.

Nigriceps is sympatric at different localities with one or more of the following pygopodids: *Aprasia aurita, A. inaurita, A. pseudopulchella, A. striolata, Delma australis, D. borea, D. fraseri, D. inornata, D. molleri, D. nasuta, D. pax, D. plebeia, D. tincta, Lialis burtonis, Ophidiocephalus taeniatus, Paradelma orientalis, Pygopus lepidopodus.* The geographic ranges of *D. elegans* and *D. torquata* are very close to that of *nigriceps* and they too may be found in sympatry.

DICHOTOMOUS KEY TO SPECIES OF THE FAMILY PYGOPODIDAE[1]

1a. Ventral scales strongly keeled (Fig. 4) ....*Pletholax gracilis* (Figs. 3-6, 103-4)
1b. Ventral scales smooth (Fig. 4).......................... 2

2a. Preanal pores present (Fig. 6) 3
2b. Preanal pores absent (Fig. 6) 7

3a. Less than nine preanal pores present...................... 4
3b. More than eight preanal pores present.................... 6

4a. Two internostril scales present .... *Paradelma orientalis* (Figs. 101-2)
4b. More than three internostril scales present 5

5a. Almost always four preanal pores present (4.0, 2-6); usually five internostril scales present (5.0, 4-6); usually two suborbital scales present (2.3, 1-3)....... *Lialis burtonis* (Figs. 6, 87-91)
5b. Almost always six preanal pores present (6.2, 6-8); usually seven internostril scales present (6.9, 5-8); usually three suborbital scales present (3.3, 2-5) .... *Lialis jicari* (Figs. 94-5)

6a. Ventral body plates without dark pigmentation; interorbital, parietal and/or nuchal dark bands almost always present; usually five interorbital scales present (5.1, 5-7)................. .... *Pygopus nigriceps* (Figs. 1, 3, 5, 109-111)
6b. Ventral body plates usually covered with conspicuous dark pigmentation; interorbital, parietal and/or nuchal dark bands

[1]All characters are defined on pages 4-14. The mean and range of certain meristic characters may be enclosed in parentheses.

absent; usually seven interorbital scales present (6.7, 5-9) ....*Pygopus lepidopodus* (Figs. 1-3, 6-7, 105-8)

7a. Parietal scales present (Fig. 2); external auditory meatus present (Fig. 1; small and hidden beneath temporal scales in *Ophidiocephalus taeniatus*) 8
7b. Parietal scales absent (Fig. 18); external auditory meatus absent (Fig. 21; present in *Aprasia aurita;* Fig. 19)............. 10

8a. Anterior-most pair of internostril scales separated on midline by rostral; twenty midbody scales present; continuous dark stripes present on body and tail .... *Aclys concinna* (Figs. 4, 6, 16-7)
8b. Anterior-most pair of internostril scales in contact on midline[2] (Fig. 48); almost always less than 19 midbody scales present; continuous dark stripes absent (*Delma impar* is an exception; Fig. 60) 9

9a. Less than eight nuchal scales present (Fig. 99); external auditory meatus extremely small, hidden beneath temporal scale... .... *Ophidiocephalus taeniatus* (Figs. 99-100)
9b. More than eight nuchal scales present; external auditory meatus large, not covered by temporal scales (Fig. 1) 19

10a. External auditory meatus present (opening small and partially concealed beneath emarginate temporal scale) ....*Aprasia aurita* (Figs. 18-20)
10b. External auditory meatus absent 11

11a. Head and tip of tail black, body and remainder of tail conspicuously lighter in color ......*Aprasia smithi* (Figs. 33-4)
11b. Color and color pattern of head and tip of tail not conspicuously different from body and remainder of tail (Fig. 37)... 12

12a. Nasal and supralabial scales completely or partially fused together posterior to nostril (Fig. 25) 13
12b. Nasal and supralabial scales not fused together posterior to nostril (Fig. 28) 15

13a. Two preanal scales present.... *Aprasia pulchella* (Figs. 5, 25-6)
13b. Three preanal scales present (Fig. 6) 14

14a. Ventral scales average 162.3 (158-169) in males, 170.0 (160-184) in females; three preorbital scales often present; lateral head pattern absent... *Aprasia parapulchella* (Figs. 22-3)
14b. Ventral scales average 175.4 (166-186) in males, 185.1 (174-193) in females; two preorbital scales present; faint lateral head pattern often present... *Aprasia pseudopulchella* (Fig. 24)

[2]One *Delma australis* possesses a rostral which separates the pair of internostril scales on the midline.

15a. One postorbital scale present (Fig. 28) 16
15b. Two or more postorbital scales present (Fig. 36) 17

16a. Twelve midbody scales present[3]. . *Aprasia repens* (Figs. 7, 28-9)
16b. Fourteen midbody scales present .... *Aprasia rostrata* (Figs. 30-31)

17a. Twelve midbody scales present ... *Aprasia striolata* (Figs. 36-9)
17b. Fourteen midbody scales present........................ 18

18a. Two preanal scales present; snout very long and pointed in profile when viewed dorsally .... *Aprasia rostrata* (Figs. 30-31)
18b. Almost always three preanal scales present; snout relatively short and round in profile when viewed dorsally .... *Aprasia inaurita* (Fig. 21)

19a. One or two narrow dorsolateral white stripes present on body and tail; nasal and supralabial scales fused together anterior to nostril .... *Delma impar* (Figs. 7, 59-60)
19b. Stripes absent on body and tail; nasal and supralabial separate scales anterior to nostril (Fig. 48) 20

20a. Two broad dark bands present posterior to parietal scales (Figs. 49, 86) 21
20b. One or no dark bands present posterior to parietal scales (Figs. 53-55) 22

21a. Five frontal scales present; fourth supralabial located below orbit; three preanal scales present . . *Delma elegans* (Figs. 48-50)
21b. Four frontal scales present; third supralabial located below orbit; two preanal scales present . . *Delma torquata* (Figs. 6, 85-6)

22a. Almost always 14 midbody scales present; four frontal scales present; third supralabial located below orbit .... *Delma tincta* (Figs. 81-4)
22b. Almost always more than 14 midbody scales present; five frontal scales almost always present (*Delma australis* and *D. molleri* almost always possess four); fourth or fifth supralabial almost always located below orbit (*Delma pax* almost always has the third in that position) 23

23a. Almost always 18 midbody scales present; four frontal scales almost always present.............................. 24
23b. Almost always less than 18 midbody scales present; five frontal scales almost always present 25

24a. Ventral body plates usually not conspicuously wider than those of sides of body; dark pigmentation (reticulation) almost always present on throat; ventral scales average 82.5 (77-88) in males, 88.5 (81-95) in females . . *Delma australis* (Figs. 4,6,41-2)

[3]One *Aprasia repens* possesses 14 midbody scales.

24b. Ventral body plates conspicuously wider than those of sides of body; pigmentation absent on throat; ventral scales average 72.7 (69-77) in males, 76.1 (71-84) in females .... *Delma molleri* (Figs. 65-8)

25a. Almost always two preanal scales present; conspicuous lateral lip pattern present; dorsal head bands absent .... *Delma plebeia* (Figs. 78-80)
25b. Almost always three preanal scales present; lateral lip pattern present or absent; dorsal head bands present or absent 26

26a. Third supralabial almost always located below orbit; throat and ventral body surfaces devoid of dark pigmentation.. *Delma pax* (Figs. 74-7)
26b. Fourth or fifth supralabial almost always located below orbit; dark pigmentation usually present on throat and ventral body surfaces (absent in *Delma grayii* and *D. inornata*).......... 27

27a. Conspicuous dorsal head bands absent (Figs. 57, 63, 71-2)... 28
27b. Dorsal head bands present (Figs. 45-6, 53-5) 30

28a. Usually eight (7.9, 4-11) preorbital scales present; usually 16 (15.5, 12-19) nuchal scales present; usually 17 (16.8, 13-20) gular scales present; ventral body dark pigmentation usually present on ventral plates .... *Delma nasuta* (Figs. 70-72)
28b. Usually less than eight preorbital scales present; usually less than 16 nuchal scales present; usually less than 17 gular scales present; dark pigmentation absent from ventral body plates. . 29
29a. Conspicuous lateral lip pattern present; ventral surfaces bright lemon yellow in life............... *Delma grayii* (Figs. 56-7)
29b. Conspicuous lip pattern absent; ventral surfaces flesh color in life .... *Delma inornata* (Figs. 62-4)

30a. Dark pigmentation almost always absent on throat; four anterior orbital scales present; usually less than six infralabial scales present; usually less than three hind limb scales present.. *Delma borea* (Figs. 44-6)
30b. Dark pigmentation almost always present on throat; almost always more than four anterior orbital scales present; usually more than five infralabial scales present; usually more than three hind limb scales present .... *Delma fraseri* (Figs. 4, 51-5)

SUMMARY

The Pygopodidae is the only reptile family endemic to Australia and New Guinea, and it provides an excellent group of lizards with which to study convergence in snake-like form and function. The goals of this study are primarily to revise taxonomically all of the species in the family, and secondarily to investigate the likelihood of multiple convergence of snake-like habits.

Wermuth's (1965) checklist of the family includes only seven genera and 13 species, with an additional three subspecies. The present revision involved identification of a total of 3321 individuals and the scoring of 59 characters on 1690 representatives. The 59 characters were selected from among a much larger number surveyed, because very few are logically redundant, they exhibit very little statistical correlation (except for the morphometric subset), sexual difference or sampling error, and they represent the three qualitatively different phenotypic systems of size and shape, scutellation and color pattern. Perhaps most important is the fact that each character's states are readily identified as a homologous set. A phenetic species concept (*sensu* Sokal and Crovello, 1970) was employed, and the geographic range, diagnosis, species, individual and geographic variation, and sexual dimorphism are described for all those recognized. Each species' description is preceded by a primary synonyomy and followed by a remarks section in which important nomenclatural and biological issues are discussed.

As might be expected in a group which has relatively recently evolved a snake-like form, pygopodids exhibit the least conservatism in those morphometric dimensions which describe the long axis of the head and body. The morphometric characters also display a range of coadaptation, in the sense that there is a negative correlation between mean within- and between-population correlation coefficients. The species' relative growth was used in analysis of interspecific phenetic similarity. Similarity among species based on the growth dimension corresponded very little to that obtained from the cluster analysis of the scale and color pattern characters. Pygopodids are similar to snakes in that males of a species almost always have shorter bodies, but longer tails, than females. The species were clustered according to four morphometric variables: largest snout-to-vent length, head width and eye width as percentages of the largest individual, and tail length as a percentage of the largest adult male. The groups of species that are delimited do not correspond to the broad adaptive types—locomotor and mode of prey location—that might be expected to be predicted by the dimensions. Moreover, there is very little similarity between these groups and those obtained from cluster analysis of the scale and color pattern variables.

Interspecific phenetic relationships were revealed by cluster analysis of equally weighted scale and color pattern characters. The cluster analytic methods were also applied to a weighted data set consisting of the same species and characters. The average within-local-sample standard deviation served as the weighting function. My choice of that function was based on the fact that pygopodids, like many other vertebrates, exhibit a large significant positive correlation between the mean within local sample standard deviation and the degree to which the character has evolved. Similar major clusters of species and between group relationships are identifiable in both the phenetic and evolutionary analyses, except for the placement of

Pletholax gracilis, and these form the basis for the generic classification enumerated below. In both phenetic and evolutionary analyses there are significant within group differences; *Aprasia* species differ very little from each other while those within *Lialis* and *Pygopus* are very highly divergent.

The following list summarizes the geographic, nomenclatural and taxonomic conclusions.

1. *Aclys concinna* gen. et sp. nov. is known from two specimens from the western coast of Western Australia.
2. *Aprasia aurita* sp. nov. is known from a restricted region in northwestern Victoria. It is unique within the genus *Aprasia* in possessing an external auditory meatus.
3. *Aprasia inaurita* sp. nov. is irregularly distributed in the central portion of southern Australia.
4. *Aprasia parapulchella* sp. nov. is known from two localities in the Australian Capital Territory and a nearby part of New South Wales.
5. *Aprasia pseudopulchella* sp. nov. appears to be restricted to the Flinders Ranges, South Australia.
6. *Aprasia pulchella* Gray is confined to southwestern Western Australia, and its type locality is restricted to Kalamunda National Park, Western Australia.
7. *Aprasia repens* (Fry) is confined to southwestern Western Australia, and its type locality is restricted to Swan View National Park, Western Australia. An ecophenotypic effect may be identified in the significant positive correlation between number of ventral scales and mean December temperature.
8. *Aprasia rostrata* Parker is known from Hermite Island, Western Australia. The differences between *A. rostrata* and *A. repens* seemed sufficient to warrant their recognition as closely related allopatric species.
9. *Aprasia smithi* Storr is known from the vicinity of Kalbarri, Western Australia. It is unique among pygopodids in possessing a jet black head and tail tip.
10. *Aprasia striolata* Lütken exhibits a highly discontinuous distribution along the southern margin of Australia, in addition to a geographically exceptional record from Mt Buring, Northern Territory. The Western Australia isolate to which Parker (1956) applied the name *A. s. glauerti* cannot be distinguished from some eastern populations and it has been placed in the synonomy of *A. striolata.* The type locality of *A. striolata* is restricted to Tea Tree Gully, South Australia. An ecophenotypic effect may be identified in the significant positive correlation between number of ventral scales and mean December temperature.
11. *Delma australis* sp. nov. has a widespread southern distribution, and multivariate analysis reveals some geographic differentiation.
12. *Delma borea* sp. nov. is widespread in northern Australia.

13. *Delma elegans* sp. nov. is known from three localities in the vicinity of the Hamersley Range, Western Australia.

14. *Delma fraseri* Gray is confined to southwestern Western Australia, and the type locality is restricted to John Forrest National Park, Western Australia.

15. *Delma grayii* A. Smith, previously recognized as a synonym of *D. fraseri,* appears to be confined to Western Australia between Wittecarra Gully, Rockingham and Koorda. Its type localtiy is restricted to Kalamunda National Park, Western Australia.

16. *Delma impar* (Fischer) is confined to southeastern Australia. NMV R10883, collected at Hamilton, Victoria is designated the neotype of *D. impar.*

17. *Delma inornata* sp. nov. is widely distributed in eastern Australia.

18. *Delma molleri* Lütken, previously recognized as a synonym of *D. fraseri,* is confined to southcentral South Australia. Its type locality is restricted to Tea Tree Gully, South Australia.

19. *Delma nasuta* sp. nov. is widespread throughout the more arid regions of the western two-thirds of Australia.

20. *Delma pax* sp. nov. is confined to the Hamersley Plateau, Western Australia.

21. *Delma plebeia* De Vis, previously placed in the synonomy of *D. fraseri,* is confined to southeastern Queensland and eastern New South Wales. QM J254 is designated the lectotype of *D. plebeia* and Brisbane, Queensland is given as the species' restricted type locality.

22. *Delma tincta* De Vis is widely distributed throughout the northern part of Australia. *Tincta* can no longer be considered a subspecies of *D. fraseri*; they are sympatric and their numerous differences indicate that they are relatively distantly related. QM J241 is designated the lectotype of *D. tincta* and the species' type locality is restricted to Normanton, Queensland. The distinctive head banding of *D. tincta* may serve to render the head cryptic when it projects above the substrate.

23. *Delma torquata* sp. nov. is confined to southeastern Queensland.

24. *Lialis burtonis* Gray is widespread throughout most of Australia and along the south and northeast coasts of New Guinea. It is a locally variable species but it exhibits little between locality differentiation. AM R27914 is designated the neotype of *L. burtonis* and its type locality is restricted to Round Hill Fauna Reserve, New South Wales.

25. *Lialis jicari* Boulenger is confined to New Guinea and New Britain. Lindholm's (1905a) descriptions of *Alopecosaurus cuneirostris* and *A. c. inornata* have been overlooked in the recent past and both forms are referred to the synonomy of *L. jicari.* North and south coast samples exhibit considerable differentiation, and character displacement may be present in south coast samples where it is sympatric with *L. burtonis.* BM 1946.8.26.69 is designated the

lectotype of *L. jicari* and Wasua, New Guinea is considered the species' type locality.

26. *Ophidiocephalus taeniatus* Lucas and Frost is known only from the holotype from Charlotte Waters, Northern Territory. Its small, movable eyeball and hidden ring of ocular scales are unique among the pygopodids and may indicate a "fossorial sand swimming" mode of locomotion.

27. *Paradelma orientalis* (Günther) is confined to the region between 23° and 26° south latitude east of the Great Dividing Range, Queensland, and BM 1946.8.13.48 is designated the lectotype of the species.

28. *Pletholax gracilis* (Schlegel) is confined to a narrow range in Western Australia between Eneabba and Mandurah. Schlegel must be credited with the authorship of *P. gracilis* while Cope is retained as the original describer of the genus *Pletholax.* The type locality is restricted to Neerabup National Park, Western Australia.

29. *Pygopus lepidopodus* (Lacépède), with few exceptions, occupies the southwestern, southern and eastern margins of Australia. The Tasmania records cannot be confirmed. Tepper's (1882) long-forgotten name, *Pygopus longicaudatus,* was almost certainly based on a *P. lepidopodus* and it is considered a *nomen oblitum.* East coast populations exhibit some differentiation from those to the west. The type locality of *P. lepidopodus* is restricted to the northwest mainland opposite King Georges Sound, Western Australia.

30. *Pygopus nigriceps* (Fischer) is widespread throughout the more xeric parts of Australia. In the absence of distinguishing features Günther's *Delma baileyi* must be considered a synonym of *P. nigriceps.* There is considerable divergence between eastern and western *P. nigriceps* and two subspecies are recognized, a western *n. nigriceps* and an eastern *n. schraderi* Boulenger. Geographically proximate samples of the two subspecies are very different while far western samples tend to converge with those to the east.

The status of almost all of the named genera in the family is reviewed and no reason can be found to recognize *Ophioseps* Barboza du Bocage as distinct from *Aprasia* Gray, *Nisara* Gray and *Pseudodelma* Fischer as distinct from *Delma* Gray, and *Alopecosaurus* Lindholm as distinct from *Lialis* Gray. *Aclys* is described as a new genus, accommodating the species *concinna* sp. nov., which exhibits several unique features in the family and it is, in general, quite divergent from all other forms.

Sexual dimorphism, when present, is almost always confined to the number of ventral scales. In those species with head bands the pattern becomes less conspicuous with increasing size (? = age).

A dichotomous key to the species is constructed, and a gazetteer to all place names which appear in the locality records of the pygopodids examined, a complete list of all specimens examined and a bibliography to the family through 1972 are provided.

Fig. 115. North facing slope leading to Molonglo R, Coppins Crossing, Australian Capital Territory. The vegetation on the slope consists largely of short grasses and the native oak, *Casuarina cunninghami*, and granite rocks are common throughout the area. This is the type locality of *Aprasia parapulchella*.

Fig. 116. The type series of *Aprasia parapulchella* from Coppins Crossing, Australian Capital Territory (see Fig. 115), was collected under weathered lichen-covered granite rocks, and a typical site is shown in this photograph. The upper arrow points to a shed skin of *A. parapulchella* adhering to the base of a flat granite rock. The lower arrow points to the mouth of an ant (*Iridomyrmex* sp.) tunnel into which *A. parapulchella* attempt to escape when disturbed. The Australian 20¢ piece has been placed in the photograph for perspective.

Fig. 117. Open pasture land, with scattered termite mounds, approximately 20 mi S Townsville, Queensland. A relatively tall sclerophyll woodland predominates beyond the grazed areas. *Lialis burtonis* occurs in this and similarly disturbed habitats.

Fig. 118. Vicinity of Cape Jervis looking towards Kangaroo Is, South Australia. The vegetation is a mixed temperate woodland (sclerophyll mallee). *Aprasia striolata* and *Pygopus lepidopodus* have been collected in the same habitat several miles north of this locality.

