https://doi.org/10.26749/rstpp.107.247

Papers and Proceedings of the Royal Society of Tasmania, Volume 107

(ms. received 9.10.72)

OBSERVATIONS ON SOME TASMANIAN FISHES - PART XIX

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(with one table and two text-figures)

ABSTRACT

It has been found that in a number of fins of the specimens examined a simple consistent relationship subsists between the lengths of the spines and/or rays and their numerical sequence along the base of the fin. Thus, the set of dorsal spines of *Enoplosus armatus* (White,1790) comprises an ascending subset (I-IV) and a descending subset (IV-VIII), in both of which subsets the logarithms of the lengths of the spines are a linear function of the serial numbers of the spines, counting caudad: in the dorsal of *Threpterius maculosus* Richardson,1850 the lengths of the spines of the ascending subset (I-V) are a linear function of their serial numbers counted caudad, while in the descending subset (V-XVIII) the lengths of the spines are a linear function of the logarithms of their inverse serial numbers (i.e., ordinal numbers counted cephalad). Other species for which length-position patterns of radial elements of fins are specified are *Brama brama* (Bonnaterre,1788), *Dactylosargus arctidens* (Richardson,1839), *Neosebastes pandus* (Richardson,1842), *Neosebastes panticus* McCulloch & Waite,1918, *Neothunnus macropterus* (Temminck & Schlegel,1844). The majority of patterns involve the logarithms of both the length and the serial number of the spine or ray.

Two species, *Muraenichthys ogilbyi* Fowler,1908 (Echelidae), *Neothunnus macropterus* (Temminck & Schlegel,1844) are added to the local list. *Neoodax attenuatus* (Ogilby, 1887), not recognized since its discovery, is reported, redescribed and figured.

Some miscellaneous observations are made as follows: Hexanchidae: *Notorhynchus cepedianus* (Peron,1807), notes on a juvenile male. Sphyrnidae: Undetermined species of *Sphyrna*, large example from the East Coast. Rajidae: *Raja whitleyi* Iredale,1938, size, possible sexual dimorphism. Haplochitonidae, Galaxiidae: occurrence in a sample of whitebait of *Lovettia sealii* (Johnston,1883), *Galaxias attenuatus* (Jenyns,1842), *Galaxias truttaceus* (Cuvier,1816); specification of the sample by species number, sex, length; pigmentation patterns in the galaxiids; general notes. Muraenidae: *Gymnothorax leecote* Scott,1965, second specimen, differences from holotype, head figured. Bramidae: *Brama brama* (Bonnaterre,1788), description of a specimen, radial length-number patterns. Enoplosidae: *Enoplosus armatus* (White,1790), metrical and other data on 6 specimens, venomous spines, variation with age, radial length-number patterns. Chironemidae: *Threpterius maculosus* Richardson,1850, second Tasmanian example, radial length-number patterns. Aplodactylidae: *Aplodactylus arctidens* (Richardson,1839), characters of 4 local specimens, radial length-number patterns. Scorpaenidae: *Neosebastes pandus* (Richardson,1842), variation exhibited by a Tasmanian example, radial length-number patterns; *Neosebastes panticus* McCulloch & Waite,1918, additional records, venomous spines, radial length-number patterns.

Notes are given on two fishing contests held in 1970 and 1971.

INTRODUCTION

The abbreviations *Ls*, *Lt*, *TLs*, *TLt* denote, respectively, standard length, total length, thousandths of standard length, thousandths of total length. Dimensions are given in millimetres or in millesimals of standard length; the unit being noted only where ambiguity could arise. A practice introduced in Part IX (1960) of including in locality specifications the county name has since been, and is here, continued: it is to be noted, however, that these areas are now officially designated (by what would seem to be an infelicitous alteration) land divisions (Davies 1965).

Certain other conventions are set out in earlier contributions in this series.

NOTES ON CERTAIN FIN PATTERNS IN WHICH LENGTH OF RADIAL ELEMENT IS A FUNCTION OF ITS SERIAL NUMBER

From an examination of the lengths of the radial elements (spines, rays) of certain fins of some of the fish noticed in the present communication it has been found that, in the material investigated (and though all fins, except the caudal, have been considered in one species, and several fins in some other species, time has not permitted the survey of all fins of all fish), a simple relation subsists between the lengths of the elements and their disposition serially along the base of the fin. The size component of these size-position patterns is in some instances the simple length of the element, but is more commonly the logarithm of the length; the position component is in some instances the natural number indicating the sequential relation, in linear series, of the radial item, but is more commonly the logarithm of that number. Such relationships have been observed for dorsal spines (first dorsal only), dorsal rays, anal spines, anal rays, pectoral rays, ventral rays, ventral ray and spine (combined): caudal rays have not been examined.

The mere existence of such patterns appears to be a matter of considerable interest. Further interest attaches to their diversity, the curious nature of their components, their mathematical elegance and their high degree of fidelity, the question of their occurrence or non-occurrence in other individuals of the species here noted and in other species, and, perhaps the most inviting aspect of all, the problem of their morphological, metabolic, and, presumably, ultimately their genetic, significance. Alternatives in the way of treatment that here present themselves are, first, to extend the inquiry beyond its present state with a view to lending it the scope and status of a separate formal investigation; secondly, to accept the limitations imposed by an arbitrary time limit (namely, that for the submission for publication of the present contribution in a continuing series of these Observations), and to place on record the data available at the present time, foregoing any immediate discussion of the significance of the remarkable patterns thus reported. In adopting, after some consideration, the latter course, steps have been taken at least to present the data in adequate detail, including the provision, primarily in the interests of practising systematists, of both measured lengths and lengths calculated from the defining regression equations. Two isolated references to length-position spine patterns - both in the first dorsal of *Vincentia lemprieri* (Johnston,1883) will be found in Part XII (1969: 105) and Part XVII (1970a:44).

Let L = length of radial element (measured direct from base to tip, no account being taken of any curvature present; dimension recorded to estimated nearest tenth of a millimetre; base of spine or ray felt for with divider tip). Let N = serial number of radial element, counting all items in the set, starting from the first, first being defined thus: in dorsal and anal fins, most anterior element; in pectoral, uppermost (preaxial); in ventral, farthest from spine (nearest to medioventral line of fish; postaxial); in caudal, uppermost. The symbols f, l, m denote, respectively, first, last, longest (*m*aximum) spine or ray. Where the distal contour of the fin, as constituted by the line joining the free tips of the spines or rays, exhibits points of inflexion, the first, last items of the subsets of elements thus formed can be designated f_1, l_1; f_2, l_2; f_3, l_3...: however, where no point of inflexion occurs in the fin, or where, for any other reason (as with one point of inflexion, m, with m common to both subsets) no confusion can arise from the absence of the numerical subscripts, these are conveniently omitted. Note that each radial element of a given fin has its fixed serial number, N, as defined above, f and l remaining invariable. Hence, if, as is frequently the case, it is necessary to plot the graph of the elements of a subset, say {5th-15th-spines}, in reverse order, with the last element now taken as the first of this subset, the reverse serial number N^1, is obtained from $N^1 = l - N + 1$ (giving, e.g., for 15th spine $N^1 = 15 - 15 + 1 = 1$; for 14th $N^1 = 15 - 14 + 1 = 2$; and so on). Capital letters are used to denote sets of spines, lower case letters to denote sets of rays; with a two-letter symbol, capital and lower case, indicating a mixed system of rays and spine(s). For typical fin structures we thus have: dorsal fins $\{D\} \cup \{d\}$ or $\{D\} \cup \{D, d\}$; anal fin $\{A\} \cup \{a\}$; pectoral fin $\{p\}$; ventral fin $\{vV\}$; caudal (not here considered) $\{c\}$. Subsets are marked by subscripts *1, 2, 3*... Thus, for a set of spines ascending from f to m, then descending, in one segment, to l (a common first dorsal disposition) we have $\{D\} = \{D_1\} \cup \{D_2\}$; often with $\{D_1\} \cap \{D_2\} = \{m\}$. The symbols k_1, b are parameters of the regression equations of length (or its logarithm) on serial number (or its logarithm); K measuring the slope of the linear graph, b (log b) being its intercept on the L-axis (log L axis).

Though no discussion of these size-length patterns will be entered on here, attention may be called in passing to the fact that the most common equation among those set out below is $\log L = k \log N + \log b$, or $\log L = k \log N^1 + \log b$, a convenient form for graphing and subsequently testing for goodness of fit of the relation otherwise formulated as $L = b N^k$, or $L = b N^{1k}$, which is of the form of the familiar $y = bx^k$, the equation of simple allometry (Huxley,1932) with y, length of organ or part of organ, and x, length of organism or organ, here represented, respectively, by L, length of structure (radial element), and N or N^1, the serial number of structure in a prescribed linear series (and hence at spaced intervals along a morphological - morphogenetic? - axis).

Brama brama (Bonnaterre,1788)

One specimen, *Ls* 325.
$\{D\} = \{f - m = 1 - 3\}$. Log $L = k N + b$
$\{v\} = \{f - l = 1 - 5\}$. Log $L = k N + b$

Enoplosus armatus (White,1790)

Six specimens, *Ls* 52.1, 161.7, 182, 185, 200, 210.
$\{D\} = \{D_1\} \cup \{D_2\}$. $\{D_1\} = \{f - m = 1 - 4\}$; $\{D_2\} = \{m - l = 4 - 8\}$.
$\{D_1\}$. Log $L = k_1 N + b_1$
$\{D_2\}$. Log $L = k_2 N + b_2$
$\{A\} = \{f - l = 1 - 3\}$. Log $L = k N + b$
Remarks - Note $\{D_1\} \cap \{D_2\} = \{m\}$. Only 5 specimens used for $\{A\}$, the 3rd spine being imperfect in specimen (i).

Threpterius maculosus Richardson,1850

One specimen, *Ls* 210.
$\{D\} = \{D_1\} \cup \{D_2\}$. $\{D_1\} = \{f - m = 1 - 5\}$; $\{D_2\} = \{m - l = 5 - 15\}$.
$\{D_1\}$. $L = k_1 \log N_1 + b_1$
$\{D_2\}$. $L = k_2 \log N^1 + b_2$
Remarks - It will be seen that in the equation for $\{D_2\}$ the descending series of spines (decreasing in length caudad) is graphed as an ascending line (k_2 positive), since the definitive serial numbers, N, as counted conventionally caudad, are reversed in the graph ($N^1 = l - N + 1$), the last spine (15th) being plotted on log 1. The slopes and intercepts of the two graphs do not differ greatly ($k_1 = 22.54$, $k_2 = 18.34$; $b_1 = 16.49$, $b_2 = 13.54$). Again $\{D_1\} \cap \{D_2\} = \{m\}$.
$\{vV\} = \{v_1\} \cup \{v_2 V\}$. $\{v_1\} = \{f - m = 1 - 4\}$; $\{v_2 V\} = \{$rays $m - l = 4 - 5 +$ V, spine$\}$.
$\{v_1\}$. $\log L = k_1 \log N + \log b_1$
$\{v_2 V\}$. $\log L = k_2 \log N + \log b_2$: for V_1 spine, arbitrarily, $N = 10$
Remarks - Only left ventral measured. No obvious reason suggests itself for locating the ventral spine on log 10. A hint from a curious connotation of log 10 (as an opis-

thion) noted (data unpublished) in length-number patterns in certain sharks and whales (lengths here being from anterior point of animal to certain morphological landmarks, and serial numbers being the positive integers 1-10; logarithms being taken in each set) prompted its trial here. It appears to be clearly called for, visually, in the graph for the present specimen, and equally clearly in the graphs for the ventral fins of other species dealt with below. (No significant role, however, has been found for V in the pattern exemplified above by *Brama brama*, in which $m = 5$, with, accordingly, no division of $\{v\}$ into subsets.)

Dactylosargus arctidens (Richardson, 1839)

Three specimens, *Ls* 249, 266, 357.

$\{D\} = \{D_1\} \cup \{D_2\} \cup \{D_3\}$. $\{D_1\} = \{f - m = 1 - 3\}$; $\{D_2\} = \{f_2 - l_2 = 4 \quad 6/7\}$; $\{D_3\} = \{f_3 - l = 7/8 - 15/16\}$.

$\{D_1\}$. $\log L = k_1 \log N_1 + \log b_1$

$\{D_2\}$. $\log L = k_2 \log N_1 + \log b_2$

$\{D_3\}$. $\log L = k_3 \log N + \log b_3$

$\{A\} = \{1 - 3\}$. $\log L = k \log N + \log b$

$\{a\} = \{a_1\} \cup \{a_2\}$. $\{a_1\} = \{f - m = 1 - 3\}$; $\{a_2\} = \{f_2 - l = 4 - 7\}$.

$\{a_1\}$. $\log L = k_1 \log N_1 + \log b_1$

$\{a_2\}$. $\log L = k_2 \log N + \log b_2$

Remarks - In specimen (iii) $\{a_1\} \cap \{a_2\} = \{m\}$, giving $\{a_2\} = \{m - l = 3 - 7\}$, instead of $\{a_2\} = \{f_2 - l - 4 - 7\}$, as above. The intersecting of subsets - the intersection being a maximum length (total or local), to which attention has been directed above, and of which further instances are to be found below - may perhaps be regarded as being an archetypal or "normal" feature of them.

$\{vV\} = \{v_1\} \cup \{v_2V\}$. $\{v_1\} = \{f - m = 1 - 4\}$; $\{v_2V\} = \{$rays $m - l = 4 - 5 +$ v, spine$\}$.

$\{v_1\}$. $\log L = k_1 \log N + \log b_1$

$\{v_2V\}$: $\log L = k_2 \log N + \log b_2$: for V, spine, arbitrarily, $N = 10$.

$\{p\} = \{p_1\} \cup \{p_2\} \cup \{p_3\}$. $\{p_1\} = \{f - l_1 = 1 - 3\}$; $\{p_2\} = \{f_2 - m = 3 - 9$ (9, upper ramus$\}$; $\{p_1\} \cup \{p_2\} = \{f - m = 1 - 9$ (9, upper ramus)$\}$; $\{p_3\} = \{f_3 - l =$ 9 (lower ramus) - 15/16 $\}$.

