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OBSERVATIONS ON SOME TASMANIAN FISHES: PART XXIX

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(with two tables, six text-figures and three plates)

ABSTRACT

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REGALECIDAE. *Regalecus glesne* Ascanius, 1772: recent local stranding. TRACHIPTERIDAE. A comprehensive study has been made of seven Tasmanian dealfish determined as *Trachipterus arawatae* Clarke, 1881. Unfortunate misapprehensions by Australasian authors of the status of the genera *Trachipterus* Gouan, 1770, *Desmodema* Walters & Fitch, 1960 and *Zu* Walters & Fitch, 1960 have led to widespread and continued confusion regarding dealfishes in the local literature: a chronological synopsis of emended names is provided. the genus *Zu* is here recorded for the first time from Australian waters, a specimen from Stanley being provisionally determined as *Z. cristatus* (Bonelli, 1820). EMMELICHTHYIDAE. *Emmelichthys nitidus* Richardson, 1845: general observations on an example about two-thirds grown. PEMPHERIDAE. *Parapriacanthus elongatus* (McCulloch, 1911): general observations, special reference to coloration. SOLEIDAE. *Zebrias fasciata* (Macleay, 1882): two additional local records; some unusual features.

INTRODUCTION

This paper follows the general plan of others in the series. Linear measurements are given throughout in millimetres, the name of the unit commonly being omitted, or are given as thousandths of standard length. The symbols *Ls*, *Lt*, *TLs*, *TLt* denote standard length, total length, thousandths of standard length, thousandths of total length, respectively. Registration numbers are those of the Queen Victoria Museum and Art Gallery, Launceston. Certain other conventions are noted in earlier contributions.

SYSTEMATIC ZOOLOGY

Family Regalecidae

Genus *REGALECUS* Ascanius, 1772

Regalecus Ascanius, 1772, p.5; type species *Ophidium glesne* Ascanius.

Regalecus glesne Ascanius, 1772

Regalecus glesne Ascanius, 1772, p.5.
Regalecus pacificus: Scott, 1982, p.189, pls 2-4 (local synonymy).

Recent Tasmanian examples

Two recent Tasmanian examples, one from Mersey Bluff, Devonport and one from Low Head have been reported and illustrated (Scott 1982). In September 1982 an example noted as about 3 m long (possibly with some distal imperfection) and 30 cm deep was found on the foreshore at Turners Beach, northwest coast. Ornamentation appeared to be confined to rounded or slightly longitudinally elongate spots ("black, thumbprint-like") and a few rather obscure smudges.

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Suborder Trachiopteroidei

In the suborder Trachipteroidei [= Taeniosomi of Regan (1907) and Trachipteroidea + Veliferoidei in part of Berg (1940)] the Trachipteridae (three genera, *Trachipterus* Goüan, 1770, *Desmodema* Walters & Fitch, 1960, *Zu* Walters & Fitch, 1960) may be summarily distinguished from the other families thus: from Lophotidae (two recent genera, *Lophotes* Giorna, 1805, *Eumecichthys* Regan, 1907, and one extinct genus) in lacking an anal fin and an ink sac, and in not having the upper profile of the head sloping forward, overhanging the snout; from Regalecidae (two genera, *Regalecus* Ascanius, 1772 and *Agrostichthys* Phillipps, 1924) in having fewer vertebrae (69-102, cf. 143-ca. 170) and the lateral line plates smooth, not each with a spine. In the Handbook (Munro 1957) and in various texts by Whitley the Agrostichthyidae, instituted by Phillipps (1924), is treated as distinct from Regalecidae; Walters & Fitch (1960), while formally subsuming the former in the latter suggest "possibly it is at least subfamilially distinct"; in their provisional classification of living teleosts Greenwood *et al.* (1966), who customarily note alternative or partly equivalent family names in parentheses following the family name as recognized by them, have no entry (either in the index or the text) of Agrostichthidae, apparently overlooked. If the two taxa are accepted they may be distinguished by some trenchant characters of their type genera: thus in *Agrostichthys* gill rakers are few (8-10), the premaxilla continues forward in line with the frontal profile, the gastric caecum ends before the vent, teeth are present on lower jaw and on vomer, whereas in *Regalecus* gill rakers are numerous (40-58), the premaxilla is set about at a right angle to the frontal profile, the gastric caecum ends well behind the vent, teeth are absent. McCann (1953) states the lower jaw is hinged in *Regalecus*, fixed in *Agrostichthys*. It may be noted that in a detailed key to the four families by Whitley (1933) a couplet separating *Trachipterus* from *Regalecus* by the specification of the upper profile of the head as convex in the former, concave in the latter is incorrect in the first term (head shape in *Trachipterus* discussed below); while in a key to Regalecidae, *s.l.*, in Part XXVIII (Scott 1982, p.189) the description of the maxillary plate as "deeper than long" for *Regalecus pacificus* and as "longer than deep" for *Agrostichthys benhami* inadvertently transposes the specifications.

Over and above the ills to which Australian ichthyological systematics have traditionally been heir, such as early identification of local fish with Old World species(e.g., in the present context local species of *Trachipterus* Goüan, 1770 with *T. arcticus* Brünnich, 1778, *T. trachypterus* (Gmelin, 1789), *T. taenia* (Bloch & Schneider, 1801), *T. altivelis* Kner, 1859, followed by recognition of a distinct local species (followed, again in a number of instances, by a return to an original position) the regional taxonomy of trachipterids has had to contend with two unusual situations; first, the confusion of specific and even generic characters with those attributed, as in McCann (1953) to sex or, as in Phillipps (1944) and many authors, to age; secondly, a curious and quite exceptional disregard or misapprehension of generic limits. The second complication, which has resulted in some incorrect generic attributions that have continued even into some quite recent publications, is considered below.

The ventral profile of the trunk is entire (E) in *Trachipterus* and in *Desmodema*, but scalloped (S) in *Zu*. The main axis of the caudal fin (or, where the fin exhibits two lobes, at least the axis of the major (upper) lobe) is at a marked angle to the general anteroposterior axis of the fish (A) in *Trachipterus* and *Zu*, but continues in the general sense of that axis (C) in *Desmodema*. The three genera may therefore be symbolized by a two-letter code, thus: *Trachipterus* EA, *Desmodema* EC, *Zu* SA. While prior to the establishment of *Zu* Walters & Fitch, 1960 and *Desmodema* Walters & Fitch 1960 species now referable to one of these genera were naturally and inevitably accommodated in the only available and utilized genus *Trachipterus* Goüan, 1770, unfortunate and avoidable misidentification has occurred since their publication. In recent Australian literature *Trachipterus arawatae* Clarke, 1881, a genuine representative of that genus, and specifiable as EA, has been placed in *Desmodema*, which would require it to be EC. By synonymization of *Trachypterus* [*sic*] *jacksoniensis* [*sic*] *polystictus* Ogilby 1898 with *Trachipterus arawatae* and concomitant relegation of Clarke's species to *Desmodema*, while Ogilby's fish is nomenclaturally identified correctly as EC, Clarke's is nominated in error also as EC. Further, the use — e.g. in Whitley (1958, fig.1) — of the name *Desmodema arawatae* applied to a figure of a specimen of *Zu* sp. leads to this fish being treated by virtue of the first

binomen as being EC and by virtue of the second as EA, while actually being SA.

In the subjoined chronological selection of Australasian papers containing either primary records or important treatments of tracheriptids, together with several regional catalogues and works of a more popular nature, an attempt is made to set straight the regional nomenclatural record.

It should be noted that while the probable identifications here presented are in accord with the present climate of local taxonomic opinion they nevertheless make two implicit assumptions: firstly, that *Trachipterus arawatae* Clarke, 1881 (April) and *Regalaecus jacksonensis* Ramsay, 1881 (May) are conspecific, being based on young and adult individuals, respectively; secondly, that Clarke's New Zealand species is not identical with an earlier-described extra-Australasian species. The first (not unanimously accepted) remains at present unproved; the second would appear to be worthy of consideration following comparison, beyond the present logistic capacity of the writer, of appropriate material.

The local nomenclatural misapprehensions thus cleared up there yet remains the prior problem of the number and identity of the extra-Australasian species, a question that does not appear at present to have been satisfactorily resolved. Though probably best known from the Old World, dealfishes are distributed throughout the whole of the tropical and temperate zones, various species being described from different regions. Writing almost a hundred years ago, Günther (1887) enumerated nine species from the Mediterranean and the neighbouring Atlantic Ocean (noting that of one of these, *T taenia* Bloch – now usually credited to Schneider, 1801 – three others, *T. filicauda* Costa, *T. iris* (Walbaum, 1792) and *T. spinolae*, C & V [= Valenciennes, 1835] are, according to Emery (1879b) successive growth stages), one each from Cuba, and the East India Archipelago, and three from the Pacific. Something like two score of other nominal species have been described.

In a review of the dealfishes of the Mediterranean and northeast Atlantic Palmer (1961) recognized only two species, namely, *Trachipterus arcticus* (Brünnich, 1788), subsuming in it five nominal species (one of which, *T. bogmarus* Valenciennes, 1835, together with Brünnich's species itself, is cited in Australasian literature), and *Trachipterus trachypterus* (Gmelin, 1788), with seventeen synonyms, of which *T. iris* (Walbaum, 1792), *T. taenia* Schneider 1801, *T. spinolae* Valenciennes, 1835 and *T. falx* Valenciennes, 1835 have been applied to Australasian fish. Lacking access to extralimital material the present writer obviously is not in a position to arrive at an informed opinion as to whether or no these two forms are valid species. However, attention may perhaps appropriately be drawn to the fact that Palmer's key to them on p.339 includes no anatomical or meristic characteris, the three couplets of differentiae being wholly morphological, the first two relating to relative regional depths (a feature subject to variation with age) and the third to the straight or upcurved body axis in the posterior caudal regions in adults, a difference that is certainly present in young New Zealand individuals apparently identifiable as *T. arawatae*, cf. the figure of the type of that species and a photograph of a specimen referred by McCann (1953, fig.7) to *T. arcticus*: the caudal region is distinctly curved up in our two smallest examples. While the distinction of the Australian fish from those described earlier remains unestablished, the final elucidation of the taxonomic status of the latter clearly remains a matter of live interest. Palmer observes "*T. arawatae* Clarke (1880) [= 1881] from New Zealand may well be synonymous with the above" [*T. trachypterus*], and gives the distribution of Gmelin's species as Mediterranean, S. Africa, Central Pacific, New Zealand, with no southern hemisphere locality for Brünnich's. Elsewhere he makes incidental mention of "the Australian species, *T. jacksonensis*" (here treated as synonymic with *T. arawatae*). No comparative study has been carried out on *T. arawatae* with a number of other nominal species from widely ranging localities in the Pacific and Indian Oceans (or indeed from localities in the West Atlantic). A review of the main texts in the Australasian literature has been made and a tabular synopsis of published names and suggested emendations to these is subjoined.

Observations on some Tasmanian fishes: Part XXIX

MISIDENTIFICATIONS OF AUSTRALASIAN RIBBONFISHES IN THE LOCAL LITERATURE

A. *Trachipterus arawatae* Clarke 1881 (genus *Trachipterus* Goüan, 1770)

1. *Trachipterus altivilis* Kner, 1829: 1873, Hutton, F.W., *Trans. N.Z. Inst.*, 5, p.264, and 1876, *ibid.*, 8, p.219: 1883, Johnston, R.M., *Pap. Proc. R. Soc. Tasm.* (1882), p.123 (this specimen, providing the first record of a Tasmanian trachipterid, was noted as being in the Royal Society's Museum, Hobart (Now Tasmanian Museum): Mr A.P. Andrews, the institution's zoologist, informs me it is now not traceable): 1884, Macleay, W., *Proc. Linn. Soc. N.S.W.*, 9(1), p.43: Lord, C.E., 1923, *Pap. Proc. R. Soc. Tasm.* (1922), p.65, and 1927, *J. Pan-Pacific res. Inst.*, 2(4), p.13: 1924, Lord, C.E. & Scott, H.H., A SYNOPSIS OF THE VERTEBRATE ANIMALS OF TASMANIA, pp.9,47: 1927, Phillipps, W.J., *N.Z. Fisher. Bull.*, 1, p.26.

2. *Trachipterus*, sp. nov. Clarke, 1881: 1881, Clarke, F.E., *Trans. N.Z. Inst.*, 12, p.195, unnumbered fig.

3. *Regalecus jacksonensis* Ramsay, 1881: 1881, Ramsay, E.P., *Proc. Linn. Soc. N.S.W.*, 5, p.361, pl.20 [*Regalaecus*]: 1881, Macleay, W., *Proc. Linn. Soc. N.S.W.*, 6(1), p.55: 1927, Phillipps, W.J., *N.Z. Fisher. Bull.*, 1, p.27: 1929, McCulloch, A.R., *Aust. Mus. Mem.*, 5 (1), p.138.

4. *Trachipterus jacksonensis* (Ramsay, 1881): 1886, Ogilby, J.D., CATALOGUE OF FISHES OF NEW SOUTH WALES, p.43 [*jacksoniensis*]: 1906, Stead, D.G., FISHES OF AUSTRALIA ..., p.217, and 1913, *Proc. Linn. Soc. N.S.W.*, 37(3), p.492: 1916, Hamilton, H., *Trans. N.Z. Inst.*, 43, pp.370-382, fig. 1 (only): 1921, McCulloch, A.R., *Aust. Zool.*, 2(1), p.25, pl.11 [Part 2 of CHECK-LIST OF FISHES AND FISH-LIKE ANIMALS OF NEW SOUTH WALES: parts 1, 2 issued in book form, with different pagination, with additions by G.P. Whitley, 1922, 1927, 1934], and 1929, *Aust. Mus. Mem.*, 5(1), p.133: 1925, McCulloch, A.R. & Whitley, G.P., *Mem. Qld Mus.*, 8(2), p.170: 1926, Marshall, T.C., *Mem. Qld Mus.*, 8(2), p.123, and 1964, FISHES GREAT BARRIER REEF AND COASTAL WATERS OF QUEENSLAND, p.124, pl.29, fig.135, and 1966, TROPICAL FISHES GREAT BARRIER REEF, p.178, pl.29, fig.135: 1927, McCulloch, A.R., *in* Whitley, G.P., *Rec. Aust. Mus.*, 15(5), p.296, pl.25, fig.2: 1957, Munro, I.S.R., *Fisher. Newsl.* (now *Aust. Fisher.*), 16(4), p.64, sp.450, fig.450 [*jacksoniensis*] ("probably adult" of *T. arawatae*): 1978, Grant, E.M., GUIDE TO FISHES, p.134 [*jacksoniensis*].

5. *Trachipterus taenia* Bloch, 1801: 1886, M'Coy, F., PRODROMUS ZOOLOGY VICTORIA, 13, p.83, pl.122: Phillipps, W.J., *N.Z. Fisher. Bull.*, 1, p.26.

6. *Trachipterus spinolae* Cuvier, 1835: 1886, M'Coy, F., PRODROMUS ZOOLOGY VICTORIA, 13, p.84.

7. *Trachipterus falx* Valenciennes, 1835: 1886, M'Coy, F., PROD. ZOOL. VICTORIA, p.84.

8. *Trachipterus iris* Valenciennes, 1835 (*non* Walbaum, 1838): 1886, M'Coy, F., PROD. ZOOLOGY VICTORIA, p.84.

9. *Trachipterus trachypterus* (Gmelin, 1789): 1916, Hamilton, H., *Trans. N.Z. Inst.*, 43, pp.370-382, figs 3,4,5,6 (only): 1927, Phillipps, W.J., *N.Z. Fisher. Bull.*, 1, p.26.

10. *Trachipterus ishikawae* Jordan & Snyder, 1901: 1927, Phillipps, W.J., *N.Z. Fisher. Bull.*, 1, p.27.

11. *Trachypterus arcticus* (Brünnich, 1788): 1953, McCann, C., *Rec. Dom. Mus.*, 2(1), pp.1-17, figs 4,7 (only): 1960, Parrott, A.W., QUEER AND RARE FISHES OF NEW ZEALAND, fig.34, a,b.