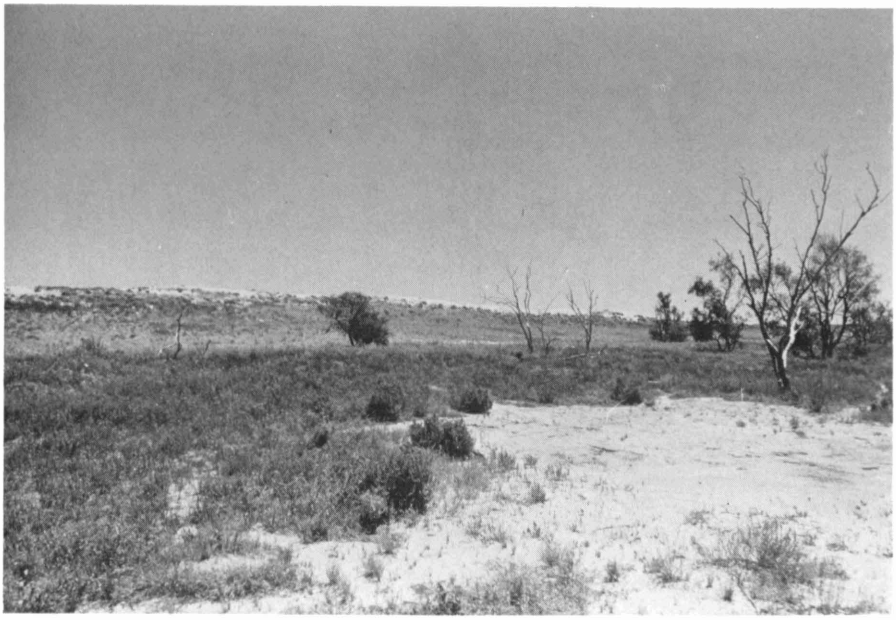

Fig. 119. Red sand ridge desert country near Innamincka No. 1 Bore, South Australia. The ridges are covered by porcupine grass (*Triodia* sp.) and the interridge areas are a sclerophyll shrub savanna. The lushness of the vegetation is due to recent rain. *Lialis burtonis* and *Pygopus nigriceps* have been collected on and between the ridges in this habitat.

Fig. 120. View of Tuttanning Reserve, Western Australia. The area is a mixed temperate woodland dominated by *Casuarina heugeliana* and *Acacia lasiocalyx*. Large granite outcrops cover an otherwise sandy soil. *Delma fraseri* is the only pygopodid that has been collected on the Reserve. *Delma australis, Lialis burtonis, Pygopus lepidopodus* and *P. nigriceps* have been taken nearby in the same habitat, and it seems reasonably certain that eventually they will be found on the Reserve. *Aprasia repens* occurs in similar habitat much farther south.

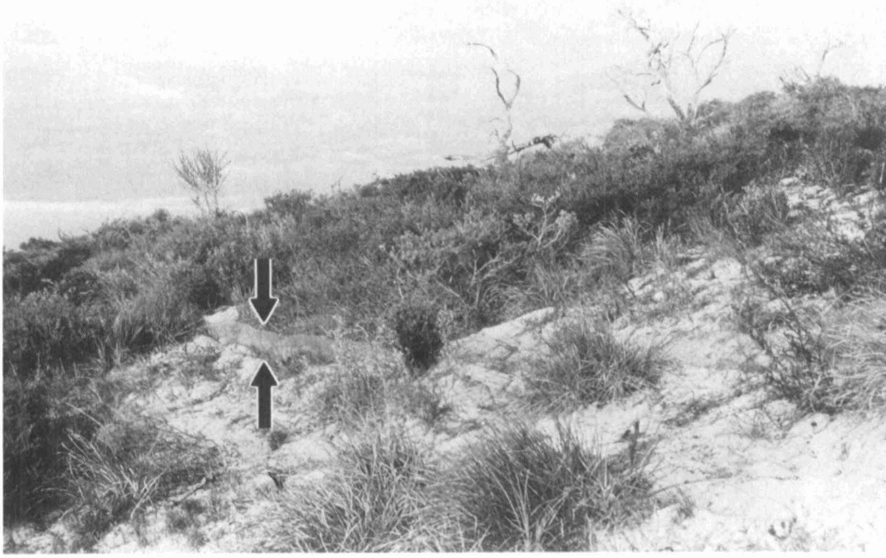

Fig. 121. Coastal sand dune environment 1 mi N Marmion, Western Australia. These seaward facing slopes are usually covered with a heath, 1-2 ft in height. The two pairs of arrows outline a 9″ by 100′ fly screen drift fence. *Aprasia repens* was collected along this fence. *Aclys concinna, Delma grayii, Lialis burtonis* and *Pletholax gracilis* almost certainly occur in this habitat as well. The above locality is approximately 100 yds west of that shown in Fig. 122 where these four species were observed or collected. *Delma fraseri* has been collected in the same habitat a few miles north of here at Yanchep Beach.

Fig. 122. A mixed *Banksia-Eucalyptus* (tuart) coastal woodland, 1 mi N Marmion, Western Australia. Coastal heath dominates the foreground and large limestone ridges protrude from the sand. *Pletholax gracilis* is very common here and *Aclys concinna, Aprasia repens, Delma grayii* and *Lialis burtonis* have been observed or collected at this site as well. See Fig. 121.

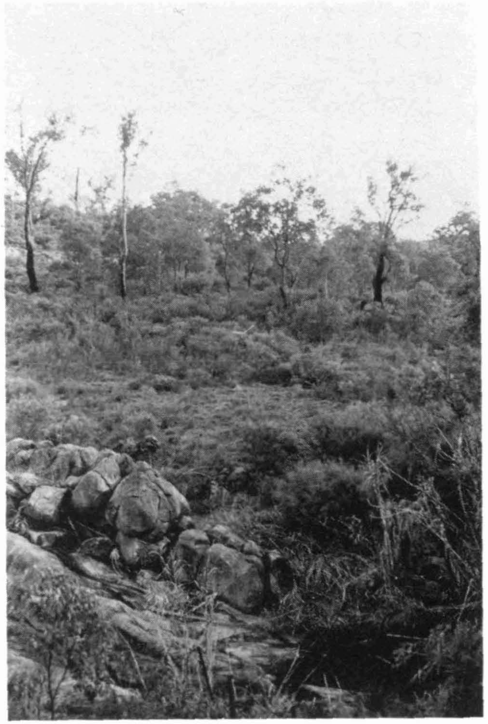

Fig. 123. Open hillside near Darlington, Western Australia. The general type of vegetation is a dry sclerophyll forest consisting mostly of *Banksia* and large *Eucalyptus* species. Very large granite boulders cover much of the surface of the ground. *Aprasia repens* was collected here in large numbers (August) beneath pieces of granite. *Aprasia pulchella, Delma fraseri, D. grayii* and *Lialis burtonis* have been collected at several localities nearby in the same habitat.

Fig. 124. Top of Mt Herbert, Pilbara Region, Western Australia. The vegetation is *Triodia* sp., and the ground is extremely stony. This is the type locality of *Delma elegans*. *Delma nasuta, Lialis burtonis* and *Pygopus nigriceps* have been collected from similar situations nearby. *Delma borea* and *D. tincta* are also known from *Triodia* sp. in the Pilbara Region and they are likely to occur here as well.

APPENDIX I

Gazetteer of Pygopodid Localities

W = Western Australia
S = South Australia
N = Northern Territory
V = Victoria
B = New South Wales (incl. A.C.T.)
Q = Queensland (incl. islands in Torres Strait)
G = New Guinea (incl. New Britain)

S Lat.	E Long.	State	Locality
8 52	143 11	G	Abam
30 02	151 46	B	Abby Green
32 10	150 54	B	Aberdeen
27 35	153 02	Q	Acacia Ridge
12 10	131 13	N	Adam Bay
34 56	138 36	S	Adelaide
13 07	131 05	N	Adelaide River
22 39	133 21	N	Aileron
3 10	142 25	G	Aitape
19 17	146 48	Q	Aitkenvale
27 57	114 38	W	Ajana
35 02	117 53	W	Albany
27 08	120 20	W	Albion Downs
36 05	146 55	B	Albury
35 01	138 44	S	Aldgate
24 16	145 29	Q	Alice Downs
23 42	133 53	N	Alice Springs
23 49	134 44	N	Allua Creek
17 20	144 41	Q	Almaden
4 14	142 50	G	Ambunti
24 49	132 14	N	Angas Downs
33 40	150 57	B	Annangrove
27 32	153 02	Q	Annerley
34 51	142 50	V	Annuello
16 33	139 24	Q	Appel Channel
32 01	115 50	W	Applecross
32 09	116 07	W	Araluen
27 59	152 32	Q	Aratula
37 47	144 48	V	Ardeer
21 42	136 36	N	Argadargada
24 15	150 26	Q	Argoon
30 20	139 22	S	Arkaroola
32 09	116 00	W	Armadale
31 26	148 28	B	Armatree
30 31	151 39	B	Armidale
17 58	139 45	Q	Armraynald
29 35	115 08	W	Arrowsmith
21 49	117 05	W	Asbestos Creek
33 53	151 07	B	Ashfield
32 02	115 48	W	Attadale
25 21	131 02	N	Ayres Rock
29 16	115 22	W	Badgingarra
10 09	142 10	Q	Badu
10 07	142 08	Q	Badu Island
18 41	122 08	W	Badur Hill
33 06	134 19	S	Baird Bay
5 33	144 07	G	Baiyer River
31 45	116 27	W	Bakers Hill
31 52	115 46	W	Balcatta Beach
27 19	153 01	Q	Bald Hills
31 51	115 49	W	Balga
8 03	142 50	G	Balimo
31 59	117 08	W	Balkuling
		B	Balladelok
32 27	123 51	W	Balladonia
27 59	115 01	W	Balla Tank
33 51	151 12	B	Balls Head
10 12	142 16	Q	Banks Island
33 55	151 02	B	Bankstown
27 23	153 05	Q	Banyo
30 56	149 04	B	Baradine
23 34	145 17	Q	Barcaldine
27 29	152 59	Q	Bardon
35 38	144 08	B	Barham
34 09	147 23	B	Barmedman
30 23	150 36	B	Barraba
21 33	133 53	N	Barrow Creek
20 48	115 26	W	Barrow Island
35 20	149 10	A	Barton
34 56	138 46	S	Basket Range
31 54	115 57	W	Bassendean

S Lat.	E Long.	State	Locality
13 04	131 01	N	Batchelor Siding
31 55	115 55	W	Bayswater
27 08	153 03	Q	Beachmere
30 26	117 51	W	Beacon
32 04	115 46	W	Beaconsfield
29 46	114 57	W	Beagle Point
29 57	148 25	B	Beanbri
27 59	152 59	Q	Beaudesert
32 11	116 01	W	Bedfordale
31 52	115 55	W	Beechborough
31 22	152 41	B	Beechwood
26 11	152 40	Q	Beenham Valley
26 51	152 58	Q	Beerwah
31 22	152 38	B	Bellangry
29 55	149 47	B	Bellata
26 01	113 17	W	Bellefin Prong
27 30	153 07	Q	Belmont
23 16	150 26	Q	Belmont Creek
33 55	151 06	B	Belmore
33 55	151 06	B	Belmore Heights
36 33	145 59	V	Benalla
30 53	151 10	B	Bendemeer
34 22	142 00	V	Benetook
33 10	115 51	W	Benger
30 01	151 40	B	Ben Lomond
9 08	141 02	G	Bensback River
31 59	115 53	W	Bentley
24 52	113 10	W	Bernier Island
33 38	151 09	B	Berowra
34 16	140 36	S	Berri
12 30	130 52	N	Berrima
32 07	116 55	W	Beverley
33 57	151 07	B	Beverley Hills
32 00	116 05	W	Bickley
32 01	115 47	W	Bicton
37 09	140 35	S	Big Health National Park
28 13	153 29	B	Bilambil
30 38	116 22	W	Bindi Bindi
29 52	150 34	B	Bingara
28 02	114 39	W	Binnu
15 39	133 13	N	Birdum
27 29	153 13	Q	Birkdale
35 14	141 22	V	Birthday Tank
32 27	137 17	S	Birthday Well
38 20	145 10	V	Bittern
24 25	145 28	Q	Blackall
34 42	139 27	S	Black Hill
11 09	132 09	N	Black Point
21 38	146 50	Q	Black Wattle Creek
18 10	145 35	Q	Blencoe Falls
33 20	135 40	S	Blesing Reserve
15 55	145 22	Q	Bloomfield River
31 22	118 52	W	Bodallin
9 08	143 14	G	Bobo Island
32 48	116 28	W	Boddington
5 27	145 45	G	Bogadjim
36 48	147 13	V	Bogong
18 53	126 14	W	Bohemia Downs
31 16	116 30	W	Bolgart
28 02	147 29	Q	Bollon
33 54	151 17	B	Bondi
37 09	140 43	S	Bool Lagoon
33 52	144 53	B	Booligal
28 00	152 41	Q	Boonah
34 13	119 33	W	Boondalup
35 17	145 07	B	Boonoke
32 02	115 50	W	Booragoon
35 07	146 35	B	Booree Creek
27 45	119 50	W	Booylgoo Spring
34 05	118 16	W	Borden
36 19	140 46	S	Bordertown
16 04	136 17	N	Borroloola
7 25	141 02	G	Boset
30 47	121 29	W	Boulder
30 06	145 56	B	Bourke
27 19	151 29	Q	Bowenville
31 23	151 09	B	Bowling Alley Point
31 56	116 03	W	Boya
32 28	116 53	W	Boyagin Reserve
9 07	143 05	G	Boze
19 34	147 22	Q	Brandon
34 23	119 25	W	Bremer Bay
27 00	153 07	Q	Bribie Island
36 45	146 58	V	Bright
37 55	145 00	V	Brighton
34 27	145 42	B	Bringagee
27 30	153 01	Q	Brisbane
28 01	153 26	Q	Broadbeach
31 57	141 26	B	Broken Hill
27 30	152 54	Q	Brookfield
21 47	142 49	Q	Brooklyn
17 58	122 14	W	Broome
33 51	117 39	W	Broomehill
36 10	141 21	V	Broughtons Waterhole
26 14	126 35	W	Brown Range
31 53	118 09	W	Bruce Rock
34 36	138 42	S	Buchsfelde
34 36	138 30	S	Buckland Park-Two Wells
30 18	149 06	B	Bullerawa
24 51	152 21	Q	Bundaberg
38 06	145 43	V	Bunyip
31 54	116 46	W	Burges Siding
17 43	139 34	Q	Burketown
28 46	117 21	W	Burnerbinmah
34 56	138 39	S	Burnside
27 10	152 57	Q	Burpengary

S Lat.	E Long.	State	Locality
33 40	138 56	S	Burra
32 05	148 16	B	Burroway
33 39	115 20	W	Busselton
33 52	151 07	B	Burwood
37 57	141 58	V	Byaduk
32 14	116 00	W	Byford
27 05	152 57	Q	Caboolture
33 55	150 57	B	Cabramatta
11 14	132 12	N	Caiman Creek
16 55	145 46	Q	Cairns
30 17	120 42	W	Callion
26 48	153 08	Q	Caloundra
27 23	145 58	Q	Calverton Downs
31 39	152 48	B	Camden Haven
34 04	150 49	B	Campbelltown
38 14	143 09	V	Camperdown
35 20	149 10	B	Canberra
32 10	116 09	W	Canning Dam
32 01	115 51	W	Canning River
22 30	124 00	W	Canning Stock Route
24 26	122 00	W	Canning Stock Route Well No. 13
23 05	123 15	W	Canning Stock Route Well No. 23
20 39	126 17	W	Canning Stock Route Well No. 46
32 01	115 57	W	Cannington
33 55	151 09	B	Canterbury
28 02	153 10	Q	Canugra
12 21	136 58	N	Cape Arnhem
37 54	140 23	S	Cape Banks
11 18	131 47	N	Cape Don
36 04	136 53	S	Cape du Couedic
33 32	115 31	W	Capel River
23 05	148 01	Q	Capella
10 43	142 28	Q	Cape York
18 16	146 02	Q	Cardwell
30 28	147 41	B	Carinda
31 59	115 54	W	Carlisle
29 42	115 53	W	Carnamah
24 52	113 38	W	Carnarvon
25 43	122 59	W	Carnegie
29 35	116 18	W	Caron
32 34	144 52	B	Carowra Tank
26 25	113 31	W	Carrarang
27 07	151 43	Q	Carrington Vale
28 52	153 03	B	Casino
24 56	150 04	Q	Castle Creek
33 44	151 00	B	Castle Hill
19 14	146 48	Q	Castle Hill
26 12	127 55	W	Cavenagh Range
30 31	115 05	W	Cervantes
24 43	118 52	W	Chalk Spring

S Lat.	E Long.	State	Locality
35 36	140 47	S	Chandos
26 24	146 15	Q	Charleville
25 55	134 55	N	Charlotte Waters
20 06	146 16	Q	Charters Towers
27 25	153 01	Q	Chermside
35 04	138 39	S	Cherry Gardens
34 23	118 06	W	Chester Pass
34 47	118 25	W	Cheyne Beach
22 18	119 20	W	Chichester Range
25 15	152 16	Q	Childers
26 45	150 38	Q	Chinchilla
18 50	125 55	W	Christmas Creek
31 56	115 45	W	City Beach
33 50	138 36	S	Clare
31 59	115 48	W	Claremont
29 25	153 22	B	Clarence River
22 49	147 38	Q	Clermont
29 31	114 59	W	Cliff Head
20 42	140 30	Q	Cloncurry
31 58	115 56	W	Cloverdale
26 42	114 19	W	Coburn
16 06	123 37	W	Cockatoo Island
32 02	126 06	W	Cocklebiddy
13 56	143 12	Q	Coen
30 18	153 08	B	Coffs Harbour
29 33	148 35	B	Collarenebri
31 40	148 18	B	Collie
32 01	115 53	W	Collier Pine Plantation
29 05	138 34	B	Combo Combo
31 36	152 29	B	Comboyne
34 00	151 04	B	Como
32 00	115 52	W	Como
31 59	115 50	W	Como Beach
33 52	151 06	B	Concord
26 16	152 53	Q	Como State Forest
29 01	134 43	S	Coober Pedy
31 32	142 10	B	Coogee
15 28	145 15	Q	Cooktown
30 57	121 10	W	Coolgardie
32 46	115 52	W	Coolup
13 01	131 15	N	Coomalie Creek
34 18	150 35	B	Coomeroo
27 23	152 30	Q	Coominya
35 58	140 12	S	Coombe
30 28	116 02	W	Coomberdale
31 16	149 17	B	Coonabarabran
35 42	139 51	S	Coonalpyn
30 57	148 24	B	Coonamble
31 50	152 37	B	Coopernook
27 34	153 02	Q	Coopers Plains
25 36	116 00	W	Coordewandy
		Q	Coorigen
27 30	153 03	Q	Coorparoo
34 39	148 02	B	Cootamundra

S Lat.	E Long.	State	Locality
34 49	139 50	S	Copeville
30 32	138 26	S	Copley
35 17	149 02	B	Coppins Crossing
32 37	136 21	S	Coralbignie
27 32	152 59	Q	Corinda
34 55	137 03	S	Corny Point
32 21	117 52	W	Corrigin
32 39	137 07	S	Corunna Hills
28 00	122 54	W	Cosmo Newberry
20 42	117 12	W	Cossack
32 00	115 46	W	Cottesloe
27 08	153 22	Q	Cowan Cowan
33 41	136 55	S	Cowell
33 50	148 41	B	Cowra
34 18	117 32	W	Cranbrook
31 59	115 49	W	Crawley
29 08	150 18	B	Croppa Creek
21 35	117 05	W	Crossing Pool
27 16	152 04	Q	Crows Nest
33 53	151 07	B	Croydon
29 55	148 42	B	Cryon
27 25	117 54	W	Cue
31 25	116 28	W	Cullham
32 54	137 44	S	Cultana
28 04	145 41	Q	Cunnamulla
28 08	153 28	Q	Currumbin
25 20	131 45	N	Curtin Springs
16 35	123 05	W	Cygnet Bay
7 58	142 55	G	Dagona Lagoon
5 10	145 35	G	Dai
16 15	145 19	Q	Daintree River
27 11	151 16	Q	Dalby
22 24	118 38	W	Dales Gorge
30 17	116 40	W	Dalwallinu
33 46	121 32	W	Dalyup River
30 40	115 42	W	Dandaragan
32 03	117 19	W	Dangin
33 28	136 12	S	Darkes Peak
31 55	116 05	W	Darlington
27 34	152 58	Q	Darra
9 08	143 09	G	Daru
9 08	143 10	G	Daru Island
12 28	130 50	N	Darwin
23 38	149 46	Q	Dawson River
27 30	153 01	Q	Deep Water Bend
33 43	151 17	B	Deewhy
20 11	119 11	W	De Gray
15 23	144 29	Q	Deighton River
29 40	150 49	B	Delungra
35 32	144 58	B	Deniliquin
34 57	117 21	W	Denmark
20 37	117 56	W	Depuch Well
31 54	115 52	W	Dianella