$\{p_1\}$. [6 fins] $\log L = k_1 \log N + \log b_1$

$\{p_2\}$. [4 fins] $\log L = k_2 \log N + \log b_2$

$\{p_1\} \cup \{p_2\}$. [2 fins]. $\log L = k_3 \log N_1 + \log b_3$

$\{p_3\}$. [6 fins] $\log L = k_4 \log N + \log b_4$

Remarks - Structurally, the pectoral is divisible into three: an ascending subset $\{p_1\}$, the "unbranched ordinary" rays (rays 1,2 simple, unbranched, 3 simple or distally nicked); a second ascending subset $\{p_2\}$, mostly "branched ordinary" rays (ray 3 simple or distally nicked; 4-8 normally branched; 9 with upper ramus, which is m, as in 4-8, with lower ramus as in 10 - 15/16; a descending subset $\{p_3\}$, the specialized digitiform rays. However, of the whole sample of the 6 pectoral fins of the 3 fish, 4 only (specimen (i) left, right; (ii) right; (iii) right) exhibit noticeable differences between the equations of $\{p_1\}$ and $\{p_2\}$ (though all 6 equations for $\{p_1\}$ have been calculated, and are recorded below), the pooled data for $\{p_1\}$ and $\{p_2\}$ being capable of being treated, in the case of the left fins of (ii) and (iii), as a continuous, statistically significant series over the whole range of the pooled subsets. Indeed, while in this and other species the set of pectoral rays can usually be analysed into more or less evident subsets, the overall curvature of the fin is at times of such a character that it becomes necessary to make a somewhat arbitrary decision as to whether, say, 3 or 4 subsets are most satisfactorily recognized (also, sometimes, as to whether a flanking ray is best associated with one or other, or even with both, of two adjoining subsets): in the limit the situation that could present itself would be comparable to that of an approximate formulation of the circumference of a circle by the specification of the perimeter of a polygon with a number of sides appropriate to the degree of precision deemed acceptable.

Neothunnus macropterus (Temminck & Schlegel, 1844)

One specimen, *Ls* 1200.

$\{D\} = \{D_1\} \cup \{D_2\}$. $\{D_1\} = \{a(m) - f_1 = 1 - 5\}$; $\{D_2\} = \{f_2 - l = 6 - 13\}$.

$\{D_1\}$. $\log L_1 = k_1 \log N_1 + \log b_1$

$\{D_2\}$. $\log L_2 = k_2 \log N_2 + \log b_2$

Neosebastes pandus (Richardson,1842) and *Neosebastes panticus* McCulloch & Waite,1918.

Save for the minor difference of the location of m in the pectoral, these 2 species exhibit the same pattern. One specimen of *Neosebastes pandus*, *Ls* 338; two of *N. panticus*, *Ls* 165, 255 - referred to below as specimens (iii), (i), (ii), respectively.

$\{D\} = \{D_1\} \cup \{D_2\}$. $\{D_1\} = \{a - m = 1 - 3\}$; $\{D_2\} = \{m - l = 3 - 12\}$.

$\{D_1\}$. $\log L_1 = k_1 \log N_1 + \log b_1$

$\{D_2\}$. $\log L_2 = k_2 \log N_2 + \log b_2$

$\{d\} = \{d_1\} \cup \{d_2\}$. $\{d_1\} = \{f - m = 1 - 2\}$; $\{d_2\} = \{f_2 - l = 3 \cdot 8\}$

$\{d_2\}$. $\log L = k \log N + \log b$

Remarks - Since $\{d_1\}$ comprises only 2 radial elements, its formation in the present context is trivial. The same observation applies to $\{a_1\}$, below.

$\{a\} = \{a_1\} \cup \{a_2\}$. $\{a_1\} = \{f - m = 1 - 2\}$; $\{a_2\} = \{m - l = 2 - 5\}$.

$\{a_2\}$. $\log L = k \log N + \log b$

$\{vV\} = \{v_1\} + \{v_2V\}$. $\{v_1\} = \{f - m = 1 - 4\}$; $\{v_2V\} = \{$rays $m - l = 4 - 5$ + V, spine $\}$.

$\{v_1\}$. $\log L = k_1 \log N + \log b_1$

$\{v_2V\}$. $\log L = k_2 \log N + \log b_2$: for V, spine, arbitrarily $N = 10$.

$\{p\} = \{p_1\} + \{p_2\} + \{p_3\} + \{p_4\}$. $\{p_1\} = \{f - l$ [m in (i), (ii)] $= 1 - 3\}$; $\{p_2\} = \{f_2 - l_2$ [m in (iii)] = 4 - 8, (i), (iii) 4 - 10 (ii)$\}$; $\{p_3\} = \{f_3 - l_3 = 9 - 14$, (i), iii/11 - 14 (ii)$\}$; $\{p_4\} = \{f_4 - l = 15 - 19$, (i)/15 - 21, (ii), (iii)$\}$

$\{p_1\}$. $\log L = k_1 \log N_1 + \log b_1$

$\{p_2\}$. $\log L = k_2 \log N_1 + \log b_2$

$\{p_3\}$. $\log L = k_3 \log N_1 + \log b_3$

$\{p_4\}$. $\log L = k_4 \log N_1 + \log b_4$

Regression equations, together with measured and predicted lengths, are recorded below in the observations on the several species. The best straight line has been found by minimization of the sums of squares of difference of the logarithms - improvement in accuracy of prediction of radial element lengths in millimetres obtainable by minimization from the raw arithmetic data has been found, by trial, to be marginal. Values of t recorded involve the assumptions that the usual method of computation is applicable to logarithmic data and that the degrees of freedom in these formulations are $n - 2$ where n is the number of pairs of observations. Entries of t with a significance not as good as $P_{0.05}$, i.e., not statistically significant at the conventional one-in-twenty level, are placed in square brackets.

Family HEXANCHIDAE

The family Hexanchidae (Check-list, Heptranchidae) is represented in Tasmania (Munro,1956a: 2) by two species: (a) *Heptranchias* Rafinesque,1810, (1) *H. dakini* Whitley,1931; (b) *Notorhynchus* Ayres,1855, (2) *N. cepedianus* (Peron,1807) - (1) being included (as *N. indicus*,Cuvier) in both lists of Johnston (1883, 1891) with (2) appearing first in the first list of Lord (1923). In the Check-list the Australian records are attributed to the widely distributed *H. perlo* (Bonnaterre,1788), and to *N. griseus* (Macdonald,1873), which latter, as *Heptranchus indicus* Macdonald & Barron, 1868 [name preoccupied by *Notidanus indicus* Agassiz,1835], has as type locality, off Flinders Island, Bass Strait. The Check-list maintains the original spelling, *Notorynchus*, now (as with other early variants of - *rhynchus*) commonly amended to *Notorhynchus*.

A third Australian member of the family, not included in the Check-list or the Handbook, but appearing in Whitley's name-list (1964) is the Seven-gill Shark, *Hexanchus griseus* (Bonnaterre,1788): first Australian record by Lynch (1964: 259). Stead (1963) treats (1) as *Heptranchias perlo* (Bonnaterre,1788), (2) as *Heptranchias* *pectorosus* Garman,1884; noting also *Hexanchus griseus.*

Key to Hexanchidae Recorded from Tasmania

Upper jaw without an unpaired median tooth. First gill slit very large, subequal to postorbital head. Head narrow, snout tapering. End of pelvic base under, or slightly behind, origin of dorsal. Adult usually uniform grey (juveniles may have scattered black spots......*Heptranchias dakini*

Upper jaw with an unpaired median tooth. First gill slit not very large, about half postorbital head. Head broad, snout rounded. End of pelvic base in advance of origin of dorsal. Adult greyish, with scattered black and white spots..*Notorhynchus cepedianus*

Genus *NOTORHYNCHUS* Ayres,1855

Notorhynchus cepedianus (Péron,1807)

Squalus cepedianus Péron,1807, *Voy. Aust.*: 337. Type locality, Adventure Bay, Tasmania.

Juvenile - A young male, 1355 in total length, caught at Dolphin Sands, near Swansea, Glamorgan, on 22 November 1970, was dark grey above, lighter below, tending, beneath lateral line, to become silvery, particularly on tail; scattered dark and light spots, somewhat variable in size, were present.

Dimensions as *TLs* - Entries in parentheses are millesimals of total length calculated from measurements given in feet, inches, lines by McCoy (1880: 16,pl.43,fig.2), under the name of *Notidanus (Heptranchus) indicus* Cuvier, of a female 8 feet 1 inch 0 lines in total length, the largest of 3 examples examined by him. Pectoral: length to origin 170 (196); base, between parallels, 83, oblique 85 (method of measurement not specified, 75); anterior border 146 ('outer edge' 108); posterior [outer] border 107, inner [postaxial] border 55; interpectoral 105. Pelvic: length to origin 415 (474); length with clasper 111; length to median notch 48; inner length of flap behind notch 70; greatest width 55. Dorsal: length to origin 476 (557); base 87 (85); vertical height 41 ('anterior edge' 64). Anal: length to origin 556 (634); base 52 (54); vertical height 27 ('anterior edge' 43). Caudal: notch to tip 46; depth at notch 21; greatest depth behind notch 34; greatest depth of first lobe 89. Length to vent 457, length of vent 18. Head to 1st gill slit 131, to 7th gill slit 176; anteroposterior interval between 1st and 7th gill slits 45 (67). Snout 44 (54). Eye 18; interorbital 96 (72). Length to nostril 9 (18); internarial 43. Length to mouth 46 ('from tip of snout to central tooth' 41); width of mouth 122. Lengths of gill slits 60 (82), 54, 49, 42, 37, 32 (36). Depth at: front of mouth 33, pectoral origin 85, vent 69, caudal origin 37; width at same points 90, 144, 70, 33.

It will be seen that the anal originates below 0.92 (McCoy 0.91) of dorsal base, and its base is 0.59 (.064) dorsal base. Pelvic begins in advance of dorsal by 0.70 (0.97) base of latter, and, with clasper, extends a little beyond middle of dorsal base.

Relative growth or sex variation - Our specimen, a male, is about half grown. Comparison with McCoy's measurement of his figured Victorian female, 1.8 times as long, and with the figure by Macdonald & Barron (1868, pl. xxxiii, fig. 1) of a male of their *Heptranchus indicus*, 1868 [figure reproduced in Handbook (Munro 1956a: fig 5) shows that, consistently for all morphological landmarks measured, the preanal region is relatively shorter in the present specimen, the difference being somewhat more pronounced when the Victorian example is considered. Both figures show a body distinctly deeper proportionally than that of the Tasmanian individual.

Family SPHYRNIDAE

Though the Check-list (McCulloch,1929: 13) enumerates 4 species - (1) *Sphyrna (Eusphyra) blochii* (Cuvier,1816), (2) *S. (S.) lewini* (Griffith,1834), (3) *S. (S.) zygaena* (Linné,1758), (4) *S. (Platysqualus) tudes* (Valenciennes,1822) - of these, (2) only is recognized in the Handbook (Munro 1956b, 11) and in the name-list of Whitley (1964, 33), the remaining entries being extralimital species, with European and American distributions. The only other species accepted by Munro and Whitley is *Sphyrna (S.) ligo* Fraser-Brunner, 1950 from New South Wales; treated in Gilbert's important 1967 revision of the Sphyrnidae as *S. (S.) motarran* (Ruppell, 1835).

In the Launceston *Examiner* of 16 February 1971 there appeared a photograph of a large hammerhead shark taken by Mr T. Tucker near St Helens, Cornwall, stated to be the first caught in Tasmania under game fishing rules: the length was given as 9 ft (nominally 2.74 m), the girth as 5 ft (nominally 1.5 m), the weight as 206 lb (93.5 kg). Though the illustration was not sufficiently clear to make possible a wholly satisfactory specific determination, it seems likely the specimen was an example of *Sphyrna (S.) zygaena* – a species which, after having dropped out of the Australian literature for some forty years, can now be reinstated in our faunal list, a second, much smaller Tasmanian hammerhead, from the same locality, having been determined, while the present paper has been in press, as that species: this specimen is the subject of another publication (*Rec. Queen Vict. Mus*, 47), also in the press.

In the original MS of this paper, written when the local taxonomic possibilities appeared to be restricted to a choice between *S. (S.) lewini* and *S. (S.) ligo*, Mr Tucker's specimen was provisionally regarded as the former.

Family RAJIDAE
Genus *RAJA* Linné, 1758
Raja whitleyi Iredale, 1938

Raja whitleyi Iredale, 1938, *Aust. Zool.*, 9, 2, 169. Type locality, Port Phillip, Victoria.
Raja whitleyi Iredale. Whitley 1940, *Fish of Aust.*, 1, 184, ? fig. 213. Munro 1956, Handbk of Aust. Fish, 16, *in Fisher. Newsl.* (now *Aust. Fisher.*), 15, 9. Scott, T.D., 1962, *Mar. and Fresh W. Fish. S. Aust.*, 48, unnumbered fig. p. 49. Scott, E.O.G., 1967, *Pap. Proc. R. Soc. Tasm.*, 101, 190 (basic synonymy 1872-1938).
Spiniraja whitleyi (Iredale). Whitley 1964, *Proc. Linn. Soc. N.S.W.*, 84, 1, 34.
Raja nasuta Müller & Henle 1801. Stead 1963, *Sharks Rays of Aust. Seas*, 54.

East Coast records - In these Observations there have already been provided tables of measurements of one female (disc width 454 mm) and three males (455, 498, 603), taken at the St Helens Surf Angling Club's Championship at Swimcart Beach, Dorset in May 1966 (Scott 1967, 191), and of 12 females (420, 427, 479, 489, 511, 530, 565, 581, 602, 610, 622, 673) and five males (457, 464, 495, 584, 578), taken at the competition in May 1968 (Scott 1970, 34, 35) - in this last contribution the table on p. 34 has date of collection 1958, a misprint for 1968, and in the heading to table on p. 35, '12 females' occurs in obvious error for '5 males'. The May 1969 catch comprised two females (597, 604) and five males (505, 584, 591, 636, 664), and the 1971 catch (no data for 1970) two females (690, 920) and two males (504, 510). Weights of the 1971 rays (in order of disc width) 15.4 kg, 8.16 kg, 3.46 kg, 3.12 kg. This appears to be the dominant species in this region, the only other rays seen at these four contests being several examples of *Raja lempriéri* Richardson, 1845.