12. *Desmodema arawatae* (Clarke, 1881): 1962, Whitley, G.P., MARINE FISHES OF AUSTRALIA, 1, p.65, one of two unnumbered figs, "Adult, after Whitley" [1927] , and 1964, *Proc. Linn. Soc. N.S.W.*, 89(1), p.41, and 1968, *Aust. Zool.*, 15(1), p.45, definitive entry only, not figure: 1974, Scott, T.D., C.J.M. Glover & R.V. Southcott, MARINE AND FRESHWATER FISHES OF SOUTH AUSTRALIA, p.99, unnumbered fig.: 1890, Vollard, J., ed.G.P. Whitley's HANDBOOK OF AUSTRALIAN FISHES, p.77, larger figure [after Clarke, 1881].

13. *Trachipterus iris* (Walbaum, 1838) (*non* Valenciennes, 1835): 1970, McKay, R.J., *Fisher. Bull. W. Aust.*, 9(5), p.7(?).

B. *Zu* sp., *cf. Zu cristatus* (Bonelli, 1820) (genus *Zu* Walters & Fitch, 1960)

1. *Trachipterus jacksonensis* (Ramsay, 1881): 1916, Hamilton, H., *Trans. N.Z. Inst.*, 43, pp.370-382, fig.2 (only): 1927, Phillipps, W.J., *N.Z. Fisher. Bull.*, 1, p.27, and *Rec. Dom.Mus.*, 1(2), p.120, pl.52 (color) [*jacksoniensis*].

Trachypterus arcticus (Brünnich, 1788): 1953, McCann, C., *Rec. Dom. Mus.*, 2(1), pp.1-17, figs 5,6 (only): 1960, Parrott, A.W., QUEER AND RARE FISHES OF NEW ZEALAND, p.100, fig.34, b (only).

3. *Desmodema arawatae* (Clarke, 1881): 1962, Whitley, G.P., MARINE FISHES OF AUSTRALIA, 1, p.65, one of two unnumbered figures, "young after Phillipps" [1914], and 1968, *Aust. Zool.*, 15(1), p.45, fig.1: 1980, Vollard, J., ed., G.P. Whitley's HANDBOOK OF AUSTRALIAN FISHES, p.77, smaller figure [after Phillipps, 1944].

C. *Desmodema polysticta* (Ogilby, 1898) (genus *Desmodema* Walters & Fitch, 1960)

1. *Trachipterus jacksoneniensis* [= *jacksonensis*] *polystictus*: Ogilby, D.J., *Proc. Linn. Soc. N.S.W.*, 22(3), p.646: McCulloch, A.R., 1929, *Aust. Mus. Mem.*, (5), 1, p.138: 1933, Whitley, G.P., *Rec. Aust. Mus.*, 19(1), p.72 (so listed, treated as synonym of *T. arawatae*).

2. *Trachipterus jacksonensis*: McCulloch, 1921, *Aust. Zool.*, 2(1), p.25 (Ogilby's specimen treated as young of this species).

The subjoined key to the three genera of Trachipteridae here recognized is based largely on the generic diagnoses by Walters & Fitch (1960) and, for the genera *Trachipterus* and *Zu*, on diagnoses of these by Palmer (1961) in a review of the dealfishes of the Mediterranean and northeast Atlantic.

KEY TO GENERA OF TRACHIPTERIDAE

1. Caudal fin with 1 lobe (5-8 weak rays); set in general sense of caudal peduncle, median rays subparallel to anteroposterior axis of fish. Number of pairs of lateral line plates per postanal vertebra > 2. Vertebrae 104-109. Scales non-imbricate, modified ctenoid (elliptical with 2 spinose ridges). Gastric caecum ends closer to vent than to pyloric valve. Color pattern uniform or polka dotted ..... *Desmodema*

   Caudal fin with 2 lobes (5-10 well developed rays); set at a pronounced angle to caudal peduncle, median rays forming an acute angle with caudad extension of anteroposterior axis of fish. Number of pairs of lateral line plates per post-anal vertebra < 2. Vertebrae 61-102. Scales absent or present; if present imbricate, cycloid. Gastric caecum ends closer to pyloric valve than to vent. Color pattern uniform; or with darker bars and/or blotches; or with several (usually 4) large, widely spaced, regularly positioned dark spots 2

2. Ventral profile of trunk strongly scalloped. Some rays in the dorsal crest and some in the pelvic fin bearing conspicuous dark (usually purplish or blackish) serially arranged bulbs or sacs (may be reduced to dark bars). Number of pairs of lateral line plates per postanal vertebra ± 1½. Vertebrae 62-69. Scales present, imbricate, cycloid, deciduous. Color pattern of dark subvertical bars and/or blotches ..... *Zu*

   Ventral profile of trunk not scalloped (may be some suggestion of scalloping in very small individuals). Dorsal and pelvic rays not bearing serially arranged bulbs or sacs. Number of pairs of lateral line plates per postanal vertebra ± 1. Vertebrae 69-102. Scales absent. Color pattern of several (usually 4) widely spaced, regularly positioned dark spots ..... *Trachipterus*

Observations are here presented on six Tasmanian examples of *Trachipterus arawatae* Clarke, 1801 and an account is given of a species of *Zu* Walters & Fitch, 1960, a genus here apparently for the first time recorded from Australia: local specimen provisionally determined as *Zu cristatus* (Bonelli, 1820).

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Genus *TRACHIPTERUS* Goüan, 1770

Trachipterus Goüan, 1770, p.104. Type-species, *Cepola trachyptera* Gmelin, 1788. [Emended to *Trachypterus* by Agassiz (1845) and authors.]
Gymnogaster Brünnich, 1788, p.408. Type-species, *Gymnogaster arcticus* Brünnich.
Trachypterus Schneider, 1801, p.480. Type-species, *Trachipterus taenia*.
Bogmarus Schneider, 1801, p.518. Type-species, *Bogmarus islandicus* Schneider.
Argyctius Rafinesque, 1810, *Caratt. nuov. Gen.*, p.55. Type-species, *Argyctius quadrimaculatus* Rafinesque.
Cephalaspis Rafinesque, 1810, *Ind. Ittiol. Siciliana*, p.54. Type-species, *Cephalaspis octomaculatus* Rafinesque.
Epidesmus Ranzani, 1818, p.137. Type-species, *Epidesmus maculatus* Ranzani.
Regalaecus: Ramsay, 1881, p.631. *Non Regalecus* Ascanius, 1772.

Trachipterus arawatae Clarke, 1881
Figs 1-6

Trachipterus arawatae Clarke, 1881, p.195, unnumbered fig. Type locality: Arawata, New Zealand.
Regalaecus jacksonensis Ramsay, 1881, p.631, pl.20. Type locality: Manly Beach, Port Jackson, New South Wales.
?Cepola trachyptera Gmelin, 1788, p.1187. Type locality: Adriatic.

Synonymy

The two references above to Clarke and Ramsay are supplemented by additional information on synonymy in Australian and New Zealand authors set out earlier in the list of citations in the general remarks on the family; the possible relationship of northern and southern hemisphere species also has been discussed above.

Material

Eight examples in the collection of the Queen Victoria Museum and Art Gallery, Launceston, here listed in order of increasing length to origin of caudal fin: (a) estimated length to caudal origin (fish, as preserved, curved in posterior half) 100, oblique length of caudal 48, T.A. Cook's Beach, Coles Bay, east coast, collected 25 January 1971, G.F. O'Brien, Q.V.M. Reg. No. 1971/5/3; (b) length without caudal 212, oblique length of caudal 85, Albatross Island, Bass Strait, collected 26 January 1973, Q.V.M. Reg. No. 1973/5/36; (c) length without caudal, mouth protracted 310, mouth not protracted ca. 296, Boat Harbour, northwest coast, R. Laughlin, Q.V.M. Reg. No. 1957/5/4; (d) length without caudal 444, oblique length of caudal 112, same history as (c); (e) length without caudal 508, Smithton, northwest coast, B.H. Wragge, Q.V.M. Reg. No. 1945.13; (f) length to caudal origin 555, oblique length of caudal 170, caught alive at Smithton, northwest coast, H. Smarden, Q.V.M. Reg. No. 1942.1; (g) length without caudal 560, oblique length of caudal 133, south end of Three Hummock Island, Bass Strait, collected December 1969, one of two found dead on beach, Alliston, Q.V.M. Reg. No. 1973/5/4; (h) badly damaged, much of head missing, estimated length to caudal base 630, oblique length of caudal 100, Marthia Lavinia Beach, King Island, Bass Strait, collected 12 January 1969, Q.V.M. Reg. No. 1969/5/4 (last specimen considered only in relation to coloration).

Dimensions

A set of measurements is given in table 1, all entries other than length to caudal origin (standard length, *Ls*) being recorded as millesimals of *Ls*; this being the first detailed schedule of dimensions reported for the local species.

Proportions

It has been known for more than a century that *Trachipterus* undergoes noticeable morphological changes during ontogeny. Working with *T. taenia* Emery (1879a,b) reported the fin rays begin to grow in the young when it is about 6 mm long, continue to lengthen till it is about four times that size, the relative size thereafter decreasing; however, Lo Bianco (1908) has since shown Emery's study pointed to the occurrence of a more profound series of morphological changes than actually occurs, his material having represented a mixture of species, including larval flounders of the genus *Ammopleurops*. It remains clear

that the course of postlarval development is characterized by a decrease in the relative magnitude of (a) the height of the nuchal crest, thus in fish 64 mm, 260 mm and 1400 mm the length of the longest crest ray is approximately 1.8, 0.3, .0.1 length of head, or approximately 2.4, 22, 80 in *Ls* (measurements of Clarke, figures of M'Coy, Ramsay – the last of the type of *Regalecus jacksonensis*); (b) the maximum height of the second dorsal, approximately 0.7, 0.5, 0.2 length of head, or approximately 6, 10, 40 in *Ls*; (c) the length of the ventral, 3.4, 0.6, ? (tubercle only) length of head, or 1.3, 6, ? in *Ls*. In our material only one first ray of the crest is intact, specimen (e); this is 0.64 head, 13.7 in *Ls*: the other intact lengthy element of the crest is a second ray, specimen (g), which is 1.28 head, 6.7 in *Ls*. The longest ray of the second dorsal (so far as this can be determined, some fins being incomplete) is 0.76-0.91, $\bar{x}$ 0.84 ± 0.019 length of head, or 5.0-11.6, $\bar{x}$ 8.37 ± 0.845 in *Ls*. The ratio ray-in-*Ls*, but not the ratio ray-times-head, yields a significant correlation with *Ls*, *r* 0.927 (*z* 1.640). Longest intact ventral ray (not necessarily largest, preservation being poor) in the Tasmanian specimens is 0.76-2.14, $\bar{x}$ 1.89 ± 0.17 length of head or 2.13-95, $\bar{x}$ 6.76 ± 1.12 in *Ls*: both ratios exhibit significant correlation with *Ls*, *r* being -0.843 (*z* -1.232), 0.961 (*z* 1.868).

Some other proportions conventionally recorded are: head in *Ls* 4.5-8.8, $\bar{x}$ 6.99 ± 0.650, length to vent in *Ls* 1.4-2.1, $\bar{x}$ 1.81 ± 106, maximum depth in *Ls*, 3.9-6.3, $\bar{x}$ 4.78 ± 0.524, depth at vent in *Ls* 5.6-8.5, $\bar{x}$ 7.68 ± 0.444, mean depth in *Ls* (mean of 10 equidistant measurements) 6.2-10.7, $\bar{x}$ 8.83 ± 0.725, eye in head 3.2-3.9, $\bar{x}$ 3.58 ± 0.095, snout in head 2.8-3.9, $\bar{x}$ 3.25 ± 0.169, interorbital in eye 1.2-3.1, $\bar{x}$ 1.65 ± 0.248.

Relative growth

In addition to the marked changes with growth of the lengths of the fin rays, size-related variations are exhibited by a number of other features. Each of the 7 dimensions for which tabulated data are set out below presents a decrease in relative value (magnitude expressed as millesimals of standard length) with increasing overall size. The recorded extremes of the ranges are those for the smallest and the largest fish (the entry in parentheses being that of a value smaller than that for the largest specimen: one such value is found in each entry, with two, equal, in depth at vent).

Length of head 220.0-116.1 (114.1), *r* -0.989 (*z* -2.599).
Length to vent 640.0-485.7 (473.9), *r* -0.964 (*z* -2.000).
Maximum depth 260.0-190.9 (153.2), *r* -0.693 (*z* -2.143).
Mean depth 162.7-93.2 (91.7), *r* -0.902 (*z* -1.483).
Depth at vent 180.0-128.6 (117.1), *r* -0.902 (*z* -1.483).
Length to pectoral origin 200.0-112.5 (106.5), *r* -0.972 (*z* -2.139).
Length to ventral origin 250.0-141.1 (120.7), *r* -0.964 (*z* -2.000).

A number of other negative correlations of the relative length of a dimension with *Ls* are noted below.

The situation in respect of the systematic variation with age (overall size) of the longitudinal extension of the three primary regions of the fish, head, trunk and tail, is an interesting one. Graphs of the *TLs* lengths of these regions plotted against *Ls* are presented in fig. 1. This shows that as overall length increases through the range of the present sample (100-560 mm), the relative length of the head (*TLs*) systematically decreases (in largest individual 53% of that in smallest), as also does that of the trunk (in largest 88% of that of smallest), while, with commensurate compensation, relative length of tail increases (in largest 143% of that of smallest). The relation is in each case effectively linear (*t* 14.911***, 3.948*, 11.704***); slopes -0.223, -0.139, 0.362; intercepts 236.7, 451.9, 311.4. While some variation during ontogeny in the relative lengths of these regions is not unusual, so large an increase in magnitude of one as here encountered (43%) is to be regarded as exceptional.

The relative forward migration of the vent from a point at 0.62 of the standard length to a point at 0.49 is of interest in view of the taxonomic importance attached to its locus in the Trachipteroidei, this being in the anterior third of the body in Regalecidae, near the end of the body in Lophotidae, while in Trachipteridae its position is specified by Walters & Fitch as "in the first half of the body or slightly behind mid-body" – the general emphasis of "in" and "slightly" perhaps suggesting examination of a sample of specimens of greater overall size.

TABLE 1

TRACHIPTERUS ARAWATAE CLARKE, 1881. DIMENSIONS OF 7 TASMANIAN EXAMPLES.
First line in mm, all other entries as millesimals of standard length.