S Lat.	E Long.	State	Locality
17 09	145 07	Q	Dimbulah
16 44	129 25	N	Dingo Gap
19 06	140 34	Q	Dismal Channels
25 46	116 44	W	Dodo
8 53	143 04	G	Dogwa
29 15	114 56	W	Dongara
33 35	115 49	W	Donnybrook
17 56	138 49	Q	Doomadgee
27 27	152 58	Q	Dorrington
31 54	115 48	W	Doubleview
19 17	146 47	Q	Douglas
31 12	117 02	W	Dowerin
32 46	116 57	W	Dryandra
23 44	149 40	Q	Duaringa
32 15	148 37	B	Dubbo
33 40	151 12	B	Duffys Forest
33 55	122 37	W	Duke of Orleans Bay
10 41	142 32	Q	Duke of York Island
26 39	149 45	Q	Dulacca
33 19	117 44	W	Dumbleyung
16 42	133 25	N	Dunmarra
36 51	143 44	V	Dunolly
34 56	138 39	S	Dunstone Quarry
23 46	122 29	W	Durba Hills
27 26	153 05	Q	Eagle Farm
32 01	115 57	W	East Cannington
28 38	114 49	W	East Chapman
30 40	115 42	W	East Dandaragan
32 03	115 46	W	East Fremantle
33 58	150 59	B	East Hills
33 55	120 00	W	East Mount Barren
12 25	130 49	N	East Point
32 00	115 54	W	East Victoria Park
28 26	113 43	W	East Wallabi Island
30 30	132 30	S	East West Line
32 46	117 31	W	East Wickepin
35 00	138 42	S	Eden Hills
30 06	149 48	B	Edgeroi
17 01	145 45	Q	Edmonton
14 44	141 35	Q	Edward River
14 54	141 37	Q	Edward River Station
25 22	151 08	Q	Eidsvold
27 35	153 06	Q	Eight Mile Plains
18 31	144 06	Q	Einasleigh
31 02	117 07	W	Ejanding
27 32	153 02	Q	Ekibin
27 01	152 57	Q	Elimbah
33 54	114 59	W	Ellen Brook
36 30	144 36	V	Elmore
31 55	115 55	W	Embleton
30 00	131 40	S	Emu
15 28	145 13	Q	Endeavor River
29 50	115 14	W	Eneabba

S Lat.	E Long.	State	Locality
29 50	115 11	W	Eneabba Creek
9 00	148 30	G	Epo
33 46	151 04	B	Epping
28 42	115 02	W	Eradu Siding
26 17	132 07	S	Ernaballa
26 40	143 17	Q	Eromanga
27 14	152 25	Q	Esk
33 51	121 53	W	Esperance
22 54	120 09	W	Ethel Creek
31 43	128 52	W	Eucla
28 46	151 59	Q	Eukey
26 29	152 57	Q	Eumundi
26 35	148 15	Q	Eurella
36 58	140 44	S	Euringa
27 05	132 28	S	Everard Range
27 25	152 59	Q	Everton Park
22 23	114 07	W	Exmouth Gulf
32 15	126 18	W	Eyre
25 34	134 35	N	Finke
25 39	134 30	N	Finke River
35 38	145 35	B	Finley
35 24	138 49	S	Finniss
34 05	119 38	W	Fitzgerald River
28 46	151 51	Q	Fletcher
35 56	136 43	S	Flinders Chase
31 25	138 45	S	Flinders Ranges
31 56	115 50	W	Floreat Park
8 30	143 30	G	Fly River
33 44	151 13	B	Forestville
30 51	128 06	W	Forrest
32 09	115 57	W	Forrestdale
32 00	115 59	W	Forrestfield
27 29	153 02	Q	Fortitude Valley
31 59	132 27	S	Fowlers Bay
38 08	145 07	V	Frankston
32 03	122 47	W	Fraser Range
18 48	121 42	W	Frazier Downs
32 03	115 46	W	Fremantle
30 25	139 06	S	Gammon Plateau
29 04	149 38	B	Garah
32 13	115 41	W	Garden Island
32 00	115 31	W	Garden Lake
27 33	152 17	Q	Gatton
32 30	135 51	S	Gawler Ranges
25 38	151 36	Q	Gayndah
27 25	152 59	Q	Gaythorne
27 22	153 03	Q	Geebung
27 21	114 09	W	Gee Gie Outcamp
24 27	132 00	N	George Gill Range
33 50	151 16	B	Georges Heights
28 46	114 36	W	Geraldton
35 50	147 00	B	Gerogery

S Lat.	E Long.	State	Locality
32 24	148 50	B	Geurie
33 39	121 48	W	Gibson Soak
24 58	128 20	W	Giles
31 43	148 39	B	Gilgandra
35 20	148 11	B	Gilmore
28 05	146 00	Q	Gilruth Plains
31 21	115 42	W	Gingin
31 15	146 54	B	Girilambone
33 50	151 08	B	Gladesville
23 51	151 15	Q	Gladstone
27 31	152 38	Q	Glamorgan
26 54	152 58	Q	Glass House Mountains
33 27	146 34	B	Glencairn
25 08	150 38	Q	Glencoe
32 17	116 11	W	Glen Eagle
34 59	138 31	S	Glenelg
34 56	138 36	S	Glen Osmond
30 03	152 58	B	Glenreagh
33 20	116 44	W	Glenside
34 17	140 32	S	Glossop
32 00	151 58	B	Gloucester
33 56	117 59	W	Gnowangerup
18 17	125 35	W	Gogo
33 49	151 13	B	Golders Gully
27 37	152 54	Q	Goodna
24 45	121 44	W	Goodwin Soak
26 39	149 37	Q	Goolagimbi
26 11	152 04	Q	Goomeri
26 39	150 04	Q	Goonalah
36 00	146 33	V	Gooramadda
31 57	116 03	W	Gooseberry Hill
33 26	151 21	B	Gosford
32 05	116 00	W	Gosnells
11 33	133 26	N	Goulburn Island
27 30	153 01	Q	Graceville
29 41	152 56	B	Grafton
29 29	150 56	B	Graman
30 05	114 58	W	Green Head
31 54	116 03	W	Greenmount
28 57	114 44	W	Greenough
34 40	118 25	W	Green Range
33 30	118 52	W	Greenshield Soak
33 57	150 56	B	Green Valley
17 53	139 17	Q	Gregory River
19 40	144 24	Q	Gregory Springs
34 17	146 03	B	Griffith
14 00	136 40	N	Groote Eylandt
32 01	117 24	W	Guairading
31 54	115 58	W	Guildford
26 16	150 03	Q	Guluguba
27 29	153 09	Q	Gumdale
35 13	149 08	B	Gungahlin
30 59	150 15	B	Gunnedah
31 41	147 38	B	Gunningbar

S Lat.	E Long.	State	Locality
34 02	151 05	B	Gymea
34 03	151 06	B	Gymea Bay
26 11	152 40	Q	Gympie
35 58	136 49	S	Halfway Hill
18 16	127 46	W	Halls Creek
8 50	146 35	G	Hall Sound
26 27	114 11	W	Hamelin
26 26	114 11	W	Hamelin Pool
37 45	142 02	V	Hamilton
32 06	115 48	W	Hamilton Hill
35 05	138 32	S	Happy Valley
33 04	151 17	B	Harbord
27 48	152 41	Q	Harrisville
30 17	115 00	W	Hastings Cave
20 56	135 12	N	Hatches Creek
34 46	142 17	V	Hattah
31 53	138 25	S	Hawker
34 30	144 51	B	Hay
32 23	151 04	B	Hebden
31 54	116 10	W	Helena Gorge
31 54	116 00	W	Helena River
31 56	116 02	W	Helena Valley
18 26	133 52	N	Helen Springs
34 55	138 30	S	Henley Beach
31 56	115 48	W	Herdsmans Lake
23 58	132 46	N	Hermannsburg
31 33	146 43	B	Hermidale
20 27	115 31	W	Hermite Island
19 15	146 48	Q	Hermit Park
31 50	116 01	W	Herne Hill
15 45	128 47	W	Hidden Valley
33 04	117 15	W	Highbury
30 34	151 54	B	Hillgrove Gorge
33 29	145 32	B	Hillston
32 10	135 04	S	Hiltaba
32 04	115 48	W	Hilton Park
35 34	140 53	S	Hincks National Park
37 46	142 06	V	Hockirch
35 44	147 19	B	Holbrook
27 32	153 03	Q	Holland Park
31 59	115 48	W	Hollywood
32 40	119 25	W	Holt Rock
21 17	149 03	Q	Homebush
19 40	147 25	Q	Home Hill
21 53	118 13	W	Hooley
33 57	120 07	W	Hopetoun
15 18	145 07	Q	Hopevale
36 43	142 12	V	Horsham
28 43	113 48	W	Houtman Abrolhos Islands
35 58	146 38	B	Howlong
20 51	144 12	Q	Hughenden
24 23	133 45	N	Hugh River
34 47	138 44	S	Humbug Scrub
33 03	137 35	S	Hummock Hill
12 37	131 16	N	Humpty Doo
35 49	137 32	S	Hundred of MacGill-ivray
35 34	140 53	S	Hundred of Nicholls
33 51	136 06	S	Hundred of Verran
32 35	116 04	W	Huntly
28 07	114 39	W	Hutt River
2 35	140 30	G	Iffar
23 30	144 30	Q	Ilfracombe
31 55	115 56	W	Inglewood
27 45	140 44	S	Innamincka
29 47	151 07	B	Inverell
12 42	143 18	Q	Iron Range Airport
24 16	144 26	Q	Isisford
33 37	123 55	W	Israelite Bay
32 21	116 04	W	Jarrahdale
36 09	141 59	V	Jeparit
35 22	145 44	B	Jerilderie
33 54	118 57	W	Jerramungup
29 58	116 52	W	Jibberding White Well
23 24	120 47	W	Jiggalong
26 40	152 28	Q	Jimna
27 41	116 44	W	Jingemarra
20 47	117 22	W	Jones River
16 37	145 21	Q	Julatten
20 39	141 44	Q	Julia Creek
33 23	123 24	W	Junana Rock
24 50	143 04	Q	Jundah
27 44	114 21	W	Junga Dam
30 17	115 00	W	Jurien Bay
27 03	151 27	Q	Kaimkillinbun
31 57	116 03	W	Kalamunda
27 43	114 08	W	Kalbarri
30 45	121 28	W	Kalgoorlie
27 15	153 00	Q	Kallangur
14 18	126 38	W	Kalumburu Mission
35 09	138 39	S	Kangarilla
35 50	137 06	S	Kangaroo Island
34 22	141 58	V	Karawinna
4 40	146 00	N	Karkar Island
36 52	141 30	V	Karnak
30 58	122 32	W	Karonie
31 53	115 47	W	Karrinyup
17 29	140 50	Q	Karumba
36 05	145 42	V	Katamatite
14 28	132 16	N	Katherine
27 23	120 38	W	Kathleen Valley
36 06	140 21	S	Keith
31 38	117 43	W	Kellerberrim

S Lat.	E Long.	State	Locality
36 02	136 45	S	Kelly Hill Caves
32 07	116 01	W	Kelmscott
27 32	152 56	Q	Kenmore
33 53	151 16	B	Kensington Estate
23 21	150 47	Q	Keppel Sands
32 02	115 58	W	Kenwick
37 49	145 02	V	Kew
31 59	115 56	W	Kewdale
36 30	142 25	V	Kewell
36 22	141 47	V	Kiata
9 30	147 11	G	Kila Kila
37 18	144 57	V	Kilmore
17 24	124 22	W	Kimberley Downs
15 38	128 43	W	Kimberley Research Station
26 32	151 50	Q	Kingaroy
14 14	126 35	W	King Edward River
35 03	118 00	W	King Georges Sound
17 30	125 45	W	King Leopold Ranges
14 49	143 00	Q	King River
16 50	123 25	W	King Sound
36 50	139 51	S	Kingston
33 59	151 07	B	Kogarah
33 50	117 09	W	Kojonup
31 16	135 15	S	Kokatha
32 30	118 16	W	Kondinin
9 35	147 20	G	Konebada
9 25	147 10	G	Konedobu
16 08	123 45	W	Koolan Island
30 47	119 31	W	Koolyanobbing
32 10	135 04	S	Koondoolka Turnoff
31 54	116 04	W	Koongamia
30 50	117 29	W	Koorda
34 17	142 05	V	Koorlong
37 29	140 14	S	Kopje Garden
32 57	118 32	W	Kuender Siding
33 11	118 05	W	Kukerin
30 29	117 16	W	Kulja
24 42	119 32	W	Kumarina
26 42	151 40	Q	Kumbia
31 07	117 55	W	Kununoppin
15 47	128 44	W	Kununurra
16 49	145 39	Q	Kuranda
12 15	136 45	N	Kwaiturumuru
32 14	115 45	W	Kwinana
36 19	145 03	V	Kyabram
30 42	134 11	S	Kychering Soak
35 16	138 42	S	Kyeema National Park
7 10	147 25	G	Lababia
6 43	147 01	G	Lae
18 41	112 45	W	La Grange
18 38	121 42	W	La Grange Bay
27 38	152 23	Q	Laidley
33 21	118 50	W	Lake Bryde Reserve
19 34	130 27	N	Lake Buck
7 35	141 15	G	Lake Daviumbo
33 06	118 28	W	Lake Grace
33 25	119 05	W	Lake Magenta Reserve
33 56	151 06	B	Lakemba
35 53	143 48	V	Lake Meering
7 03	141 30	G	Lake Murray
29 50	147 24	B	Lake Narran
21 00	137 55	N	Lake Nash
31 32	115 45	W	Lake Neerabup
34 06	117 49	W	Lake Toolbrunup
32 46	119 27	W	Lake Varley
37 02	141 18	V	Lake Wallace
20 52	119 09	W	Lalla Rookh
9 24	147 14	G	Laloki River
35 20	140 31	S	Lameroo
28 15	153 05	Q	Lamington National Park
31 01	115 20	W	Lancelin
25 09	116 54	W	Landor
17 22	144 53	Q	Lappa Junction
15 20	144 26	Q	Laura
28 38	122 25	W	Laverton
37 51	144 45	V	Laverton
22 15	114 08	W	Learmonth
31 56	115 50	W	Leederville
29 58	114 59	W	Leeman
34 34	146 24	B	Leeton
28 50	153 37	B	Lennox Head
28 53	121 19	W	Leonora
32 00	116 02	W	Lesmurdie
20 27	149 02	Q	Lindeman Island
33 46	151 10	B	Lindfield
27 27	153 09	Q	Lindum
31 54	116 08	W	Lion Mill
36 24	141 48	V	Little Desert
17 08	145 44	Q	Little Mulgrave River
11 13	132 15	N	Lizard Bay
10 47	142 28	Q	Lockerbie
34 03	151 03	B	Loftus Junction
32 22	117 37	W	Lomos
23 27	144 15	Q	Longreach
33 32	115 58	W	Lowden
31 35	116 07	W	Lower Chittering
36 59	140 22	S	Lucindale
18 09	124 02	W	Luluigui
9 16	142 44	G	Mabaduan
9 55	142 10	Q	Mabuiag Island
28 20	153 00	Q	MacPherson Range
5 15	145 50	G	Madang
32 03	115 59	W	Maddington
19 08	146 50	Q	Magnetic Island
31 56	116 01	W	Maida Vale

S Lat.	E Long.	State	Locality
32 44	151 33	B	Maitland
6 42	141 21	G	Maka
36 00	141 00	V	Mallee
33 08	135 43	S	Mamblin
32 50	137 59	S	Mambray Creek
32 51	138 05	S	Mambray Creek National Park
32 33	115 42	W	Mandurah
31 03	118 06	W	Mangowine Well
30 45	150 43	B	Manilla
33 48	151 17	B	Manly
16 40	125 55	W	Manning Creek
26 06	130 05	S	Mann Ranges
11 58	141 54	Q	Mapoon
29 45	131 35	S	Maralinga
14 32	132 47	N	Maranboy
21 11	119 44	W	Marble Bar
30 03	116 04	W	Marchagee
21 11	115 57	W	Mardie
17 00	145 26	Q	Mareeba
33 57	115 04	W	Margaret River
27 15	153 07	Q	Margate
3 57	144 16	G	Marienberg
31 50	115 46	W	Marmion
23 41	150 43	Q	Marmor
26 38	152 59	Q	Maroochydore
33 56	151 18	B	Maroubra Bay
32 52	116 26	W	Marradong
23 00	114 30	W	Marrilla
31 28	119 28	W	Marvel Loch
37 03	143 45	V	Maryborough
33 55	151 14	B	Mascot
14 56	133 07	N	Mataranka
33 57	151 14	B	Matraville
9 09	142 58	G	Mawatta
26 19	146 05	Q	Maxvale
29 52	116 30	W	Maya
31 56	115 52	W	Maylands
28 43	113 48	W	McDonnel Ranges
21 16	141 18	Q	McKinlay
35 13	138 35	S	McLaren Flat
35 11	138 45	S	Meadows
27 42	114 13	W	Meanarra Hill
31 38	117 01	W	Meckering
27 27	153 06	Q	Meeandah
21 18	120 28	W	Meentheena
37 50	145 00	V	Melbourne
31 54	115 54	W	Meltham
32 03	115 48	W	Melville
30 11	149 18	B	Merah
27 26	151 55	Q	Meringandan
31 29	118 16	W	Merredin
34 52	147 52	B	Merribindinyah
33 51	122 08	W	Merrivale
33 51	150 59	B	Merrylands
4 33	145 57	G	Miak
32 36	115 40	W	Miami
37 00	144 34	V	Mia Mia
32 31	136 36	S	Miccollo Hill
34 04	119 37	W	Middle Mount Barren
31 51	116 01	W	Middle Swan
31 54	116 00	W	Midland Junction
30 30	116 21	W	Miling
12 05	134 55	N	Milingimbi Island
27 52	151 16	Q	Millmerran
21 35	117 04	W	Millstream
29 44	141 53	B	Milparinka
35 19	150 26	B	Milton
27 35	152 33	Q	Minden
29 11	115 26	W	Mingenew
23 52	113 59	W	Minilya
29 47	153 16	B	Minnie Water
34 56	138 36	S	Mitcham
26 29	147 58	Q	Mitchell
34 04	135 34	S	Mitchell
36 13	144 14	V	Mitiamo
10 12	142 16	Q	Moa Island
31 03	116 03	W	Mogumber
9 25	147 15	G	Moitaka
31 44	116 35	W	Mokine Hills
30 27	117 31	W	Mollerin
35 36	145 58	B	Momolong
24 52	151 07	Q	Monto
26 41	152 53	Q	Montville
27 05	151 25	Q	Moola
34 18	146 41	B	Moombooldool
37 49	144 56	V	Moonee Ponds
30 57	117 05	W	Moonijin
30 39	116 01	W	Moora
30 47	116 33	W	Moorabin
31 47	152 40	B	Moorland
27 32	153 01	Q	Moorooka
29 13	116 00	W	Morawa
29 28	149 51	B	Moree
8 41	141 38	G	Morehead
27 10	153 25	Q	Moreton Island
34 02	139 39	S	Morgan
38 13	145 02	V	Mornington
16 33	139 24	Q	Mornington Island
16 39	139 10	Q	Mornington Island Mission
31 54	115 55	W	Morley Park
33 58	151 05	B	Mortdale
33 49	151 14	B	Mosman
32 01	115 46	W	Mosman Park
28 04	152 35	Q	Mount Alford
18 02	123 55	W	Mount Anderson
28 41	136 03	S	Mount Anna Peake