Sex ratio - The pooled results show virtual equality in the numbers of sexes (17 females, 15 males).
Sex and size - In three of the four samples mean female disc width exceeds male mean, the other sample containing a single female, smaller than all three males (virtually equal to smallest). For the pooled sample we find: females 420 - 920, $\bar{x}$ 574.9 ± 28.31 (with the very large individual, about one-third as big again as the next largest, omitted, 420 - 690, $\bar{x}$ 553.4 ± 20.18); males 455 - 636, $\bar{x}$ 539.5 ± 16.56. A test of the significance of the difference of the means, with all females used, gives $t = 1.862$ (P between 0.1 and 0.05), V (17 females) 20.3 ± 3.5, (16 females) 14.6 ± 2.8, (15 males) 11.9 ± 2.2.

A significant excess of female over male size has been demonstrated (1963, 11) in the Tasmanian ray *Myliobatis australis* Macleay 1881; while an analysis of data on an American species of this genus, *M. californicus* Gill, collected from shark derby records (Herald *et al.*, 1960, 63), gave mean weight of 382 males as 3.63 kg, that of 621 females as 11.5 kg.

Absolute size - No indication of size is given by Iredale (1938). Whitley (1940) states "Grows to a large size", and gives a photograph of a large skate 6 ft [nominally 1.83 m] in length and 4½ ft [nominally 1.37 m] across that he notes as possibly being the present species. The Handbook (Munro 1956c, 16) has 5½ ft [nominally 1.67 m] [i.e., in length] and upwards of 27 kg. Our largest example, a female, had a total length of 1175 mm and a disc width of 920, and weighed 15.4 kg. The difference between the disc width of this individual and the mean disc width of the other 16 females is 4.5 standard deviations, or 18.2 times the standard error of the mean of the example of 16.

Families HAPLOCHITONIDAE, GALAXIIDAE
Whitebait

The term Whitebait, used in various countries for small fish and/or fry of larger fish of various species, or combinations of species, is in Tasmania definitively applicable to the endemic haplochitonid *Lovettia sealii* (Johnston, 1883); though in different seasons, and in different parts of a season, one or more of half a dozen other species may be represented in, and may even at times be the predominant constituent in, a sample marketed under that name. There has, however, been some shift in usage. Johnston himself called his *Haplochiton sealii* (now accommodated in the monotypic *Lovettia* McCulloch, 1915) the Derwent Smelt, using Whitebait for *Retropinna tasmanica* McCulloch, 1920 (in Johnston's list as *R. richardsoni* Gill, 1862), and stating (1883, 62) - apparently having in mind another run - that the local Whitebait consists essentially of this last species, accompanied in varying numbers by *Galaxias attenuatus* (Jenyns, 1842) and *Atherina* spp. This position on vernacular names was more or less maintained by Lord & Scott (1924, 34, 35) and by Lord (1927, 12), who list *Lovettia sealii* as Derwent Smelt and *Retropinna tasmanica* as Tasmanian Smelt ("Whitebait"). Since the initiation of an effective fishery about 1941, and particularly since the important study of Blackburn (1950), the present usage has been regularly recognized. Species noted by Blackburn as being associated with the haplochitonid include *Galaxias attenuatus* (Jenyns, 1842) [this name, in unquestioned use for upwards of a century, is here, with some hesitation, retained: some recent authors treat it as a synonym of *G. maculatus* (which has page priority), an action the propriety of which has perhaps not so far been satisfactorily demonstrated], *Galaxias truttaceus* (Cuvier, 1816), *Galaxias weedoni* Johnston, 1883 [recently treated by McDowall (1970) as synonymic with *G. brevipinnis* Gunther, 1866, type locality New Zealand; thus regarded as being, with *G. attenuatus*, a second species of the genus with an extended distribution], *Retropinna tasmanica* McCulloch, 1920, *Tasmanogobius lordi* Scott, 1935, *Ctenogobius tamarensis* (Johnston, 1883), *Atherinosoma tamarensis* (Johnston, 1883) [in the name-list of Whitley (1964) the last two entries are referred to *Arenigobius* Whitley, 1930, *Taeniomembras* Ogilby, 1898].

Analyses of the composition of Tasmanian Whitebait samples by Scott (1936, 1971), Blackburn (1950), Lynch (1965) are discussed in Part XVIII, which includes also a brief review of the history of the fishery - which reached a peak in 1947, in which year the commercial catch exceeded a million pounds - together with some observations on general morphology, size, sexual dimorphism, pigmentation. Notes on a 1971 sample appear below.

1971 Sample

Source - Purchased, 30 October 1971, at a greengrocery store, Devonport, Devon. The exact source could not be ascertained with certainty; there is a high degree of probability it was either the town's own river, the Mersey, or the nearby Don River.

Constituent species - Of the 602 intact fish (sample contains fragments of several specimens; all *Galaxias attenuatus*) 466 (77.4%) are *Galaxias attenuatus*, 100 (16.6%)

Galaxias truttaceus, 36 (6.0%) *Lovettia sealii*. This presents a marked contrast to a smaller sample purchased at Devonport on 9 August 1970, in which (Scott 1971, 121) all the 128 individuals were *Lovettia sealii*.

Sex ratio - This was of course determined only for the haplochitonid, which exhibits marked sexual dimorphism (Blackburn 1950, 157; fig. 1; see also pl. 1, 2). Of 36 fish 23 (64%) were males, 13 (36%) females - cf. 85%, 15% in the 1970 sample; 69.01%, 30.99% for Blackburn's 48090 examples from northern rivers; 69.66%, 30.34% for his 30293 examples from southern rivers.

Standard length - *Galaxias attenuatus:* 37.0 - 49.1, $\bar{x}$ 43.18 ± 0.093, s 2.01 ± 0.066, V 4.7 ± 0.2. *Galaxias truttaceus:* 45.4 (next entry 49.0) - 60.0, $\bar{x}$ 54.01 ± 0.23, s 2.31 ± 0.16, V 4.3 ± 0.3. *Lovettia sealii:* males 46.0 - 54.9, $\bar{x}$ 49.29 ± 0.46, s 2.20 ± 0.33, V 4.5 ± 0.7; females 43.0 (next entry 48.0) - 58.5, $\bar{x}$ 51.42 ± 0.88, s 3.18 ± 0.62, V 6.2 ± 1.2. Thus in *Lovettia sealii* the mean *Ls* of females exceeds that of males by 2.13 mm or 4.3% of the latter, a test of the significance of the difference of the means yielding t^* = 2.305 (*cf.*, in 1970 sample, 2.69 mm, 5.7%, t^* = 2.10). Among males 8 (35%), among females 8 (62%) have *Ls* ≥ 50.0 mm. The largest female exceeds the largest male by 6.6% of latter; the smallest female measures less than the smallest male by 6.5% of latter, though the next smallest female is longer than 7 of the 23 males. Statistics of *Ls* of the 1970 sample of *Lovettia sealii* were: males (109) 42.2 - 56.8, $\bar{x}$ 47.28 ± 0.44, s 4.57 ± 0.31, V 9.7 ± 0.7; females (19) 45.0 - 54.0, $\bar{x}$ 49.97 ± 1.74, s 7.55 ± 1.23, V 15.1 ± 2.5.

Total length - This was measured only in *Lovettia sealii:* males 52.0 - 62.1, $\bar{x}$ 56.31 ± 0.53, s 2.51 ± 0.37, V 4.5 ± 0.7; females 49.0 - 66.0, $\bar{x}$ 57.98 ± 1.21, s 4.37 ± 0.86, V 7.5 ± 1.5.

Frequency distribution of length - For the present material the frequency distributions of length in 1-mm classes are as follows. *Galaxias attenuatus: Ls*, 13 classes (37.0 - 37.9...49.0 - 49.9) 1, 5, 9, 47, 71, 81, 65, 84, 57, 36, 4, 4, 2. *Galaxias truttaceus: Ls*, 16 classes (45.0 - 45.9...60.0 - 60.9) 1, 0, 0, 0, 2, 5, 4, 16, 19, 15, 19, 11, 3, 4, 0, 1. *Lovettia sealii:* males, *Ls*, 9 classes (46.0 - 46.9...54.0 - 54.9) 4, 3, 2, 6, [illegible], 4, 1, 0, 1, *Lt*, 11 classes (52.0 - 52.9...62.0 - 62.9) 2, 3, 2, 3, 4, 3, 2, 1, 2, 0, 1: females, *Ls*, 16 classes (43.0 - 43.9...58.0 - 58.9) 1, 0, 0, 0, 0, 2, 0, 2, 1, 4, 0, 1, 1, 0, 0, 1, *Lt*, 18 classes (49.0 - 49.9...66.0 - 66.9) 1, 0, 0, 1, 0, 0, 1, 0, 4, 1, 2, 0, 0, 1, 0, 1, 0, 1.

Symmetry of distributions - In *Galaxias attenuatus* the frequency of *Ls* distribution shows non-significant negative symmetry (g_1 = − 0.158, t = 1.396) and non-significant leptokurtosis (g_2 = − 0.386, t = 1.712). However in *Galaxias truttaceus* it exhibits significant positive symmetry (g_1 = 0.594, t^* = 2.462) and significant platykurtosis (g_2 1.108, t^* 2.316). For *Lovettia sealii* data are available for the frequency distributions of *Ls* and *Lt* in the 1971 sample, but only for the distribution of *Ls* in the 1970 sample. No statistically significant symmetry is shown by any set of lengths, though it is of interest to note that such departure from symmetry as is evident is positive for the three male sets (1970: *Ls*, g_1 = 0.184, t = 0.795; 1971: *Ls*, g_1 = 0.541, t = 0.121, *Lt*, g_1 = 0.348, t = 0.724), and negative for the three female sets (1970: *Ls*, g_1 = −0.437, t = 0.824; 1971: *Ls*, g_1 = − 0.370, t = o.601, *Lt*, g_1 = − 0.160, t = 0.259). The single large series (1970 males; 109) is significantly platykurtic (g_2 = 2.806, t^{**}= 2.804).

Male gonads - As far as can be judged in the *Lovettia* material as preserved, the testes of ten fish were in the first (filling) of the four stages recognized by Blackburn (1950, 167), seven in the second (full), six in the third (partly spent); but satisfactory distinction between the first and second stages presented difficulty. The female gonads of the 1970 sample have been noticed earlier (1971, 121).

Pigmentation - (a) *Lovettia sealii*. As preserved in alcohol the present fish are almost wholly opaque white, the black eyes providing the only really conspicuous contrast, though some dark pigmentation, localized and small in area, is observable on closer examination: patches of yellow or orange, noticeable features of the 1970 sample, are almost entirely lacking. Blackburn (1950, 177) recognized five stages of successively increasing pigmentation. In our material fish in stage (2) (spots numerous on back but not extending right to head) comprise eight males, two females; in stage (3) (spots on back extending to head; fewer than five spots on posterior end of lateral line) 13, 10; in stage (4) (spots more numerous on lateral line, but not continuous over more than 6-8 myomeres) 2, 0; in stage (5) (lateral line pigmentation further developed) 1, 0. In the 1970 sample, purchased some seven weeks earlier in the year, stages (1), (2), (3) were represented among males, stages (1), (2) only among females. Counting 1 point for each fish in stage (1), 2 points for each in stage (2), and so on, we obtain mean values per fish as follows: 1970, males 2.62, females 1.79; 1971, 2.74, 3.0 With sexes combined and with stages (1), (2) pooled and stages (3), (4), (5) pooled, a 2 x 2 test of frequencies in the 1970, 1971 populations yields χ^2 = 3.87, which is significant at $P_{0.05}$. Some detailed observations on pigmentation patterns have been made earlier (1971, 121). Blackburn found pigmentation is more intense in fish from southern than in those from northern rivers.

(b) *Galaxias attenuatus*. Pigmentation at this stage is slight and localized, occurring chiefly on upper surface on head, in two lines flanking each vertical fin, in one or two lines on, or near, median dorsal line of trunk and tail, along part of lateral line, sometimes as two lines on ventral surface running back from behind head to vent: lateral surfaces of trunk and tail are regularly devoid of chromatophores other than those along lateral line.

On dorsum of head the typical pattern of dark spots comprises a neat quincunx behind eyes, a median interorbital, a pair at anterior nostrils, a variable series in region of upper lip. The anterior pair of chromatophores of the quincunx are circular, or very nearly so, modally 0.1 - 0.2 mm in diameter, sharply delimited, set in a line normal to anteroposterior axis of fish above the (usually clearly discernible) optic lobes about at, or a little in advance of, their anterior margins, that is, slightly behind level of orbit; the posterior pair, almost always either equal in size to, or larger than, the anterior, rounded or somewhat elongated anteroposteriorly, their edges then usually presenting a somewhat smudged appearance, located near, commonly somewhat behind, hinder part of lateral border of cerebellum; the azygous chromatophore circular, noticeably smaller than the others, modally occurring above about middle of cerebellum. This quincunx pattern shows a high degree of stability, occasional exceptions taking the form of 1, 2, or even 3 additional chromatophores placed (usually asymmetrically) near the central member of the set, an extra doublet, or a chromatophore added to the hind pair. In one specimen in five to six, pigmentation in this region has advanced a stage further with the appearance of from fairly to very numerous minute, or extremely minute, punctulations. The single interorbital chromatophore circular, almost invariably smaller than any of the quincunx, placed mesially above middle of anteroposterior extension of cerebral hemispheres, about level with, or a trifle in advance of, middle of eye: occasionally this azygous spot is replaced by a pair. The dark spots occurring at anterior nostrils, unlike the markings already noted, are not superficial, but appear to represent pigmented areas within the narial sacs; less intensely dark, tending to be more diffuse, than other spots on dorsum of head. At tip of dorsum of snout the normal markings comprise an arc of some 4 - 6 on upper lip, with 1 - 3, exceptionally 4 - 5, often somewhat larger, partly or wholly bordering labial set: however, in an occasional fish the chromatophores here are less regularly disposed. In some, but not all, individuals in which second degree pigmentation is present on occiput, this extends further forward over dorsum of head, a high concentration of punctulations developing first near anterior tip of snout.