Dimension	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Standard length mm	100	212	296	444	508	555	560
Length of caudal	480	401	-	352	-	306	238
Head	220	182	172	140	114	117	116
Snout	65	47	54	50	39	31	41
Eye	65	57	47	36	30	34	32
Interorbital	210	35	33	27	26	24	21
Length to vent (middle)	640	613	595	547	498	474	486
Length to first dorsal origin	125	68	135	122	65	49	77
Length to first dorsal termination	155	92	149	126	77	58	88
Length to second dorsal origin	180	97	159	155	80	67	91
Length of first ray of first dorsal	-	-	-	-	73	-	-
Length of longest preserved ray of first dorsal	-	-	-	-	73(1st)	-	148(2nd)
Length of dorsal ray over first superior spot	170	-	51	81	81	67	75
Length of dorsal ray over second superior spot	210	121	57	113	(no spot)	85	102
Length of dorsal ray over third superior spot	150	-	78	84	73	76	82
Length of longest dorsal ray preserved intact	*ca* 200	149	78	119	106	101	102
Length to pectoral origin	200	172	176	140	108	166	113
Length of pectoral base (oblique)	25	189	203	15.8	15.7	11.7	12.5
Length of pectoral	100	78	67.6	51.8	39.4	45.0	42.9
Length to ventral origin	250	191	193	155	146	121	141
Length to first superior spot (middle)	360	241	291	225	181	166	205
Length to ventral spot (middle)	350	283	277	243	206	198	205
Length to second superior spot (middle)	600	462	541	428	374	403	393
Length to third superior spot (middle)	780	651	710	-	630	605	598
Depth at front of eye	180	156	135	99	93	90	98
Depth at back of eye	250	231	172	137	138	144	132
Depth at operculum	250	250	196	160	173	159	163
Depth at vent	180	156	142	117	134	123	129
Maximum depth			2	162			
10 equidistant measurements of depth	290 285	250 248	203 209	162 160	167 167	159 159	170 170
	220 195	226 203	196 189	149 142	161 150	153 149	161 138
	180 160	170 146	176 152	135 104	134 100	119 89	116 79
	130 90	90 42	132 84	72 36	63 31	58 31	48 25
	55 16	30 17	27 12	20 9	18 8	16 5	16 11
Distance of lateral line from ventral profile at its origin	175	146	109	101	91	113	96
Distance of lateral line from ventral profile at opercular border	170	146	125	90	91	90	90
Distance of lateral line from ventral profile at vent	62	47	68	110	73	67	32
Length of gill filaments on lower anterior arch	55	52	34	26	14	19	13
Length (oblique) of maxillary plate	81	76	61	45	45	41	46
Width (oblique) of maxillary plate							
Length of premaxilla, including process	50	47	34	23	26	26	30
Height of pterygiophore at operculum	56	47	50	32	35	29	32
Height of pterygiophore at vent	79	57	66	45	45	40	50
Height of pterygiophore, maximum	80	66	78	56	57	45	55

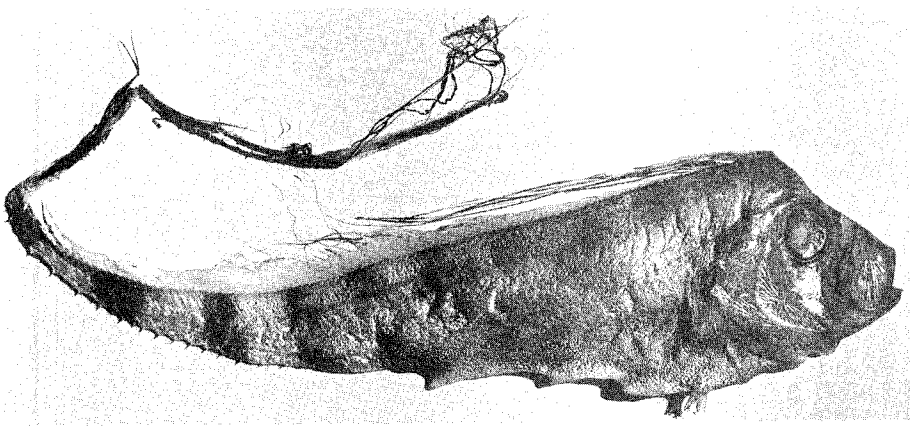

PLATE 1 - *Zu* sp., cf. *Zu cristatus* (Bonelli, 1820). Specimen collected by Mrs H. Reeman at East Inlet, Stanley, NW coast, Tasmania, July 1972, standard length 405 mm; length of head 55 mm.

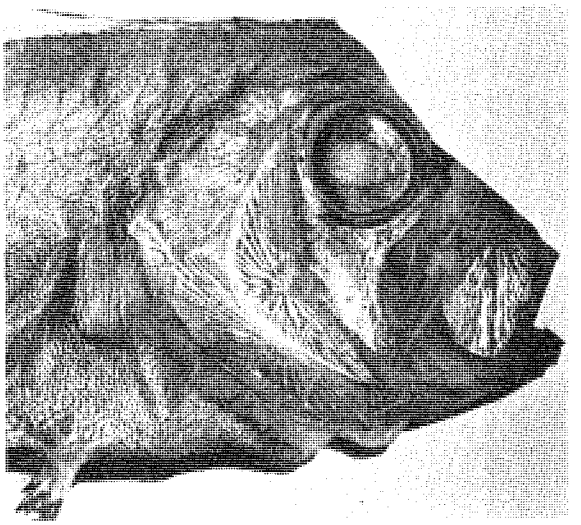

PLATE 2 - Enlargement of head of specimen shown in plate 1.

PLATE 3 - *Zu* sp., cf. *Zu cristatus* (Bonelli, 1820). Reproduction of color illustration in Phillipps (1924, pl.52) of a ribbonfish from French Pass, New Zealand, determined as *Trachipterus jacksoniensis* Ramsay, 1881.

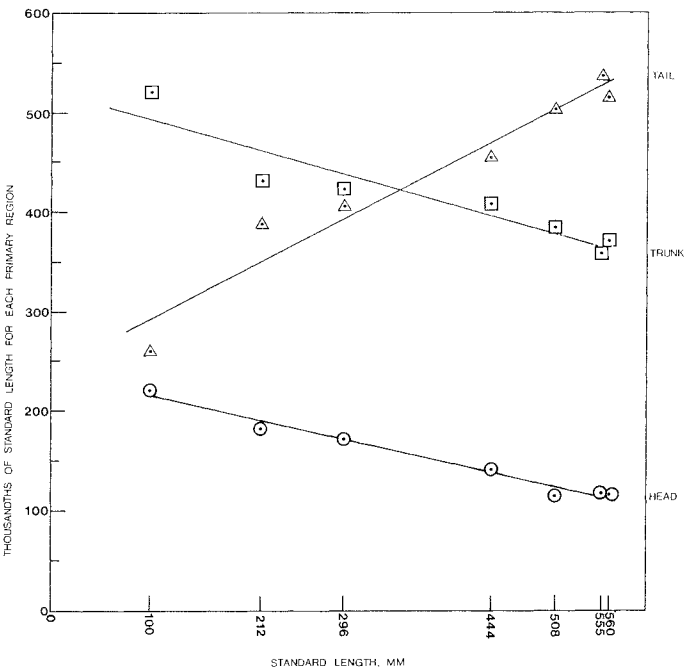

FIG. 1 - *Trachipterus arawatae* Clarke, 1881. Relative length of head, trunk, tail in 7 specimens of standard length 100-560 mm.

General description

Australian accounts of trachipterids have in general been based on a single individual. While noting he had three Victorian examples of *Trachypterus taenia* (Bloch) 419 mm, 260 mm and 66 mm in length before him, M'Coy (1886) chose to give an account, illustrated by his main figure (fig. 1 a-e), of the "average" specimen, though providing also an overall representation, natural size (fig. 2) of the smallest fish, specified in the legend as "probably of the same species", but in the text (p.85) provisionally identified as "Cuvier's" *T. spinolae*: the fish figured are *T. arawatae*. A consideration in a paper by McCann (1953) of four New Zealand trachipterids, in which there is made an assumption of striking sexual dimorphism, leading to the identification of two (figs 4, 7) as females (adult, young, respectively) of *Trachypterus arcticus* Brünnich, and two (figs 5, 6) as adult males of that species served only to confuse the general situation. Of the two fish identified as females of Brünnich's European species one (fig. 7) is certainly, one, without obvious markings, (fig. 4) is probably identifiable as *T. arawatae*, while both the fish identified as males of that form are generically distinct, being referable to the (subsequently described) genus *Zu*. (Some further relegations to *Trachipterus* of specimens properly assignable to *Zu* — resulting in continued confusion — are cited in the tabulated list of Australasian trachipterid determinations set out above.)

The present examination of a series of 7 examples, 100-560 mm in standard length, with some incidental reference to an eighth, damaged individual, ca. 730 in standard length, has made possible the recognition of some size-related characters not previously noted. Features considered in the three main Australian accounts of ribbonfish of the family Trachipteridae — *T. jacksoniensis polystictus (= Desmodema polysticta)* by Ogilby (1881), length to base of caudal ca. 140 mm; *T. taenia* (= *T. arawatae*) by M'Coy, as above; *T. jacksonensis (= T. arawatae)* by McCulloch (in Whitley 1927), length "to tip of tail (incomplete) 1925 mm" — are incorporated in the present description, together with some additional items. The description is based primarily on the well-preserved largest example, (g), *Ls* 560 mm, with variations exhibited by the other examples noticed as appropriate.

(a) General form. In the following specification of general form in the terminology of Gregory (1928) the entry in parentheses records the magnitude of the relevant ratio as exhibited by specimen (g). Dolichosomatic (0.18), gasterion preapical (0.89), apex anterior (0.16), gasterion anterior (0.14), dolichonotic (0.097), dolichogastric (0.086), leptopygidial (0.059), opisthion posturamic (0.018). It may be observed in passing that of the three categories recognized in Gregory's analysis of the proportion of the total posterior vertical (at caudal peduncle) to total anterior vertical (total body depth) — leptopygidial < ¼, nomopygidial ¼-½, macropygidial > ½ — the width of applicability of the first is such as to afford no distinction between a fish, e.g. a scorpid or typical chaetodontid with a tolerably slender caudal peduncle, and a form such as the present in which the peducnle is extremely attenuate. The anterior or entering angle between the anterodorsal and anteroventral slopes at the prosthion (most anterior point) comprises an anterodorsal angle of 31° and an anteroventral angle of 31° (indicative of a somehwat unusual symmetry; note, however, that the gasterion is slightly in advance of the apex — by 1.8% of standard length — hence the general angle of the anterior ventral contour is slightly steeper than that of the anterior dorsal contour); the posterior angle between the posterodorsal and posteroventral slopes at the uranion (point of intersection of horizontal axis and posterior border of caudal) has dorsal and ventral components of approximately 7° and 6°, respectively; the dorsal angle between the anterodorsal and posterodorsal slopes at the apex (highest point) is 143°, with the corresponding ventral angle at the gasterion (lowest point) virtually equal at 144°.

While at a glance the body shape has the appearance of being a tolerably uniform pennon, examination of an outline tracing reveals both dorsal and ventral borders undergo some changes of direction, giving rise behind the apex (at 16% of *Ls*) and behind the gasterion (at 19% of *Ls*) to three readily recognizable more or less linear segments. In the tracing of specimen (g) these account, in succession caudad, for 32% of *Ls* at an angle to the general anteroposterior axis of the fish of about 3°48', for another 32% at about 11°18'; for about 20% 2°36': for the ventral postcephalic outline the three segments are as follows, for about 27% of the length 2°40', for about 36% 8°30', for about 23% 5°0'.

As noted earlier in the section on differential growth maximum depth, depth at vent and mean depth calculated from the 10 equidistant measurements recorded in table 1 all exhibit negative correlation with *Ls* at P 0.01 or better. When the sample means of total depth (sum of these 10 measurements) are plotted at 10 equal intervals they yield the sigmoid curve shown in fig. 2, where the depths are given as *TLs*. The depth-number correlation is r -0.985 (z -2.442), equivalent to t 15.981***, the curve being adequately specified (R 0.998) by the 4° polynomial $D = 206.1 - 6.22N + 2.6162N^2 - 1.0733N^3 + 0.0068328N^4$. The upwardly convex element, with the greater amplitude, is anterior: a line joining the first and last points intercepts the curve, marking approximately the point of inflexion, about midway between the 7th and 8th deciles (for the means of the subsamples comprising the three smaller individuals and the four larger individuals the interceptions occur at about the 6th and 7th deciles, respectively).

From table 1 it is evident that first and second of the 10 successive measurements of depth are very closely similar, the sample means being equal in three individuals, with the first exceeding the second in three cases and being less than it in one case; with overall means of 200.1 and 199.4 they can reasonably be equated (t = 0.073). Using the mean of the first and second and eight other depths, two rectified formulations of the curve yielding satisfactory fits can be found. When the logarithmic values of these are plotted against their serial numbers, proceeding cephalad, the two-segment graph, with point of inflexion at the 5th decile, shown in fig. 2 is obtained. The parameters of the best straight lines are: slope 1.4872, 0.7401; intercept 1.0107, 0.7401; r 0.9972 (z 3.288), 0.9987 (z 3.669). For an alternative approach the virtual identity of the first and second depths suggests examination as a possible abscissal scale of the Fibonacci series, in which the first two terms are identical, 1, 1; the next eight terms (each the sum of the two immediately preceding) being 2, 3, 5, 8, 13, 21, 34, 55. With the logarithmic values of the *TLs* mean depths of the sample (first two averaged) plotted against the relevant nine abscissae the resultant graph, shown in fig. 3, has the form of two effectively linear segments; parameters for the two best straight lines: slope -0.03022, -0.01881; intercept 2.3194, 2.0712; r -0.9997 (z 4.402), -0.9990 (z 4.951). The first of the above two rectifications has the

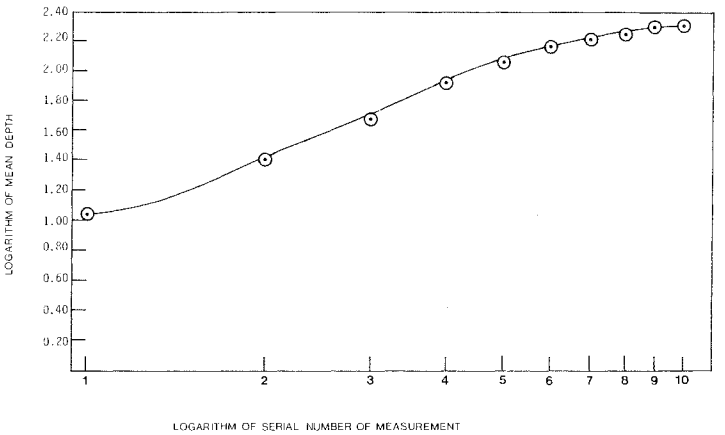

FIG. 2 - *Trachipterus arawatae* Clarke, 1881. Logarithms of means for 7 specimens of standard length 100-560 mm of 10 measurements of depth at equal intervals along anteroposterior axis of fish on logarithms of serial numbers of measurements, counting cephalad.

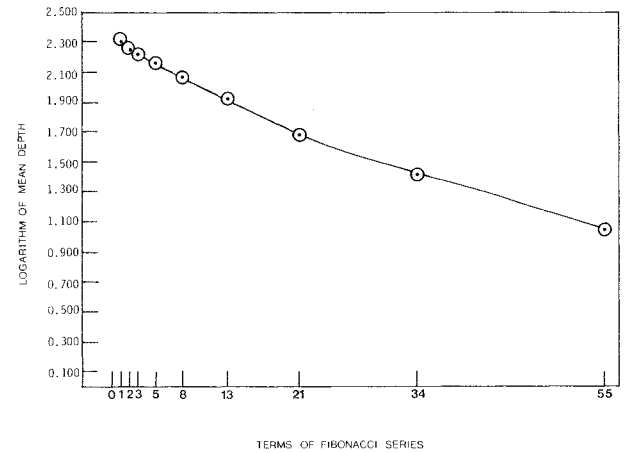

FIG. 3 - *Trachipterus arawatae* Clarke, 1881. Logarithms of means for 7 specimens of standard length 100-560 mm of 10 measurements of depth at equal intervals along anteroposterior axis of fish on the Fibonacci series: mean of measurements 1 and 2 on mean of first 2 items of series (1), measurements 3-10 on terms 1-10 of series (2, 3, 5, 8, 13, 21, 34, 55).

higher t value for the posterior depths (26.807, d.f. 4, against 22.103, d.f. 1), the lower for the anterior depths (30.293, d.f. 2, against 84.893, d.f. 5). The occurrence in each graph of a point of inflexion is not unexpected in view of the earlier noted change in the length growth gradient from negative in head and trunk to strongly positive in tail.

In a further investigation of intrasample variation, regression equations have been calculated for each of the 10 *TLs* depth measurements of the seven individuals; r ranges from -0.817 to -0.967, with a mean of -0.917 (equivalent to t 5.093; d.f. 8). The result of plotting the 10 slopes of the regressions against the serial numbers 1-10 is the evenly flowing curve shown in fig. 4.

The taeniate nature of *Trachipterus* is made evident by the fact that the maximum thickness ranges from 38 and 47 thousandths of standard length in the two smaller specimens

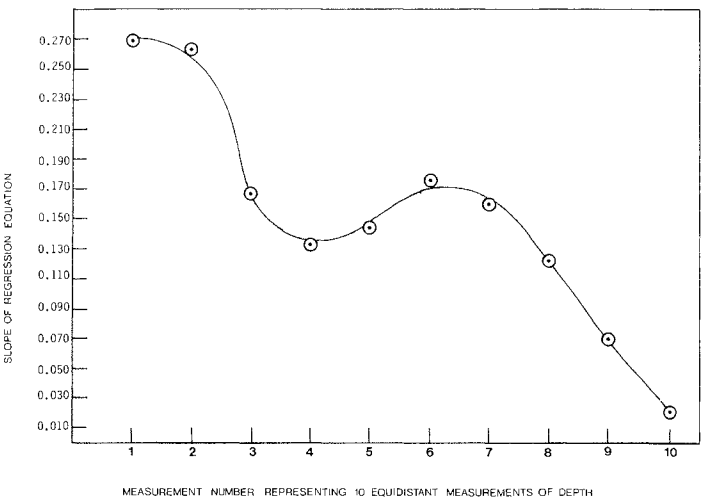

FIG. 4 - *Trachipterus arawatae* Clarke, 1881. Slope of regression equation of relative depth (depth as millesimals of standard depth) on standard length; 10 depths at equal intervals along antero-posterior axis of fish, each for 7 specimens of standard length 100-560 mm.

down to 19 among the others ($\bar{x}$ 27.6 ± 0.399). Measurements of thickness were made immediately in advance of the eye, at the thickest part of the operculum, at the level of the vent and just in advance of the caudal origin immediately preceding the small terminal subglobular swelling. The mean value of these four dimensions, in *TLs*, is 12.5-27.4, $\bar{x}$ 17.81 ± 2.205, the series exhibiting a significant negative correlation with size of fish, *Ls*; r -0.864 (z 1.053). It may be presumed that with thickness, as with depth, a certain minimum relative magnitude is a prerequisite for the general functioning of the fish, but with growth the proportionate values of these features may be progressively diminished.