S Lat.	E Long.	State	Locality
34 38	117 40	W	Mount Barker
17 10	125 19	W	Mount Bell
29 46	141 47	B	Mount Brown
26 41	153 03	Q	Mount Buderim
23 42	133 53	N	Mount Buring
16 32	145 08	Q	Mount Carbine
35 22	138 37	S	Mount Compass
32 25	116 20	W	Mount Cooke
32 08	116 18	W	Mount Dale
26 14	129 16	S	Mount Davies
15 35	128 11	W	Mount Erskine
17 41	145 07	Q	Mount Garnet
34 47	138 50	S	Mount Gawler
23 43	133 48	N	Mount Gillen
27 20	152 46	Q	Mount Glorious
27 32	153 05	Q	Mount Gravatt
34 21	135 23	S	Mount Greenly
31 53	116 12	W	Mount Helena
21 20	117 13	W	Mount Herbert
35 59	144 18	V	Mount Hope Creek
26 31	142 16	Q	Mount Howitt
20 44	139 30	Q	Mount Isa
30 41	138 09	S	Mount James
31 53	115 56	W	Mount Lawley
27 02	129 54	S	Mount Lindsay
35 00	138 42	S	Mount Lofty
35 00	138 50	S	Mount Lofty Ranges
30 50	117 55	W	Mount Marshall
27 05	152 46	Q	Mount Mee
16 41	145 20	Q	Mount Molloy
23 16	119 33	W	Mount Newman
25 19	130 46	N	Mount Olga
31 52	138 12	S	Mount Orkolo
24 23	133 45	N	Mount Peachy
25 16	119 02	W	Mount Pleasant
32 01	115 50	W	Mount Pleasant
26 40	152 52	Q	Mount Stanley
27 58	153 12	Q	Mount Tamborine
22 45	117 38	W	Mount Tom Price
34 52	138 57	S	Mount Torrens
21 49	117 05	W	Mount Ulric Gorge
24 09	118 13	W	Mount Vernon
9 29	147 11	G	Mount Walker
31 54	115 50	W	Mount Yokine
24 34	150 01	Q	Moura
31 35	115 59	W	Muchea
30 55	118 13	W	Mukinbudin
10 07	142 08	Q	Mulgrave Island
31 41	147 26	B	Mullengudgery
28 32	115 31	W	Mullewa
28 33	153 30	B	Mullumbimby
29 14	137 54	S	Muloorina
20 31	118 04	W	Mundabullangana
31 54	116 10	W	Mundaring

S Lat.	E Long.	State	Locality
31 57	116 10	W	Mundaring Weir
21 42	116 30	W	Mundarry Pool
25 36	152 36	Q	Mungar Junction
25 03	124 32	W	Mungilli Claypan
28 58	148 59	Q	Mungindi
33 38	120 49	W	Munglinup
27 39	114 14	W	Murchison House
35 22	139 22	S	Murray Mallee
23 16	141 45	V	Murray River
34 12	140 21	S	Murray River Lock No. 3
34 18	148 31	B	Murringo
26 10	131 50	S	Musgrave Ranges
22 36	144 33	Q	Muttaburra
28 12	148 42	Q	Myall Plains
32 03	115 49	W	Myaree
35 03	138 45	S	Mylor
28 30	114 47	W	Nabawa
32 06	152 23	B	Nabiac
26 38	152 57	Q	Nambour
30 39	153 01	B	Nambucca River
28 34	114 46	W	Nanson
36 58	140 44	S	Naracoorte
32 04	118 24	W	Narembeen
29 21	142 30	B	Narriearra
32 56	117 10	W	Narrogin
32 09	148 15	B	Narromine
34 46	143 13	V	Narrung
36 03	145 12	V	Nathalia
34 57	143 13	V	Natya
31 59	115 48	W	Nedlands
21 53	114 07	W	Neds Well
34 57	138 33	S	Netley
31 51	147 43	B	Nevertire
32 55	151 45	B	Newcastle
10 50	142 37	Q	Newcastle Bay
17 24	133 24	N	Newcastle Waters
38 13	144 30	V	Newington
32 07	123 10	W	Newman Rock
28 43	114 49	W	Newmarracarra
30 58	116 13	W	New Norcia
32 04	139 11	S	Newton
33 53	151 12	B	Newtown
36 20	141 40	V	Nhill
18 05	128 55	W	Nicholson River
24 18	118 52	W	Nichol Spring
20 39	116 52	W	Nicol Bay
37 45	144 52	V	Niddrie
33 49	151 18	B	Nielsen Park
12 23	130 51	N	Nightcliff
22 41	113 41	W	Ningaloo
17 04	139 30	Q	Ninyilki
31 53	115 49	W	Nollamara

S Lat.	E Long.	State	Locality
26 23	153 09	Q	Noosa
26 23	153 09	Q	Noosa Head
22 18	120 10	W	Noreena Downs
17 40	141 05	Q	Normanton
35 28	138 19	S	Normanville
32 12	121 46	W	Norseman
31 40	116 40	W	Northam
28 21	114 37	W	Northampton
31 52	115 45	W	North Beach
24 51	152 21	Q	North Bundaberg
34 59	138 31	S	North Glenelg
30 20	117 07	W	North Kalannie
27 30	153 02	Q	North Quay
33 47	151 00	B	North Rocks
33 51	151 13	B	North Sydney
33 04	118 14	W	North Tarin Rock Reserve
35 26	146 05	B	Nowranie
3 41	142 28	G	Nuku
21 53	120 06	W	Nullagine
31 26	130 55	S	Nullarbor
28 17	153 15	B	Numinbah
36 06	145 26	V	Numurkah
37 49	145 10	V	Nunawding
32 04	146 20	B	Nymagee
31 34	147 11	B	Nyngan
27 26	151 43	Q	Oakey
12 20	133 04	N	Oenpelli
33 53	120 51	W	Oldfield River
28 54	141 11	Q	Omicron
33 58	118 29	W	Ongerup
27 33	135 28	S	Oodnadatta
24 13	134 01	N	Ooraininna
33 07	147 27	B	Ootha
35 04	142 19	V	Ouyen
23 53	133 28	N	Owen Spring
33 52	151 16	B	Paddington
36 36	140 29	S	Padthaway
19 12	146 46	Q	Pallaranda
12 21	130 57	N	Palm Creek
16 05	142 43	Q	Palmer River
18 32	126 20	W	Palm Springs
26 41	152 58	Q	Palmwoods
30 12	139 27	S	Paralana Hot Springs
12 26	130 50	N	Parap
34 21	135 28	S	Parenti Hills
31 38	119 32	W	Parker Range
31 53	116 08	W	Parkerville
33 49	151 00	B	Parramatta
33 51	151 10	B	Parramatta River
33 33	151 16	B	Patonga
22 56	148 05	Q	Peak Downs
33 58	151 05	B	Peakhurst
33 57	134 16	S	Pearson Island
21 50	115 38	W	Peedamullah
33 44	151 04	B	Pennant Hills
37 23	140 49	S	Penola
29 27	116 16	W	Perenjori
36 06	144 36	B	Pericoota
31 31	137 14	S	Pernatty Lagoon
31 56	115 47	W	Perry Lakes
31 56	115 50	W	Perth
25 00	129 46	N	Petermann Ranges
30 51	116 22	W	Piawaning
21 06	118 51	W	Pilgangoora Well
30 21	148 54	B	Pilliga
26 09	130 18	S	Piltadi
19 16	146 47	Q	Pimlico
33 18	123 20	W	Pine Hill
36 30	142 25	V	Pine Rise
20 28	118 41	W	Pippingarra
30 24	116 40	W	Pithara
27 43	151 38	Q	Pittsworth
23 25	136 31	W	Plenty River
17 21	122 09	W	Point Coulomb
33 44	136 58	S	Point Germein Gorge
35 04	117 09	W	Point Hillier
32 17	115 41	W	Point Peron
10 42	142 31	Q	Point Stewart
23 02	127 42	W	Pollock Hills
26 22	152 52	Q	Pomona
32 43	134 53	S	Poochera
9 25	147 00	G	Porebada
34 39	117 54	W	Porongorups
20 30	148 20	Q	Port Bowen
12 28	130 50	N	Port Darwin
11 10	132 08	N	Port Essington
15 23	124 42	W	Port George IV
28 12	114 14	W	Port Gregory
20 19	118 34	W	Port Hedland
38 20	141 36	V	Portland
12 35	143 24	Q	Portland Road
14 00	136 40	N	Port Langdon
34 44	135 52	S	Port Lincoln
31 26	152 55	B	Port MacQuarie
9 25	147 15	G	Port Moresby
34 06	136 20	S	Port Neill
34 57	137 21	S	Port Turton
10 40	142 10	Q	Prince of Wales Island
20 25	148 35	Q	Proserpine
37 00	144 58	V	Puckapunyal
33 56	151 05	B	Punchbowl
34 52	139 37	S	Purnong
36 04	144 08	V	Pyramid Hill
36 44	142 01	V	Quantong

S Lat.	E Long.	State	Locality
31 58	115 52	W	Queens Park
30 25	123 33	W	Queen Victoria Spring
4 45	152 15	G	Rabaul
4 20	144 45	G	Ramu River Delta
		B	Randenbah
33 50	146 16	B	Rankins Springs
28 43	113 47	W	Rat Island
33 45	120 02	W	Ravensthorpe
20 06	146 53	Q	Ravenswood
34 15	122 50	W	Recherche Archipelago
30 57	148 24	B	Redbank
27 38	152 53	Q	Redbank Plains
27 14	153 07	Q	Redcliffe
31 57	115 57	W	Redcliffe
34 19	142 11	V	Red Cliffs
31 23	116 06	W	Red Hill
29 59	153 13	B	Red Rock
36 56	140 01	S	Reedy Creek
33 54	151 02	B	Regents Park
36 03	136 46	S	Remarkable Rocks
34 11	140 45	S	Renmark
23 01	147 54	Q	Retro
33 36	150 46	B	Richmond
20 43	143 08	Q	Richmond
9 47	147 34	G	Rigo
35 00	146 00	B	Riverina District
36 43	142 12	V	Riverside
32 02	115 53	W	Riverton
31 59	115 53	W	Rivervale
34 36	142 48	V	Robinvale
29 45	151 01	B	Rob Roy
27 34	153 08	Q	Rochedale
37 43	144 39	V	Rockbank
33 57	151 10	B	Rockdale
23 23	150 30	Q	Rockhampton
32 17	115 43	W	Rockingham
21 47	144 17	Q	Rockwood
17 04	139 30	Q	Rokoti
32 07	116 04	W	Roleystone
26 35	148 47	Q	Roma
8 45	147 20	G	Rona
27 40	152 16	Q	Ropely
14 43	135 27	N	Roper River
14 44	134 44	N	Roper River Mission
20 28	116 37	W	Rosemary Island
14 16	135 45	N	Rose River
14 17	135 44	N	Rose River Mission
33 46	151 11	B	Roseville
31 40	152 44	B	Rossglen
32 02	115 52	W	Rossmoyne
33 03	145 28	B	Roto
32 00	115 30	W	Rottnest Island
32 58	146 10	B	Round Hill
29 48	148 55	B	Rowena
22 38	119 57	W	Roy Hill
33 41	136 16	S	Rudall
22 16	122 47	W	Rudall River
36 03	146 28	V	Rutherglen
24 20	144 10	Q	Ruthven
33 49	151 06	B	Ryde
26 41	150 28	Q	Rywung
32 18	115 42	W	Safety Bay
32 30	133 18	S	Saint Francis Island
28 02	148 35	Q	Saint George
18 39	125 17	W	Saint George Range
32 00	115 54	W	Saint James Park
34 56	138 36	S	Saint Leonards
18 03	144 46	Q	Saint Ronan
34 46	138 38	S	Salisbury
26 32	113 45	W	Salutation Island
27 59	119 17	W	Sandstone
24 42	153 17	Q	Sandy Cape
34 00	151 11	B	Sans Souci
34 16	150 57	B	Scarborough
31 54	115 45	W	Scarborough
32 05	150 51	B	Scone
34 16	115 14	W	Scott River
34 50	138 29	S	Semaphore
32 00	115 31	W	Serpentine Lake
33 53	138 38	S	Sevenhill
25 55	113 32	W	Shark Bay
31 59	115 48	W	Shenton Park
33 51	135 15	S	Sheringa
21 45	114 10	W	Shothole Canyon
14 04	143 41	Q	Silver Plains
21 10	116 02	W	Six Mile Creek
35 01	138 36	S	Sleeps Hill
11 07	132 08	N	Smith Point
20 19	129 58	N	Smoke Hills
13 11	131 06	N	Snake Creek
33 22	151 17	B	Somersby
10 45	142 35	Q	Somerset
31 50	115 45	W	Sorrento
10 15	150 51	G	South East Cape
31 13	119 19	W	Southern Cross
32 04	115 46	W	South Fremantle
31 59	115 52	W	South Perth
27 58	153 24	Q	Southport
30 12	153 16	B	South Solitary Island
31 14	121 28	W	Spargoville
31 43	116 40	W	Spencers Brook
31 56	119 38	W	Split Rocks
27 25	153 01	Q	Stafford
34 55	137 47	S	Stansbury
28 40	151 57	Q	Stanthorpe

S Lat.	E Long.	State	Locality
31 56	116 03	W	Stathams
37 03	142 46	V	Stawell
29 42	115 00	W	Stockyard Gully
31 53	116 10	W	Stoneville
33 25	115 37	W	Stratham
32 48	134 13	S	Streaky Bay
19 19	146 50	Q	Stuart
37 51	144 54	V	Studley Park
31 56	115 49	W	Subiaco
27 35	153 03	Q	Sunnybank
37 47	144 50	V	Sunshine
31 54	115 56	W	Swan
31 58	115 46	W	Swanbourne Beach
35 21	143 34	V	Swan Hill
32 03	115 45	W	Swan River
31 53	116 03	W	Swan View
31 53	116 03	W	Swan View National Park
33 53	151 12	B	Sydney
35 16	139 27	S	Tailem Bend
22 51	121 09	W	Talawana
37 10	143 42	V	Talbot
26 42	113 45	W	Tamala
34 02	117 39	W	Tambellup
24 53	146 15	Q	Tambo
21 38	117 36	W	Tambrey
31 06	150 56	B	Tamworth
19 59	129 43	N	Tanami
35 28	138 21	S	Tapanappa Rocks
21 17	150 28	Q	Tara
9 05	142 00	G	Tarara
35 17	147 43	B	Tarcutta
27 31	152 58	Q	Taringa
33 08	118 14	W	Tarin Rock Reserve
25 39	149 48	Q	Taroom
27 32	153 02	Q	Tarragindi
34 52	150 44	B	Tarrara
32 44	151 33	B	Tarro
36 44	146 06	V	Tatong
30 31	151 29	B	Tea Tree Creek
34 49	138 44	S	Tea Tree Gully
24 22	132 24	N	Tempe Downs
19 39	134 12	N	Tennant Creek
28 00	143 49	Q	Thargomindah
20 35	130 23	N	The Granites
27 29	153 12	Q	Thorneside
27 33	153 16	Q	Thornlands
29 32	115 45	W	Three Springs
10 35	142 13	Q	Thursday Island
25 44	152 35	Q	Tiaro
24 18	134 53	N	Todd River
2 00	139 00	G	Toem
9 11	142 44	G	Togo
31 02	115 19	W	Tombstone Rocks
26 11	129 05	S	Tomkinson Ranges
34 01	117 50	W	Toolbrunup
33 51	135 42	S	Tooloogie
33 47	150 57	B	Toongabbie West
35 23	138 44	S	Tooperang
31 26	148 54	B	Toorahweenah
27 33	151 58	Q	Toowoomba
35 00	117 44	W	Torbay Junction
10 30	142 15	Q	Torres Strait
19 15	146 48	Q	Townsville
32 02	147 59	B	Trangie
37 06	145 13	V	Trawool
31 07	117 48	W	Trayning
31 52	115 45	W	Trigg Island
16 40	145 35	Q	Trinity Bay
13 45	126 09	W	Troughton Island
34 25	139 07	S	Truro
28 09	153 30	Q	Tugun
35 47	148 01	B	Tumbarumba
34 23	136 05	S	Tumby Bay
35 18	148 13	B	Tumut
23 35	117 25	W	Turee Creek
23 37	118 39	W	Turee Creek
33 05	149 24	B	Turon River
33 44	151 08	B	Turramurra
32 33	117 14	W	Tuttanning Reserve
34 57	118 12	W	Two People Bay
23 37	150 35	Q	Ulam
23 15	116 11	W	Ullawarra
14 00	136 40	N	Umba Kumba
6 15	146 11	G	Umi River
27 28	152 52	Q	Upper Brookfield
33 25	150 44	B	Upper Colo
27 54	153 18	Q	Upper Coomera
27 34	153 06	Q	Upper Mount Gravatt
31 46	116 01	W	Upper Swan River
35 20	146 16	B	Urana
33 52	151 17	B	Vaucluse
33 11	134 39	S	Venus Bay
31 59	115 53	W	Victoria Park
27 23	153 04	Q	Virginia
36 00	137 11	S	Vivonne Bay
21 48	114 05	W	Vlaming Head
33 18	117 21	W	Wagin
33 43	151 07	B	Wahroonga
25 55	144 36	Q	Wahyunyah
34 11	139 59	S	Waikerie
32 19	115 45	W	Waikiki
33 36	134 49	S	Waldegrave Island
35 46	146 54	B	Walla Walla

S Lat.	E Long.	State	Locality
17 40	135 52	N	Wallhallow
31 44	116 05	W	Walyunga Pool
23 46	114 33	W	Wandagee
32 41	116 40	W	Wandering
24 21	149 59	Q	Wandoo
36 22	146 20	V	Wangaratta
27 38	120 35	W	Wanjarri
31 10	116 03	W	Wannamal
31 45	115 49	W	Wanneroo
26 44	114 37	W	Wannoo
21 45	114 10	W	Wapet Creek
26 09	126 38	W	Warburton Range
26 09	126 38	W	Warburton Range Mission
36 22	146 10	V	Warby Ranges
28 57	153 28	B	Wardell
20 51	120 42	W	Warrawagine
30 46	152 53	B	Warrell Creek
31 42	147 49	B	Warren
23 29	113 46	W	Warroora
31 27	149 10	B	Warrumbungle Mountains
34 56	138 36	S	Waterfall Gully
33 53	151 14	B	Waterloo
31 51	115 45	W	Watermans Bay
30 29	131 31	S	Watson
30 44	151 03	B	Watsons Creek
32 02	116 00	W	Wattle Grove
34 56	138 36	S	Wattle Park
31 27	152 44	B	Wauchope
20 36	134 15	N	Wauchope
27 25	153 02	Q	Wavell Heights
36 26	143 38	V	Wedderburn
30 50	115 11	W	Wedge Island
22 30	119 12	W	Weeli Wolli Creek
22 55	119 13	W	Weeli Wolli Springs
33 43	146 38	B	Weethalle
30 14	149 26	B	Wee Waa
31 56	115 50	W	Wembley Downs
13 06	142 58	Q	Wenlock
34 07	141 55	B	Wentworth
33 49	150 58	B	Wentworthville
37 54	144 40	V	Werribee
37 54	144 40	V	Werribee Plains
33 20	117 01	W	West Arthur
27 37	151 52	Q	Westbrook
28 07	153 26	Q	West Burleigh
27 29	153 00	Q	West End
33 05	115 50	W	West Harvey
12 28	130 49	N	Westhead
17 30	124 30	W	West Kimberley District
20 35	116 39	W	West Lewis Island
37 41	142 58	V	Westmere
31 54	115 59	W	West Midland
28 28	113 41	W	West Wallabi Island
3 34	143 38	G	Wewak
33 57	136 14	S	Wharminda
17 16	128 54	W	White Mountain
30 29	118 07	W	Wialki
32 46	117 30	E	Wickepin
33 39	115 20	W	Wilcox Plantation
32 56	142 26	B	Willaba
32 03	115 48	W	Willagee
33 01	116 52	W	Williams
33 47	151 12	B	Willoughby
32 39	138 06	S	Wilmington
32 00	138 22	S	Wilson
38 14	143 59	V	Winchelsea
29 47	115 55	W	Winchester
27 26	153 02	Q	Windsor
21 47	142 49	Q	Winton
8 44	142 44	G	Wipim
32 24	134 31	S	Wirrulla
27 44	114 08	W	Wittecarra Gully
22 15	118 18	W	Wittenoon Gorge
30 32	152 03	B	Wollomombi Lookout
33 49	151 12	B	Wollstonecraft
26 19	151 52	Q	Wondai
30 53	116 42	W	Wongan Hills
28 46	114 36	W	Wonthella
15 41	126 24	W	Woodhouse River Crossing
34 02	117 39	W	Woodlands
32 09	115 46	W	Woodman Point
27 38	153 06	Q	Woodridge
21 37	118 57	W	Woodstock
19 36	146 50	Q	Woodstock
27 16	153 06	Q	Woody Point
30 07	153 12	B	Woolgoolga
26 40	152 58	Q	Woombye
35 41	142 41	V	Woomelang
31 49	116 20	W	Wooroloo
16 10	123 37	W	Wotjulum
33 03	135 28	S	Wudinna
27 37	152 44	Q	Wulkuraka
36 04	143 14	V	Wycheproof
36 02	147 17	B	Wymah
30 33	133 32	S	Wynbring
15 28	128 06	W	Wyndham
27 27	153 10	Q	Wynnum
27 27	153 09	Q	Wynnum West
33 51	146 50	B	Yalgogrin North
28 20	116 41	W	Yalgoo
33 42	115 02	W	Yallingup
23 35	148 22	Q	Yamala
31 33	115 37	W	Yanchep Beach

S Lat.	E Long.	State	Locality
34 36	146 24	B	Yanco
33 28	145 00	B	Yandembah
21 16	118 24	W	Yandeyarra
29 21	145 00	B	Yantabulla
24 53	144 05	Q	Yaraka
29 19	113 48	W	Yardie Creek
21 53	114 00	W	Yardie Creek Station
32 58	115 54	W	Yarloop
33 14	151 17	B	Yarramalong
26 50	151 59	Q	Yarraman
36 01	146 00	V	Yarrawonga
34 22	142 11	V	Yatpool
37 13	145 26	V	Yea
34 09	135 44	S	Yeelanna
34 43	117 56	W	Yellanup
31 18	119 39	W	Yellowdine
23 08	150 44	Q	Yeppoon
12 14	136 56	N	Yirrkala
31 54	116 46	W	York
32 44	117 09	W	Yornaning
28 37	118 49	W	Youanmi
30 11	139 15	S	Yudnamutana
32 08	137 09	S	Yudnapinna
28 20	115 00	W	Yuna
17 17	145 35	Q	Yungaburra
27 22	153 02	Q	Zillmere
8 45	143 05	G	Zim

APPENDIX II

Specimens Examined

Aclys concinna (total 2)

Western Australia—±8 mi N Jurien Bay turnoff, Dongara-Eneabba Rd (WAM R41156); Sorrento (WAM R17312).