Lateral surface of head characteristically immaculate, except for a small subcutaneous spot, almost invariably present, just behind preopercular border about level with lower one-third of pupil; a small, variable number of dark spots or dashes, mostly subcutaneous, fringing all, or lower part, of opercular border; from one dot to a short arc of 6 - 7 closely bordering orbit at 7 - 8 o'clock (left side viewed), this marking not developed in one of four to five individuals. In some specimens exhibiting secondary pigmentation on dorsum of head this peppering may extend on to lateral surface of snout.

Lower lip almost always with an arc of chromatophores, seldom more than eight, usually smaller, and almost invariably set closer together, than markings on upper lip. Only other markings on ventral surface of head two oblique series of dots and/or short dashes, commonly brownish, outlining ventral borders of branchiostegal membranes, each set continuous or subcontinuous with arc noted above as occurring on posterior margin of operculum: a median dash between these two series occasionally present.

Dorsal surface of trunk commonly presenting several largish chromatophores, in a single or regular or irregular double row, immediately anterior to dorsal base (absent in about one individual in ten). From this region spots may extend cephalad, usually in one line, occasionally at least partly in two lines, often with considerable interspaces between dots, especially anteriorly, reaching forward (in maximum extent; front chromatophore at times more than a head-length in advance of next) from dorsal fin by 0.0 - 0.2, 0.2 - 0.4...0.8 - 1.0 of fin-head interval in 8, 5, 5, 4, 7, 9, 5, 3, 1, 3, fish in a sample of 50. Only when the forward development reaches to 0.8 of the distance is there initiated a caudad progression of pigmentation from the cephalic quincunx, this usually involving at least two lines of spots, typically accompanied by a rather intense local proliferation of minute dots. Deposition of pigmentation on back of trunk other than the median chromatophores occurs only in one individual in about 30, then taking the form of very numerous minute closely set dark dots. Pigmentation on dorsal surface of tail is always more intense than that on dorsal surface of trunk: it characteristically comprises a well-developed spot on either side of base of each dorsal ray; behind this a median marking, usually in its anterior half a single line of dots, then becoming double, each series then swinging down to encroach on lateral surface along base of caudal ridge bearing the procurrent caudal rays.

Lateral surface of tail and of a variable portion of trunk marked by a line of closely set dots indicating position of lateral line. This marking develops cephalad; reaching, in 50 fish to within 3 - 4 head-lengths of head in one fish, 2 - 3 head-lengths in two, 1 2 head-lengths in 16, 2/3 - 1 head-length in nine, 1/3 - 2/3 head-length in 14, 1/3 head-length or less in eight (in five of these right to head). Posterior part of this marking, with about 35 spots per cm, more conspicuous than anterior part, with 20 - 25 spots per cm; usually more intensely black on tail. Except in one fish in about 50, no peppering has yet appeared on flank, which remains, except for lateral line marking, uniform white.

The pigmentation pattern in the form of longitudinal paired linear markings on ventral surface of trunk that has previously been noted (1970, 122) as conspicuous in females of *Lovettia sealii* (less prominent in males) is met with also in both species of *Galaxias*, though little developed and inconspicuous in the present examples of *G. attenuatus*, being absent, in a sample of 50 fish, in 24, and extending only 0.1, 0.2, 0.3, 0.4 of the distance from the head to the vent in 9, 13, 3, 1, respectively: in 17 cases it presents two lines throughout its length, in three initially one line then two, in six one line only, pigmentation always proceeding caudad. On ventral surface of tail, pattern is much as on dorsal surface, with anal fin base flanked on either side by a line of chromatophores, typically one for each ray; behind this a single followed by a double line, the segments along base of caudal ridge swinging slightly upward to become located on lateral surface.

The paired fins lack pigmentation. Dorsal, anal, caudal rays may be more or less clearly marked-out by dots and/or dashes; in caudal noticeable coloration develops earlier than in dorsal and anal, and extends, as a rule, throughout a greater part of length of ray.

In many individuals these can be traced, even after opacification consequent upon preservation, a linear series of dark areas, often subrectangular, along each side of the enteric canal, about 15 in each row anterior to pelvic origin, and about 20 behind that point, the hinder segments of the lines approaching closer to the external body surface, the markings set closer together, more readily seen.

(c) *Galaxias truttaceus*. Apart from greater absolute size (in the sample) and the usual morphological differences (e.g., greater relative depth - modally 7 - 8 in *Ls*; *cf*. 10 - 11 - differences in size and relative location of dorsal and anal fins) specimens of *G. truttaceus* and specimens of *G. attenuatus* may be distinguished at sight by the presence in the former only of a conspicuous marking on caudal base. This takes the form (Scott 1940, 64) of a dark subvertical almost straight bar (constituted of two contiguous gently proconcave arcs) crossing bases of all, or almost all, caudal rays.

The chief differences between the pigmentation on the head in the present specimens of this species and those of *G. attenuatus* as described above are: (i) above posterior part of brain no regular quincunx, but instead 8 - 19 irregularly disposed larger spots and 0 - 11 (modally about 5) smaller spots, together with, in most individuals, a from slight to abundant sprinkling of submicroscopic specks; (ii) characteristically more than one spot (usually 2 - 3) above cerebellum; (iii) dorsum of head in advance of middle of eyes lacking conspicuous narial spots, with or without a few larger and smaller spots, accompanied, unaccompanied, or replaced by punctulations; (iv) small spots on and behind upper lip more numerous, often in two or three rows; (v) lower lip lighter, chromatophores fewer, and less intense, than upper and than lower lip of *G. attenuatus*; (vi) on lateral surface of head, more often than not an arc of 3 - 7 spots extending forward from posterosuperior angle of operculum towards orbit, reaching, at maximum, more than halfway towards it; (vii) subcutaneous spot just behind preopercular border less prominent, seemingly set deeper, but subcutaneous arc round opercular border more noticeable; (viii) arc fringing orbit much more extensive, reaching, at maximum, from 2 o'clock, round beneath eye to 9 o'clock (left side viewed), hinder portion developing first, front portion following, with, in some individuals, the spots there still extremely minute; (ix) brownish dots or dashes at borders of branchiostegal membrane seldom present, though minute punctulations may occur on isthmus.

Pigment patterns on upper surfaces of trunk and tail, and on lower surface of tail, in general not noticeably different from those in *G. attenuatus*, though rows of spots flanking caudal ridges less pronounced: however, in 30 of 50 individuals a secondary phase of pigmentation, involving the deposition of very numerous minute punctulations on dorsum of trunk, not observed in *G. attenuatus*, has here set in, appearing first between about middle of standard length and dorsal origin as an invasion from lateral surface, developing shortly thereafter on tail, then extending towards head, reached on five of 50 fish.

Except in the smallest two specimens (*Ls* 45.4, 49.0), in which flank is immaculate, a line of dots marks out (in general more firmly, but on account of the lesser intensity of the color, which is commonly brownish rather than black, somewhat less conspicuously than in *G. attenuatus*) position of lateral line, pigmentation in the present species, however, extending forward right to head, with the primary line of chromatophores regularly surmounted by a second, usually somewhat less developed, line, above which imperfect third and fourth rows may arise prior to the appearance of oblique rows of evenly spaced dots delimiting the myomeres, more or less definite indication of the course of most of the length of the myocommas dorsad of lateral line being apparent in one fish in three or four. The initiation of this phase of pigmentation all but invariably takes place above the lateral line, the rows of spots first appearing between the levels of pelvic origin and vent, shortly after extending at first caudad then cephalad. In one individual only has the oblique lineation below the lateral line commenced: this represents the stage designated Interphase AB, Preliminary Pigmentation Stage, in an earlier paper on *Galaxias truttaceus*, in which pigmentation in this species is traced from an unornamented stage through barred and barred-spotted stages to the adult spotted condition from which the second binomen derives (1940; see, in particular, pl. IX). It may be remarked in passing that such a sequence of unpatterned, barred, spotted stages, reminiscent of that in the salmon, does not appear hitherto to have been reported elsewhere in the Galaxiidae.

Ventral surface presents a conspicuous marking extending from throat to vent, comprising, in its complete and typical form, a median line running from near level of posterior border of orbit backward to near point, about two eye-diameters behind eye, at which margins of branchiostegal membranes first become apposed on isthmus; line then becoming double, the segments, after brief initial divarication, either proceeding caudad for a short distance subparallel and then coming to diverge or diverging gradually and more or less evenly from the beginning, reaching a modal maximum distance apart of 0.3 - 0.5 eye-diameter at a head-length, or somewhat less, behind head; thereafter converging, frequently to become quite closely approximated, to level of pelvic origin; continuing immediately behind fin base, usually parallel or diverging but slightly, at about the same, or a somewhat greater, distance apart, finally coming to loop right around vent: anterior azygous segment occasionally absent or incomplete. Marking appears as very closely set black dots, dashes, continuous segments, or a combination of these; quite exceptionally, some secondary much smaller spots may occur between the primary paired markings. In general the pattern is similar to, but better developed than, that of the corresponding marking in *Lovettia sealii*, and much better than that in the present sample of *Galaxias attenuatus*. In fish retaining a vestige of the yolk-sac (see below) the lines usually become widely disparted, encircling the proximal part of the yolk-sac itself, their distance apart thus being increased locally fourfold or more: however, markings in this region may become (apparently temporarily) obsolescent or obsolete; alternatively, may swing asymmetrically to one side of small yolk-sac remnant.

Remnants of yolk-sac - (a) *Galaxias attenuatus*. In four of 50 individuals examined the site of the yolk-sac appeared to be detectable, located at 0.3 of standard length, or behind head by about length of head, or somewhat nearer to pelvic origin than to snout tip; indicated in two fish by a slightly rugose external swelling, in two by the apparent presence internally of a small mass of unabsorbed yolk: regression has gone much further in this species than in *G. truttaceus* in spite of the fact that the mean standard length of the latter is one-fourth as great again.

(b) *Galaxias truttaceus*. Sizable remnants of the yolk-sac are present in 14 of the 100 fish. In its most extensive appearance it takes the form of an apparently tolerably thick-walled, somewhat compressed and more or less flaccid bag, originating at about 0.25, ending at 0.4, of standard length, thus reaching to within about one-third of a head-length of pelvic base: in some individuals it becomes reduced to one or two ridges, usually somewhat rugose, and later to a median dimple, with or without a raised periphery.

Family ECHELIDAE

In a cosmopolitan context the status and scope of the group are subjects of debate. Recognizing the family under this name (alternative, Myridae), Berg (1940) located it - along with Ophichthyidae, Congridae and seven other families less pertinent here - in his final section, Group C, of the suborder Anguilloidei, order Anguilliformes. According to Schultz (1953, 61), no fewer than 22 genera have at various times been placed in the Echelidae; of these, half a dozen have otherwise been referred, by various writers, more or less definitively to at least five other families, Ophichthyidae, Congridae, Dyssomidae, Moringuidae, Muraenidae. In their provisional outline classification of teleostean fishes Greenwood *et al.* (1966, 393) abandon Echelidae altogether, distributing it between Xenocongridae (along with Chlopsidae, Myridae in part, Muraenichthyidae, Chilorhinidae) and Ophichthidae (Ophichthyidae; including Myrophidae, Myridae in part). However, Australian authors have traditionally accepted Echelidae for a tolerably compact group of local eelworms (at least, in more recent times: in both his Tasmanian lists Johnston (1883, 1891) employs the old, wide Güntherian Muraenidae), and, in general, continue to do so (Marshall (1964) adopts Myridae).

In the Check-list (McCulloch 1929, 67) Echelidae is constituted (in respect of its Australian representation) by two genera, *Muraenichthys* Bleeker,1865 [without pectorals; seven species recorded] and *Myrophis* Luken,1851 [with pectorals; two species recorded, one, *M. australis* Castelnau,1879, from New South Wales, not seen again since its discovery]. Except for the dropping of *Myrophis chrysogaster* Macleay, 1881, the Handbook (Munro 1957, 46) adopts the same position. Entries in the name-list of Whitley (1964, 30) - this does not note taxa higher than genus: however, elsewhere Whitley (1968, 31) accepts Echelidae - in general agree with those in the Handbook, with certain notable exceptions: (a) *Muraenichthys australis* Macleay,1881 [in Handbook, in error, 1882] and *M. tasmaniensis* McCulloch,1911 are referred to *Scolenchelys* Ogilby,1897; (b) *S. tasmaniensis smithi*,Whitley 1944, from Western Australia, is added; (c) *M. godeffroyi* Regan,1909 is entered as *M. laticaudata godeffroyi* Regan,1909 (i.e. as a subspecies of *Myroptura laticaudata* Ogilby,1897; type locality, Fiji); (d) *M. gymnotus* Bleeker,1857 and *M. macropterus* Bleeker,1875 are added. While inclined to consider the last-named species (type locality, Amboina) as distinct from the Australian *M. breviceps* Gunther,1876, McCulloch (1911, 22) remarked, 'The specimens identified as *Muraenichthys macropterus* Bleeker, from Port Phillip and the Murray River, are probably not that species, but are *M. breviceps.*' Schultz (1953, 78) synonymized Günther's species with Bleeker's.