(b) Size of head. Expressed as millesimals of length to caudal origin the length of the head ranges from 220 in the smallest down to 116 in the largest. For absolute length of head and of fish the correlation is r -0.958, for relative length of head (as *TLs*) and measured length of fish r -0.989; the slopes of the regression equations (significant at t 7.457, 14.931) are 0.0851 and -0.223, respectively, the intercepts 19.1 and 236.7. The application of these formulations to specimens noted in the literature yields very satisfactory results with examples not exceeding in size those of our material, but does not extend to examples with length of the order of two metres. Thus head length as *TLs*, as calculated from Clarke's measurement of the type-specimen is 209.5 (as estimated by extrapolation of the relevant regression equation above 222.4); for M'Coy's larger individual (data for others inadequate) it is 178.9 (cf. 178.7). On the other hand, use of approximate dimensions derivable from McCulloch's account of his large *T. jacksonensis*, length 1 925 mm+, would yield a negative value for head length, zero length being reached at a fish length of 1 000-1 100 mm.

(c) Shape of head (figs 5 and 6). Early misconceptions regarding the shape of the head (largely arising from failure to distinguish between the very different profiles, particularly the dorsal profiles presented with the mouth parts protruded and with these retracted) has continued and found their way into family keys and synoptic surveys. Thus in a detailed key to the ribbonfishes of Australia and New Zealand by Whitley (1933) - based on a key in a paper by Phillipps (1924) instituting the family Agrostichthyidae - in which each of the four families is regarded by being represented by a single species, the upper profile of the head is specified thus: Trachipteridae "convex", Regalecidae "markedly concave", Agrostichthyidae "convex", Lophotidae "sloping obliquely forward, overhanging the snout" (this is appropriate and needs no comment). In the Handbook (Munro, 1957) the entries for the three families in order as above are "concave" for *T. arawatae* and "convex"

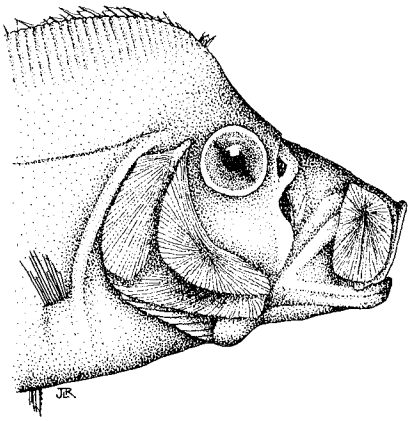

FIG. 5 - *Trachipterus arawatae* Clarke, 1881. Head, lateral view of a specimen collected by Mr B. Laughlin at Boat Harbour, northwest coast, Tasmania, 1957, standard length 444 mm; length of head 62 mm.

FIG. 6 - *Trachipterus arawatae* Clarke, 1881. Frontal view of a specimen collected by Mr D. Milledge at Albatross Island, Bass Strait, 26 January 1973, standard length 212 mm.

for *T. jacksonensis* [rendered *jacksoniensis*], *"concave"*, *"convex"*. Again, in a recent key by the writer in Part XXVIII (1982) to Regalecidae, treated as embracing both *Regalecus* and *Agrostichthys*, the former genus is noted as having the profile concave, the latter convex. With the mouth of the fish not extruded, the correct indication for Australasian species of the anterior head profile, or at least of the greater part of it with the possible exception of a small section antecedent to its becoming the dorsal profile, would appear to be as follows: Trachipteridae, *T. arawatae*, specimens to about 1 m in length linear, oblique, at an angle of round about 50° (in a figure by McCulloch (in Whitley 1927) of a presumed adult, about 2 m in length, identified as *T. jacksonensis*, barely convex), Regalecidae (as represented by type-genus), Agrostichthyidae (as represented by type-genus) virtually linear at an overall angle of approximately 60°, gently rounded.

In the present material the long, movable premaxillary process, fitting, above the level of about the middle of the pupil, into a fleshy sheath, extends in a straight line obliquely from the upper lip, located close to the level of the inferior border of the orbit, for about two-thirds of the distance to the base of the first dorsal ray, terminating vertically above the middle of the eye (in specimens (e), (b) above 0.9, 0.3 eye), directly distant from it by approximately half an eye diameter. The remaining, soft portion of the anterior cephalic profile is straight, or very nearly so, extending either in the same general line as the longer rigid premaxillary segment or inclined a trifle forward, the angle showing some individual variation. The inferior profile of the head is overall close to linear or somewhat sinuous, with some tendency towards a local convexity posteriorly; in general its length from lower lip to margin of branchiostegal membrane and its degree of slope from anteroposterior axis of fish more or less parallel those of the rigid segment of the superior profile. The lateral surface of the head is close to flat, the two sides being largely parallel, but tending to diverge somewhat posteriorly the maximum thickness being subequal to an eye diameter.

Comparison of our material with some published illustrations of this species reveal certain differences as follows. The figure of the type specimen (Clarke 1881) shows the profile between mouth and dorsal origin as comprising three subequal segments, the upper slightly concave or sinuous, the others concave, these latter extending to above the level

of the eye and together representing the region of the premaxillary processes, which actually is linear. The significance in this figure of the pair of closely apposed parallel lines between mouth and dorsal origin is unclear; does it perhaps represent a cubist notation intended to draw attention to the plate described further below, that constitutes such a conspicuous feature of the flat frontal aspect of this region of the head? McCann's (1953) fig. 7 (fish identified as *T. arcticus*) shows a head of characteristic form, but in his fig. 4 (similarly identified) the (slightly convex) frontal slope is set at a lower angle. (The identity of the wholly unornamented fish illustrated by this photograph presents something of a problem, a curious feature being the location of the origin of the dorsal fin, as far as can be judged well behind the head, instead of over the oreoperculum or hind part of the eye. Unfortunately the size is not reported, though the photograph includes an unmarked rule: if this is 1 foot long (305 mm), the standard length of the specimen would be about 1.7 m, a size that would ally it with *T. jacksonensis*, here regarded as *T. arawatae*). In the illustrations of *T. jacksonensis* by Ogilby and by McCulloch the frontal profile is gently convex, being set at a lesser angle than in our material. In both figures by M'Coy the mouth parts are protracted, the contour between upper lip and dorsal insertion thus coming to consist of two subequal virtually linear moities set at an angle of approximately 160° (larger individual) and 150°, resulting in the profile coming to be reported as concave.

(d) General features of head. In specimens with the mouth not produced the maxillary extends from the anterior border to the middle of the pupil. The large tolerably rigid flat membranous plate is subovate, widest in its hind two-thirds, margins in anterior one-third or so somewhat concave or sinuous and converging to a blunt point; length, measured obliquely between tips, 1.5-2.0, $\bar{x}$ 1.70 ± 1.003, width, measured obliquely, 2.4-3.1, $\bar{x}$ 2.71 ± 0.0890 in head. From a point near its anterior one-fifth there radiate backwards right to margin about a score of well developed striae, longer ones mostly bifid distally, some shorter ones, particularly near upper anterior border, somewhat ramose; plate articulated anteriorly upon exposed processes of quadrate and hyomandibular (as noted by McCulloch for his specimen of *T. jacksonensis*, movable upon these). When mouth is retracted major axis of plate is at about 45°, but as mouth is protruded it swings round to end up by being vertical. Attached to, and partly overlapping, anterior four-fifths of its posterior border is a tumid fleshy structure, its anterior half little more than a ridge, rest widening out into rounded subtriangular flap, its greatest width about one-third that of plate and subequal to its distance from orbit; length (chord) about 2.5 width, about 1.5 in head. Below posterior two-thirds of eye a large naked area, filling more or less triangular space between preoperculum and maxillary plate. The preoperculum is crescentic, the strongly concave anterior border extending from upper third of posterior border of orbit to below about middle of eye, more than an eye diameter below it and about one-third as far from ventral profile; hind border evenly convex; anterior border with a narrow smooth raised rim; rest of surface with about a score of striae, radiating from a point near middle of anterior border; length (chord) about 2.5 times width, about 1.5 in head. Originating behind preoperculum at level of inferior orbital border and sloping down and back at about 45° for a distance subequal to diameter of orbit border or interoperculum continues more or less parallel with preoperculum, ending below tip of that plate; strong striae radiating from point somewhat beneath middle of anterior border; length four times width, a little less than length of preoperculum, subequal to distance of plate from pupil. Operculum extending down to level of mouth, smaller than is usual in most fish as result of extensive development of interoperculum; free border originating at level of superior orbital border, tracing concave arc down and back to small rounded or squared-off process, usually with several denticulations, near level of inferior orbital border, continuing down, somewhat concave, for about half as far to meet small downwardly and forwardly striated suboperculum; oblique down-back striae from point near upper extremity, a few short ridges above this point: both plates with outer marginal unstriated gelatinous strip. All plates of the complex thin, fragile.

Upper lip a narrow band of equal height throughout or a little deeper anteriorly. Viewed from in front region above lip an almost flat trapezoidal plate covered with transversely wrinkled integument, width about an eye diameter subequal to height, upper border about level with upper border of pupil; on either side curve down the ends of the premaxillary processes, their gradually converging upper portions rising to half an eye diameter

or more above eye; processes received into a groove flanked by an elevated triangle formed by the sharp edges of the frontals, separate throughout their extent, convergent upward; floor of groove containing mesethmoid and orbitosphenoid (fig. 6). The *TLs* height of the plate is 28-60, $\bar{x}$ 37.4 ± 4.26, of plate plus free premaxillary processes 84-121, $\bar{x}$ 105.3 ± 6.86; both magnitudes negatively correlated with *Ls*, r -0.940 (z -1.737), -0.890 (z -1.432). With mouth protruded three subtriangular naked areas develop; largest very thin, translucent, approaching transparent, bounded above by premaxillary process, in front by upper jaw, behind by subocular pre-preopercular fleshy area present with mouth shut; next largest semitranslucent, bounded by upper and lower jaws and in front by erect maxillary plate; smallest bounded above by mandible, behind by operculum and branchiostegal apparatus, below forming ventral profile, here mostly translucent but thickened, opaque along most of free margin.

Mandible widening posteriorly to one-fourth of its length, which is subequal to distance of slightly expanded tip from pupil, longitudinally ridged and grooved, with some irregular ridges and rugosities particularly in its hinder half. Upper jaw somewhat less stout than lower, slightly upwardly concave, of subequal depth throughout, longitudinally ridged. A palatal foramen in anterior third of mouth. In lower jaw on each mandible a row of 3-4 teeth of variable size, largest twice smallest, in general larger than teeth of upper jaw, subconical or somewhat flattened, straight, acute, directed upward and slightly backward, interval less than height, innermost almost on symphysis; on each side 1-2 minute behind primary row. Along the inner border of each premaxilla a linear row of elongate straight slender pointed teeth, directed downward and markedly inward, intervals between them subequal, about half interval between the two sets. No vomerine or palatine teeth were detected. No note on dentition was provided for the type specimen of *T. arawatae*; of the type of *Regalaecus jacksonensis* Ramsay noted" four teeth on either side of the lower jaw, conical, not strong; and five teeth on each side of the upper jaw", in general agreement with the situation as found in our material; however, in his account of a large ribbonfish determined as Ransay's species McCulloch reports two mandibular rows, as here, but adds three acute teeth in a row on a median process of the vomer and one or two on the palatine. In his generic diagnosis of *Trachipterus* Palmer (1961) observes, "Recurved pointed teeth in both jaws, 6 to 12 in the upper, 6 to 10 in the lower. Vomer with 1 to 2 median teeth. Palatine teeth, if present, feeble".

Nostril single, small circular pore set in shallow oblique subelliptical depression at 9 o'clock relative to eye (left side viewed), distance from eye subequal to that from upper edge of rhomboidal supralabial plate (in advance of which mouth extends when protracted), subequal to internarial interval. Gills 4, slit behind last. Relative length of gill lamellae in smallest specimen in sample much greater than (about four times) that in largest, i.e. absolute dimensions of same order of magnitude: *TLs* length of longest lamella near middle of anterior branchial arch 13-55, $\bar{x}$ 30.4 ± 7.70. An areal relation would seem to be involved: it is found by trial that with *TLs* lamellar length denoted by G and standard length by *Ls* there obtains a statistically significant relation, $G^{-2} = -0.00827 + 8.48$, with r -0.965 (z -2.007), equivalent to t 8.172***. Branchiostegals 6, the membranes not broadly connected across the isthmus. Gill rakers on upper limb of anterior arch usually 4, sometimes 5, small slender and pointed or tolerably stout and blunt (variation may occur on two sides of same fish), generally with a few often broad-based small setiform spines; on lower arch 9-10, modally 9, uppermost longest, up to 6-8 times lowermost, size decreasing regularly, typically 1st elongate slender pointed, 2nd less pointed, 3rd to 5th or 6th, sometimes to last spatulate, tending to become increasingly recurved towards inferior end of series, most with some spines, on one edge or both, commonly best developed proximally but exhibiting considerable variation in location, also in number, size and form.

(e) Lateral line. Lateral line originating at, or slightly below, level of upper orbital border, less than an eye diameter behind eye, sloping down briefly subparallel to dorsal profile, thereafter from above opercular border running back in virtually a straight line, evenly approaching ventral border, almost reaching it round about a head length from caudal origin, thereafter being almost parallel with it. Each lateral line scale bears a spine, small inconspicuous but readily detectable by touch in front, becoming progressively larger caudad, the last 8-12 large spines, height about half interval, projecting beyond

ventral profile; plates smaller anteriorly, 8-10 in an eye diameter at origin of line, 6-7 near vent, about 3 near caudal origin, at which point and earlier the length corresponds with that of a caudal vertebra. No count was given for the type of *T. arawatae* and no counts appear to be available for Australian specimens; approximate counts for three examples 55, 51, 50 precaudal plus 62, 52, 54; the number evidently subject to considerable individual variation in this genus, Fitch (1964) recording for *T. altivelis* 106-122, of which 66-81 are precaudal (these totals, it may be observed, differ markedly from the 88-120 + 174-186 reported for the type species of *Desmodema* Fitch, 1964, i.e. the Australian *Trachypterus jacksoniensis polystictus* of Ogilby, 1898).

(f) Vent. A small simple slit, 474-620 *TLs* units behind snout tip, more caudad in small individuals, subequal to pupil diameter; in our material regularly placed on mid-ventral line, no examples with it eccentrically on right or left side as often in *Desmodema polysticta*. Where course of hind portion of enteric canal is made evident by retained food, it is seen to bend down rather sharply shorter before vent, chord of curve about half of height of body in this region.

(g) Fins. Variation in length to first dorsal, as measured along general antero-posterior axis from level of snout tip, shown in table 1, is largely the result of individual differences in relative height and slope of forehead, the insertion tolerably stable anatomically above 0.4-1.00 eye; fin imperfect in all specimens, from ray-stumps probable number 5-7 (?8); sole 1st ray preserved, specimen (e), 37 mm, 0.64 head, longest intact ray, 2nd, specimen (g), 83 mm 1.3 head, rays simple, apparently smooth, hyaline. Second dorsal originating very shortly behind first, with which in some examples it is connected by low membrane, rising rapidly anteriorly, reaching maximum height at, or somewhat behind, middle of length, extending virtually to caudal base; in five specimens 171-178 rays; rays slender, finely pointed, often filamentous distally, minutely spinigerous throughout most of length on lateral surfaces, proximally on anterior and posterior surfaces; each arising from a broadly subelliptical convex cluster of elevations with 1-2 recognizably spine-like or a distinct acute spine; membrane hyaline, immaculate. Relative height of first dorsal fin, forming nuchal crest noticeably less than in type of *T. arawatae*, much greater than in McCulloch's example of *T. jacksonensis*; as preserved 1.3 head (cf. 1.8, ca 0.25 with mouth protruded). Height of second, as *TLs*, 101-200, $\bar{x}$ 36.5 ± 13.80, significantly negatively correlated with *Ls*, *r* -0.970 (*z* -2.086), *t* 8.862***; 0.7-1.01, $\bar{x}$ 0.88 ± 0.0488 head (cf. 0.76, ca 0.5 with mouth protruded). No anal fin.