Aprasia aurita (total 17)

Victoria—Ouyen (CAS-SU 12631; NMV D598-602, D605-11, D1911; UMMZ 131224-5); Woomelang (NMV D635).

Aprasia inaurita (total 24)

South Australia—Blesing Reserve (SAM R9210, R9215); Cultana (SAM R11655); Fowlers Bay (NMV D4686); Lameroo (SAM R8410); Mitchell (SAM R379); Murray R Lock No 3 (SAM R1673); Port Lincoln (SAM R3885); nr Renmark (SAM R2752); Salisbury (SAM R2808); Streaky Bay (SAM R3089a); Tumby Bay (NMV D18001; SAM R4302); "A" Is, Venus Bay (SAM R8994); 5 mi NW Wharminda (SAM R12617); Wudinna (AM R14382). **Victoria**—Birthday Tank (NMV D11181); Brighton (NMV D594); Mallee (NMV R7171; UMMZ 131672); Ouyen (NMV D4751); Robinvale (NMV D11985). **Western Australia**—Eyre (WAM R5280).

Aprasia parapulchella (total 22)

Australia—no data (NMV R7056). **Australian Capital Territory**—Coppins Crossing (AM R31632-5; FM 195547; NMV D18045; QM J22308; UMMZ 131157, 131193-4, 6-204; WAM R41231). **New South Wales**—10 mi NE Tarcutta (NMV D15389).

Aprasia pseudopulchella (total 18)

Australia—no data (UMMZ 131208-10). **South Australia**—N Burra (SAM R6357-61); Clare (SAM R406a-c); Lower Flinders (MCZ 74511); Mambrey Ck Reserve (SAM R10778-9); Mylor (SAM R2110); between Sevenhill and Clare (QM J9761); Yudnamutana (SAM R12510).

Aprasia pulchella (total 45)

(?) **State**—Rockhampton (AM 5168). **Australia**—no data (AM R6553, R12529). **Western Australia**—no data (BM 1946.8.30.93); Albany (BM 1955.1.4.24-5); (?) Araluen (UMMZ 131235-6); Bayswater Dist (AMNH 99705-6); Boddington (SMF 60463); 20 mi S Bordon, 200 m (CAS 94302); nr Busselton (WAM R20588); 2 mi SE Byford (UMMZ 131230); 1 mi W Canning Dam (UMMZ 131241); 2 mi W Canning Dam (WAM R21211-2); Darlington (CAS 104381; WAM R21267); 12 mi SE Donnybrook (WAM R25068); Geraldton (MCZ 24467-8); Guildford (UMMZ 129986; WAM R4629); Helena R (WAM R22581); 6 mi E Kalamunda (WAM R16889, R22773); Kojonup (WAM R24983); Lowden (AMNH 61070; WAM R3873); Mt Barker (WAM R2371); Mt Dale (WAM R12154); Mt Helena (WAM R1984); Mundaring Weir (MCZ 24460); Parkerville (WAM R34334); Perth (FM 73321, 97031); Scott R (WAM R36456);

4 mi N Scott R (WAM R36054); Stathams (WAM R5994); Swan R (BM 1962.240); Upper Swan (WAM R3409); West Arthur (WAM R642); Wilcox Plantation (WAM R26842-3).

Aprasia repens (total 202)

Australia—no data (WAM 11360, R909, R2596, R6924). **Western Australia** —no data (FM 73873; WAM R364, R21314); Albany (WAM R10952, R14822); Applecross (WAM R7390, R7406, R13227); Bakers Hill (WAM R6927); Balcatta Beach (MCZ 24427); Balga (WAM R31184); Bassendean (WAM R2150); (?) Bayswater (FM 75488); Bayswater (AMNH 102383; UCB 80049; WAM R5310, R8721, R10208, R14815, R21598, R21878); Bicton (WAM R12483); Booragoon (WAM R34706); Borden (WAM R10692); Bremer Bay (WAM R19856); Busselton Dist (WAM R26615); Cannington (NMV D5438); Claremont (CAS 104384; WAM R8186, R14163, R15818); Cottesloe (WAM R123, R14812-3, R28142-3); Cranbrook (AMNH 61071); Culham (WAM R14810-11); Darlington (CAS 100895; WAM R14816, R29402; UMMZ 124458-60, 129978-9, 129987a-f, 129988); Dianella (WAM R34724); Doubleview (WAM R12665-6, R26606); Dumbleyung (AM R8015; WAM R373, R4332); East Cannington (WAM R13550); East Fremantle (WAM R707, R13552, R21613); Ellen Brook (WAM R13228); Embleton (WAM R28157); Floreat Park (CAS 104383; WAM R21946-7, R25678, R26815, R28392, R31085); Garden Is (WAM R766); Geraldton (MCZ 24458-9); Gooseberry Hill (WAM R2837, R31140); 2 mi WSW Greenshield Soak (WAM R39865); Hamilton Hill (WAM R37797); Herdsmans Lake (WAM R17696-7); Hopetoun (AMNH 61072); Inglewood (WAM R11283); Jerramungup (WAM R14819-21); Kalamunda (WAM R15205, R19848, R21241); 3 mi E Kalamunda (WAM R19987); 6 mi E Kalamunda (WAM R22386, R22772); Kalgoorlie Dist (NMV D14906); Karrinyup (WAM R26684); Koongamia (WAM R12450); NE end Lake Neerabup (WAM R36344); Lancelin (WAM R32012); Leederville (WAM R1374); Lomos (WAM R9222); 1 mi N Marmion (UMMZ 131238); Maylands (WAM R5351, R28150); Meltham (WAM R21286); Melville (WAM R16892); Morley Park (WAM R28934-5, R28971, R29825-6, R32369); Mt Lawley (WAM R2397, R4186, R12099, R12100-103, R40316); Mt Pleasant (WAM R13457, R13480, R31530); Mt Yokine (WAM R13366, R13689, R13796, R21715); Mundaring (WAM R21242); Mundaring Weir (AM R9138; CAS 104382; WAM R14869, R16431, R26479); Myaree (WAM R40732-3); Nedlands (WAM R4173, R5344, R9093-4, R14814, R19984, R27271); Newmarracarra (WAM R1730); Nollamara (WAM R26753); Northam (AMNH 61069; WAM R8891, R29736); Oldfield R (WAM R29771); Perth (WAM R1742, R2251, R2424, R3347, R6944); Queens Park (WAM R19358); Rivervale (WAM R9664-5); Roleystone (WAM R14817-8); Rossmoyne (WAM R29620); Rottnest Is (CAS 77653; MCZ 33028-9, 33032; WAM R3759, R4582); Shenton Park (WAM R21323); South Fremantle (WAM R4383); South Perth (WAM R4373); Stoneville (WAM R4356-7, R24909-10); Subiaco (WAM R13311); Swanbourne Beach (WAM R21216, R22304); Swan Dist (WAM R16912); Swan View Natl Park (MCZ 33027); Tambellup (FM 15772); Toolbrunup (FM 11677); Walyunga Pool (WAM R40750); Wanneroo (WAM R20584, R31217-9); Watermans Bay (WAM R19357); Wembley Downs (AMNH 102382); West Arthur (WAM R631); West Midland (WAM R10893-5); Willagee (WAM R21567); Wongan Hills (WAM R11275); Woodlands (WAM R2868, R2870-71, R12128); Wooroloo (WAM R8185).

Aprasia rostrata (total 1)

Western Australia—Hermite Is (WAM R13861).

Aprasia smithi (total 4)

Western Australia—Kalbarri (WAM R34325, R34579, R38994); S Kalbarri (WAM R39047).

Aprasia striolata (total 117)

Northern Territory—Mt Buring (SAM R10378-80). **South Australia**—37° 11′ S Lat, 140° 30′ E Long (SAM R12513); 37° 17′ S Lat, 140° 44′ E Long (SAM R12738); 37° 22′ S Lat, 140° 37′ E Long (SAM R12773a); 37° 28′ S Lat, 140° 09′ E Long (SAM R12780); Adelaide (FM 95842); Basket Range (SAM R12069-70); Big Heath Natl Park (SAM R12613a); Cape Banks (SAM R12935); Cape du Couedic (SAM R11675); Coombe (SAM R2355, R10384-6); Copeville (SAM R947); Euringa (SAM R3266); Flinders Chase (SAM R1263, R2667, R10382-3, R11922); Glenelg (SAM R3005); 8 mi N Halfway Hill (NMV D15854); Happy Valley (NMV D3303-4); Henley Beach (SAM R1478); Hundred of Macgillivray (SAM R3882); Kangaroo Is (AMNH 24839); Kelly Hill Caves (SAM R4048); Kingston (NMV D18003; SAM 2243); 5 mi S Kingston (SAM R8408); Kopje Garden (SAM R12759); Meadows (SAM R1668); Mitcham (SAM R1172); Mt Lofty (SAM R1469a; UMMZ 131176-80); Mt Lofty Ranges (CAS-SU 16223-4; KU 93802-7; QM J9729-30); Mt Torrens (SAM R2609); Mylor (SAM R2110a-b); Netley (SAM R2588); North Glenelg (SAM R2994); Padthaway (NMV D14653); Pearson Is (SAM R10232); 4 mi W Penola (SAM R12372a-d); 2 mi E Reedy Ck (NMV D18002); Remarkable Rocks (NMV D15388); St Francis Is (SAM R2479); St Leonards (SAM R2488); Semaphore (SAM R791); Sleeps Hill (SAM R2400); Tapanappa Rocks (SAM 2876, R10381); Tea Tree Gully (SAM R4053); 1 mi NE Tea Tree Gully (SAM R11184-5); Vivonne Bay (SAM R11108-11); Waldegrave Is (SAM R11079). **Victoria**—36° 21′ S Lat, 141° 00′ E Long (NMV D18004); Jeparit (AM R11759a-b, R11760); Karnak (NMV D3327); Lake Wallace (NMV D5372); Little Desert (NMV D15390-91); 14 mi SW Nhill (NMV D16523); Portland (NMV D1884, D3336). **Western Australia**—Albany (WAM R6782a, R10949-51, R14809, R29336, R29611); Bremer Bay (WAM R26616); East Mt Barren (WAM R14808); Esperance (WAM R13680, R19046); Tambellup (AM R12305a-b, R27521-2); Two People Bay Reserve (WAM R37839); Yellanup (WAM R7214).

Delma australis (total 112)

Australia—no data (AMNH 29). **Northern Territory**—Alice Springs (SAM R2240). **South Australia**—5 mi W Arkaroola (SAM R5613); 4 mi S Baird Bay (SAM R9224); Blesing Reserve (SAM R9189, R9213); Coober Pedy (AM R17622); Corunna Hills (SAM R12454-5, R12751); Ernaballa (SAM R3123); Gawler Ranges (SAM R5375, R10376); nr Kokatha (SAM R3872, R10375); Koondoolka turnoff (SAM R3863); Mambray Ck Natl Park (SAM R12746-7); Miccollo Hill (SAM R12481, R12669); Mitchell (SAM R380); Mt Davies (AM R17306-8); Mt Greenley (NMV D15440,56); Muloorina (SAM R12756a); Musgrave Ranges (AM R17460); Pt Germein Gorge (SAM R4301); 15 mi E Poochera (SAM R3852, R10374); Port Lincoln (NMV D8857-8; WAM R27359); Purnong (NMV D3075,7, R11127-31); 3 mi NW Tailem Bend (SAM 12670); Watson (SAM R10800); 23 mi ENE Wirrulla (WAM R24528). **Victoria**—Annuello (NMV D13943); Hattah (NMV D8736); Karawinna (NMV D5653); Narrung (NMV R10839-40); Natya (NMV R10838); Ouyen (NMV R11126, R11170-72, R11344); Swan Hill (NMV R10821-6); Woomelang (NMV R10812); Woomelang Mallee (NMV R10808-9). **Western Australia**—Boondalup R (WAM R37208); Bremer Bay (WAM R30238); Chester Pass (WAM R17866); Cheyne Beach (WAM R31168, R36033); 8 mi E Fraser Range (WAM R30704-8, R30749, R30760); Lake Bryde Reserve (WAM R41140); Lake Toolbrunup (UMMZ 84309); Middle Mt Barren (WAM R36897-8, R36902); 12 mi NE Narembeen (WAM R26802); Narrogin (WAM R40236); 76 mi E Norseman (UMMZ 129998); North Tarin Rock Reserve (WAM R40054, R40088-93); Pine Hill (WAM R36229); Rat Is (WAM R30444-6, R37528-32); Tarin Rock Reserve (WAM R40061-2,4); Toolbrunup (FM 11310, 11325,7-8); Wagin (WAM R12604); 14 mi NE Wialki (WAM R14784); Woodlands (AM R11114; WAM R1999).

Delma borea (total 112)

Northern Territory—no data (AM R14336); 23° 21′ S Lat, 129° 23′ E Long, 1625′ (JSE 269); 7 mi N Adelaide R (WAM R24001); Alice Springs (NMV D174); 6 mi S Alice Springs (AMNH 86286-7); Batchelor Siding or Berrima (MCZ 48812-5); Birdum (AMNH 86288); Black Pt (AM R30014-5); Cape Arnhem (AM R13569a-b, R13570a-b, R13648); Darwin (AM R8249, R12877, R19121; NMV D5528, D8492-4; NTM 9, 1680, 3080, 4582; WAM R21980, R40296, R40835); Darwin area (AM R12794, R12841, R13004); 48 mi S Darwin (WAM R37131); Goulburn Is (NMV D14205); Groote Eylandt (AM R13471, R13609; NTM 4950); Helen Springs (WAM R24198); Katherine (SAM R8409); Nightcliff (AM R13713, R13777; USNM 128260; WAM R23480); Parap (WAM R26224); Pt Charles (AM R4162); Port Darwin (AM R3662a-b; QM J2261-2); Roper R Mission (NMV D10086); Rose R (NMV D8763); Westhead (AM R12901); Yirrkala (USNM 128679-82; WAM R13496, R34331-2). **Queensland**—Mt Isa (AM R26138-9, R28445, R31627); Mt Isa Dist (AM R31629-30). **Western Australia**—16° 06′ S Lat, 128° 44′ E Long (UMMZ 131239); Barrow Is (AMNH 99708; UMMZ 131205; WAM R28656); 16 mi E Bohemia Downs (WAM R23048); Cockatoo Is (WAM R14072, R34333); Gogo (WAM R26806); Hermite Is (WAM R37406); Hidden Valley (WAM R37703); 20 mi E Jiggalong (WAM R25201); Kalumburu (AMNH 102388-9; WAM R13570, R27614-5); King Leopold Ranges (WAM R19814); Koolan Is (WAM R29143, R34343); Mt Anderson (WAM R27613); Mt Erskine (QM J21775); Rosemary Is (WAM R37371); St George Range (WAM R32142-3); Tambrey (SAM R4475); Troughton Is (WAM R13466); Warburton Range (SAM R5058); White Mt (WAM R37045); Wotjulum (WAM R11240, R11449); 38 mi SSE Wyndham (WAM R25092).

Delma elegans (total 3)

Western Australia—Mt Herbert (WAM R20070); Mt Tom Price townsite (WAM R31051); Tambrey (SAM R4475).

Delma fraseri (total 181)

South Australia—No 3 Overland Rwy (NMV D2659); 15 mi N Poochera (SAM R3853, R10586). **Western Australia**—no data (WAM 11364); 9 mi N Badgingarra (WAM R36314); Balkuling (WAM R5130); Bayswater Dist (AMNH 99707); Beaconsfield (WAM R5933); Bentley (WAM R29740); Bentley-Manning area (UMMZ 131217-20); Beverley (WAM R22852,7); 25 mi W Beverley (WAM R36474); Bindi Bindi (WAM R28371); 7 mi E Bindi Bindi (WAM R31494); Bodallin (WAM R7463); 8 mi W Bolgart (AMNH 100945, 102386); Boya (WAM R37975); Boyagin Reserve (WAM R22667); Bremer Bay (WAM R30237,9); Broomehill (MCZ 8974); Bruce Rock (SMF 60485); Burges Siding (CAS 104386); Canning R (AM R3436); Cannington (WAM 10635); Como (WAM R13458, R25083); Coolup (WAM 22514); Coomberdale (WAM R24807); 8 mi E Corrigin (WAM R30257); 20 mi SE Corrigin (WAM R21939); Cranbrook (USNM 59944; WAM 11328, R784); Culham (CAS 104385; WAM R14796-9, R21238, R22441-7); Dalwallinu (WAM R28368); Dalyup R (WAM R14787-8); Dongara (WAM R3858); 20 mi S Dongara (UMMZ 131227); Dryandra (WAM R14790); Dumbleyung (WAM R18587); Esperance (WAM R14786); Forrestfield (QM J22307); Fremantle (UMMZ 131216); 5 mi E Gibson Soak (WAM R21993); Gingin (WAM R8456); Glenside (WAM R1676); Gnowangerup (WAM R21537); 7 mi E Greenshield Soak (WAM R39903); 2 mi WSW Greenshield Soak (WAM R39864); Hollywood (WAM R4392); Holt Rock (WAM R20551); Israelite Bay (WAM R31089, R31113); 5 mi N Kalamunda (WAM R21852); Kewdale (WAM R17661); Kuender Siding (WAM R28276); Lake Toolbrunup (FM 11326; UMMZ 84308); Mangowine Well (WAM R7856); Merredin (WAM R8579, R13654, R19999, R22327); Mokine Hills (WAM R19847); Moorabin (WAM R12620); Mt Merivale (WAM R31088); Munglinup (WAM R36235-6); Nanson (WAM R31214); Narembeen (WAM R1172); Narrogin (WAM R514, R25966-7); Northam (WAM R3768, R4926, R14783, R28369, R29735); vic Northampton (WAM R31969-70); North Tarin Rock Reserve (WAM R40087); Parker Range area (WAM R29660); Perth (AM R2443-4,6; FM 97154; MCZ 24462-4; WAM R1310, R1403, R4394); Perth area (NMV D18044); E Perth (FM 75483); 5 mi N Ravensthorpe (WAM R30829); Redcliffe (WAM R2720); Rockingham (WAM R29217-8); 27 mi S Southern Cross (WAM R29661-2); South Perth (WAM R9714); (?) South Perth (NMV R868); Spencers Brook (SMF 60473); Split Rock (WAM R37832); Stockyard Gully (WAM R26740); Tambellup (AM R9890, R9956, R10005, R11649-51; R11665a-e; WAM 2423, R10877, R22337, R36148); Tarin Rock Reserve (WAM R40039); Toolbrunup (FM 11347, 11678,80, 11727); Tuttanning Reserve (UMMZ 131221); Victoria Park (WAM R1316, R3370,3, R10871); Wagin (WAM R14828-9); Wandering (WAM R4365); Wannamal (WAM R26871); West Arthur (WAM R633); Williams (WAM R37955); Wonthella (WAM R30287); Woodlands (AM R11111-2,5, R12129-30, R12131a-b, R12132a-b; WAM R2332a, R2413-4, R4295-7); Woodman Pt (SMF 60474); Yanchep Beach (WAM R40829); York (WAM R10555-6, R10562, R22662).