Discussing *Scolenchelys* Ogilby,1897, proposed for *Muraenichthys australis* Macleay, 1881, McCulloch (1911, 21) stated Ogilby informed him it 'differs from *Muraenichthys* in the more slender and elongate body and the origin and development of the dorsal fin (as comparing *australis* with *breviceps)'*. McCulloch commented, 'I regard these as specific rather than generic characters.' Attention may be drawn in passing to the fact that in the Handbook illustration of the anterior part of *M. australis* (fig. 322), which appears to be redrawn, with bolder lines, from the rather faint outline sketch of the type by McCulloch (1911, fig. 6), there is no indication of the dorsal, which should be shown as beginning behind level of anal origin by about one-fourth of the distance behind that point and the truncated end of the sketch. An inclination to divide *Muraenichthys* on the basis of the dorsal origin being anterior, or posterior, to the anal origin has probably been experienced by most systematists who have had occasion to look at the genus. (If this criterion were adopted as valid and sufficient for *Scolenchelys*, Ogilby's genus would include also *M. iredalei* Whitley,1927). Regarding species centring round this genus, Schultz (1953, 61) remarks, 'Since there is so much variability in the origin of the dorsal among the various species' [occasionally within a species the location of the dorsal origin may range from a little behind to slightly in front of the vent; e.g., in *M. gymnotus* Bleeker,1864] 'that character, in my opinion, cannot be used generically with this group of species. The arrangement of the teeth is variable, differing on the jaws and vomer from bands to a uniserial row, or they may be absent from the vomer. I believe the dentition to be an excellent specific character. I have concluded that *Muraenichthys* should include all those echelid eels with teeth on premaxillary, maxillary, dentary and vomer, but without pectoral fins, and without the median groove under the snout' [i.e., the groove found in *Leptenchelys* Myers & Wade,1941]. Adopting a suggestion by Gosline, Schultz accordingly divides this group of species into 3 subgenera (or genera), *Muraenichthys s.s.*, *Leptenchelys* Myers & Wade,1941 and *Schultzidia* Gosline,1951: all Australian species would be accommodated in the first-named.

Muraenichthys breviceps (here treated as being distinct from *M. macropterus*) and *M. tasmaniensis* have Tasmania as type locality: no other species is credited in the Check-list to this State. However, *M. australis* was added to the local list in Part III of these Observations (1936, 114). A fourth species, *M. ogilbyi* Fowler,1908, is here reported. Other echelid references in this series comprise: *M. breviceps* (1953, 1957, 1963), *M. tasmaniensis* (1961). As pointed out in Part X (1961, 52), a key to the Tasmanian species provided earlier, in Part VI (1953, 146), unfortunately appeared in quite a confused form, with some critical items transposed. A revised key, incorporating *M. ogilbyi*, appears below. *S* denotes a ratio introduced by Schmidt and used by him in his classic studies on eels (e.g. 1928, 183): $S = \frac{a - d}{t} \times 100$, where a, d = length to vent, to dorsal origin, respectively, t = total length. The writer has suggested (1953, 142) this ratio should be known as Schmidt's Index.

Key to Echelidae Recorded from Tasmania

1 Dorsal originating behind vent................................2
Dorsal originating in advance of vent.........................3

2 Anal originating in advance of dorsal by < length of mouth; the interval between origins about 5-7 head. Head 4.5-5.3 in trunk. *S* about (–1) - (–2). Reddish yellow or brownish green above, speckled with darker dots; silver below..*M. australis*
Anal originating in advance of dorsal by > length of mouth; the interval between origins about 1 head. Head 4.1-4.3 in trunk. *S* about (–6) - (–8). Pale greenish or yellowish, spotted above with darker dots........................*M. tasmaniensis*

3 Teeth in 1 series in jaws; in 3 series on vomer. Depth 3-4 in head. Dorsal mostly pale, though with some minute peppering; becoming noticeably darker near tail-tip. Length to about 550 mm.....................................*M. breviceps*
Teeth in ≥ 3 series in front of jaws, in 2 series laterally; in 2 series on vomer. Depth 2.3-3.8 in head. Dorsal pale, immaculate or almost so; more or less uniform in coloration throughout. Length to about 350 mm........................*M. ogilbyi*

Genus *MURAENICHTHYS* Bleeker,1865
Muraenichthys ogilbyi Fowler,1908

Muraenichthys ogilbyi Fowler,1908, *Proc. Acad. Nat. Sci. Philad.*, 59, 3, 1907 (1908), 423, fig. 3. Type locality, Victoria.

Tasmanian record - A specimen, *Lt* 239, collected by Mr R.H. Green, Zoologist, Queen Victoria Museum, at Green's Beach, Devon, January, 1969 (Q.V.M. Reg. No. 1971.5.36) provides the first Tasmanian record of this species, hitherto known only from Victoria. Opportunity is here taken to provide a somewhat more detailed account of the species than is at present available.

Chief dimensions, *TLs* - Length to dorsal origin 178, to vent (middle) 364, to anal origin 372, to end of tail without caudal fin 996. Head 92; snout 21; eye 8; interorbital 12; mouth cleft to end of oral groove 35, to actual angle of gape 28; maxilla 50. Depth (in parentheses width) at: front of eye 18 (17); back of eye 21 (21); deepest (widest) part of head in advance of branchial sac 33 (34); gill opening 30 (30); dorsal origin, the maximum depth of body 33 (30, the maximum width of body); vent 27 (25); middle of tail 21 (17).

General features - Body long, slender, subcylindrical anteriorly, becoming progressively more compressed caudad. Branchial sac extending beyond the general profile, both vertically and horizontally, its depth subequal to its width, slightly more than combined eye and snout. Gill opening small, rather less than an eye-diameter, extending a little above, mostly below, the lateral line of demarcation of upper dark, lower light coloration, its inferior angle below horizontal level of inferior orbital border. Head small, somewhat compressed, and, in front of eye, depressed; both jaws with upper and lower surfaces about equally convex. Snout rounded dorsally, moderately pointed, tip minutely papillate. Jaws long, lower shorter than upper: with mouth closed, front of lower jaw fitting up into palate, the lower half of its tip exposed, but overhung by anterior nostril, which is tubular, with a short digitiform process arising from its anterior margin, its basal diameter exceeding its height, the former subequal to distance behind jaw-tip of insertion of organ. Posterior nostril is a longitudinal slit in upper lip, anteroposterior extension subequal to that of anterior narial tube; wholly covered by a subquadrangular downwardly directed flap, more than twice as long as deep, its posterior margin barely behind vertical of front of eye. Eye moderate, a trifle longer than deep, 11.0 in head, rather closer to dorsal profile than to mouth cleft, its distance from latter about one-fourth its own vertical diameter; without free margin, surrounded by a narrow unpigmented fleshy annulus. Interorbital gently convex (but may have suffered some post mortem depression). Actual gape of mouth about to posterior border of eye; rictal groove to behind eye by about two-thirds of an eye-diameter, interval between its termination and snout-tip a trifle less than half head. Maxilla slender, concealed, extending behind eye by about two and a half eye-diameters. Tongue lanceolate, mesially nicked behind; in its anterior half moderately, in its posterior half markedly, tumid; strongly papillose; adnate. Teeth moderate, stout, conical, some a little recurved; a few (irregularly disposed) larger than the rest. An irregular patch on premaxilla. In three rows in front part of maxilla, decreasing to two in about its posterior two-fifths. In two rows on vomer. On the dentary in a band, mostly biserial, but shortly triserial at front, where band briefly widens; a narrow non-dentigerous strip at symphysis. The dentition is in good agreement with that of the holotype as described and figured by Fowler (1907, 424, fig. 3, inset). A system of regularly disposed, rather conspicuous pores on head, including, on each side: (a) on dorsum a linear series of four, approximately equally spaced first shortly behind snout-tip, last over hinder half of eye; (b) four on orbital rim between 2 o'clock and 7 o'clock (left side viewed); (c) two on upper lip between nostrils; (d) at about a snout-length behind eye a vertical series of three (right side) or two (left side), the lateral line originating behind the outer one: azygous pores comprise (e) one just behind the end of series (a), a little nearer to the last member of it than the members of the series are to one another; (f) one median, linking right and left sections of (d). A second system, in this case of smaller pores, includes, on each side, a line of about eight, extending along under surface of lower jaw and chin about to middle of head; a single pore about one-third of an eye-diameter dorsad of the hindmost pore of that series. Lateral line starting from near front of branchial basket, on which it is slightly convex upwards; immediately behind this situated about equidistant from dorsal and ventral profiles; then rising somewhat to be, at origin or dorsal, twice as far from inferior as from superior border of trunk; thereafter descending gradually to become at vent, and on tail to continue to run, equidistant from the profiles; with round about 170 pores, counting only those spaced at subequal intervals, there being, at several points, one or more additional pores in close proximity to a pore of the main series.

Origin of dorsal fin a little closer to snout-tip than to vent (at 0.49 of combined head and trunk); origin of anal just behind vent, at 0.37 of total length. Both fins well developed; vertical height of each, at middle of tail, where it is at its maximum, more than half snout, the combined heights here exceeding depth of fleshy tail; at middle of tail about 19 rays in 1 cm. Dorsal and anal confluent with a barely recognizable caudal of about 15 minute rays.

Coloration - Ground color of formalin specimen mostly deep cream. Beneath a line from upper part of gill opening along flank, gradually approaching ventral profile, to meet it about a head-length behind vent, trunk and beginning of tail immaculate, on both lateral and ventral surfaces. In this anterior half of fish, the strip above lateral line with small brown spots, narrowly annulated with yellowish or deep cream, mostly clearly delimited, variable in size, modally about 0.1 mm in diameter, and, between the spots, irregular brownish splashes, these markings so closely set as to produce almost the overall effect of a continuous brown coloration; below lateral line, chromatophores father apart, increasingly so ventrad, the general brown color showing correspondingly lighter. Between about a head-length behind vent and about half as far again from tail-tip, whole surface deep warm brown, with gradual decrease caudad in difference in depth of color between the darker upper and lighter lower strips: behind this, dorsal, lateral, ventral surfaces virtually concolorous, rather warm medium brown. Lateral line lying in a slender streak of darker brown. Head, like trunk, conspicuously bicolor. Except for cream tip of snout, cream anterior nostril and flap covering posterior nostril, all upper jaw and rest of head above a line from rictus to gill opening dark brown, about concolorous with trunk down to same horizontal level; rest of head cream. Dorsal and anal mostly pale greyish, tending to show some pale fawn in distal one-third of tail; immaculate throughout.

Proportions; comparison with holotype - Our values appear in parentheses. Head about 11 3/4 (10.8) in total length. Depth at thorax 2¼ (2.75), width of head 3½ (at greatest width of branchial sac 2.72, in advance of branchial sac 4.40), length of snout 4 1/3 (4.40), gape 2 7/8 (to end of oral groove 2.62, to actual angle of gape 2.75), maxilla 2 (1.83), in length of head. Eye 2 1/8 (2.50), interorbital 2 (1.74) in snout. Head and trunk 1 2/3 (1.73) in tail. Dorsal fin originates at about 2/7 (0.31) of distance between gill opening and vent.

Comparison with *M.breviceps* - In general bodily form *M. ogilbyi* apparently differs little from *M. breviceps* Gunther,1876. Comparison with the dimensions of six individuals of the latter species, with total lengths 234.8, 313.5, 370.5, 393.3, 491.0, 583.0, recorded in Part VIII (1957, table II), shows that, with magnitudes expressed as millesimals of total length, the present fish falls within the extremes for *M. breviceps* in respect of length of trunk, 272 (cf. 270-305, $\bar{x}$ 296.7 ± 5.16), and of tail, 636 (619 - 643, $\bar{x}$ 629.5 ± 3.36); with head, 92.1 (75.5 - 90.7, $\bar{x}$ 84.2 ± 2.07), lying just outside the upper limit. *TLs* lengths of head, trunk, tail all show, in the 1957 material of *M. breviceps* significant correlation with total length; thus: head $r = -0.920$ ($t^{**} = 4.705$), trunk $r = +0.935$ ($t^{**} = 5.279$), tail $r = -0.863$ ($t^{*} = 3.414$). It will be seen that *TLs* values of our specimen of *M. ogilbyi* for head, trunk, tail lie near the upper, lower, upper extremes, respectively, and are consistently closer to the value for the smallest member than to that for the largest member of that series. Hence, in so far as these dimensions are concerned, if the *M. ogilbyi* value for each dimension were interpolated at the appropriate point, as determined by *Lt*, in that series, the pooled sequence would continue to follow a similar general pattern of correlation with length of fish to that presented by *M. breviceps* alone. Indeed, such pooling results in an increase in magnitude of the correlation coefficient in the cases of head, with $r = -0.979$ ($t^{**} = 10.864$), and of trunk, with $r = +0.953$ ($t^{**} = 7.071$); though there is a decrease for the tail value, with $r = -0.665$ ($t = 1.950$).

Two dimensions for which the millesimals for *M. ogilbyi* lie outside the range for the *M. breviceps* sample are: length to dorsal origin, 178 (161 - 169, $\bar{x}$ 166.1 ± 0.97), correlation with *Lt* non-significant at $r = -0.508$, $t = 1.179$; dorsal-anal interval, 190 (203 - 225, $\bar{x}$ 213.9 ± 2.89), with $r = +0.748$, $t = 2.252$.

Comparison of the present specimen with the *M. breviceps* material in respect of relative dimensions of parts of the head yields the following. Snout in head 4.4 (4.2 - 5.0, $\bar{x}$ 4.74 ± 0.11); eye in head 11.0 (5.9 - 18.3, $\bar{x}$ 10.95 ± 1.62); eye in snout 2.5 (1.3 - 3.7 $\bar{x}$ 2.32 ± 0.32); eye in interorbital 1.5 (0.7 - 2.1, $\bar{x}$ 1.39 ± 0.20). Thus all these four ratios fall within the range of the sample of *M. breviceps*.

From the above analysis it would appear *M. ogilbyi* closely resembles *M. breviceps* in general proportions. Of the morphometric characters that exhibit, in the material examined, some formal difference, perhaps those likely to be of taxonomic significance are millesimal values of length to dorsal, and the important dorsal-anal interval. The *M. ogilbyi* values for these differ from the *M. breviceps* means by, respectively, 12, 8 times the standard errors of the latter: however, in view of the possible (in the case of fin interval, not improbable) correlation of the relevant magnitude with overall length of fish, just how much significance should be allowed to these results is questionable. The *TLs* value of the dorsal-anal interval is, of course, virtually (vent substituted for anal origin) that of Schmidt's Index, *S*, multiplied by 10. For our example of *M. ogilbyi* this virtual *S* is 19.04; while for the six specimens of *M. breviceps*, in descending order of *Lt*, it is 22.47, 22.00, 21.01, 21,24, 20.25, 21.38.