Pectoral small, broadly rounded, set about twice as far from dorsal as from ventral profile; base short, set horizontally or somewhat obliquely upward and backward, its *TLs* length 13-25, $\bar{x}$ 17.9 ± 1.51, decreasing in relative size with increase in length of fish, *r* -0.892 (*z* -1.482), *t* 4.415**; length to origin, *TLs*, 108-200, $\bar{x}$ 144.9 ± 14.34, the wide range of relative length largely determined by length of head and like it negatively correlated with *Ls*, *r* -0.974 (*z* -2.175), *t* 9.710***; rays 11 (1 specimen), 12(3), 13(3), mostly simple, occasionally divided distally, smooth, 1st much shorter than 2nd, longest about 5th; length of fin, *TLs* 34-95, $\bar{x}$ 50.3 ± 8.20, negatively correlated with *Ls*, *r* -0.906 (*z* -1.506), *t* 4.791**.

Ventrals inserted very close together, on short base, about one-third eye diameter, behind head by about postorbital head at 121-250, $\bar{x}$ 170.9 ± 16.5 *TLs* units, largest value that for smallest individual with that for largest 141 (minimum for second largest), length to origin and *Ls* showing significant negative correlation, *r* -0.974 (*z* -2.164), *t* 9.565***; while not presenting the impressive fan of the type specimen, in which length is 3.4 in head or of the smaller of the two individuals figured by M'Coy, about 1.7 in head with mouth protruded, this fin in our material is very much longer than pectoral, its length as determined from preserved rays (fins generally with some damage), ranging (for six specimens, smallest with stumps only) from 0.8 to 1.3, $\bar{x}$ 1.03 head, or from 4.1 to 9.5, $\bar{x}$ 6.7 ± 1.12 in *Ls*; relative length (six specimens) and *Ls* negatively correlated at *r* 0.939 (*z* -1.726), *t* 5.443**; rays 8-9, 9th if present minute; as regularly described and figured first ray much stouter than rest, with numerous spines along proximal part of anterior border, distance from second greater than interval between any other two spines, 2nd spine longest.

Caudal peduncle abruptly enlarged terminally to form small globose fleshy mass, lower half, or rather less, of this constituting a distinct heel; attached to hinder border of this 4-5 very small slightly or strongly downwardly curved spines, their general direction in line with main axis of fish; may be enclosed in membrane beyond which tips briefly project; sometimes closely preceded by a larger azygous midventral spine situated shortly behind last pair of lateral line spines; in one specimen, (g), a flexible filiform process 3 mm long just above uppermost spinule. This represents the lower lobe of the originally two-lobed caudal fin that develops at an early stage, it being generally noted that in *Trachipterus* the rays of the lower lobe fragment as the fish grows, their bases persisting as spines – represented in the illustration of the type specimen of *T. arawatae* as six curved processes, the longest somewhat suggestive of a vestigial caudal filament. (It is of interest to note that in *Desmodema*, a genus which, as noted above, has been confused in Australasian literature with *Trachipterus*, the caudal rays are on the same axis as the caudal peduncle and a ventral lobe of the caudal fin is never present.) From an examination of a number of young examples of the three Mediterranean and southeast Atlantic species of dealfishes recognized by him (*Trachipterus arcticus*, *T. trachypterus*, *Zu cristatus*) Palmer concluded that characters present in the young persist until a definite developmental stage is attained, a stage that does not appear to be directly correlated with size alone, but nevertheless commonly takes place within the size limits 50 and 70 mm; the larger dimension being well below that of our smallest individual. It is certainly an unfortunate taxonomic circumstance that an accepted species of *Trachipterus* should be based on a specimen with retained larval features.

Above heel on caudal peduncle, posterior border of a continuation as a fleshy pad, its general sense at about 45° to main axis, constitutes the very short base, one-third eye diameter or less, of the persistent lower lobe of caudal carried more or less normal to anteroposterior axis; 8 rays, subequal in length, upper and lower stouter than rest, all minutely spined on both free surfaces; fin missing in two examples, imperfect in one; *TLs* length in specimens of *Ls* 100, 212 mm 480, 401, in specimens of *Ls* 550, 560 shorter, 306, 304; fin, as preserved, in general very narrow rays close together, subparallel, narrowly joined by translucent membrane, not fanlike as in illustrations by Clarke and M'Coy; however in specimen (b) distal half of fin presents a wide irregular plume of whitish and dusky fluffy membrane.

Clarke described and figured the type specimen of *T. arawatae*, 64 mm in length without caudal, as possessing two features, a "little rudimentary [= vestigial] dorsal", between second dorsal base and caudal origin, and, opposite and equal to it, a "low rudimentary adipose anal fin", regarding these as characters unique to his fish. No such structures are reported elsewhere in the Australasian literature, nor are they to be found in our material. It is evident that, as noted by Palmer (1961), who incidentally makes express reference to Clarke's fish, these are to be interpreted as representing the persistence, perhaps to a somewhat longer overall size than usual, of larval structures in the form of portions of fin fold supported by actinotrichia: such lobes were reported earlier in young stages of trichipterids by Emery (1879a,b), Smitt (1893) and Ehrenbaum (1905).

(h) Pterygiophores. The fact that the pterygiophores, embedded and hidden in muscle in most teleosts, are usually visible in dealfishes as a conspicuous palisade occupying up to two-thirds of distance between vertebral column and dorsal profile lends a curious appearance to this fish and to illustrations of it (not depicted in figure of type specimen of *T. arawatae*). The height of the apparent portion of the radial (perhaps supplemented basally by a shallow component and possibly by a small distal one) reaches a maximum near middle of overall length, decreasing rapidly in an early anterior section and more slowly and evenly caudad. Samplings of height at operculum, at vent, and maximum height give *TLs* ranges of 29-50, 35-79, 45-80, respectively, with means of 38.7 ± 3.27, 54.0 ± 5.70, 61.5 ± 4.82. All three magnitudes are negatively correlated with length of fish, r -0.918 (z -1.574), -0.877 (-1.361), -0.880 (-1.376), giving t 5.164**, 4.073*, 4.143**.

(i) Integument. The character of the external surface is diagnostic in Trachipteroidei – scales absent, skin smooth in Lophotidae (*Lophotes* Giorna, 1809, *Emecichthys* Regan, 1907, *Protolophotus* Walters 1957); scales absent, skin with bony tubercles arranged in ill-defined longitudinal bands or pronounced longitudinal ridges in

Regalecidae (*Regalecus* Brünnich, 1771, *Agrostichthys* Phillipps, 1924): in Trachipteridae either scales absent, skin with tubercles not arranged in longitudinal bands or ridges *Trachipterus* Gouan, 1770 or deciduous scales present, either imbricate, cycloid, *Zu* Walters & Fitch, 1960, or non-imbricate, modified ctenoid, *Desmodema* Walters & Fitch, 1960. Genera represented in Tasmania are *Lophotes, Regalecus, Agrostichthys, Trachipterus,* (present paper) *Zu*.

In the present material as preserved the skin is everywhere smooth to the touch except along the lateral line where its spines are evident, particularly when a finger is drawn caudad, and along a very narrow fringe to the ventral border, where the tubercles become spinigerous (see below); striated bones of head slightly rough. Small tubercles, flattish or gently convex, cover all exposed surfaces; least developed in small individuals; closely set, interspaces in some regions subequal to, in other regions decidedly less than, their diameter; in specimen (e), *Ls* 508 mm, about 400-500/sq. cm. Along whole ventral surface, below region of body housing the internal organs, a distinct translucent or subtranslucent pennon-like strip, height immediately behind ventrals equal to, or somewhat exceeding, eye diameter, progressively decreasing caudad; noticeably thinner than body above it. On this strip the tubercles become more evident, especially in its lower half or so, where they increase in size progressively downward, at the same time becoming increasingly elevated mesially to develop distinct projections, finally at ventral border bearing rows (two more or less regular lines, one on each side of fish) of small but tolerably stout subconical, at times slightly recurved spines, their height about twice basal diameter, latter 1-4 in interspaces; in specimen (e) about 15/10 mm in each row.

(j) Coloration. The ground color of our specimens as preserved varies from whitish to yellowish, differences of intensity often characterizing one or other of several longitudinal regions (pterygiophores, along or below lateral line); in general some silvery tinge; one specimen tending towards pale purplish. Fin in general whitish or virtually colorless; specimen (b) with distal part of caudal dusky. Pigmentation of the characteristic four dark spots on each side normally black or nearly so, usually continuous within a well defined border, occasionally in large discrete patches with border less sharp. The locations and relative dimensions of the spots, together with serial numbers of second dorsal rays surmounting them, are specified in table 2; in all cases the left side of the fish has been examined. The color in life is succinctly described as silvery, fins scarlet, Marshall (1925) noting of a large example of *T. jacksonensis* [rendered *jacksoniensis*] "when received at night ... its silvery surface was flowing with phosphorescence". Clarke recorded of the holotype that the collector described the fins as "like brilliant feathers more than fins", continuing "this, coupled with the brilliant silver sides made it [the fish] gorgeous in the extreme".

In our material the pattern of the spots broadly conforms to that familiar from early European depictions, e.g. that of Bushnan (in Jardine 1840, vol.2, pl.5) to illustrations of Australian fish by, e.g. Clarke, McCann, M'Coy — namely, three widely spaced near the dorsal border, the first about one head length behind head, and one near ventral border, more or less under first of dorsal series (this last, generally present in local illustrations, is, somewhat surprisingly, not depicted for the holotype). This widely spread pattern admits of variation, thus the photograph of the holotype of *T. pentastigma* Norman, 1961 presented by Palmer (1961, pl.5, fig.2) — species identified by Palmer as *T. trachypterus* — shows two ventral spots, while of the three dorsal the first lies just behind the head, apparently on the fin. Palmer notes he has seen several Mediterranean specimens with five dark blotches: Günther (1887, p.72, footnote) had earlier defended his *T. ruppellii*, 1861 against question of its validity by observing of his type specimen in respect of the first dorsal spot it "differs from other Mediterranean specimens of the same size which are known to me" (Palmer regards this as "undoubtedly an adult example of *T. trachypterus*").

While with each fish viewed separately our sample would appear to present a constant pattern of spots, reference to table 2 shows each spot exhibits considerable variation in its relative distance from snout tip, the upper value of the *TLs* range being 2,2, 1.8, 1.6, 1.2 times the lower. In general the ventral lies more or less beneath the first dorsal (directly below in one individual, slightly in front in four, slightly behind in two),

TABLE 2

TRACHIPTERUS ARAWATAE Clarke, 1881
Specification of color spots, general location, size, serial number of second dorsal ray surmounting middle of spot in seven Tasmanian specimens of standard length 100-560 mm. Dimensions as millesimals of standard length.

	Ventral spot	1st dorsal spot	2nd dorsal spot	3rd dorsal spot
Length to spot, range	166-360	198-350	374-600	598-780
Length to spot, mean	192.1±30.3	252.2±20.8	457.3±31.7	666.5±24.6
Length to spot, correlation with *Ls*; *r*, *z*	-0.894, -1.442	-0.979, -2.274	-0.892, -1.432	-0.833, -1.197
Length to spot, correlation with *Ls*; *t*	4.462**	10.279***	4.415**	3.363*
Length to spot, mean as percent of mean to first spot	100.0	131.3	238.1	347.0
Vertical axis of spot, range	34-35	24-68	20-43	20-49
Vertical axis of spot, mean	28.5±3.67	41.4±5.32	30.5±3.16	38.4±3.45
Horizontal axis of spot, range	27-50	13-70	34-60	24-40
Horizontal axis of spot, mean	36.7±2.65	31.9±2.65	48.2±3.75	32.8±2.81
Serial number of dorsal ray above middle of spot, range	28-31	32-38	62-70	99-117
Serial number of dorsal ray above middle of spot, mean	28.9±0.446	34.6±0.448	67.4±3.10	107.8±2.80
Distance of spot from body profile, range	16-30	7-54	12-20	25-47
Distance of spot from body profile, mean	20.3±2.04	17.7±7.24	14.8±1.65	36.1±2.94
Distance of spot from body profile, correlation with *Ls*; *r*, *z*	-0.643, -0.879	-0.321, -0.333	-821, -1.161	-0.776, -1.037

while among the dorsal series, the mean lengths to the successive spots are 131.3, 238.1, 347.0% of length to ventral spot. Plotted against the serial numbers of the dorsal spots, these percentages given a significantly linear regression (t 177.889**), slope 2.31, intercept 107.83, yielding estimated values 131.0, 238.8, 346.7. The mean of *TLs* lengths to all four spots in general decreases with length of fish from 298.6 in a specimen 100 mm long to 196.1 on one 555 long (200.3 in fish 560 long), with mean 230.5±14.3; r -0.919 (z 1.581), t 5.201**.

It has long been known that in northern hemisphere dealfishes of the genus *Trachipterus* the characteristic early dark spots become wholly obsolete in large individuals. In this connection some data is provided by our material, the more interesting that it is derived from a sample from a single general locality. While in specimens of *Ls* 100, 212, 296 mm the full suite of spots is conspicuous, in the next largest, 444, they show signs, particularly posteriorly, of disintegrating into discrete patches of pigmentation; in the largest but one, 555, all spots are faint or very faint, with on the right side ventral and third dorsal unrecognizable; in the largest, 560, on the left the second dorsal is mainly light brown with only a few small areas with distinct melanophores, the rest barely recognizable, on the right the second dorsal is faint, the fourth very faint,

the first and the ventral absent. Specimen (h) of an estimated standard length 630 mm (caudal approximately an additional 100) is so badly mutilated it has not in general been noted in these observations; so far as can be determined it is totally unornamented.

The range and mean of the vertical and horizontal axes of all spots are set out in table 2. Height exceeds length in the first (ventral) spot in five of the seven specimens, in the second in three, in the third in seven and of the fourth in two specimens; it is equal in first spot in one specimen. With sum of the two axes taken as a measure of overall size, the greatest mean is that of the middle dorsal spot, *TLs* 79.1±14.2, followed in sequence by the first dorsal, 73.4±7.67, third dorsal 69.2±6.28, ventral 66.6±5.03. Size of spot as thus specified shows some evidence of being negatively correlated with size of fish, the values of r (z) for ventral spot, dorsal spots 1.3, and means of all spots for each fish being (all minus) 0.990, 0.751, 0.866, 0.678, 0.860 (2.670, 0.976, 1.144, 0.826, 1.295), significant at much better than P 0.001 for ventral spot, better than 0.02 for third and fifth entries, below this for second and fourth.

The vertical location of the spot as measured by its distance from body profile is variable; in ventral spot 16-30, $\bar{x}$ 20.3 *TLs*, first dorsal 7-54, $\bar{x}$ 19.1, second 7-20, $\bar{x}$ 14.3, third reaching profile in five cases, with 9, 2 *TLs* of it in 2. The superior position of the posterior dorsal spot is evident "in the larger of M'Coy's figures" and in some New Zealand illustrations, though but slightly marked in that of the holotype. Mean distance from profile as a fraction of vertical extent of marking is for ventral spot 0.53, first dorsal 0.80, second 0.34. Correlation of distance with size of fish and first two dorsal spots is in all cases negative; numerical values of r 0.643, 0.321, 0.821 (z 0.879, 0.333, 1.160), of which the last only is statistically significant (t 3.626*).

The serial numbers of the rays of the second dorsal directly above the middle of each of the four spots, recorded in table 2, show an upper limit of 4 beyond a lower of 28, 6 beyond 32, 8 beyond 62, 13 beyond 99 ($\bar{V}$ 4.2±7.3±2.0, 12.2±3.3, 6.9±1.84). With N number of spots, n = number of ray, the mean count surmounting each of the dorsal set is given by the equation $N = 36.60n-3.28$ with t 16.550*; a distinctly better value (t 28.485) is obtained by using instead of value for first dorsal spot mean of that and value for ventral spot, the parameters of the best straight line then being 38.03, -7.09.