Delma grayii (total 36)

Australia—no data (BM 1946.8.30.81). **Western Australia**—8 mi N Badgingarra (WAM R25821); Bassandean (WAM R4482); Beagle Pt (WAM R19756); Cannington (WAM 10631,3-4); Coomberdale (WAM R12789); Culham (WAM R21239); Dowerin (WAM R4439); East Dandarragan (WAM R3159); Ejanding (SMF 60472); Eneabba (WAM R31938); Forrestdale (WAM R4401); Gooseberry Hill (WAM R34350); Gosnells (WAM R8391, R25900); Guildford/Caversham (WAM R31990); 3-4 mi E Jurien (WAM R29204); Kalamunda (WAM R39159); Koorda (WAM R14010); Kukerin (SAM R3889); Lancelin (WAM R14789); 1 mi N Marmion (UMMZ 131233); 8 mi E Meckering (UMMZ 132005); Middle Swan (WAM R7260); 6 mi S New Norcia (WAM R26795); 7 mi N New Norcia (WAM R26868); Perth (AM R10006); Pt Peron (WAM R14785); Rockingham (WAM R29393); Sandstone (AMNH 102387); Wattle Grove (WAM R31225); West Wallabi Is (WAM R185); Wittecarra Gully (WAM R33892); Yanchep Beach (WAM R22339).

Delma impar (total 70)

Australia—no data (UMMZ 129982). **Australian Capital Territory**—Barton (AM R14349); Canberra (UMMZ 131159,62-8); Gungahlin (AM R31621). **New South Wales**—Gilmore (AM R11245); nr Tumut (AM R9639). **South Australia**—Bool Lagoon (SAM R8387, R9977, R10060-61, R10715-7, R10718-22, R11143, R12666-8); 3 mi E Naracoorte (SAM R8782). **Victoria**—no data (AK 1079; MCZ 22159; UMMZ 62167); Ardeer (NMV D15447); Byaduk (NMV R11146); 16 mi NE Camperdown (NMV D15441); Hamilton (CAS-SU 12634; NMV D3496-9, R10883); Hockirch (NMV R10802-4); Horsham (NMV R10799); Kew (NMV D1843); Lake Meering (NMV D15443); Laverton (NMV D15444, D16525); Maryborough (AM R4061; UMMZ 129983); Mia Mia (NMV D15442); Mitiamo (NMV R10800, R10827); Moonee Ponds (NMV 55123); Mt Hope Ck (AM R8777); Niddrie (NMV D15445); (?) Riverside (NMV D2874); Rockbank (NMV D15446); Studley Park (NMV D4705); Sunshine (NMV D15439); Trawool (NMV R8390); Werribee (NMV 54957, R10880-81); Werribee Plains (NMV D3324); Westmere (NMV D1025); Winchelsea (NMV D1521); Yea (NMV D12715).

Delma inornata (total 118)

Australia—no data (NMV D1855). **Australian Capital Territory**—Canberra (UMMZ 131160-61). **New South Wales**—Albury (AM R27986); 20 mi S Albury (NMV D8729); Barham (NMV D15457-8); Barmedman (AM R10118, R10126); Bellata (AM R30278); Cootamundra (AM R679-82, R952); Finley (AM R13890; NMV D5715; UMMZ 131185-6); Gerogery (AM R6988); Hillston (AM R10497-8); Holbrook (AM R15946); 18 mi N Holbrook (NMV D15455); 6 mi N Howlong (NMV D15472); Lake Narran (AM 17656); Merah (AM R15495); 1 mi W Momolong (NMV D15465); Moombooldool (AM R20587); Murringo (NMV D2852-4, D2862-3); Nymagee (AM 17982); Pericoota (AM R15451); Riverina Dist (AM R30329); Round Hill (AM R27922); 13 mi NE Tarcutta (NMV D15466); 22 mi W Urana (NMV D15464); 20 mi N Walla Walla (SAM R11095); Wymah (AM R20729); Yanco (AM R17163); Yandembah (AM R973). **Queensland**—Cooktown (BM 98.10.19.4-6); Marmor (AM R12584); Myall Plains (FM 97150); nr Pittsworth (QM J14753). **South Australia**—Renmark (NMV D15453-4); Tooperang (SAM R12745). **Victoria**—no data (AM R15977-80); Annuello (NMV D13945); Benalla (NMV D15448-52, R10844, R10888; UMMZ 130000); Bogong (FM 75326); Bright (NMV D3488-91, R10807, R10813-8); Elmore (CAS-SU 12632; NMV R10836); .5 mi W Goorumadda (NMV D15470); Hattah (NMV D8746); Katamatite (NMV D15459); Kewell (NMV 46502, D3492-4); Kilmore (NMV D4317); Kyabram Dist (NMV D302-6); Maryborough (NMV D15471); Mitiamo (NMV D8154); 10 mi SW Nathalia (NMV D15460); 12.5 mi SW Nathalia (NMV D15461); Newington (NMV D3533); Numurkah (UMMZ 131155-6); Nunawding (NMV 46348); Portland (NMV D2226); Puckapunyal (FM 97146); 10 mi ESE Pyramid Hill (NMV D15467-9); Quantong (AM R11763); Rutherglen (NMV R10830); Stawell (NMV D8918, D15462-3; R10819); Talbot (NMV D16526); Tatong (NMV D14602); Wedderburn (NMV D2721); Woomelang Mallee (NMV R10810-11); Yarra-Wonga (NMV D12045).

Delma molleri (total 35)

Australia—no data (AMNH 24848-53); **South Australia**—Adelaide (MCZ 74512); Black Hill (SAM R1584); Burnside (SAM R3021); few mi N Burra (SAM R6362-70); Hummock Hill (SAM R8140); Mambray Ck (SAM R12918); Mt Lofty (SAM R1470, R12672-3); Mt Lofty Ranges (SAM R2233; SMF 60488); Port Turton (SAM R12624, R12671); 2.5 mi S, 2.5 mi W Stansbury (SAM R12591); 1 mi NE Tea Tree Gully (SAM R11186-7); 4 mi E, 1 mi N Truro (SAM R12550); Waterfall Gully (SMF 60486,90); N Wilmington (SAM R12514-5).

Delma nasuta (total 129)

Northern Territory—23° 22′ S Lat, 129° 26′ E Long, 1600′ (JSE 305); 25° 37′ S Lat, 131° 47′ E Long (EP 9774); Alice Springs (NTM 4808); Angas Downs (WAM R20816); Barrow Ck (NMV D541, D4947); 6 mi SW Barrow Ck (WAM 24353-4); Curtin Springs (AM R14362); Darwin (NMV R11132-6); Finke R (SMF 9646); nr George Gill Range (NTM 2008-9); Hermannsburg (NTM 10); Mt Peachy (NTM 2011-2); Mt Gillen, 1500′ (AM R12013); 28 mi E Lake Buck (NTM 2225); Oorainінna (NTM 2010); nr Petermann Ranges (AM R26398); Smoke Hills (AM R31624); Tempe Downs (NTM 2003-5, 2013); Todd R Stn (NTM 1494). **Queensland**—Mt Isa (AM R26010, R31631). **South Australia**—Birthday Well (SAM R3066a); Coralbignie (SAM R3067); Corunna Hills (SAM R12450-51); 407 mi EW Line (AM R7649); Hiltaba (SAM R13041); Gawler Ranges (SAM R5376a-b); Mamblin (SAM R10727-8); Mann Ranges (AM R17535); 27 mi NE Maralinga (WAM R36649); Mt Davies (AM R17309-15, R17376, R17646, R17939); Oodnadatta (NMV D91); Paralana Hot Springs (SAM R10932); 15 mi N Poochera (SAM R3851a-c); Waikerie (SAM R54); west coast (SAM R5022a-b);

Wilson (SAM R3878a-c; UMMZ 131211). **Western Australia**—28° 27′ S Lat, 119° 05′ E Long (EP 10259, 10497, 10520,8-9, 10538, 10620, 12510, 13); 28° 43′ S Lat, 118° 38′ E Long (EP 13661); Asbestos Ck (WAM R20111); Barrow Is (UMMZ 131206-7; WAM R27611-2, R28453, R28655); 16 mi E Bohemia Downs (WAM R23049); 21 mi W Brown Range (WAM R21043); 21 mi W Carnegie (WAM R21073); Cavenagh Range (WAM R20735); southern Chichester Ranges (WAM R31484); 2 mi W Christmas Ck (WAM R25590); Dales Gorge (WAM R14806-7); Esperance (AMNH 102384); 10 mi N Ethel Ck (WAM R28359); Giles (NTM 1429); 23 mi SE Giles (WAM R20751); 32 mi E Giles (WAM R20770); Halls Ck (WAM R26638); 27 mi SE Halls Ck (WAM R23060); Hermite Is (WAM R37405); 7 mi SSW Learmonth (UMMZ 129999); 10 mi S La Grange (AMNH 100946); Marble Bar (NMV R869; WAM R14800); Millstream (SAM R4513; WAM R20110); Mt Newman (WAM R26547); Mt Ulric Gorge (WAM R20112); 18 mi NW Mt Vernon Stn (WAM R25230); Newman Rocks (UMMZ 130001-2); Nichol Spring (WAM R22806); 25 mi NE Ningaloo (WAM R21773); Noreena Downs (WAM R37018); Pollock Hills (WAM R40178); Queen Victoria Spring (WAM R18551); 13 mi NW Ullawarra (WAM R25261); Warburton Range (SAM R12674-5); Weeli Wolli Springs (AMNH 102385); Woodstock (WAM R14782, R27610); Yardie Ck (WAM R13195a); 22 mi NE Yuna (WAM R26503).

Delma pax (total 16)

Western Australia—Jones R (WAM R14804); Mardie (WAM R13420, R13863); Millstream (WAM R20069); Mt Newman (WAM R28930); Mundabullangana (UMMZ 129889; WAM R14802-3); 9 mi SE Mundabullangana (WAM R17066); Pilgangoora Well (SAM R3445a); Tambrey (SAM R4514); Turee Ck (WAM R22696); Weeli Wolli Ck (WAM R22629); Woodstock (WAM R14805); Yandeyarra (SAM R3452).

Delma plebeia (total 42)

New South Wales—Hebden (AM R15414); Turon R (AM R31622); Warrumbungle Mts (AM R14960). **Queensland**—no data (AM R12485); Banyo (QM J8002, J13543); Belmont (QM J18051); Boonah-Beaudesert Rd (QM J11986); Brisbane (QM J254, J5891, J8735, J8835); Brisbane or Gympie (QM J12768-70); Brookfield (QM J21347); Como State Forest (QM J8409); Deep Water Bend (QM J6288); Eagle Farm (QM J8598); Everton Park (QM J21716); Geebung (UMMZ 131183-4); Glamorgan Vale (QM J7811); Graceville (QM J3426); Harrisville (QM J21358); Kaimkillinbun (AM R11684); Kenmore (QM J10490); Kingaroy (QM J11192); Laidley (QM J1416); Meeandah (QM J20277); Mt Stanley (QM J21757); Pittsworth (QM J12399); Ropely (QM J6743); Rywung (QM J10081); Stafford (QM J9246, J13511, J20697); Tiaro (AM R9211); Toowoomba (QM J258); West End (QM J4895, J15291); Windsor (QM J6766).

Delma tincta (total 168)

New South Wales—Bingara (AM R16683); Clarence R (AM R4123); Croppa Ck (AM R18582); 13 mi E Manilla (UMMZ 131181); Mt Brown (AM R5946); Narriearra (AM R32595). **Northern Territory**—Alice Springs (NTM 12-7, 1070, 1805-6, 2232-6, 2341, 3021, 3124-5, 4806); (?) Alice Springs (NTM 11); 25 mi NE Alice Springs (SMF 60475); Borroloola (NMV D5125); vic Finke (AM R26477-9); Humpty Doo Dist (QM J21786); Oenpelli (NMV D1965); Plenty R (AM R11529); Port Darwin (QM J1781); Tennant Ck (SAM R8062); 6 mi N Wallhallow (AMNH 86285); Yirrkala (AM R12364). **Queensland**—Aitkenvale (DU R3041); Aitkenvale Dist (DU R3131); Alice Downs (BM 1924.3.3.22-4); Appel Channel (SAM R4978, R10377); 10 mi NE Beaudesert (QM J22024-5); Blackall

(QM J11643); Blencoe Falls (QM J10349); Brandon (QM J6577); Brooklyn (AM R12201); Bundaberg (QM J3286); Cairns (FM 124825; QM J3124); N Cairns (FM 97151); Castle Hill (DU R3042; UMMZ 131153); Charters Towers (WAM R21420-22); Cooktown (AM R2283, R7003, R10237; AMNH 69544,59; MCZ 6486); Cunnamulla (AM R11653, R21131; QM J7452); Daintree R (NMV D11168); SE Dalby (FM 97153); Dismal Channels (QM J14281); Douglas (DU R3262-3); Edmonton (AMNH 69347); Einasleigh (AMNH 82700); Endeavor R (MCZ 118688); Glencoe (QM J9663); Gregory Springs (AM R17080); Hermit Park (DU R3213); Homebush (QM J4634); Hughenden (AM R13010; QM J15571-3); Ilfracombe (SAM R4062); Jundah (QM J10303); nr Keppel Sands (QM J15757); King R (MCZ 118686); Lappa Jct (AM R16671); Laura (AM R17028; CAS 121096); Little Mulgrave R (QM J1420); Morington Is Mission (SAM R5027); Mt Carbine (MCZ 35190; SMF 60489); Mt Howitt (QM J6600); Mt Isa (AM R31628); between Mt Molloy and Julatten (QM J17811); Mungar Jct (AM R13714); Normanton (QM J241, J1412-3); Oakey (AM R5853; QM J1862); Pallarenda (UMMZ 131187); Pimlico (DU R3199); Proserpine (AM R12321); Rockhampton (QM J4934, J8467); 118 mi NW Rockhampton (AM R9361); Roma (QM J1418, J21010); Ruthven (QM J5922); Silver Plains (AM R16347, R16684,6); Townsville (AM R13801; DU R3135, R3611; NMV D7537; QM J7475); 18 mi W Townsville (DU R3309); Wahyunyah (QM J6235-6); Winton (AM R9453, R12202); Woodstock (FM 97148-9); Yamala (FM 97152); Yaraka (QM J6146). **Western Australia**—no data (AM R4939); 16° 09′ S Lat, 128° 44′ E Long (UMMZ 131237); Barrow Is (WAM R28454); Binnu (WAM R24812); Carnarvon (WAM R9782-4, R30259); Coordewandy (WAM R28370); East Chapman (WAM R4511); Eradu (WAM R31487); 6 mi NE Exmouth turnoff (UMMZ 131228); Houtmans Abrolhos (NMV R867); Kalumburu (WAM 13838); Kimberley Research Stn (WAM R12114); (?) Kimberley Research Stn (WAM R22366); La Grange Bay (SMF 60476; WAM R3440); Learmonth Dist (WAM R11494); 22 mi NE Mingenew (WAM R31396-7); Minilya (WAM R10615); Mt Pleasant (WAM R13933); Mundabullangana (WAM R14801); Murchison House (WAM R25221, R28391); Nabawa (WAM R22323); Northampton (WAM R14791-5); Pilgangoora Well (WAM R3444); Turee Ck Stn (WAM R17683); Wandagee (WAM R8109); Wyndham (WAM R13653); 2 mi E Wyndham (SAM R7875).

Delma torquata (total 6)

Queensland—Crows Nest (QM J5683); Kenmore (QM J21220); Pomona (QM J9285); Ulam (AM R12611); Upper Brookfield (QM J14365); Yarraman (UMMZ 131242).

Lialis burtonis (total 1142)

Australia—no data (AM 4809-10, 5007, A5747, A5750-51, A5753, A9815, A18694, A18697, B5080, R2570, R2855-6, R3759, R5607, R9367, R10093, R15948, R15982; FM 11116; MCZ 3655, 5242, 5251; NMV D1473, D1496,8, D1500,03, D2774, D8696, R10894, R10910, R10921-3). (?) **State**—Garrah Plains (AM R13406). **New Guinea**—no data (AM R5615, R9511, R24435); Abam (MCZ 119545); Bensback R (AM R3593); Boze (CAS 121973); Dogwa (AMNH 57894); Epo (MCZ 59097); Hall Sound (AMNH 43924, 44003); Kila Kila (MCZ 59102-4, 7-8); Konebada (MCZ 59093-5,8,100); Konedobu (QM J6945); Laloki R (AM R14559-64); Moitaka (CAS 118882; MCZ 123980); Morehead (UMMZ 131188); Mt Walker (UMMZ 131190-91); Porebada (NMV D2296, 8-9); Port Moresby (AM R10914-5, R13703, R14476-7, R24296, R24324, R24364, R24430; AMNH 82548; MCZ 59092, 64304-7; NMV R10919; QM J221); 7 mi N Port Moresby (AM R13207); Rigo (MCZ 59096); Rouna (AMNH 59069); Southeast Cape (AM R5754; UMMZ 56420); (?) Tarara (AMNH