Status - While the marked overall morphological similarity between *M. ogilbyi* and *M. breviceps* just noted naturally raises a question as to the distinctness of the two forms, it is to be borne in mind that, apart from differences in length of the dorsal fin, all Australian species of *Muraenichthys* exhibit a close general resemblance. If such weight as Schultz's experience of the family leads him to attach to dentition be granted, the distinctness of *M. ogilbyi* from *M. breviceps*, and indeed from any described local form, would seem to be quite satisfactorily established.

Family MURAENIDAE
Genus *Gymnothorax* Bloch,1795
Gymnothorax leecote Scott,1965

Gymnothorax leecote Scott,1965, *Pap. Proc. R. Soc. Tasm.*, 99, 54, fig. 1. Type locality, off George Rock, north of St Helens, Cornwall, Tasmania, in 10 fathoms (18 m).

New material - The species has heretofore been known only from the holotype, caught in July, 1963 in a crayfish pot off the east coast of Tasmania. Through the courtesy of Mr A.P. Andrews, Curator of Vertebrates, Tasmanian Museum, Hobart, an examination has been made of a second individual, taken by Mr M. Thorburn in a fish trap on 21 July, 1970, 5 miles (8 km) south of Babel Island, Bass Strait (Tasm. Mus. Reg. No. D 1012).

Comparison with holotype - (a) General dimensions - The present specimen, *Lt* 823, is about 1% longer than the holotype (815); however, it is somewhat less deep and decidedly less thick. In the following dimensions, as *TLt*, holotype values are noted in parentheses. Lengths to origin, termination of dorsal 94 (94), 996 (996); of anal 532 (538), 995 (993). Length to vent (middle) 507 (515). Head (to gill slit) 113 (104). Depth [in square brackets thickness] at front of eye 30 (31) [18 (18)], back of eye 39 (37) [21 (20)], gill slit 79 (67) [44 (26)], midway between gill slit and vent 62 (56) [49 (29)], vent 51 (40)[44 (26)], midway between vent and tip of tail 51 (40) [33 (20)]. Some dimensions, in head: snout 5.8 (5.4), eye 15.5 (15.5), interorbital 8.2 (8.9), mouth cleft 2.5 (2.5), gill slit 10.3 (9.3), interval between posterior nostrils 13.7 (10.8), rictus to eye 4.6 (4.25; in original description, by obvious typographical error,42.5).

(b) Chief differences in form - Examination of the Bass Strait specimen reveals a need for modification of two items in the species diagnosis, which notes 'Mouth not closable; upper jaw projecting.' The wide gap, in lateral view, between the jaws described and figured for the holotype is here non-existent, the mouth being fully closable; the jaws are equal anteriorly. The dorsal profile of the postorbital part of the head here rises much more abruptly (fig. 1; contrast 1965 fig. 1b), giving this region a noticeably different appearance. In holotype gill slit slopes backward and downward. All three median fangs on premaxillary readily depressible. Two well-developed black-ringed pores, not recorded for holotype, on lateral surface of posterior one-third of head, the hinder a little in advance of gill slit, distant from it by about 1 1/3 length of gill slit, about on horizontal level with top of orbit; second pore in advance of, and slightly above, first, separated from it by a distance subequal to direct distance of first from gill slit.

(c) Coloration - In general much as in holotype; dorsal, however, not anywhere margined with blackish; vent sulphur-yellow, set in a dark purplish subcircular area, with diameter about thrice that of vent (5 mm); anal pore just within dark region; no dark stripe between anterior and posterior nostrils: for coloration of fin bases see below.

(d) Fin bases - Along almost the whole length of the dorsal surface runs a raised median strip that apparently represents a specialized dorsal fin base. On the ventral surface occurs a raised median area apparently representing a specialized anal fin base: immediately behind the vent it has the form of a low platform, its width about one-fourth of total width here; it soon becomes delimited on either side by a dark-colored narrow, shallow groove; as it proceeds caudad the fin base decreases less rapidly in width than the fish, so that in about last one-third of tail its width is

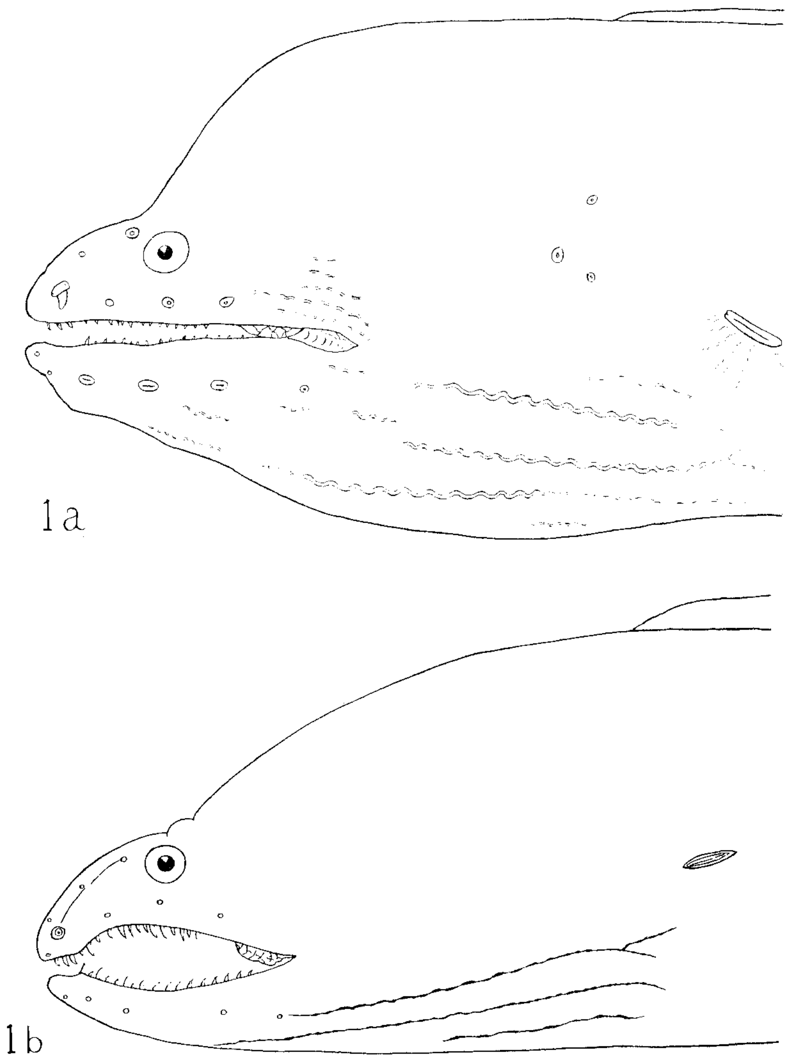

FIG. 1. - *Gymnothorax leecote* Scott,1965. 1a. - Outline of head of a specimen 823 mm in total length, 5 miles (1.8 km) south of Babel Island, Bass Strait (Mr M. Thorburn); the second recorded example of the species: natural size. 1b. - Approximate outline of head of holotype, 815 mm in total length, off George Rock, near St Helens, Cornwall, Tasmania (Mr J. Lipsius): about natural size.

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subequal to combined width of the right and left unelevated strips. Both these raised bands are conspicuously marked out by color, being a dark khaki, noticeably lighter than contiguous areas.

(e) Longitudinal markings on head - Conspicuous longitudinal markings on the lateral surfaces of the head described and figured in the holotype occur also in the present specimen. Each dark brown or blackish stripe lies in a more or less distinct groove formed of a series of contiguous short arcs, with or without at their junction a sub-circular depression, somewhat wider than the arc segments. The main structures are tolerably similar in size, shape and disposition in the two fish; though several minor ones are more apparent in the present fish. They are perhaps elements of a neuromast system.

Family BRAMIDAE

In a paper, not seen by the writer, De Buen (1935) regarded *Brama* Bloch & Schneider,1801 and *Lepidotus* Asso as synonymous, treating the latter as the earlier name, thus making the family Lepidotidae. This action has been endorsed by Whitley (1938, 1964, 1968); and this family name was employed earlier in these Observations (1955). However, the long-established Bramidae continues to be widely accepted (e.g. Berg 1940, Munro 1958b, Greenwood *et al.* 1966) and is conveniently used here. For a detailed discussion of the complex problems of both the generic and the specific status of the species usually called by authors *Brama raii* Bloch & Schneider,1801, or, latterly, *Brama brama* Bonnaterre,1788, reference should be made to an important paper by Whitley (1938) on Ray's Bream and its allies in Australia.

The Handbook recognizes only two species from Australian waters: (a) *Brama* Bloch & Schneider,1801, (1) *Brama brama* (Bonnaterre,1788), with *Sparus raii* Bloch,1891 and *Toxotes squamosus* Hutton,1875 noted as synonyms; (b) *Taractes* Lowe,1843, (2) *T. longipinnis* (Lowe,1843), with *T. miltonis* Whitley,1938 noted as synonym. Both forms have been recorded from Tasmania, though neither is entered in any local formal list. Two Tasmanian examples of (1) are noted in Part VII (1955, 136). The first report of (2) - as *Taractes (Taractichthys) longipinnus miltonis* Whitley,1938 (in Whitley's 1964 name-list, *T. miltonis* Whitley,1938) - was made by Whitley (1961, 66), the specimen being netted in South Arm Bay, near Hobart, Monmouth, 30 July 1958.

Key to Bramidae recorded from Tasmania

Middle and hinder sections of vertical fins higher; middle dorsal rays subequal to eye. Oblique length of anal base about 2½ in total length (including caudal). Lateral line present (may be indistinct). About 85 - 95 scales in median series; predorsal scales about 40 - 50. Free edges of scales minutely serrated, not notched; some larger scale on flank with prominent median vertical ridge. Vomerine teeth present........................*Brama brama*

Middle and hinder sections of vertical fins lower; middle dorsal rays half eye or less. Oblique length of anal base about 3 in total length (including caudal). Lateral line absent. About 45 scales in median series; predorsal scales about 35. Free edges of scales with deep notch, through which projects a spine from scale beneath. Vomerine teeth absent.....................*Taractes longipinnis*

Genus *BRAMA* Bloch & Schneider, 1801
Brama brama (Bonnaterre, 1788)

Sparus brama Bonnaterre,1788, *Tabl. Encycl. Meth. Ichth.*, 104, pl. 50, fig. 19. Type locality, English seas.
Sparus raii Bloch,1791, *Nat. ausl. Fische*, 5, 95, pl. cclxxiii. Type locality, Northern seas [= Yorkshire, England, *fide* Whitley 1938].
Toxotes squamosus Hutton,1875, *Ann. Mag. Nat. Hist.*, 4, 16, 313. Type locality, Cook Strait, New Zealand.
Brama rayi (Bloch) McCoy,1887, *Prodr. Zool. Vict.*, dec. 14, 127, pl. 133.
Brama raii (Bloch) McCulloch,1929, *Aust. Mus. Mem.*, 5, 2, 194.
Lepidotus squamosus (Hutton) Whitley,1938, *Aust. Zool.*, 9, 2, 192, pl. 19, fig. 2. Scott 1955, *Pap. Proc. R. Soc. Tasm.*, (1954) 136.

Additional record - As has been remarked by Whitley (1938, 191), the finding of an example of Ray's Bream (Pomfret, Castagnole) in any part of the world is always noteworthy. Two Tasmanian specimens captured in April 1953 (south of Temma, Russell) and in November of the same year (east-south-east of Fortescue Bay, Pembroke), were recorded in Part VII (1955, 136). An example, *Ls* 325, *Lt* 424, length to end of middle caudal rays 360, was collected by Mr T.A. Wicks at Weymouth, Dorset, on 10 November 1970 (Queen Victoria Museum, Reg. No. 1970. 3. 15). Some observations on this specimen are made here.

Meristic characters - D.III, 33 (last split to base). A.II, 27 (last split to base). P.22/22. V.I, 5. C.16 main rays + 4/5. L.lat. 88. Sc.tr. 16 + *ca* 28: predorsal 42. These counts fall within the ranges in the Handbook (Munro 1958, 121), except that for pectoral, which is here three rays more, and that for lateral line (cf. 90 - 94).

Principal dimensions as *TLs* - Lengths to dorsal origin, termination 363, 878; anal origin, termination 465, 869; pectoral, ventral origins 274, 310; vent 405 - 422. Dorsal rays, 1st - 10th 171, 169, 142, 129, 112, 98.5, 83.4, 66.5, 61.5, 61.5; 20th 60.9; 30th 55.1; 33rd 52.6. Anal spines 61.5, 87.7. Anal rays, 1st - 10th 117, 114, - , 84.6, 66.2, 52.3, 51.1, 49.5, 49.5; 25th - 27th 59.1, 52.3, 49.2. Length of pectoral (whole fin) 372; longest (6th) ray 332. Length of ventral (whole fin) 98.5; ventral flap 47.7. Head 274. Snout, from tip of upper jaw 52.9, from tip of lower jaw 64.6. Eye 70.8. Interorbital 89.1. Depth (in parentheses, thickness) at front of eye 246 (88), back of eye 323 (105), opercular border 415 (105), vent 422 (108); maximum 428 (-); caudal peduncle 64.6 (37).

Other characters - Maxilla (left, right) to 0.4, 0.5 eye; sloping length 86; maximum width, measured normal to main axis, 40. Teeth in upper jaw mostly in 2 - 3 (occasionally, 4, or more) rows, but very irregularly disposed; longest tooth about 2 mm, inner teeth much smaller, in front part of mouth almost microscopic. Teeth in lower jaw mostly in two fairly good rows, outer about 2 mm long, inner about 1 (but decidedly variable); the 1st pair of teeth of the inner series very conspicuous, 3.5 mm long, curved backward, occurring 6 mm behind level of tip of jaw, 5 mm apart at their bases. A line of small teeth on each palatine; patch, barely visible, on vomer. Scales on preorbital stop at horizontal level of middle of eye. Maxilla scaly, premaxilla smooth. Lower jaw smooth back to its point of articulation, though a small space below base of mandible and end of maxilla is squamous. Whole pectoral base covered with small scales. Scales along dorsal and anal bases; also between caudal rays for the proximal half, or more, of their length. Adpressed pectoral to level of 10th anal ray. Adpressed ventral reaching just short of anterior border of vent.