Other than that provided by the spots, ornamentation is relatively insignificant. Most striking feature, fully developed only in its lower half (upper half with pigmentation fragmented) in largest individual, not apparent in largest but one, a vertically elongate marking extending from lower lip to level of tips of premaxillary processes, occupying whole of frontal aspect to this point, mostly black or blackish with one or two transverse lighter, usually more or less horn-colored, bands below line of junction of mobile upper jaw with forehead. In two specimens a complete, in one an incomplete, narrow dark line continuing from premaxillary process to first dorsal base, this expanding terminally in the smallest individual to form a dark brown patch covering pterygiophores of first dorsal. In smallest individual but one a conspicuous narrow black line extending along whole length of dorsal bases, constituted of a series of rectangular blocks, occupying the spaces between the ray bases, each 3-4 times as long as high, height subequal to interspace. This marking more or less clearly recognizable in other specimens, lighter in color and much less conspicuous.

Natural history

Apart from the fact that they have all been collected in shallow water or cast ashore the present specimens provide no information on the natural history of our dealfishes. In the northern hemisphere trachipterids, though probably normally dwellers in deep water (being trawled in up to 1 000 m, and found in the stomachs of deep-feeding albacores, Scombridae, and lancetfish, Alepisauridae) are often captured at or near the surface. Food includes an assortment of crustaceans (particularly euphausids), cephalopods and small fishes (most commonly lanternfish, Scopelidae and lampfish or deepwater smelts, Bathylagidae, occasionally hatchetfish, Sternoptychidae). Little local information on feeding habits is available, though McCann (1953) stated the young and adults of his material feed on the "whitebait" stage of other fish. In specimen (c), *Ls* 212 mm, taken in January at Albatross Island, Bass Strait, the caecum has perforated the body wall on the

right side, protruding for about 10 mm, its tip just in advance of the third dorsal spot, 23 mm before vent: the length of the caecum is diagnostic in allotriognaths, the organ extending in *Regalecus* beyond the vent halfway to tail tip; while stopping short of vent in trachipterids, it ends closer to it than to pyloric valve in adult *Trachipterus*, but in adult *Zu* somewhat closer to valve. On being opened up the fully distended caecum was found to be filled with partly digested remains of numerous small white crustaceans, identified as krill, *Euphausia superba* Dana, by Mr Roger Springthorp, Australian Museum, Sydney.

Genus *Zu*
(Plates 1,2)

Zu Walters & Fitch, 1960, p.445. Type-species, *Trachypterus cristatus* Bonelli, 1820.

Zu sp., cf. *Zu cristatus* (Bonelli, 1820)

Trachypterus cristatus Bonelli, 1820, p.487. Type locality: Gulf of Spezia.
Trachypterus cristatus: auct. 1861-1958. Cf. Palmer, 1961, p.346, who lists references under this taxon to 17 European and American authors; specimens chiefly from the Mediterranean.
Gymnetrus repandus Metaxa, 1833, p.53. Type locality: Gulf of Naples.
Trachypterus bonelli Valenciennes, 1835, p.331. Type locality: Mediterranean.
Trachypterus bonelli Canestrini, 1862, p.266.
Gymnetrus müllerianus Risso, 1840, p.13. Type locality: Nice.
Trachypterus repandus Costa, 1850, p.11, pl. Type locality: Mediterranean.
Trachypterus repandus: Buonaparte, 1846, p.79 (synonymy): Steindachner, 1868, p.676. Canestrini, 1871-1872, p.194. Giglioli, 1880, p.92. Goode & Bean, 1895, p.480. Pietschmann, 1925, figs 1-3.
Trachypterus [sp.] Günther, 1887, p.72 (larva).
Trachipterus jacksonensis: Hamilton, 1916, fig.2 (Nelson, New Zealand). (*Nec Regalaecus jacksonensis*, Ramsay, 1881). [cf. Whitley, 1968, below]
Trachypterus iris: Buen, 1917, pp.23-26, 2 figs. (*Nec Cepola iris* Walbaum, 1792).
Trachypterus gavardi Bounhiol, in Bounhiol & Gavard, 1923, pp.1-4. Type locality: Bay of Algiers.
Trachipterus jacksoniensis [=*jacksonensis*]: Phillipps, 1944, p.120, pl.52 (color) (French Pass, New Zealand) (*Nec Regalaecus jacksonensis* Ramsay, 1881).
Trachypterus arcticus (adult males): McCann, 1953, figs 5,6 (New Zealand). *Nec Gymnogaster arcticus* Brunnich, 1788).
?Zu cristatus Walters & Fitch: 1960, p.445.
Zu cristatus Palmer: 1961, p.346 (with synonymy).
Desmodema arawatae Whitley, 1958, p.45, fig.1 (New Zealand). (*Nec Trachypterus arawatae* Clarke, 1881). [Legend to figure reads "*Desmodema arawatae*. Sketch of a specimen presumably male and doubtless the long-missing original of the illustration (inset) published in 1916 by Hamilton" — cf. Hamilton, 1916, above, who identified his specimen as *Trachypterus jacksonensis*.]

Note on synonymy

From the above table of synonymy it is apparent that northern hemisphere ichthyologists were long content to treat Bonelli's *Trachypterus cristatus* as a genuine member of Gouan's 1770 genus, the first to accept its generic distinctness apparently being Palmer (1961), writing immediately following the establishment by Walters & Fitch of *Zu*. The same conservative attitude was adopted by writers — Hamilton, 1916, Phillipps, 1944, McCann, 1953 — who examined New Zealand examples prior to the establishment of *Zu*, the most striking external features of this genus, the strongly scalloped ventral trunk profile and the usual presence on some fin rays of conspicuous bulbous structures (noted by Palmer as characterizing young stages, but treated by Walters & Fitch as a diagnostic generic character), being interpreted by them as merely features in the growth of *Trachipterus* (as by Phillipps) or as sexual characters (McCann): McCann's observations drew highly critical comment from Palmer (1961, p.348). However, the misidentification in 1968 by Whitley of what he regarded as a specimen figured earlier by Hamilton, who had regarded it

as a *Trachipterus (T. jacksonensis)*, as a member of the genus *Desmodema* Walters & Fitch 1960 introduced a positive element of confusion that, as made evident in a table of dealfish generic and specific names in Australasian texts given above in observations on *Trachipterus arawatae*, later extended rather widely through the relevant literature. No representative of *Zu* appears hitherto to have been reported from Australian waters. Some significant features, additional to trunk outline and fin-ray ornamentation, that distinguish *Zu* from the two other trachipterid genera are noted in a table included in observations above on *Trachipterus arawatae*. For discussion of taxonomic status of present specimen, see below.

Material

A specimen collected at East Inlet, Stanley, northwest coast, by Mrs H. Reeman, 27 July 1972, Q.V.M. Reg. No. 1972/5/511; label notes "Pink and silvery grey, red on fins: beachwashed". Tail broken at 285 mm behind snout tip, a further 120 mm before caudal fin, while still attached (barely) considerably contorted, giving standard length 405 mm; caudal fin filamentous distally, possibly imperfect, its present length 120 mm, giving total length 525 mm or 525+ mm.

Dimensions

All dimensions are recorded as millesimals of standard length, 405 mm. Length of head 136, maximum depth of head (overall maximum) 156. Eye 46. Interorbital 27. Snout 44. Length to origin, to termination of first dorsal 67, 88; to origin of second dorsal 94, of pectoral 56, of ventral 146. Length to vent 146. Depths at 10 equal intervals along anteroposterior axis 155, 111, 91, 62, 37, 20, 13, 10, 9, 6. Distance from dorsal profile of lateral line at 10 equal intervals (including origin, termination) 44.4, 55.6, 69.1, 71.6, 67.2, 64.2, 63.0. Oblique length of pectoral base 14, length of longest ray 39. Length of first ray of first dorsal (filamentous, longest preserved) 617, of second ray 494. Second dorsal rays: first 17, at level of operculum 54, at vent 91 (about maximum). Length of longest gill raker 57. Length of middle gill filament on first arch 57. Lengths to (in parentheses depths at) tips of main ventral trunk scallopings 59(128), 81 (153), 128(158), 214(131), 274(121), 388(101).

Proportions

Some conventionally reported ratios are noted below. Length of head 7.4 in standard length. Lengths to origins of first dorsal 15.0, second dorsal 10.7, pectoral 7.6, ventral 6.9, all in *Ls*. Length to vent 3.80, depth at vent 12.5, maximum depth 6.4, all in *Ls*. Snout 3.06, eye 2.97, interorbital 1.68, first dorsal base 6.47, pectoral base 10.0, all in head. With length of head as unity, lengths of trunk, tail are 1.63, 1.74.

As has been found to be the case with the sample of *Trachipterus arawatae* examined above, the depth can be codified in simple formulas, 10 measurements of depth taken at equal intervals along the anteroposterior axis between (and including) snout tip and end of caudal peduncle being such that when log D is plotted on log N , the inverse serial number of the measurement (i.e. counting cephalad) two statistically significant straight lines with widely differing slopes are obtained. For N^1 = {4-10}, log D = 2.8426 log N^1 -0.6415; for N^1 = {7-10}, log D = 0.4787 log N^1+0.7881. For these relations we find r 0.997 (z 3.262), 0.992 (z 2.774), giving t 29.087*** (*d.f.* 5), 11.281** (*d.f.* 2). The two sets intersect at N^1 = 7. It would appear the two segments relate to the preanal and postanal sections of the fish (known in *T. arawatae* to exhibit length growth gradients of differing sign and magnitude), the abscissal length of the set N^1 = 4-10 (anterior part of fish) constituting 0.398 of the abscissal scale, cf. length to vent 0.357 standard length.

As with *Trachipterus arawatae*, a formulation with first and second depths averaged, and nine entries then plotted against terms of the Fibonnaci series as abscissae yields a significant result.

General description

(a) Head (plates 2 and 3). Head moderate, length subequal to height, strongly compressed; anterior profile from upper lip to just above level of orbit straight, at 40°, above which exposed edges of frontals bounding groove in which premaxillary processes are housed are elevated above premaxillae, the profile here rising more steeply, at 50°, for

about half an eye diameter, a slight notch separating it from dorsal base, origin of base extending forward very slightly beyond frontal profile immediately below it. Profile at gape briefly rounded, lower jaw then extending down and back, at much the same angle to horizontal as main upper profile, to below anterior border of orbit, here meeting a lobe where branchiostegal membranes are attached to isthmus. Maxillary plate subovate, narrowing above to end in a digitiform process, broadly rounded below, its length 1.85 its width, subequal to eye; strongly striated, striae radiation from point near upper border, about 25, median 2-3 widest, highest, bifid distally, anterior lateral proconcave, posterior lateral linear. Mouth of specimen permanently slightly protruded, the exposed fleshy strip marking point of disjunction on anterior profile, at level of upper border of pupil, about a pupil wide; in these circumstances it is not feasible to determine accurately position of maxilla with mouth fully closed, but from structure of head here it would appear to reach beyond level of middle of eye. Upper lip rapidly narrowing backward. Inferior surface of lower jaws increasing gradually in width forward, ending anteriorly in a trilobate expansion, the median lobe, smallest, briefly bounding symphysis on either side; lateral surface widening backward with truncate termination above lobe at junction of branchiostegal membranes on each side with isthmus. Frontal aspect of head with a broad subtriangular region, about 1.5 times as long as wide, widest below, bounded by the prefrontals, at their lower termination in contact with a forwardly and upwardly directed fleshy lobe continuous below with an oblique very narrow flexible strip bounding eye between 9 and 7 o'clock (left side viewed); this strip continuous below with an area, concave in front convex below, extending down to level of inferior tip of preoperculum, and extending above to top of orbit, hind edge of which it narrowly borders; anterior portion of this area silvery with some slight rigidity, but yellow hinder portion almost the consistency of flesh (corresponds to area noted above in description of *Trachipterus arawatae* as yellowish, fleshy). Below upper triangular region frontal aspect continues down at approximately same width to gape, surface here distinctly convex. Preoperculum lunate, chord of proconcave anterior border subequal to exposed lengths of premaxillary processes, and to distance between most convex point on convex posterior border and highest point on orbit; silvery, tolerably rigid save for extremely narrow colorless membranous border; numerous well developed striae radiating from near middle of anterior border, lowermost leaning forward. Operculum broadly subtriangular, 1.5 times as long as high, originating above near level of middle of pupil, upper border virtually straight sloping back and slightly down, posterior border of two subequal concave arcs separated by bluntly rounded lobe, with 2-3 small and imperfectly spinous processes representing ends of striae, which here form a small patch of short ridges, overall subvertical, somewhat downwardly concave, their general sense almost normal to that of some 25 strong striae forming a fan centred at anterosuperior angle of plate. Suboperculum large, bounding preoperculum up to horizontal level of opercular lobe, its width subequal throughout, about one-quarter vertical height of plate; covered with striae originating near middle of anterior border, radiating up and down in somewhat proconcave arcs, their general sense approaching vertical near inferior border of plate. Interoperculum small, subtriangular, striate. Orbital rim elevated. Some irregular rugosities above and in front of eye. Nostril single small pore at level of upper border of pupil, nearer eye than snout profile. Eye large, its diameter in head equal to its distance from dorsal profile at origin of nuchal crest (highest point on profile), 1.5 in distance from ventral profile directly below it, its shortest distance from front of gape subequal to that from hindmost point of operculum. Lower jaw with 4 teeth in left ramus, 3 subequal 1 decidedly smaller, 5 in right ramus, 1 about 1.5 times as long as each of 3 others, 1 minute; subconical, acutely pointed, erect. In upper jaw on left 6, 2 small; on right 6, 5 subequal, 1 minute inserted just internal to 3rd from front; conical, acute, strongly inwards, somewhat downwards, tips of innermost of a pair on each side of synphysis very close together, interval about half length of tooth. Teeth on palate, if present, not detected. Gill rakers on lower limb of anterior arch 8, set rather closely, briefly enclosed in membrane proximally, gradually decreasing in height and increasing in relative basal width downwards, uppermost slender, rodlike, subequal to adjacent gill lamellae, others tending to become more or less spatulate; most (possibly all) with 1-3 spinules. Branchiostegals 6, membranes not uniting across isthmus, inserted almost contiguous beside a lobe at posterior end of isthmus.

(b) Trunk and tail. Upper profile of trunk and tail virtually linear, highest point at origin of dorsal fin, above middle of eye (contrast *Trachipterus arawatae*, our material of which shows some small rise to a maximum briefly behind dorsal origin). Lower profile of trunk markedly scalloped, with three recognizable minor emarginations anterior to ventral origin, first small notch, half as deep as long, bordered in front by a rounded process immediately in advance of lowest branchial ray, second and third very shallow, their chords subequal; behind ventral base, for a distance half that between base and first branchial ray, two deep scallops bordered anteriorly by somewhat hooklike processes, length of the first subequal to one pupil diameter, that of the second twice as great, hind border of posterior process in advance of vent by longitudinal extent of vent, reaching below level of body immediately behind it by about one-sixth of chord of scallops, its own chord equal to its distance below lateral line at this point, the line here rather more than three times as far from dorsal as from ventral profile. Behind vent height soon becomes small and tail continues back to its termination in an extremely attenuate form. At a length of 285 mm, or 0.7 of standard length the specimen is broken, the rest of the tail barely attached and much distorted. In the intact half of the tail ventral profile slopes progressively backward and upward, not decisively scalloped, but with some slight sinuosity, particularly anteriorly.

Whole trunk and tail tolerably smooth, finely reticulated with scale-pockets, deciduous scales lost. Below an arc from about half an eye diameter behind ventral fin to end of last scallop, just in advance of vent, a conspicuous thinner more flexible silvery fleshy flap, wholly without tubercles found here in *Trachipterus arawatae*.

Lateral line

Originating against uppermost point of operculum about at level of superior border of orbit, directly distant from eye by half eye diameter, curving down gently for a head length behind head, its distance from dorsal profile now subequal to that from ventral profile at bay of first main scallop behind ventral fin, thereafter sloping down subparallel with dorsal profile to about 23 mm behind vent, continuing for about 4 mm now parallel with ventral profile, and apparently (as described by Phillipps) joining its fellow of the opposite side; a well defined groove enclosing small low regular elevations, length equal to interval, each with minute inconspicuous but readily felt spine; exact course of line defined by a series of ten equidistant measurements of distance from dorsal profile note in section on Dimensions, above. The termination of the lateral line shortly behind vent in agreement with diagnosis of *Zu* by Palmer (1961), in disagreement with that by Walters & Fitch (1960) is discussed in a subjoined section on the taxonomic status of the Tasmanian specimen.