58419); Wipim (CAS 126831-8; MCZ 119542-3, 121259-60; NMV D14429-31, D14515; SAM R10555). **New South Wales**—no data (AM R7935); 13 mi E Abby Green (AU 1365); Aberdeen (AM R14306); 6 mi W Armidale (AU 1005); Balladelok (AMNH 7675); Balls Head (AM R10933); Baradine (AM R14948); Barraba (AM R1688); Barraba Dist (AU 802-3); Beechwood (AM R14011); between Bendemeer and Watsons Ck (AU 148); Ben Lomond (AM R16126); Bourke (AM R2586, R29537-8); Bowling Alley Pt (AM R13890); Burroway (USNM 58709); Camden Haven (AM R10180); Casino (AM R4913); Coffs Harbour Dist (AM R11816, R14816); Comboyne (AM R11075, R13002); Coogee (AM 4814, R4543, R8864); Coonabarabran (AM R25879); Coopernook (AM R9333); Cooranga (AM R20297); Cowra Dist (AM R31626); Delungra (AM R3972); Dubbo (MCZ 6298); Forestville (AM R30375); Georges Heights (AM R8635); Gilgandra (AM R19622); Gladesville (AM R13542); Glenreagh (AM R10012); Grafton (NMV 15340); Graman (AM R27991); Gunnedah (AM R19295); Harbord (AM R18885); Hermidale (AM R21449); Herne Bay (AM R14003); Hillgrove Gorge (AU 801); Inverell (AM R19097); nr Inverell (UMMZ 83428); Kensington Estate (AM R7072); Lennox Head (AM R13800); Lindfield (AM R16900); Loftus Jct (AM R1798); Maitland (AM R14820); nr Manly (AM R8117); "Merribindinyah" (AM R27990); Minnie Water (AM R28359); Moorland (AM R8260); Mosman (AM R12566, R13082, R13442); Mullumbimby (AM R13838; QM J10556); Nambucca R (AM R5897); North Sydney (AM R8771); northwest (CAS 77658); Numinbah (QM J8026); Nymagee (AM R18547); 25 mi W Nyngan (AM R30280); Parramatta (AM R4192); Pilliga (AM R15492); Red Rock (AM R27993); Rob Roy (AM R13832); Roseville (AM R10454); Rossglen (AM R14010); Round Hill (AM R27911-21, R27992, R31619; UMMZ 131169-72); 2.5 mi W Round Hill (UMMZ 131154); Ryde Dist (AM R30281); Scone (AM R6986); Somersby (AM R8712); South Solitary Is (AM R11086); Sydney (AM R11255, R13414; FM 75162); Sydney Dist (AM R16642,4,7, R19275); Tamworth (AM R17988, R19096); Tarro (AM R12319); Tea Tree Ck (AU 209); Toorahweenah (AM R15360); Tumbarumba (AM R4163); Upper Colo (AM R10491); Warrell Ck area (AU 146); Warren (CAS 77657); Warrumbungle Mts (AM R14959, R15663); Waterloo (AM R1373); Wauchope (AM R8057); Weethalle (AM R11528); Willaba (SAM R7912); Woolgoolga (AM R12301, R31625); Wollomombi Lookout (AU 147); Wollstonecraft (AM R11508); Yantabulla (AM R15937). **Northern Territory**—no data (AM R14334; NMV 46159-61, D4537-9,48, D4643-4); 23° 17′ S Lat, 130° 21′ E Long, 1928′ (JSE 404a-c); 23° 21′ S Lat, 129° 23′ E Long (JSE 238); Adam Bay (AM R9183); Alice Springs (AMNH 86294; NMV D169-73); nr Alice Springs (SAM R3636); 10 mi S Alice Springs (NTM 1499); Ayres Rock (NMV D8194); 15 mi SW Barrow Ck (WAM R24366); Berrima (MCZ 48816); Black Pt (AM R30108-11); Booroloola (NMV D5098); Cape Arnhem (AM R13547-8a, R13647); Cape Don (WAM R26672); Charlotte Waters (NMV R10902-3); Coomalie Ck (AM R12694); Curtin Springs (AM R14363); 6 mi W Curtin Springs (WAM R37689); Darwin (AM R12880; AMNH 27314-5; NMV D8333, R10895-6; NTM 32; QM J2568; SAM R2288; WAM R21974, R40295); nr Darwin (AM R13409; CAS 127453; MCZ 31902); East Pt (AM R13411); Groote Eylandt (AM R10196,200, R13477-80a-e, R13610a-b, R25780, R26283); Hatches Ck (SAM R3484); Hermannsburg (MCZ 35191-2; NTM 2353); Hugh R (NTM 1978); Katherine (SAM R9319; WAM R13988, R23889); Kwaiturumuru Ck (USNM 128514); between Lizard Bay and Caiman Ck (AM R30112); Mataranka (AM R13232; WAM R37109); 9 mi NNE Mt Olga (AM R26409); Milingimbi (USNM 128504); Newcastle Waters (AMNH 86293); Nightcliff (USNM 128259); Oenpilli (NMV D3155; SAM R2846); Owen Spring (WAM R20846); Palm Ck (NMV D282); Port Darwin (AM R4985, R8251; QM J1780, J1979, J2216-8, J2570-71, J2983); Port Essington (AM R30052); Port Langdon (USNM 128467-8); Roper R (AM R9918); Rose R Mission (NMV D8725, D12152, D13862-3); Smith Pt (AM

R30051); Snake Ck (WAM R24004); Tennant Ck (KU 93808; NTM 2694); (?) Tennant Ck (WAM R21416); 1 mi E Tennant Ck (WAM R21415); 6 mi E Tennant Ck (WAM R21414); "Todd R" Stn (NTM 1464); Umba Kumba (USNM 128379-83, 128441); 14 mi N Wauchope (WAM R24279); Yirrkala (AM R12090, R12359-61a; KU 93809-10; SAM R3503, R10595-8; USNM 128576; WAM R13511a-f, R13512a-f). **Queensland**—no data (AM R11374, R12475, R12600; NMV R10907, R11154); Acacia Ridge (QM J8645, J10519, J13168); Almaden (AMNH 69268); Annerley (QM J7082); Appel Channel (SAM R4976); Argoon (QM J8358); Armraynald (AMNH 87704); Badu Is (AM R3668, R9652); Bald Hills (QM J13609); Banks Is (NMV D14032); Barcaldine (QM J9751); Bardon (QM J7244, J8001); Beachmere (QM J12290); Belmont Ck (AM R12701); Birkdale (QM J6530, J7675); Black Wattle Ck (UMMZ 131151); Bloomfield R Dist (NMV R10901); Bribie Is (QM J9665); Brisbane (QM J6801, J8532, J8595, J8681, J8714, J8726, J8837, J8919, J9081, J10636); Broadbeach (QM J8855); Brookfield (QM J4602); Bundaberg (QM J1157-8, J1901-2, J2714, J3206); Burketown (NMV D1966); Burpengary (QM J2074, J2101, J8685); Caboolture (QM J5882); Cairns (FM 124884; NMV D8328; QM J3120, J3141); Calverton Downs (QM J5775); Canugra (FM 29111); 20 mi W Capella (CAS 77654-5); Cape York (AM R9592; NMV D562-3, D3536); Cardwell (AM R10778); Carrington Vale (QM J4020); Castle Ck (QM J4542-3); Charters Towers (AM R31623; QM J7373-4; WAM R21412-3); Chermside (QM J8198, J9670-71); Childers (QM J1616, J8723); Chinchilla (QM J8029); Clermont (QM J1356, J8587); 29 mi SSE Clermont (UMMZ 131150); Coen (AM R16533-4; QM J6776); Cooktown (AM R10267, R10423; CAS 121094; QM J20250; SAM R12801); Coominya (QM J8019, J9266); Coopers Plains (QM J10266); Coorigen (QM J8380); Coorparoo (QM J10071); Corinda (QM J10072); Cowan Cowan (QM J4078); Crows Nest (AM R11710); Cunnamulla (AM R12318, R18474); Currumbin (QM J7990); Dalby (QM J7237); Darra Dist (QM J4133); Dawson R (AM R5401); Deighton R (QM J20251-2); Dimbulah (QM J6589); Doomadgee (SAM R5385); Dorrington (QM J10011); Douglas (DU R3301); 15 mi S Duaringa (CAS 77656); Duke of York Is (NMV R11179); Dulacca (QM J1180); Edward R Stn (AM R27187; CAS 121095; MCZ 118687); Eight Mile Plains (QM J8171); Einasleigh (AMNH 82701); Ekibin (QM J8633, J9764, J17510); Esk (QM J7542, J8076); Eukey (QM J8096); Eurella (QM J10782); Fletcher (NMV D5694-5; QM J7508); Fortitude Valley (QM J6081, J8267); Gatton (QM J11205); Gayndah (QM J1487, J6632); Gaythorne (QM J10777); Geebung (UMMZ 131182); Gilruth Plains (QM J14358-60); Gladstone (QM J8292); Glass House Mts (QM J4358, J8106); Goodna (QM J10484); 21 mi S Goomeri (UMMZ 131149); Goonalah (QM J11276); Gregory R (AM R9337); Guluguba (QM J11213); Gumdale (QM J8634); Holland Park (QM J11277); Home Hill (QM J8538); Hopevale (AM R13880); 12 mi W Hughenden (AM R5461); Iron Range Airport (AMNH 69307); Jimna (QM J10191); Kallangur (QM J9037); Karumba (AM R27989; AMNH 86295-302, 87701-3; AU 1016); Kingaroy (QM J7391); Kumbia (QM J8094); Kuranda (SAM R11921); Lamington Natl Park (QM J7496); Lindeman Is (QM J5634); Lindum (QM J8834); Lockerbie (AMNH 69290); Longreach (QM J8880-81); Mabuiag Is (AMNH 30); Macpherson Range (AM R9371); Magnetic Is (AM R16765-6); Mapoon (AM R3469-73); Mareeba (FM 97561); nr Mareeba (MCZ 115583); Margate (QM J928); Maringandan (QM J4055); Maxvale (QM J3563); Millmerran (QM J14319); Minden (QM J13676); Mitchell (QM J3230); Moa Is (AM R7929); Monto (QM J9618, J10182); Montville (AM R10014); Moola (AM R11685); Moorooka (QM J7471, J9590); Moreton Is (QM J2228,79); Mornington Is (NMV D8432; SAM R4974, R10589); Mornington Is Mission (SAM R5028); Mt Alford (QM J8679); Mt Buderim (QM J3026); Mt Garnet (NMV D12017); Mt Gravatt (QM J7278, J9597); Mt Isa (QM J18604); Mt Isa Dist (AM R26594-5); Mt Tamborine (QM J3099-101, J8201); Moura (QM J8653); Mulgrave Is (AM R3668); Mungindi (AM

R15072, R19077-8); Nambour (QM J7498); nr Nambour (QM J12256); Newcastle Bay (AMNH 69284); Ninyilki (SAM R4973); Noosa (QM J15880); Normanton (AMNH 87700; QM J2076-7); North Bundaberg (QM J7387); North Quay (QM J1233); Oakey (QM J1861, J2116); 3 mi S Omicron (UMMZ 131173); Palmer R (NMV R11147-8); Palmwoods (QM J8202); Pittsworth (FM 29110; QM J351, J8586); Pt Stewart (MCZ 35193-4); Pomona (QM J9606); Portland Road (QM J8160); Prince of Wales Is (MCZ 9493); Proserpine (QM J13742); Ravenswood (DU R3238); Redbank Plains (QM J4445); Redcliffe (QM J8705); Retro (AM R12107; QM J6118, J6124, J6369, J15581, J15594); Rochedale (QM J11583); Rockhampton (CAS-SU 12633; QM J5, J11104); Rokoti (SAM R4975); Roma (QM J8824); 28 mi SW Roma (AU 1328); St George (QM J8588); St Ronans (AM R17054); Sandy Cape (QM J5178); Somerset (AMNH 20883); Southport (QM J6170); Stanthorpe (AM R12082); Stuart (UMMZ 131148); Sunnybank (QM J9120, J9934, J14252); Tambo (QM J11640); Taringa (QM J5251, J8842); Tarragindi (QM J7812, J8020, J9626); Thargomindah (QM J8867); Thorneside (QM J16646); Thornlands (QM J10721); Thursday Is (AM R9666); nr Toowoomba (QM J14396); Torres Strait (UMMZ 65935); Townsville (DU R3254-5, R3419, R3695; NMV D7538); 9 mi SSW Townsville (UMMZ 131152); Trinity Bay (NMV D1833, R10897-8); Tugun (QM J8564); Upper Coomera (QM J8219); Upper Mt Gravatt (QM J10640); Virginia (QM J8093, J9259); Wavell Heights (QM J9271); Wenlock (QM J7866-7, J8447); Westbrook (QM J1598); West Burleigh (NMV D15398); Winton (QM J4877); Wondai (QM J8030); Woodridge (AMNH 83858; QM J9601); Woodstock (FM 97562); Woody Pt (QM J7377); Woombye (QM J7376); Wulkuraka (QM J10208); Wynnum (QM J6593, J10570); Wynnum West (QM J11031); Yepoon (AM R15677); Zillmere (QM J10087). **South Australia**—Berri (SAM R2873); Birthday Well (SAM R3065); Buckland Park-Two Wells (SAM R2117); Coralbignie (SAM R3064); Darkes Peak (SAM R390, R10592); 69 mi W Emu (WAM R31804); Ernaballa (SAM R3115, R10588); Fowlers Bay (SAM R1598); Glossop (SAM R3829); Hincks Natl Park (SAM R10130); nr Innamincka (SAM R739); Koondoolka turnoff (SAM R3862, R10590); Morgan (SAM R5482, R10593); Mt Lindsay (WAM R31785); W Mt Orkolo (SAM R10696); Murray Mallee (SAM R8074); Oodnadatta (NMV D89-90); N end Pernatty Lagoon (SAM R12752); 20 mi E Piltadi (AM R17178); Poochera (SAM R3830, R7846, R10591); Port Neill (WAM R27326); Purnong (NMV D3073, D4480, R11150-52); Renmark (NMV D15396-7); nr Renmark (UCB 81715); St Francis Is (SAM R1194, R12896); Waikerie (SAM R55); nr Wattle Park (SAM R4308); Yudnapinna (MCZ 78651). **Victoria**—no data (NMV D1718, R10911-3,5, R11962); Benetook (NMV D12155-8); Koorlong (NMV D15395); Mallee (NMV R10908-9, R11180); Narrung (NMV R10918); Ouyen (MNV R11153); Red Cliffs (NMV R10917); Wangaratta (NMV D3330); Warby Ranges (NMV D15399); Woomelang (NMV R3534-5, R10904-6). **Western Australia**—no data (AM R4942-3, R5608; NMV R883, R2461, R10899-900; WAM R515, R782, R2129, R11462); 19° 18′ S Lat, 121° 23′ E Long (EP 9846-7); 26° 17′ S Lat, 121° 00′ E Long (EP 13311); 28°09′ S Lat, 123° 56′ E Long (EP 12885); 28° 27′ S Lat, 119° 05′ E Long (EP 10550); 28° 28′ S Lat, 122° 50′ E Long (EP 10710, 10725); Ajana (WAM R22996); Applecross (WAM R5058, R12866); Armadale (WAM R13784-5); Arrowsmith (WAM R21855); Attadale (WAM R18500); Badgingarra (WAM R25907); Badur Hill (WAM R27600); 2 mi SSE Bakers Hill (UMMZ 129995); Balladonia (USNM 59942); Barrow Is (WAM R27604-5); Bassendean (WAM R2836, R5157); Bayswater (WAM R6160); Bayswater Dist (AMNH 100949); Bedfordale (WAM R16905); Beechborough (WAM R13994); S end Bellefin Prong (WAM R39037); Benger (WAM R12892, R12918); Bentley (WAM R39113); Bentley-Manning area (UMMZ 131212-4); Bernier Is (WAM R13197); (?) vic Bickley (FM 75413); Bicton (WAM R19114); Bodallin (WAM R26472); 16 mi E Bohemia Downs (WAM R23047); 8 mi W

Bolgart (AMNH 99710); Boulder (AM R3179,81); Boya (WAM R29289, R37903); Bremer Bay (WAM R30240); Broome (WAM R14111); Burnerbinmah (WAM R29746); 3 mi NW Callion (WAM R22537); Canning Stock Rte Well No 13 (WAM R40103); Canning Stock Rte Well No 46 (WAM R40902); 15 mi W Canning Stock Rte Well No 23 (WAM R40161); Cannington (WAM R39039); mouth Capel R (WAM R26553-4); Carlisle (WAM R21949); Carnarvon (NMV R881); 15 mi NE Carnegie (WAM R21069); Cervantes (WAM R41144); Chalk Springs (WAM R22791); Christmas Ck (WAM R26017); City Beach (WAM R14155, R14864, R21883); Cloverdale (CAS 104379; WAM R15020, R18548, R21300); (?) Coburn (WAM R19913); Collier Pine Plantation (WAM R28155); Como (WAM R14160); Como Beach (WAM R18505); Coomberdale (WAM R13465); 133 mi ENE Cosmo Newberry (WAM R19601); Cossack (WAM R14778); Crawley (WAM R14768); Crossing Pool (SAM R4664); Culham (WAM R19845); Cygnet Bay (QM J13016); Dandaragan (WAM R22666); Depuch Well (WAM R27596-7); Derby (WAM R13813, R20316); Dianella (WAM 1458a); 18 mi SE Dowerin (WAM R25083); Dumbleyung (WAM R28947); Durba Hills (WAM R40336); East Victoria Park (WAM R19113); East Wallabi Is (WAM 19137); East Wickepin (WAM R24843); vic Exmouth (WAM R31406-9); Forrestfield (WAM R39146); 8 mi E Fraser Range (WAM R30702-3); Frazier Downs (WAM R27598-9); nr Fremantle (NMV R10916); Garden Is (WAM R776, R26217-8, R28372, R28471, R31073, R34120, R36151); Garden Lake (WAM R2352); Gee Gie (WAM R34038); Geraldton (NMV R11149; WAM R25856); (?) Geraldton (WAM R21610); Gingin (WAM R8455); Glen Eagle (AMNH 100948); Goodwin Soak (WAM R27603); Gooseberry Hill (WAM R24057, R25855); 1.5 mi E Gosnells (UMMZ 131240); Gosnells (WAM R8029); Green Head (WAM R23320); Greenmount (WAM R2082); Guairading (WAM R2463); 27 mi SE Halls Ck (WAM R23059); Hamelin (WAM R13927); Hastings Cave (FM 75412); Helena Valley (WAM R204, R31993, R34654); Herne Hill (WAM R17651); Hilton Park (WAM R14132); Hooley (WAM R20020); Hopetoun (WAM R8923); Houtman Abrolhos Is (NMV R882); Jarrahdale (WAM R14777); Jiggalong (WAM R13636-7); Jingemarra (WAM R28734); Kalamunda WAM R14081, R26470); 12-14 mi ESE Kalbarri (WAM R33865); Kalumburu (WAM R13634, R27606); Kelmscott (AMNH 99711); Kenwick (WAM R13368); Kewdale (WAM R33395); Kimberley Research Stn (WAM R22367); (?) Kimberley Research Stn (WAM R22355); King Edward R (WAM R28206, 19-20, R28246); King Sound (AM R5606); Kojonup (AMNH 102396); Koolan Is (WAM R37765); Koolyanobbing (WAM R31224); Kumarina (WAM R23942-4); ca 5 mi N Kununoppin (WAM R29792); Kwinana (WAM R10681, R29599); La Grange (AMNH 100947, 102394-5); La Grange Bay (WAM R3438); 10 mi NE La Grange (WAM R37177); 10 mi S La Grange (AMNH 99712-7; WAM R27590-95); Lake Grace (WAM R13433); Lake Varley (WAM R27257); 8 mi NW Learmonth (UMMZ 129994); 3-7 mi S Learmonth (WAM R22407-14); 8 mi N Leeman (WAM R22271); Lesmurdie (WAM R24800); Lower Chittering (WAM R24743); Luluigui (WAM R13635); Maddington (WAM R24694); Mandurah (WAM R13783); Manning Ck (WAM R37697); Marble Bar (NMV R885-6); 20 mi S Marble Bar (WAM R22886); Mardie (WAM R13447, R14601); Marrilla (WAM R4752, R5326-7); Maylands (WAM R334, R872, R1381, R26471); McDonnel Ranges (AMNH 24823-5); Meanarra Hill (WAM R33532-4); S Meentheena (WAM R13240a); Melville (WAM R28309); Merredin (WAM R11755, R18501); Miami (WAM R34544); Midland Jct (WAM R7920, R13546); Millstream (KU 93911-2; WAM R20019); Mogumber (WAM R19845); Morawa (WAM R17099); Mosman Park (WAM R34073); Mt Bell (WAM R32262); Mt Newman (WAM R29744); nr Mt Tom Price (WAM R31016); Mt Yokine (WAM R1400, R13367, R13743); Muchea (WAM R455); Mundabullangana (WAM R14769,73); Mundaring (MCZ 24466; WAM R4640); Mundaring Weir (WAM R16913, R40021); nr Mundaring Weir (AU 1252); Mundarry Pool (WAM R19224); 3 mi W mouth Murchison R

(WAM R33864); Nedlands (WAM R14767, R21713); Neds Well (WAM R28323); Nicholson R (NTM 3870); Nichol Spring (WAM R22792); Ningaloo (WAM R16865); 25 mi NE Ningaloo (WAM R21770-72); Nollamara (WAM R13375); Northampton (NMV D7618); North Beach (WAM R26877); North Kalannie (WAM R25353); Nullagine (WAM R14166); Palm Springs Ck (SAM R4663); 10 mi W Peedamullah (WAM R25654); 12 mi W Peedamullah (WAM R25648,61); Perenjori Dist (WAM R29160); Perry Lakes (UMMZ 131243); Perth (FM 97563; MCZ 24465; NMV R872-80; WAM R1112, R1791); nr Perth (AM R8364; NMV R884; UMMZ 124456); Perth Dist (WAM R1196); 80 mi S Perth (AM R2986-7); Piawaning (WAM R29600); Pilgangoora Well (SAM R3438, R10587); Pt Coulomb (WAM R40251); Port George IV (NMV D2364); Port Gregory (WAM R14770); Port Hedland Dist (WAM R36328); Queen Victoria Spring (WAM R18550); Riverton (WAM R21940); Roleystone (WAM R17669); Rottnest Is (FM 75411; MCZ 33026; UMMZ 124457; WAM R3271, R3715,35, R14774,6); S Roy Hill (WAM R37019); Safety Bay (WAM R13979); Salutation Is (WAM R25774); Scarborough (WAM R19825, R28924); Serpentine Lake (WAM R2351); Shark Bay (SAM R3716); mouth Shothole Canyon (UMMZ 130003); Sorrento Beach (WAM R26657); South Perth (WAM R8940, R21712); Stratham (WAM R29619); Subiaco (WAM R3452); Swan View (WAM R14084, R24803, R34009); Talawana (WAM R39128); Tambrey (WAM R6479, R20021); 10 mi S Trayning (WAM R27195); Trigg Is (WAM R19678); Turee Ck Stn (WAM R17684); Victoria Park (WAM R3359); Vlaming Head (WAM R14775); 10 mi N Wanneroo (WAM R29748-9); Wapet Ck (AMNH 102390); Warrawagine (WAM R13241); 5 mi NNE Warroora (UMMZ 131223); West Harvey (WAM R34354); (?) West Kimberley Dist (WAM R26713); West Lewis Is (WAM R14501, R37333); West Wallabi Is (MCZ 33024-5; QM J5507; WAM 14771, R29495); 75 mi NW Wittenoom Gorge (WAM R29095); Woodhouse R crossing (WAM R28240); Woodman Pt (WAM R848); Woodstock (AMNH 102391-3; WAM R13312, R31211); Wotjulum (WAM R11237-8); 4 mi E Wyndham (SAM R7878); Yandeyarra (SAM R3447, R10594); Yarloop (WAM R2433); Yardie Ck (WAM R27601-2); Yardie Ck Stn (WAM R13196, R13812, R14772); York (WAM R10554); Yornaning (WAM R19753); Youanmi (WAM R506); 20 mi NE Yuna (WAM R26498).