Handbook proportions - Proportions given in the Handbook, with our values in parentheses: depth 2.6 - 3 (3.05), head 4.5 - 5 (4.71) in total length; eye 3.75 - 4.5 (3.91) in head; eye equal to (1.10) snout; pectoral 1.2 - 1.4 (1.34) in head.

Comparison with McCoy's specimen - McCoy (1887) has given a detailed account, with figures - under the name of *Brama rayi* (Bloch), family Scomberidae - of a Victorian example 1 ft 3 in. 0 11 [381 mm] long from tip of lower jaw to end of lobe of caudal. Millesimals of total length for most dimensions recorded by McCoy, calculated from his table of measurements, are here set out in parentheses, following values for the (somewhat larger) Tasmanian specimen. Depth of body 328 (333), thickness 83 (100). Head 212 (200); postorbital head 104 (89). Eye 54 (50). Length of pectoral 285 (217) - our measurement represents total length of fin, including all base; length of longest ray, with which McCoy's value is perhaps more closely comparable, is 255. Length of ventral 75 (72) - our longest ray 63. Highest dorsal ray 131 (150). Length of dorsal base 395 (422). Length of lobe of caudal 233 (239), of middle of caudal 83 (67). Length of anal base 310 (333); longest anal ray 85 (111); middle anal ray 38 (44). McCoy reports five more dorsal, two more anal, three fewer pectoral, and perhaps, with minor elements counted, two fewer caudal, rays than are found in our example. L. lat. 94 (cf. our 88). L.tr. 15/28 (cf. our 16/ca 28).

Fin patterns - See general treatment earlier in this paper of length-position patterns of radial elements in fins of several species: data for dorsal spines and ventral rays of the present specimen are recorded below.

For (*D*) the equation is Log $L = 0.2148\ N + 0.9466$; $t = 295.67$. Lengths of the three spines, as measured, and in parentheses as calculated from the equation, are 14.5 (14.5), 23.8 (23.8), 39.0 (39.0).

For (*v*) , comprising all ventral rays(without formulation for spine), the equation is Log $L = 0.0552\ N + 1.1402$; $t = 9.32$. Measured (calculated) lengths are 16.0 (15.7), 17.3 (17.8), 20.5 (20.2), 22.5 (23.0), 26.5 (26.1).

Family ENOPLOSIDAE
Genus *ENOPLOSUS* Lacépède,1802
Enoplosus armatus (White,1790)

Chaetodon armatus White,1790, *Voy. N.S. Wales*, 254, fig. 1. *Ex* Shaw Ms. Type locality, New South Wales [Check-list specifies 'Between Broken Bay and Botany Bay'].
Enoplosus white Lacépède,1802, *Hist. Nat. Poiss.*, 4, 541. Type locality, New South Wales (White).
Enoplosus serotinus De Vis,1911, *Ann. Qld Mus.*, 10, 29. Type locality, Cairns, Queensland.

Remarks - The Old Wife, Zebra Fish, Bastard Dory, or Double Scale is usually regarded as the only member of its family, De Vis' *E. serotinus* commonly being synonymized with White's species. De Vis presents no direct comparison of his species (the type of which is noted in a rigid and dilapidated condition) with *E. armatus;* from typical examples of which it would appear to differ chiefly in being somewhat less deep. The spines of the first dorsal are given as 7, instead of the usual 8. However, the third spine is stated to be 'two-thirds of the depth of the body at its insertion'; this spine must be the longest one, which is normally the fourth. It seems probably the low count of 7 is to be accounted for simply by the overlooking of the very small first spine.

It is found in all Australian States, being first recorded for Tasmania in Johnston's second list (1891, 30) (in which the number of local species is increased from 188 to 214.): it is there accommodated in the old wide Percidae. Lord & Scott state "It is not often seen in Tasmanian waters". It is found chiefly in harbours and sheltered foreshores, where it occurs in schools, but as it rarely takes the hook, it does not often come under the notice of the line fisherman. Southcott (1970, 724) gives an account of the collecting of numerous examples, mostly only a few inches long, by dragnets, along the Adelaide beaches and at American River, Kangaroo Island; with remarks on injuries sustained in the course of operations.

Juvenile - In the course of examination of a juvenile a little more than 5 cm in length (adults commonly reach 20 - 23, rarely 30 cm) it was noticed the unpaired fins appeared to originate somewhat further caudad than usually figured - several illustrations are available in, e.g. Stead (1906, pl. 32; frequently reproduced), Scott (1962, fig. on p. 185), Roughley (1916, pl. 26). A survey of available specimens was thereupon undertaken to check this point and to ascertain what other changes in proportion, if any, may be associated with increase in overall size in this species: some results of this investigation are here reported.

Material - six examples have been examined: (a) *Ls* 52.1, Bridport, Dorset, netted (K. Cartledge); (b) *Ls* 161.7, Beachford, Dorset, 2 February 1970, 3 m of water, R. Brooks (Queen Victoria Museum Reg. No. 1970. 5. 8); (c) *Ls* 182.0, northern Tasmania (Q.V.M., Reg. No. 1940. 124); (d) *Ls* 185.0, 16 km north of Eddystone Point, Dorset, February 1971, J. Singline (Q.V.M. Reg. No. 1971. 5. 8); (e) *Ls* 200.0, outside Wilson's Point, just west of the estuary of the Rubicon, Devon, 14 February 1971, J. Temple-Smith (Q.V.M. Reg. No. 1970. 5. 6); (f) *Ls*221.0, northern Tasmania, T. Cannon

(Q.V.M. Reg. No. 1939. 0084z).

Venomous spines - A note on a case of severe poisoning occasioned by the dorsal spines of specimen (e) has been published elsewhere (Scott 1970b, 239), an account of the incident, which occurred while the paper was in press, being included in a report on the venomous character of *Neosebastes panticus* McCulloch & Waite, and several other Tasmanian fishes. An earlier report of the present species as a venomous one has been given in a paper (overlooked when the Tasmanian case was recorded) by Bell (1967, 71), who discusses an injury suffered by a spear fisherman off Phillip Island, Victoria: further cases, this time from South Australia, are noticed by Southcott (1970, 724). In the notice of the Tasmanian case it was observed, 'An *ad hoc* dissection at the bases of the anterior dorsal spines of the specimen has failed to disclose any positive indication of the presence of poison glands - however, in view of the somewhat cursory nature of this examination, the negative result should not be regarded as definitive evidence of the absence of venom-producing tissue.' No consideration of venom glands is to be found in the papers of Bell and Southcott: however, the former writer observes, 'The symptoms suggest that this toxin is at least partly proteolytic in nature.'

Dimensions as *TLs* - A series of measurements of the six individuals examined, expressed as millesimals of standard length *(TLs)*, is exhibited in table 1. To provide an indication of whether or no a linear dimension tends to undergo alteration in magnitude relative to length of fish *pari passu* change in overall size, and if so whether by increase or decrease, r has been calculated for the correlation of each dimension with standard length; the results, together with their t values, are incorporated in the table. A t value is there entered only for coefficients representing a probability of 0.1 (unmarked), 0.05 (one asterisk), or 0.01 (two asterisks).

In discussing the interpretation of r for biological data, Snedecor (1950, 141) remarks, 'It is clear that judgment about the size of a correlation should be made in the light of similar correlations encountered in the same field, sometimes with little reference to the theoretical limit, $\pm$ 1.' A consistent run of instances of r with the same sign, representing a probability as low as 0.1, when encountered in what are in effect repetitions of the same situation (as, for instance, the correlation with *Ls* of a set of *TLs* lengths of fin rays or spines) may well be of importance, even if only as a pointer to the existence of a state of affairs worthy of further investigation, or, more definitely, as a valid indication of a probable general correlation not formally exhibited by individual members of the series under examination. Examples of such repetitive low-significance correlations come under notice below.

Location of dorsal and anal origins - From this point onward all dimensions (other than *Ls*) will be cited as *TLs*. In specimen (a) dorsal origin occurs at 418 (418.4), in specimens (b) - (f) 370 - 393, $\bar{x}$ 379.4 ± 3.8. Thus the difference between the value for (a) [*Ls* 52.1] and the mean for the 5 other individuals [*Ls* 161.7 - 221.0, $\bar{x}$ 189.5 ± 8.9] is more than 10 times the standard error of the latter, and is highly significant. For length to anal we find: (a) 620 (620.0), (b) - (f) 55.4 - 590, $\bar{x}$ 570.4 ± 6.7, the difference being over seven times the standard error of the mean of the larger individuals.

Other variations in proportion with *Ls* - The greater proportional length in the immature example of the anterior portion of the body is demonstrated further by extending the scope of the inquiry to include, in addition to the dorsal and anal origins, the origins of the pectoral and ventral. For the correlation of *Ls* with lengths to the four fin origins, specimens (a) - (f), we find the following negative values of r: ventral $-$ 0.789, t 2.567; pectoral $-$ 0.755, t 2.305; dorsal $-$ 0.838, t^* 3.146; anal $-$ 0.832, t^* 2.798. The regression equation for the mean lengths in specimens (b) - (f) to the four fin origins on the lengths to the same points in the small specimen (a) is $y = 0.996 \;\; x - 45.4$, $t^{**} = 33.626$. Predicted values agree closely with measured values, varying from them by 2.3 - 8.0, $\bar{x}$ 4.0 *TLs* units, or by 0.4 - 2.1, $\bar{x}$ 1.12%. Variations in the lengths of dorsal and anal bases in fish of different

TABLE 1

Feature	Dimension, *TLs*						Correlation *TLs* with *Ls*	
	a	*b*	*c*	*d*	*e*	*f*	*r*	*t*
Length to: end of caudal	1367	1302	-	1331	1363	1348	-0.261	-
end of middle caudal rays	-	1206	1195	1235	1248	1206	+0.171	-
vent	582	536	486	539	520	515	-0.749	2.260
First dorsal: length to origin	418	370	385	393	375	374	-0.838	3.146*
length to termination	597	577	599	601	576	579	-0.416	-
base, between parallels	179	206	214	208	201	206	+0.856	3.308*
base, direct with dividers	184	212	220	223	205	212	+0.790	2.540
length of 1st spine	38	29	31	24	43	31	-0.265	-
length of 2nd spine	73	62	66	53	78	61	-0.340	-
length of 3rd spine	171	132	148	119	165	113	-0.614	-
length of 4th spine	344	287	272	284	305	254	-0.869	3.494*
length of 5th spine	244	155	166	196	173	161	-0.851	3.243
length of 6th spine	152	90	99	120	118	86	-0.772	2.433
length of 7th spine	86	49	58	64	50	47	-0.898	4.061*
length of 8th spine	58	27	30	42	35	31	-0.582	-
Second dorsal: length to origin	639	617	637	638	623	624	-0.406	-
length to termination	839	839	860	858	844	851	+0.517	-
base,between parallels	200	222	223	220	221	227	+0.977	9.166**
base,direct with dividers	221	266	265	273	270	267	+0.940	5.277**
length of spine	228	185	147	161	195	158	-0.790	2.539
length of 1st ray	307	599	570	728	-	520	+0.738	-
length of longest ray	378	599	570	728	-	520	+0.590	-
length of last ray	94	83	80	88	120	76	-0.080	-
Total dorsal: base,between parallels	421	469	475	465	469	472	+0.964	7.245**
base,direct with dividers	405	478	485	496	475	479	+0.909	4.598*
Anal : length to origin	620	576	552	590	580	554	-0.832	2.798*
length to termination	866	848	841	872	863	857	+0.215	-
base,between parallels	245	271	289	282	283	303	+0.958	6.682**
base,direct with dividers	298	315	310	337	330	335	+0.336	-
length of 1st spine	106	74	71	82	75	86	-0.758	2.323
length of 2nd spine	173	111	107	132	107	118	-0.867	3.490*
length of 3rd spine	-	160	153	191	162	153	-0.647	-
length of 1st ray	265	302	378	344	343	435	-0.647	-
length of longest ray	288	302	378	344	393	435	-0.820	2.867*
length of last ray	90	80	71	95	80	435	-0.553	-
Pectoral: length to origin	345	288	275	307	305	301	-0.755	2.305
length of whole fin	344	338	384	374	385	386	+0.612	-
length of longest ray	269	296	308	333	350	346	+0.891	3.926*
Ventral: length to origin	326	297	264	281	253	288	-0.789	2.567
length of whole fin	367	352	385	410	490	432	+0.604	-
length of spine	230	185	192	208	215	199	-0.597	-
length of 1st ray	309	333	352	376	465	401	+0.717	-
length of 2nd ray	305	304	347	357	448	385	+0.658	-
length of 3rd ray	288	272	284	297	353	352	+0.616	-
length of 4th ray	228	219	225	246	235	226	+0.158	-
length of 5th ray	154	169	184	202	198	181	+0.870	3.526*
Head	384	318	313	352	320	331	-0.780	2.495
Snout: from tip of upper jaw	104	80	73	95	90	88	-0.567	-
from tip of lower jaw	96	71	63	83	80	77	-0.652	-
Eye	115	80	77	77	80	77	-0.950	6.115**
Interorbital	77	61	60	71	68	73	-0.399	-
Depth: at front of eye	154	136	137	153	150	158	-0.035	-
at back of eye	250	247	269	306	280	277	-0.569	-
at opercular border	422	444	456	508	480	475	-0.740	2.197
at origin of first dorsal	457	451	467	519	490	502	+0.590	-
at vent	455	488	500	536	505	516	+0.827	2.950
maximum	480	494	505	541	510	525	+0.739	2.197
of caudal peduncle	134	139	153	158	145	145	+0.620	-

lengths may also be considered.With measurements made along anteroposterior axis of fish, we find correlations (all positive) of base-lengths with *Ls* as follows: first dorsal 0.855, t^* 3.908; total dorsal 0.964, t^{**} 7.245; anal 0.958, t^{**} 6.682. When fin bases are measured direct with dividers, the results, in sequence as before, are 0.790, 2.540; 0.940, 5.277**; 0.336, 0.384.