Along the ventral profile behind lateral line termination on each side of tail a series of strong rounded or elliptical bucklers, striated radially from small circular pit at summit. Also along profile on each side a row of strong subconical spines, first 3-4 smaller than rest; most arising from middle of boss, some from some other part of it, some between bosses; mostly directed downwards, occasionally somewhat sideways; on two sides generally opposite, at times alternate or irregular; 26 on one side to break in tail of specimen, approximately 30 behind this (cf. Phillipps, 54).

Fins

First dorsal originating about above middle of eye, front of base highest point on dorsal profile, projecting very slightly in advance of frontal profile immediately below it; base less than half eye; formed of six contiguous subtriangular bosses, pointed above; arising from each a stout rounded spine, first with a few minutes spines proximally; 1st spine intact, length 617 *TLs*, filamentous distally, whitish throughout lacking serial bandings or enlargements; 2nd imperfect, length ca 494 *TLs*, 3rd 4th 5th represented only by stumps (all with some indications of dark banding); 6th 300 long, with seven dark brown segments 5-6 mm long, length 1.5-2 times interspace; these dark segments presenting no morphological difference from intervals between them (contrast lobate membranous expansions described and figured by Phillipps, and apparent vestiges of these on caudal of present individual).

Second dorsal originating behind termination of first by 6 *TLs*, distant from last ray of crest by about interval between that ray (6th) and 4th; 1st ray short, one-eighth head length, length then increasing rather rapidly to more than thrice this at level of operculum, about five and one-third times at level of vent, this being about maximum height; rays rather stout basally, tapering rapidly, acute distally, interval about twice basal diameter; each arising as if from a sack from a more or less globose enlargement at base, enlargements mostly continuous with basal ridge; both surfaces distinctly rough to the touch, minutely, almost invisibly spinose; rays to level of vent 49, to break in tail of fish at 0.70 of standard length 108, possible total round 140 (cf. Phillipps 111, Palmer 120-150: these rays are very brittle; part of one found in specimen jar bore distinct black paired flaps that appeared clearly to represent vestigial vesicles).

Caudal, reported by Phillipps as having 14 rays and being a single fan, diagnosed by Palmer as being in two parts, upper fanlike of 8-12, lower of 1-5 rays, is in a poor state of preservation in our specimen, especially distally where the rays, some filamentous, are imperfect and inextricably tangled: satisfactory description is hence not possible; as far as can be determined the position is as follows. Length at least 300 *TLs*, quite possibly more; at base 10 closely set rodlike transparent rays, upper two very slender, minutely but profusely spinose, terminally a tangled mass; immediately below these, three rays, uppermost about 200 *TLs* long, lowermost about 150 long, each with two barely developed (vestigial?) dark membranous flaps in basal portion and with one-two morphologically undifferentiated dark bars in distal portion; between these two rays an imperfect ray of different appearance, apparently regularly noded; below these three rays, which are mainly colorless, a slender twisted, apparently braided black flexible rope-like strand, its end not separable from tangled ends of other rays; below its insertion some contorted bases, possibly four, of black somewhat leathery rays, one extending back to become braided into main dark strand.

Pectoral very small, rounded, originating below opercular border, about level with bottom of maxillary plate (mouth closed); base horizontal, two-thirds eye; 12 simple rays, first minute, longest 40 *TLs*, less than eye diameter.

Ventral originating about under hindmost pectoral ray, almost contiguous with its fellow on other side; on both sides rays reduced to stumps not exceeding 5 mm in length; six rays, 1st much stouter than rest, its stumps on either side with one spine; base a fleshy pad, subequal in length to pectoral base.

Coloration

The ground color, noted on collection as pink and silvery grey, now mainly whitish or yellowish, with some silvery tinge; fins originally red now all colorless except matted mass of distal parts of caudal rays, predominantly dark brownish, in places black. Frontal aspect in general brownish; fleshy regions exposed by partial protraction of mouth dark cream or pale brownish; upper lip with inferior border dark, rest lighter, brown; lower lip very dark brown anteriorly, off-white behind with some brownish patches (possibly originally wholly brownish); isthmus yellowish behind, dark brown in front. Lateral aspect of head in general silvery, except large sublunate region below eye, pale yellow.

On trunk markings above lateral line faint brown, deepening somewhat caudad; five main items, all extending to, or virtually to, dorsal profile; more or less circular, increasing in size backward, first somewhat indeterminate, diameter about half eye, subcontinuous in front with vague streak bordering first dorsal base, last extending three-fourths of distance to lateral line here; below lateral line some indeterminate duskiness just behind head, three longitudinally subelliptical brownish markings above light strip bordering ventral profile above two main scallopings behind ventral fin; hindmost extending briefly behind terminal process of last scallop, here reaching inferior border and embracing whole white vent. On tail up to point at which it is broken markings, darkening posteriorly from mid to dark or very dark brown, are in sequence caudad as follows: rounded, diameter half eye, touching dorsal profile above, partly behind, level of vent; large, subrectangular, from ventral profile to within one-fifth of its height of dorsal profile; complete bar, height nearly twice width, latter two-thirds eye, distance from marking in front subequal to width of either; after slightly greater interval, darker

band, 1.5 times as long as high, very dark at each profile; an interval, a little longer than last marking, bright silvery in its inferior two-thirds or more, narrowly bordered below finrays by dark strip; from here to break in tail, i.e. for some four-fifths of an eye diameter, wholly blackish; the damaged and contorted partly attached portion from here to caudal origin largely blackish, with some off-white. An obscure regularly interrrupted dark line along second dorsal base.

Taxonomic status of present specimen

Given the known ontogenetic variability of the group and with the local fauna so little researched, the relation to recorded Australasian material of the new specimen presents some difficulty, particularly so in the absence of direct comparison of material. Judging on the grounds of published information, there would seem to be no obvious caveat against recognition of consepcificity of the New Zealand specimens, nor against acceptance of identity with them of the Tasmanian fish. Somewhat more problematical is the relation of the Australasian representative of *Zu* to a species or to species with an extralimital distribution, the precise taxonomic scope of the genus in other waters not yet having been definitively resolved.

Zu was described (Walters & Fitch 1960) in a general review of the families of the suborder Trachipteroidei without mention of any species other than the genotype, and in a subsequent paper by one of its co-authors (Fitch 1964) on the Trachipteridae of the eastern Pacific Ocean the genus remained monotypic, its distribution being described thus: "Known from all tropical and temperate world seas, but rare in the eastern Pacific, having been found off Newport Beach, California, off Cedros Island, Baja California, and east of the Galapagos Islands, Ecuador". In his review of the family in the Mediterranean and northeast Atlantic, Palmer referred to *Zu* half a dozen nominal species of *Trachipterus* (and the synonymic *Gymetrus*), and noted of the larval specimen, 32 mm in standard length, taken by the *Challenger* near the Philippines and reported on by Günther (1887) and of another specimen, 31 mm in standard length, taken by the *Discovery* off the Cape of Good Hope they were both "morphologically indistinguishable from *Zu cristatus*", adding "it may be that the genus *Zu* is monotypic"; observing, however, he had not included in his table of synonymy two species reported outside the region dealt with in his review, namely, *T. ijimae* Jordan and Schneider, 1901 from Japan, *T. semiphorus* Bleeker, 1868 from Amboina. He concluded by giving the distribution of *Zu cristatus* as: "Mediterranean, Madeira, Azores, Durban, ?Cape of Good Hope, ?Philippines, ?New Zealand".

Setting aside the Australasian confusion in the systematics of the Trachipteridae (a significant factor in the later part of the history of which apparently was the fact that Whitley, picking up *Desmodema* Walters and Fitch, 1960, apparently interpreted it as an overall substitute for *Trachipterus* Gouan, 1770, and proceeded to apply it to specimens correctly attributable to Goüan's genus, e.g. Clarke's holotype of *T. arawatae*, and at the same time to specimens, e.g. that of Hamilton (1916, fig.2) properly referrable to *Zu*, this genus, though established in the same paper as *Desmodema*, seemingly being wholly overlooked), the matter of the nomenclatural status of the present specimen has been more or less one of plain sailing. However, the lateral line raises a problem, published accounts of its course in differing markedly in papers by Walters & Fitch (1960), Palmer (1961), and Fitch (1964).

In the definition of the family Trachipteridae Walters & Fitch (p.444) state "The lateral line terminates at the base of the caudal fin in the ventral part of the tail, or extends onto the ventral lobe of the caudal fin", while noting (p.445) in the diagnoses of their new genus *Zu* it there "is straight on the trunk, wavy on the tail, and extends onto the caudal filament between the rays where it is once more straight". In marked contrast Palmer, in diagnosing *Zu*, sites its termination just behind the vent, writing (p.345) "Lateral line straight as far as the ventral constriction where it joins the lower edge of the body" (the meaning of the not wholly felicitous expression "ventral constriction" is made evident by an earlier entry, "The caudal region is sharply constricted dorso-ventrally behind the vent"). Hence, if Palmer's specification is unreservedly accepted, it would appear that *Zu cristatus*, as recognized by him, does not formally qualify as a member of the Trachipteridae as that order is defined by Walters & Fitch!

The New Zealand dealfishes here relegated to *Zu* – that of Hamilton (1916, fig.2) also that regarded as Hamilton's fish re-figured by Whitley (1968, fig.1); that of Phillipps (1944); that of McCann (fig.6; position of lateral line not traceable in fig.5, which, however, depicts a fish closely comparable with Phillipps') – all show the obvious lateral line as ending just behind the ventral scalloping, i.e. just past the end of the trunk. In our specimen the lateral line, which from just behind the head runs down and back virtually straight, ends barely above the ventral profile beind the vent by 27 mm, or 0.4 head; its quite short section on the tail continuing to be linear; subparallel now with ventral profile, and apparently finally turning down to make contact with its fellow on the opposite side.

An adequate reconciliation on the different locations of the point of termination as noted by Walters & Fitch and by Palmer turns on an interpretation of what is and what is not to be regarded as the lateral line. In a paper published later than the three cited above Fitch (1964) in a description of *Zu cristatus*, based on a juvenile, *Ls* 213 mm, and an adult, *Ls* 535 mm, wrote " The lateral line commences on the nuchal crest about half-way between the eye and the dorsal contour, curves downward to just over the opercle and then progresses posteriorly in a relatively straight line, reaching the ventral contour about one-half head length behind the anus. From that spot to the caudal fin, the lateral line undulates as scales from opposite sides of the body alternately align along the ventral contour". This specification is applicable to our specimen, also, as far as can be determined, to the New Zealand dealfishes here relegated to *Zu*. The preferable interpretation of the lateral line would seem to be that adopted by Palmer, namely, the conspicuous conventional visually obvious groove terminating at the ventral profile less than a head length behind the vent.

Family Emmelichthyidae

This family (members of which have been referred in Tasmanian texts also to three other families, Percidae, Erythrichthyidae, Pristipomatidae) is formally represented in the local list by a single species, *Emmelichthys nitidus* (Richardson, 1845) recorded from all Australian States (and New Zealand). However, it may be noted it is possible the specimen of a second species, *Plagiogeneion rubiginosus* Hutton, 1876, taken by the *Endeavour* on the "Eastern slope of Bass Strait, between Gabo and Flinders Islands, outside one hundred fathom line" (McCulloch 1914, p.104) was collected in what are conventionally accepted as Tasmanian waters.

Genus *EMMELICHTHYS* Richardson, 1845

Emmelichthys Richardson, 1845, p.47. Type-species, *Emmelichthys nitidus* Richardson.
Erythrichthys Temminck & Schlegel, 1845, p.117. Type-species *Erythrichthys* sp. Temminck & Schlegel. Preoccupied by *Erythrichthys* Bonaparte, 1831 (Pisces).

Emmelichthys nitidus Richardson, 1845

Emmelichthys nitidus Richardson, 1845, p.47, pl.29, figs 7,8. Type locality: Western Australia.

Tasmanian history

Though R.M. Johnston, doyen of Tasmanian ichthyology, included this species (as *Erythrichthys*, family Percidae) in his first catalogue (1883a, p.111), he did so only by virtue of its appearance in the MS list of Morton Allport. In a paper on six rare fishes recently captured in Tasmanian waters (1885, p.254) he observed (under Pristipomatidae) of an example, "My attention was first drawn to this specimen by Mr. Morton [Director, Tasmanian Museum], who obtained it in one of the fish-stalls. It was captured with flounders [commonly associated in mainland States with the pilchard, *Sardinops neopilchardus* (Steindachner, 1879)] in shallow water near Sorell in the estuary of the Derwent on 15th May. This is the first representative of the species seen by me during a residence of 14 years in Tasmania. I have reason to believe, however, that it is seen by fishermen occasionally in the neighbourhood of Swansea"; noted, in second list (1891), as "rare". In his first list Lord (1923) referred it to Erythrichyidae, in his second (1927) to

Emmelichthyidae; both papers simple name-lists unaccompanied by comments. Lord & Scott (1924), who adopt Erythrichthyidae (p.11), state "rarely obtained in the mature state, but instances have been known of immature forms occurring off the South Coast. Mr W. Gates, of Hobart, was the first to secure specimens of this species in Tasmanian waters" (p.66). Some notes are here given on the first specimen received by the Queen Victoria Museum, an example about two-thirds grown, *Ls* 176 *Lt* 206, taken by Mr D. Wright at The Gardens, north-east coast, December 1980, "found with schools of mackerel" (Q.V.M. Reg. No. 1981/5/1).

Meristic characters

D. XIII, 10. A. III, 10. P. 22. V. I, 5. L. lat. 95.

Dimensions

The principal characters are recorded as millesimals of standard length. Length to origin, termination of first dorsal 438 710, of second dorsal 710 824, of anal 710 830. Length to pectoral 273, length (total) of fin 227. Length to ventral 324, length (total) of fin 170. Length to vent 685. Head 270. Snout 74. Eye 63. Interorbital 74. Depth at front of eye 111, back of eye 139, opercular margin 188, vent 185; maximum 199, depth of caudal peduncle 73.

Aspects of form

(a) Anal spines. Following a pattern frequently encountered, the logarithmic lengths of the three spines are significantly linear on logs {1 2 3}.

Log L = 1.0706 log N + 1.0392; t = 18.188*; estimated (measured) lengths, *TLs*, 10.8 (10.9) 22.4 (23.9) 35.4 (34.7).

(b) Ventral rays 1-4. As in many fishes, the rays postaxial to the spine — ray 1 conventionally defined (Scott 1974) as that furthest from the spine — are specified by $L = b\ N^K$, with here, as customarily, N = {1 2 3 4}.

Log L = 0.2212 log N + 1.9822; t 16.578**; estimated (measured) lengths, *TLs*, 97(97) 113(115) 124(125) 132(131). The length of the spine is 110; that of ray 5 is 127 (as usual, >3 <4).

Coloration

Upper half of body almost uniform slaty, with some silvery lights; lower half brownish. Head much like body; anterior two-thirds of upper surface of snout dark brown in parts approaching black (tip scaleless); an arc of pale yellow behind eye (scaleless). Dorsals dusky, anal pale yellowish, ventral dark yellowish, caudal chiefly yellowish with two blackish longitudinal pennons at base.

Family Pempheridae

This family, the members of which are characterized by a deep compressed body, single short dorsal fin, long anal fin and usually a very large eye (this feature suggesting the vernacular name bullseye, other vernacular names being sweepers, beach-salmon), is represented in Australia by eight or (Whitley 1964) nine species of which two, *Liopempheris multiradiata* (Klunzinger, 1879) and *Parapriacanthus elongatus* (McCulloch, 1911) are recorded from Tasmania. Neither species is included in the first catalogue of Johnston (1883a) but the former appears in the second (1891) as the synonymic *Pempheris macrolepis* Macleay, being referred as in the Australian catalogue of Macleay (1881) to the Kurtidae. Lord & Scott (1924) observe of *Liopempheris multiradiata* "seldom taken in Tasmania" but offer no comment on *Parapriacanthus elongatus*.