Lialis jicari (total 109)

New Britain—Rabaul (AM R6990). **New Guinea**—Abam (MCZ 126164); Aitape (AM R11823-4; MCZ 48571-2); Ambunti (AMNH 99553); Baiyer R, 4900′ (CAS 118944; MCZ 100147-9); Balimo (AM R23952,6-8, R24249, R24420; MCZ 126182); Bobo Is (CAS 126818; MCZ 119548, 126165); Boset (MCZ 126178); Boze (MCZ 119547); Dai (UMMZ 129996); Dagona Lagoon (AM R23842); Daru (CAS 121092, 121790, 121492, 126819-25, 126839; MCZ 119541,6, 126163,6-7, 126180-81; UMMZ 131189); Daru Is (AM R8049; MCZ 125006); Fly R (AM 8539; BM 1946.8.26.69-70); Iffar (BM 1938.6.7.83-93); Karkar Is (AM R12559); Lababia (MCZ 19723); Lae (AMNH 95659); Lake Daviumbo (AMNH 59955); Lake Murray (AM R24253, R24285-6; MCZ 126184); Mabaduan (MCZ 119549); Madang (AM R13528, R13722; FM 13939); Maka (MCZ 126179); Marienberg (FM 13869-70); Mawatta (MCZ 126185); Miak (AM R25237); Nuku, 800′ (AMNH 100242); Porebada (NMV D5950); Port Moresby (AMNH 82547; MCZ 49395); Ramu R delta (BM 1926.5.31.1); Toem (USNM 119258); Togo (CAS 126830; MCZ 126172-5,7); Umi R (AMNH 92670); (?) Upper Fly R (AMNH 57506-7); Wewak (AMNH 74512, 74979-80); Wipim (CAS 126826-9; MCZ 126168-71,6, 126186; NMV D14511-2); Zim (MCZ 126183). **Queensland**—Eidsvold (QM J2198).

Ophidiocephalus taeniatus (total 1)

Northern Territory—Charlotte Waters (NMV D11761).

Paradelma orientalis (total 5)

Australia—no data (AM R3463). **Queensland**—15 mi S Duaringa (CAS 77652); Gayndah (BM 1946.8.13.47); Peak Downs (BM 1946.8.13.48); Wandoo (QM J14400).

Pletholax gracilis (total 23)

Western Australia—Applecross (UMMZ 129997); Bentley (WAM R36172); Coomberdale (WAM R9697); Dianella (WAM R13682, R23918); Eneabba (WAM R25701); Jurien Bay (WAM R12687); 15 mi N Jurien Bay (MCZ 61166); Mandurah (AM R13815, R26628); 1 mi N Marmion (UMMZ 131215,22,29,31-32,34); North Beach (SMF 60677-9); Red Hill (WAM R16886); St James Park (WAM R10627); South Perth (WAM R11150); Victoria Park (WAM R4212).

Pygopus lepidopodus (total 334)

Australia—no data (AM 28, 4802a-b, 5005, B5878, R3342, R4572, R5610, R6020, R10179). **New South Wales**—no data (AM R1433a-d, R5609, R10446; AMNH 22354-5; KU 69876; USNM 56234); Annangrove (AM R9885); Ashfield (AM R10488); Bankstown (AM R10318, R10781, R11853); Bellangry (AM R14927); Belmore (AM R13295); Belmore Heights (AM R6346); Berowra (AM R1551, R21586); Beverley Hills (AM R15597); Bilambil (AM R10025); Bingara (AM R9019); Bondi (AM R5614, R8420); Bullerawa (AM R11056); Burwood (AM R3758); Cabramatta (AM R14315); Campbelltown (AM R1389, R1890, R4182; CAS 74311); Canterbury (AM R1454); Castle Hill (AM R17168); 8 mi N Coffs Harbour (AU 1017); Como (AM R13540); Concord (AM R13980); Coomeroo (AM R7100); Croydon (AM R5185); Deewhy (AM R10321); Duffys Forest (AM R31620); East Hills (AM R11737); Epping (AM R10764, R13976a-b); Forrestville (AM R15460); Gloucester (AM R8924, R13276); Golders Gully (AM R13410); Gosford (AM R8987); Grafton (NMV 15339); Green Valley (AM R13415); Gymea (AM R21409); Gymea Bay (AM R10949); Kogarah (AM R12769); Lakemba (AM R10501, R10510, R11415); Lindfield (AM R4362, R4598, R4899, R6136); Manly (AM R13006); Maroubra Bay (AM R9336); Mascot (AM R10088); Matraville (AM R10320, R10484, R28275); Merrylands (AM R11854); Milton (AM R19115); Mortdale (AM R10376, R11093); Nabiac (AM R19357); Newcastle (AM R12041); Newtown (AM R10777); Nielsen Park (AM R12236); North Rocks (AM 27995); North Sydney (AM R2692); Paddington (AM R1891, R13277); Parramatta (MCZ 10288); Parramatta R (NMV 37848); Patonga (AM R15498); Peakhurst (AM R8639); Pennant Hills (AM R8319, R10125); Port Macquairie (AM R14800); Punchbowl (AM R8272, R9749, R13061); Regents Park (AM R12422); Richmond (AM R27987); Rockdale (AM R10514); Round Hill (AM R27923); Ryde (AM R11414); Sans Souci (AM R10002); Scarborough (AM R9462); Somersby (AM R8709-10); Sydney (AM R10511, R13235, R13878; CAS 77660; NMV D2861, D3329; UMMZ 83427); Sydney Dist (AM R5458, R15763, R28276); Tarrara (AMNH 20881); Toongabbie West (AM R10492); Turramurra (AM R8537, R27996); Vaucluse (AM R8873); Wahroonga (CAS 77659); Wardell (AM R12608); Wentworthville (AM R9611, R10599; MCZ 10197); Willoughby (AM R12178); Yarramalong (AM R3690). **Queensland**—no data (FM 29112); nr Aratula (QM J14236); Beaudesert (AMNH 27322); Beenham Valley (QM J8384); Beerwah (QM J9693); Caloundra (QM J9083); Canungra (QM J4710); Chinchilla (AM R4324); Currumbin (QM J6650); Elimbah (QM J20424); Eumundi (NMV D961); Maroochydore (QM J7328); Montville (AM R10018); Mt Glorious (QM J9902); Mt Mee (QM J9035); Yeppoon (QM J6363). **South Australia**—Aldgate (SAM R5119); Big Heath Natl Park (SAM R11067, R11068); Blesing Reserve (SAM R9191, R9211); Bordertown (SAM R5777); Cherry Gardens (CAS-SU

16225); Coonalpyn (SAM R1479); Corny Pt (KU 93816); SE County Chandos (SAM R9002); Cowell (SAM R3952); Eden Hills (SAM R2123); Finniss (SAM R8446-7); Fowlers Bay (SAM R5366, R10584-5; NMV R10929-31); Gammon Plateau (SAM R3943); Glen Osmond (SAM R1337); Hincks Natl Park (SAM R10129); Humbug Scrub (SAM R2268); Hundred of Verran (SAM R10133); Hundred of Nicholls (SAM R10154); Keith (KU 93814); Kingston (SAM R2818); Kyeema Natl Park (SAM R11097); 3 mi E Lucindale (SAM R10294); McLaren Flat (SAM R2126); Mt Compass (SAM R1997); Naracoorte (SAM R9308); Newton (USNM 59943); Normanville (KU 93817); Nullarbor Stn (SAM R9911); Port Lincoln (AM R5613; NMV D9041; SAM R3808); Purnong Landing (AMNH 24914; NMV R11163); Rudall (SAM R10614); 12 mi Sheringa (KU 93815; SAM R3623); Sleeps Hill (SAM R2286); west coast (SAM R1598); Yeelanna (KU 93813). **Tasmania**—no data (NMV R10933). **Victoria**—no data (NMV D3341); Bittern (NMV D1651); Broughtons Waterhole (NMV D15385-7); Bunyip (NMV D1712); Dunolly (NMV R10928); Frankston (NMV D617); S Kiata (NMV D8114, R11672); (?) Mornington (WAM R9859); Wycheproof (NMV R11821); Yatpool (NMV D5448). **Western Australia**—no data (AM R4940-41; CAS-SU 12635); Ajana (WAM R25820); Albany (WAM R13482); Balla Tank (WAM R27609); Bayswater (WAM R1283); Bindi Bindi (CAS 104380); Bolgart (WAM R8997); Bruce Rock (or Pt Hillier) (WAM R24844); Carnamah (WAM R37497); Caron (WAM R28884); Carrarang (WAM R39021-2); Cheyne Beach (WAM R22520); Cliff Head (WAM R22255); 15 mi SE Cocklebiddy (WAM R34446); Coolgardie (WAM R5697, R6496); Cranbrook (WAM R5389, R6106, R10905); Dalwallinu (WAM R21721); Dangin (WAM 12652); Denmark (WAM R5073, R5825); Dongara (WAM R8452); Duke of Orleans Bay (NMV D8750); 6 mi SE Eneabba (WAM R41207); Esperance (WAM R27607); (?) Esperance (WAM R15128); 14 mi E Esperance (WAM R14780); Eucla (WAM R282); Fitzgerald (WAM R36866); Forrest (WAM R16897); 22 mi S Forrest (WAM R28417); Geraldton (WAM R27137); Green Head (WAM R23319, R39851); Greenough (WAM R25620, R26326); Green Range (WAM R34715); Highbury (WAM R7071); Hutt R (AMNH 102397); Israelite Bay (WAM R10108); Junana Rock (WAM R17615); Junga Dam (WAM R33814); 3 mi NE Jurien Bay (WAM R29205); 4 mi NNE Jurien Bay (WAM R30483); 15 mi N Jurien Bay (UMMZ 129991); 22 mi NE Kalbarri (WAM R31075); Kalbarri (WAM R27608); S Kalbarri (WAM R39046); 8 mi S Kalbarri (WAM R30319); 11 mi S Kalbarri (WAM R33755, R33771); Kalbarri Natl Park (WAM R39074); Kalgoorlie (AMNH 20880); King Georges Sound (NMV D3331, 46338); Kojonup (UMMZ 129981; WAM R2343, R22850); Kondinin (WAM R3430); Koorda (WAM R1507, R36124); Lake Grace (WAM R4215); Lake Magenta Reserve (WAM R40751); Lake Varley (WAM R20552); Lomos (WAM R2834); Maida Vale (WAM R577); Marchagee (WAM R4519); Marradong (WAM R1549); Marvel Loch (WAM R4154); Maya (AMNH 102398); 5 mi W Margaret R (WAM R24808); Meanarra Hill (WAM R33521, R33528); Miling (WAM R20585); Moonijin (WAM R13848); Moora (WAM R367); (?) Moora Dist (WAM R26076-7); Morawa (WAM R606); Mt Barker (WAM R4637); Mt Cook (AMNH 99709); Muchea (WAM R23884, R34335); 9 mi SW Mukinbudin (WAM R14781); Mundaring (NMV R860); 20 mi ESE Narembeen (WAM R22289); Narrogin (UMMZ 129990; WAM R513, R6431); Norseman (WAM R34352); Northampton (WAM R8528); North Tarin Rock Reserve (WAM R40055); Ongerup Dist (WAM R36684); Perth (MCZ 24470; NMV R856-7,9); Pithara (WAM R8119); Porongorups (WAM R11574); Ravensthorpe (WAM 10353); Recherche Archipelago (NMV D8251); Rockingham (WAM R5977); Spargoville (WAM R26727); 4 mi E Tamala (WAM R23850); 40 mi W Three Springs (WAM R37713); Tombstone Rocks (WAM R31966); Torbay Jct (WAM 10715); Two People Bay (WAM R6823, R39698); Waikiki (WAM R40986-7); Wandering (WAM R30043); 10 mi N Wedge Is (WAM R39053); Woodlands (AM R11110); Yallingup (WAM R9079); Yellowdine (WAM R23899, R31187); 20 mi NE Yuna (WAM R26497).

Pygopus nigriceps (total 227)

Australia—no data (AM R3401, R3461, R8273-4, R15071; MCZ 21884). **New South Wales**—Armatree (AM R9190); Beanbri (AM R12312); Booligal (UMMZ 131158); Boonoke (AM R13732); Bringagee (AM R13198); Booree Ck (WAM R9860); Broken Hill (AM R9545; SAM R5397); Carinda (AM R10064); Carowra Tank (AM R10313); Collarenebri (AM R21576); Collie (AM R14410); Combo Combo (AM R10445); Coonamble (AM R11087); Cryon (AM R11074); Cunnamulla (AM R12322); Deniliquin (AM R13289; NMV D8445); Edgeroi (AM R12594); Garah (AM R12315); Geurie (AM R13752); Gilgandra (AM R12237, R28011; UMMZ 129984); 5 mi N Gilgandra (AM R26320); Girilambone (AM R8854); Glencairn (AM R11802); Griffith (AM R10784); Gunnedah (AM R18884); Gunningbar (AM R8988); Hay (AM R9687); Hermidale (AM R9127); Hillston (AM R10071; MCZ 33036); Jerilderie (AM R640); Leeton (AM R9475; UMMZ 129993); Moree (AM R11562); Mullengudgery (AM R6764); Narromine (AM R20754); Nevertire (AM R6971; UMMZ 129992); Nowranie (AM R12302); 20 mi E Nyngan (AM R19296); Ootha (AM R13837a-b); Randenbah (AM R781); Rankin Springs (AM R11643, R11871); Redbank (UMMZ 129985); Roto (AM R20725); Rowena (AM R15702); Sydney (AM R5221); Tooraweenah (AM R14921); Trangie (AM R11329); Weethalle (AM R9108); Wee Waa (AM R7944); Wentworth (AM R3790); Yalgogrin North (AM R11810). **Northern Territory**—23° 21′ S Lat, 129° 26′ E Long, 1600′ (JSE 283); Aileron (NTM 1630); Alice Springs (NMV D168; NTM 30; SAM R4791); (?) Alice Springs (WAM R25621); nr Alice Springs (SAM R3637); 20 mi S Alice Springs (AMNH 86292); Allua Ck (NTM 2532); Argadargada (NTM 31); Barrow Ck (NMV D534); Darwin (AM R12716); Dingo Gap (NMV D11003); Dunmarra (AMNH 86290-91); Hermannsburg (NTM 2356); Katherine (AM R13048); S Katherine (AMNH 86289); "Lake Nash" Stn (NTM 5033); Maranboy (WAM R23792); Mataranka (AM R13233; SAM R8116); Petermann Ranges (NTM 3268); Tanami Sanc (NTM 2209, 2216, 3228); Tennant Ck (WAM R21418); 4 mi E Tennant Ck (WAM R21419); 36 mi S Tennant Ck (WAM R21417); "Todd R" Stn (NTM 1427-8, 1470); The Granites (NTM 2141); Yirrkala (SAM R3510). **Queensland**—Barcaldine (QM J7919); Bollon (QM J4570); Bowenville Dist (QM J2917-8); 10 mi W Bundaberg (QM J11029); Charleville (QM J2735); Cloncurry (QM J11116); Coen (AM R26579); Cunnamulla (AM R12322; QM J7288, J8436); Currumbin (QM J6079); Dalby (AM J5238); Doomadgee (SAM R5386); Dulacca (QM J1266); Eromanga (QM J5092); Goolagimbi (QM J7282); Hughenden (AM R6691); nr Hughenden (AM R8974-5); Isisford (QM J5440, J5921); Longreach (QM J7489, J8882); nr McKinlay (QM J13010); Mungindi (AM R19079); Muttaburra (QM J9116); Richmond (QM J13560); Rockhampton (NMV D4586); Rockwood (QM J21444); Tara (QM J9241); Taroom (QM J7473); Yungaburra (QM J3899). **South Australia**—Burra (SAM R2234); Coober Pedy (AM R17527, R17621); Copley (SAM R5893); between Everard and Musgrave Ranges (SAM R600); Gawler Ranges (NMV D4559); Hawker (SAM R11752); 23 mi N Innamincka No 2 Bore (UMMZ 131174-5); W Kychering Soak (NMV D2651); Mt Anna Peake (SAM R4996); 1 mi W Mt James (SAM R5051); 40 mi NW Mt Lindsay (WAM R31724); Parenti Hills (SAM R5626); Tomkinson Ranges (AM R17531); Wynbring (SAM R876). **Victoria**—Kewell (NMV D1821); Murray R (NMV R10924); Ouyen (NMV R11387); Pine Rise (NMV D559). **Western Australia**—no data (AMNH 32851); 26° 18′ S Lat, 120° 58′ E Long (EP 10172); 28° 28′ S Lat, 122° 50′ E Long (EP 10758, 10779, 10811, 10852, 11024, 11057, 12012); 28° 28′ S Lat, 122° 51′ E Long (EP 10879, 13415); 28° 46′ S Lat, 118° 31′ E Long (EP 10601); 29° 35′ S Lat, 117° 08′ E Long (EP 10461); Ajana (WAM R26016); Albion Downs (WAM R30986); 8 mi W Beacon (WAM R29605); Binnu (WAM R22318); Booylgoo Spring (WAM R1103, R6498; UMMZ 129980); Burnerbinmah (WAM R29613); Carnamah (WAM R404); 8 mi S

Carnarvon (WAM R25899); N edge Chichester Range (WAM R30930); Cue (WAM R31527-8); Cue Dist (WAM R740); De Gray (WAM R2137); Dodo Well (MCZ 24469); 50 mi S Exmouth Gulf Stn (UMMZ 129989); 180 mi N Giles Weather Stn (NMV D9841); Hamelin Pool (WAM R6532); Jibberding White Well (UMMZ 124455); Jiggalong (WAM R13350, R26071-2); Karonie (WAM R2783); Kathleen Valley (WAM R24918, R40525); 1 mi ESE Kathleen Valley (WAM R40528); 5 mi W Kellerberrim, 325 m (CAS 94367); Kimberley Downs (NMV D4830); King Sound (AM R8776); 4 mi E Kulja (WAM R22657); Kunumurra (SAM R8117); Lalla Rookh (WAM R19239); Landor (WAM R1889); Laverton (AM R3371; NMV D615); Leonora (WAM R10111); 28 mi S Leonora (WAM R14779); Marrilla (WAM R5328-9); Mollerin (WAM R21284); Mt Marshall area (WAM R39126); Mukinbudin (WAM R22858); Mullewa (WAM R5892); Mungilli Claypan (WAM R25851); Pippingarra (WAM R29882); Port Hedland Dist (WAM R36327); Rudall R nr Larrys Ck (WAM R40238); 4 mi W Six Mile Ck (UMMZ 131226); Wanjarri (WAM R40526-7); Wannoo (WAM R30256); Warburton Range (WAM R22114, R22299); 91 mi S Warburton Range (WAM R25870); Warburton Range Mission (WAM R22074); (?) Warburton Range Mission (WAM R22014); Winchester (WAM R5083); Yalgoo (WAM R4792); 25 S Yalgoo (WAM R21577); 22 mi NE Yuna (WAM R26501).

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