While *Parapriacanthus elongatus* was correctly placed in Pempheridae in the earlier Tasmanian list of Lord (1923) where it remained in the synopsis of Lord & Scott (1924), in Lord's later list (1927) it was incorrectly transferred to Priacanthidae, a different family of fishes (Bigeyes), none of the three Australian representatives of which has been recorded (McCulloch 1929, p.165) south of New South Wales.

The Pempheridae, which have a virtually worldwide distribution, closely resemble the Berycidae both superficially and osteologically, differing trenchantly from them, however, in lacking additional soft rays in the ventral fins, being provided only with five found in most acanthopterygians. Both the Tasmanian species are referable to that group of

genera in which the eye is large, the origin of the dorsal lies in the anterior half of the standard length and the maxilla is noticeably expanded distally.

KEY TO PEMPHERIDAE RECORDED FROM TASMANIA

Depth of body >1.5 (about twice) head length.
Anal originating below middle of dorsal fin base, its base with some scales: rays >30 (31-34). L. lat. <60 (46-50). Teeth in jaws mostly uniserial ..... *Liopempheris multiradiata*
Depth of body <1.5 (subequal to) head length.
Anal originating below posterior end of dorsal fin base, its base without scales; rays <30 (24-27). L. lat. >60 (68-72). Teeth in jaws pluriserial ..... *Parapriacanthus elongatus*

Genus *PARAPRIACANTHUS* Steindachner, 1870

Parapriacanthus Steindachner, 1870, 1.623. Type-species, *Parapriacanthus ransonneti* Steindachner.
Pempherichthys Klunzinger, 1871, p.470. Type-species, *Pempherichthys guntheri* Klunzinger.

Parapriacanthus elongatus McCulloch, 1911)

Pempheris elongata McCulloch, 1911, p.47, pl.4, fig.1. Type-locality: Bass Strait.
Parapriacanthus elongatus McCulloch, 1929, p.235: Whitley, 1964, p.46 (species 1271).

Material

Two specimens, *Ls* 69.7 70.9 *Lt* 87.9 89.5, taken by Mr Shane Down in March 1980 6 km north of Eddystone Point, east coast, in 26 m (Q.V.M. Reg. No. 1980/5/43). Where two entries for the same feature occur below that given first is for the smaller individual.

Meristic characters

D. V, 9 10. A. III, 24. P. 18. V. I, 5. C. total rays 18. L. lat. 69 67. In general these counts are in agreement with those given by McCulloch (1911); however, spceimen (a) has one fewer dorsal ray and one more ray in caudal (all elements).

Dimensions

Though McCulloch reports a number of proportional magnitudes (see below) he provides no absolute measurements other than the length range (16 specimens 90-132 mm). The following dimensions are recorded as thousandths of standard length.

Total length 1261 1262. Length to origin termination of dorsal 443 451 617 601, of anal 623 609 915 884. Length to origin of pectoral 316 298, length (total) of fin 307 315. Length to origin of ventral 350 324, length (total) of fin 194 206. Head 339 336. Snout from tip of lower jaw 60 66, from tip of upper jaw 55 56. Eye 128 126. Orbit 142 141. Interorbital 88 92. Depth at front of eye 165 154, back of eye 280 255, opercular border 330 324, vent 294 275; maximum 337 339, of caudal peduncle 99 100. First dorsal ray 263 –, last 72 75. First anal ray 128 118, last 36 –, longest (5th) pectoral ray 287 278. For dorsal spines anal spines ventral rays see Aspects of Form, below.

Proportions

Proportional dimensions recorded for the type material are given below for the present specimens (McCulloch's values in parentheses). Depth 2.97 2.95 (2.7-3.1) in standard length. Caudal peduncle 1.29 1.26 (1.3) in eye. Orbit 2.39 2.38 (2.4) in head, 1.61 1.54 ("much greater than") interorbital, which is 0.26 0.27 ("rather more than one-fourth") head, or 1.47 1.39 snout measured from tip of lower jaw or 1.60 1.64 snout measured from tip of upper jaw ("one-third longer than the snout"). Length to dorsal origin 0.54 1.56 ("usually somewhat less, sometimes rather more than half") total length. Last dorsal spine 0.9 – ("about two-thirds") first ray, which is 1.4 – ("a little longer than") space between end of snout and hinder orbital margin. Anal base 1.68 1.73 ("1.5 to 1.7") dorsal base, its anterior rays 0.49 – ("only two-thirds, or less") first dorsal ray.

Other diagnostically useful proportions include the following. Head 2.95 2.98 in standard length, 3.72 3.76 in total length. Pectoral 1.10 1.07, ventral 1.75 1.63 in head. Depth of caudal peduncle 3.42 3.36 in head, 0.86 1.16 in its length. Depth at vent 0.87 0.81 greatest depth.

Coloration

Available accounts convey little or no idea of the quite bright color pattern. In his account of the original material trawled off Flinders Island, Bass Strait, in 73 m and off Wilsons Promontory, Victoria, McCulloch (1911, p.48) remarked, "Upper surface of the head, back and upper portion of the sides closely speckled with microscopic brown dots which give them a greyish colour. Breast, lower jaw and lips more or less similarly dotted and the specks also extend onto the dorsal and caudal rays. Otherwise colourless in preserved samples". Upwards of sixty years later Scott *et al.* (1974, p.216), repeating the observations on the dark spots, add only "Colour of body greyish above, lighter below". Some notes made on Mr Down's specimens shortly after their receipt at the Museum when they clearly retained most of their original coloration are summarized below.

Lateral line prominent, yellowish; trunk and tail above it dark sage green with a hint of brownish occasioned by the minute spots; lateral surface behind level of anal origin pink with some silvery sheen, the pink deepest in a narrow curved band immediately above anal base and following its course, in advance of anal in general bright silvery with underlying tinge of pink, an obscurely delimited patch of plumbeous immediately in advance of and extending above pectoral base. Head chiefly pinkish or pinkish with silver lights, iris deep grey with external annulus of pale grey, pupil whitish. Dorsal rays deep pink in proximal two-thirds rest whitish, membrane hyaline. Anal very pale cream except for basal sheath which is salmon pink. Pectoral white. Ventral mostly whitish: between the fins a dark plumbeous strip beginning just behind their origin and extending well beyond their tips. Caudal mostly pink, a conspicuous dusky longitudinal mark along upper border, lower one or two rays white. After a week in formalin the overall color was greyish becoming somewhat lighter ventrally: the general color below the lateral line has become essentially yellowish behind the vent, silvery in front of it.

The small dots on trunk and tail above the lateral line to which area they are almost entirely confined are numerous; they would appear to constitute a good specific character in preserved material. Their extension on to the dorsal rays is here confined to the proximal half of the anterior half of the fin, where they are intense; on the caudal they are prominent on the upper 5-6 rays (more so in the smaller individual) but are lacking elsewhere in the larger fish, while in the smaller they form a small patch on the proximal one-sixth of the rays above the lowermost which is immaculate. On the head the spots cover most of the dorsum in places becoming very closely set and even coalescent, forming very dark almost black patches or streaks, the most noticeable aggregations being blotches above the upper lip and below the lower lip and stripes on the lips themselves; on the ventral surface where they extend back to the level of the end of the rictus they are dispersed.

It is of interest to note that in the recently published Coastal Fishes of Southern Japan (Matsuda, Araga & Yoshino 1975) all four pempherids shown in color in plate 33 are brightly tinted. The type-species of the present genus, *Parapriacanthus ransonetti* Steindachner, 1870, is chiefly pinkish, with, as in the present fish, some obscure leaden tinge behind the head and again as in these with a small dark area at the tip of the upper caudal lobe. Schultz (1953, p.561) has observed of the translucent pinkish *Parapriacanthus beryciformes* Frankz, 1910 "on some specimens tips of caudal lobes black pigmented". There is here no green strip above the lateral line as in *P. elongata*; however, its place is taken in another species, *Pempheris oulensis* Cuvier, 1831, by a similarly disposed band of brilliant blue.

Comparison with original account

Apart from the extended information on coloration now available some quantitative variations from the original account, mostly of a minor nature, are evident from the data recorded above. Several other differences are here noted. Maxilla extending to below 0.5 0.6 eye, rather further than figured, its hind end considerably expanded, the distal border markedly excavate. A fleshy circumoral ring, not clearly evident in illustration,

supplemented by a contiguous fleshy or adipose crescent embracing anterior one-third or more of eye, extending backward above for a lesser distance than as depicted, widest at 9 o'clock (right side viewed) where it extends forward to make contact with and partly or wholly to surround the closely approximated nostrils. This structure would appear to represent a rudimentary or vestigial adipose eyelid, the presence of which as a well developed structure is employed by Marshall (1964) and Munro (1957) to key off *Leptobrama* Steindachner, 1879 (synonym *Neopempheris* Macleay, 1881) with one Australian species, *L. muelleri* Steindachner, 1879 from other genera occurring in Australian waters. The location of the nostrils is in our material lower relative to the eye, lying on instead of above horizontal level of upper border of pupil, but on the other hand higher relative to mouth, occurring well above instead of level with upper lip, latter higher in general head profile in illustration. Border of preorbital, shown as distinctly sinuous, swinging in towards eye at level of lower one-third of latter, exhibits some slight concavity in this region on left side of (b) but is in the other individual virtually linear or overall convex. A shallow notch in opercular border defined above and below by a pair of very weak flat spine-like projections (noted in text as almost hidden by scales, not clearly evident in figure), the lower level with inferior border of pupil, the higher just above level of pupil, below origin of lateral line by a distance slightly less than the space between the projections. This contrasts strongly with the plate, which depicts a less extensive but deeper notch embracing the first lateral line scale.

A feature not noticed in the original account (nor indeed in that of any member of the family dealt with in the *Endeavour* report but probably present, being developed in our second Tasmanian species) is the curious conformation of the ventral surface between the point, about level with hind border of orbit, at which the branchiostegal membranes curve in to become subparallel (continuing forward without fusion) and a median point shortly beyond the ventral bases. The subtriangular isthmus proper, a little longer than wide and barely convex transversely, is immediately followed behind by a distinct platform virtually flat throughout though with some indication (possibly post-mortem) of mesial depression, its anterior border linear where it is wholly contiguous with the isthmus, the lateral borders barely convex in (a) slightly concave in (b) in the anterior one-fourth thereafter somewhat convex, with greatest width, about two-fifths of the length, found at or behind the middle. The whole platform is very clearly defined, being almost at right angles to the lateral surfaces, its lines of junction with them sharply drawn, barely rounded. After maintaining its general width to level of insertion of ventrals it continues between them as a short broad tongue the scales on which have the appearance of overlapping some larger darker colored ordinary midventral scales. It is chiefly yellowish with some slight median dark grey, contrasting strongly both with the isthmus which presents a network of whitish and plumbeous and with the flanks which are here (in the preserved material) silvery.

Between the interpelvic process and the vent the ventral surface takes the form of a narrow flattish strip, clearly delimited throughout its length, of very dark grey, indicating the location of the intestine; in some parts this is discernible beneath the integument as a yellow or slightly greenish yellow tube marked with small regularly disposed sharply defined black dots.

Aspects of form

(a) Dorsal spines. These vary in this species from four to five, the latter number being present in both our specimens (spines in (b) damaged). In (a) the spine lengths are 6.0 9.6 13.0 15.9 16.7 mm or 86 138 187 228 240 *TLs* units; if all the log lengths are plotted on the logs of the spines' serial numbers the best straight line yields t 18.729 ($P < 0.001$). However, the increase in length of the 5th over the 4th spine is less than that expectable from the general line trend of the first four spines, which as a restricted set give a t value, 265.361 of much greater magnitude (even with 1 d.f. fewer). Both equations are set out below (in each case $P < 0.001$).

Log L = 0.6624 log N + 1.9410; estimated lengths, *TLs*, 87 138 181 219 254.

Log L = 0.7048 log N + 1.9325; 86 140 186 227.

(b) Anal spines. Presenting a common pattern, the lengths of the spines are collinear in a loglog context when plotted on their serial numbers.

Log L = 1.6662 log N + 1.3596; t 412.450**; estimated (measured) lengths, *TLs*, 23(23) 73(72) 143(144).

Log L = 1.6459 log N + 1.3509; t 206.459**; 22(23) 70(69) 137(138).

(c) Ventral rays. In (a) the spine is damaged, in (b) it measures 5.8 mm or 82 *TLs*, the rays in sequence from it 13.0 13.4 12.5 11.0 9.6 mm or 183 189 176 155 135 *TLs*. In conformity with a plan frequently encountered the plot of the logarithmic lengths of rays {1 2 3 4 — 1 farthest from spine} falls linear on logs {1 2 3 4}.

Log L = 0.2433 log N + 2.1273; t 43.076***; estimated lengths, *TLs*, 134 159 175 184.

Family Soleidae

Genus *ZEBRIAS* Jordan & Snyder, 1890

Zebrias Jordan & Snyder, 1890, p.38. Type-species, *Solea zebrias* Temminck & Schlegel.

Zebrias fasciata (Macleay, 1882)

Synaptura fasciata Macleay, 1882, p.14. Type-locality: Port Jackson.
Synaptura fasciata: Waite, 1899, p.126, pl.31: McCulloch 1916, p.61, pl.8, fig.2 and 1929, p.285.
Brachirus fasciatus: Norman, 1926, p.295.
Zebrias fasciatus: Munro, 1957, p.71, fig.494.
Zebrias fasciata: Scott, 1975, p.162 and 1976, p.178.

Tasmanian occurrence

This fish does not appear in any Tasmanian faunal list, the only sole there reported being a member of the Cynoglossidae, *Paraplagusia unicolor* (Macleay, 1881), first included in the first list of Lord (1923) (a footnote mentions it was reported from the northeast coast by the writer's father). The present species was first recorded from Tasmanian waters by the writer (Scott 1975, p.162), a detailed series of observations being made on an example, *Ls* 131, from between East Sandy Cape and Thirty Day Island (Q.V.M. Reg. No. 1973/5/109) and an example *Ls* 96, from off Prime Seal Island, Furneaux Group, Bass Strait (Q.V.M. Reg. No. 1974/5/38). Later (1976) a specimen, *Ls* 140, taken off St Helens, east coast, was reported (Q.V.M. Reg. No. 1975.5.156). Two additional examples here noted exhibit unusual features.

Material

Two specimens, (a) *Ls* 109 *Lt* 118 (b) *Ls* 114.5 *Lt* 123, collected by Mr J. Shea at Goose Island, Furneaux Group, Bass Strait in May 1980 (Q.V.M. Reg. No. 1980/5/63).

Remarks

D. 87 78, A. 68 68, V. 4 4: these fin counts are in accord with those given in the Handbook (Munro 1957, p.71). Of two lateral line counts that for (a), 98, falls just outside, that for (b), 96, just within the Handbook range of 92-96. Some proportions (Handbook values in parentheses): head in standard length 5.45 5.87 (6) , maximum depth 2.73 2.60 (2.5). Eyeball in head 4.8 4.8 full eye 4.0 2.8 ("eye" 4).

The caudal is somewhat differently represented in figures by Waite (1899) and McCulloch (1916); in the latter the free margin of the fin extends but little beyond the curve formed by continuation of the dorsal and anal and is broadly rounded, whereas in the former it has more the appearance of a separate structure and is bluntly pointed. The second condition was found to characterize out earlier material (1975, p.164), but in both the present individuals the outline of the caudal is even more fully assimilated to the outlines of the other fins than is the case in McCulloch's figure, the combined border being barely if at all resolvable into separate components, and being boldly rounded behind.

Two unusual features may be noted. While closely set moderate-sized cirri normally occur along upper and lower profiles of head and margin of gill opening, and also cover most of the undersurface of the head, in (b) those on the dorsal profile extend back to an arc joining the end of the mouth to junction of the gill cleft and the profile, and a few

are more or less similarly disposed along the ventral profile, but the whole of the rest of the head is without any cirri; in (a) only three or four minute cirri, difficult to detect, occur on either profile, and no others at all are to be found. In both individuals the typical pattern of cross-bars (here 20+, Handbook 22-24, most narrower than their interspaces) is present, but (b) presents some unusual additional markings — two well defined rounded dark spots 7-8 mm in diameter shortly in advance of the middle of the standard length, one near the ventral border the other just above the midlateral line; two similar spots half the size, both on the upper half of the side, just in front of and just behind the nearer large spot.

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