Mean percentage increases of direct over anteroposterior measurements of total dorsal base, second dorsal base, anal base are 12.4 ± 1.1, 20.1 ± 2.3, 15.4 ± 2.1, respectively: all exhibit very considerable variation, the respective coefficients of variation being 21.8 ± 6.6, 28.6 ± 8.9, 22.0 ± 10.0.

To reduce complexity of statement in the text, numerical values of r and t for the items considered in the next 3 paragraphs are not there cited: they are, however, recorded in table 1.

Though of the lengths of the dorsal spines only the fourth and seventh are significantly correlated with *Ls* at $P_{0.05}$, and the fifth and sixth at $P_{0.1}$, all values of r agree in being negative. On the other hand, positive correlations characterize the first and the longest dorsal rays, the only dorsal rays measured (only four sets of data available for each magnitude). The lengths of all the ventral rays, together with the length of the fin as a whole, yield positive values, of which only that for the fifth ray is formally significant; but r for length of ventral spine is negative. For all three anal spines (only five variates available for third spine) regression coefficients are negative; as also are those for the only three anal rays measured (first, longest, last), only that for longest ray being statistically significant. For the length of the longest pectoral ray (only ray measured) and of the fin as a whole r is positive, significantly so only in the case of the ray. Thus, all species (in respect of *TLs* length) exhibit negative correlation (of a variable degree of significance) with length of fish; while the relative lengths of some rays show signs of increasing, and some of decreasing, as fish grows. Bases of the unpaired fins all show positive correlations, six of the eight entries in table 1 at $P_{0.01}$ and two others at $P_{0.05}$. Paired fins have r = + 0.6.

Depths at back of eye, posterior opercular border, dorsal origin, vent; maximum depth; depth of caudal peduncle all yield positive values of r, with only that for vent achieving significance at $P_{0.05}$.

Head, snout (from tip of upper jaw; from tip of lower jaw), eye, interorbital all give negative value, that for eye being (not unexpectedly) highly significant.

Fin patterns - In this discussion fish are arranged in order of ascending magnitude of *Ls*; entries for individuals are separated by colons.

As noted in the general section above, the length-position relationship in the ascending subset of four dorsal spines, (D_1) is Log $L = k_1N + b_1$. Values of k_1 are 0.3225: 0.3315: 0.3168: 0.3593: 0.2872: 0.2994; of b_1 - 0.3564: + 0.3384: + 0.4482: + 0.2698: + 0.6271: + 0.5295; of t 27.49: 173.26: 25.27: 43.32: 31.96: 28.31. Measured lengths, mm (in parentheses regression values) 2.0 (1.9), 3.8 (4.1), 8.9 (8.5), 17.9 (18.0): 4.7 (4.7), 10.0 (10.0), 21.3 (21.5), 46.5 (46.2): 5.7 (5.9), 12.0 (12.1), 27.0 (25.0), 49.5 (50.8): 4.4 (4.3), 9.7 (9.7), 22.1 (22.3), 52.0 (50.9): 8.6 (8.2), 15.5 (15.9), 32.9 (30.8), 61.0 (59.2): 6.9 (6.6), 13.4 (13.5), 25.0 (26.9), 56.0 (53.6).

TABLE 1 explanation - *Enoplosus armatus* (White, 1790). Dimensions, as millesimals of standard length, *TLs*, of six Tasmanian specimens, (a) - (f), standard length, *Ls*, 52.1, 161.7, 182.0, 183.0, 200.0, 210.0 mm. Also correlation of these *TLs* dimensions with *Ls*: values of t without an asterisk, with one asterisk, with two asterisks representing probabilities of 0.1 - 0.05 - 0.01, $\leq$ 0.01, respectively, values for probability $>$ 0.1 not entered.

For the descending subset of five spines, (D_2) - with $(D_1) \cap (D_2)$ = spine 4 - the relationship is of the same form. Values of k_2 are − 0.2002: − 0.2565: − 0.2384: − 0.2146: − 0.2418: − 0.2365; of b_2 2.0782: 2.6924: 2.6674: 2.6012: 2.7588: 2.7036; of t 27.07: 79.43: 30.55: 20.70: 13.98: 26.93. Measured (calculated) lengths 17.9 (18.9), 12.7 (11.9), 7.9 (7.5), 4.5 (4.7), 3.0 (3.0): 46.5 (46.4), 25.1 (25.7), 14.6 (14.2), 8.0 (7.9), 4.3 (4.4): 49.5 (51.8), 30.3 (29.8), 18.0 (17.3), 10.5 (10.0), 5.4 (5.8): 52.0 (55.1), 35.9 (33.7), 22.0 (20.6), 11.7 (12.6), 7.7 (7.7): 61.0 (61.9), 34.5 (35.5), 23.5 (20.3), 10.0 (11.6), 7.0 (6.7): 56.0 (57.3), 35.5 (32.2), 18.9 (19.3), 10.4 (112.), 6.8 (6.5).

The equation for the set of three anal spines, (A) , is of the same form. With specimen (a) omitted (third spine imperfect) the data are: k 0.1679: 0.1675: 0.1834: 0.1686: 0.1257; b 0.9140: 0.9463: 1.0003: 1.0007: 1.1566; t 35.24: 32.34: 14.08: 25.51: 22.10; measured (calculated) lengths 12.0 (12.1), 18.0 (17.8), 26.0 (25.6): 12.9 (13.0), 19.4 (19.1), 27.9 (28.1): 15.0 (15.3), 24.0 (23.3), 34.9 (35.5): 14.9 (14.8), 21.4 (21.8), 32.4 (32.1): 19.0 (19.2), 26.0 (25.6), 33.9 (34.1).

In (D_1) the correlation of k_1 with Ls is $r = -0.326$, $t = 0.69$; the correlation of b_1 with Ls is $r = 0.913$, $t^* = 4.48$: corresponding values in (D_2) are $r = -0.782$, $t = 2.51$, and $r = 0.948$, $t^{**} = 5.97$.

In (A) , for the five specimens available, the correlation with Ls of the slopes of the graphs is $r = -0.712$, $t = 1.93$, of the intercepts $r = 0.931$, $t = 4.41$. If the assumption be made that the relationship between length and serial number of spine found in specimens (b) - (f) holds good also for (a), the calculated value for this individual of k is 0.2139, of b 0.5265. If these hypothetical values are now incorporated for those of equations for specimens (b) - (f), we have, for six entries, for correlation with Ls of slopes $r = -0.858$, $t^* = 3.34$, of intercepts $r = 0.921$, $t^{**} = 4.72$.

Examination of two other species, discussed below, in which two or more individuals have been measured yields the following results. For the three examples of *Dactylosargus arctidens* (Richardson 1839) arranged in order of increasing magnitude of *Ls* there is an ascending (numerically ascending; one entry negative) run of k values in four equations and a descending run in two, with nine groups of values not forming a run: for log b the corresponding counts are 7, 0, 8. The value for the largest specimen, *Ls* 410, exceeds the mean of the values for the 2 smaller specimens, *Ls* 249, 266, in 8 of the 9 non-run entries for k, in 5 of the 8 for log b. For the two specimens of *Neosebastes panticus* McCulloch & Waite,1918 k is larger (numerical; 2 negative entries) in the larger fish in 13 equations, smaller in 4: log b is larger in 16 cases, smaller in 1.

A positive correlation of b_1 or log b_1 with Ls is in general only to be expected, this parameter being nothing other than a measure of the length of the first spine or ray of the set or subset. The data on the slopes of the graphs would appear to provide a hint of the possible existence of more than one type of growth rate, but the material examined is too scanty to permit of the drawing of any firm conclusion.

Family CHIRONEMIDAE

The Check-list (McCulloch 1929, 255) admits three Australian species: (a) *Chironemus* Cuvier,1829, (1) *C. georgianus* Cuvier,1829, (2) *C. marmoratus* Gunther,1860; (b) *Threpterius* Richardson,1850, (c) *T. maculosus*,Richardson 1850: a second species of *Threpterius*, (4) *T. chalceus* Scott,1954, has been described from South Australia; recently reported (McKay 1970, 13) also from Western Australia. The two Tasmanian representatives, (2) and (3), may be separated as follows.

Key to Chironemidae recorded from Tasmania

Dorsal spines 15. Anal rays 6. Simple pectoral rays 6. Membrane of spinous dorsal not deeply excavated, being attached behind to about distal one-fourth of spine; not produced to form a free lobe at tip of spine. Base of soft dorsal subequal to base of spinous dorsal (both measured between parallels). Maxilla to, or short of, anterior border of eye. No silver spot on operculum...*Chironemus marmoratus*

Dorsal spines 14. Anal rays 7. Simple pectoral rays 7. Membrane of spinous dorsal deeply excavate, being attached behind to near (in some anterior spines, below) middle of spine; produced to form a small free lobe at tip of spine. Base of soft dorsal about two-thirds base of spinous dorsal (both measured between parallels). Maxilla to below 0.3 - 0.5 eye. Conspicuous silver spot on operculum.................*Threpterius maculosus*

Genus *THREPTERIUS* Richardson,1850

Threpterius maculosus Richardson,1850

Threpterius maculosus Richardson,1850, *Proc. Zool. Soc. Lond.*, 18, 70, pl. ii, figs 1, 2. Type locality, King George's Sound, Western Australia.

Distribution - The Check-list gives Western Australia only. The species is included by Scott in his South Australian catalogue (1962, 207, unnumbered fig.); while the first record for Tasmania has been published by Andrews (1968, 63), who gives notes on, and a photograph of, an example, *Lt* 325, from North Bruny Island, Buckingham.

Second Tasmanian record - A northern Tasmanian specimen, *Ls* 210, *Lt* 252.5, length to base of caudal rays 217.5, was caught by Mr J. Curtis at Low Head, Dorset on 24 April 1971 (Queen Victoria Museum Reg. No. 1971. 5. 9).

Meristic character - D. XIV, 18. A. III, 8. V. I, 5. P. 15/15. C. 16 main rays. L. lat. 60. L. tr. 11/*ca* 18. The pectoral count is one more than that given by Scott and by Andrews.

Some comparative dimensions - Values for our example, followed in parentheses by those for the southern fish, for the 13 measurements in Andrews' table, both here calculated as *TLs*, are as follows. Tip of snout to: base of caudal 861 (852), dorsal origin 178 (169), ventral origin 287 (285), anal origin 507 (486), posterior edge of dorsal 808 (748), posterior edge of anal 684 (637), posterior edge of operculum 238 (249), eye origin 35.6 (33.9). Maximum depth of body 281 (302); length of fifth [longest] dorsal spine 127 (108); eye width 63.0 (55.4), eye height 63.4 (58.5). Dimensions have been given above as millesimals of total length, instead of millesimals of standard length, as usual in these studies, to make possible direct comparison with Andrews' data, his length 'to base of caudal fin' apparently being caudad of the hypural joint (these levels being in our example some 29 *TLs* units apart). It will be seen that in the northern specimen the origins of the unpaired fins are somewhat, their terminations decidedly, more caudad, relative to length of fish, than in the southern specimen.

Other dimensions - Values are *TLs*. Length to middle of vent 731; length to pectoral origin 252; length of pectoral (whole fin) 276, of longest (10th) pectoral ray 199; length of ventral (whole fin) 186, of ventral rays 110, 140, 162, 172, 162, of ventral spine 110; lengths of dorsal spines 48.6, 110, 131, 144, 152, 148, 142, 138, 133, 126, 118, 106, 90.0, 64.3; lengths of 1st, longest (9th), last dorsal rays 133, 181, 70.5;

lengths of anal spines 49.5, 88.1, 105; lengths of 1st, longest (3rd), last anal rays 148, 162, 110; interorbital 46.7.

Non-metrical characters - Adpressed pectoral to below dorsal spines XI - XII; ventral just short of vent (by half eye-diameter); anal beginning below last dorsal spine, ending below 8th ray. Maxilla to below 0.3 eye (contrast figure in Scott, to beyond middle of eye). The point of inflexion in the dorsal profile, depicted in that figure in advance of eye, occurs in our fish above anterior one-fifth of eye; the convexity shortly in front of dorsal origin is here less pronounced than in the illustration.

Fin patterns - See section above on length-position relationships of radial elements in general: numerical data for the present specimen are recorded below.

(D_1) . $L = 22.54 \log N + 16.49$; $t = 46.06$; measured (in parentheses, predicted) lengths 16.5 (16.5), 23.0 (23.3), 27.5 (27.2), 30.2 (30.1), 32.0 (32.2).

(D_2) . $L = 18.34 \log N^1 + 13.54$; $t = 68.97$; measured (predicted) lengths 13.5 (13.5), 19.0 (19.1), 22.3 (22.3), 24.7 (24.6), 26.5 (26.4), 28.0 (27.8), 28.9 (30.1), 32.0 (31.9).

(v_1) . $\log L = 0.333 \log N + 1.365$; $t = 17.92$; measured (predicted) lengths 23.0 (23.2), 29.4 (29.2), 34.0 (33.4), 36.1 (35.9).

(v_2V) . $L = - 0.510 \log N + 1.875$; $t = [8.31]$; measured (predicted) lengths 36.1 (37.0), 34.1 (33.0), 23.0 (23.2).

Family APLODACTYLIDAE

The family name Aplodactylidae, adopted in the Check-list (McCulloch 1929, 256) is accepted by Greenwood *et al.*: Berg (1940) gave preference to the form Haplodactylidae. Only one Tasmanian species, *Dactylosargus arctidens* (Richardson 1839), with Tasmania as type locality. With this species Richardson's other species, *D. meandratus*, described in 1842, with a New Zealand type locality, but reported also from Victoria, and entered separately in the Australian Check-list, is here taken to be synonymous, as it virtually was by Waite (1924, 480), and as it is in the most recent New Zealand Check-list (Whitley 1968, 62), though, indeed, in his earlier Australian name-list Whitley (1964, 48) had treated the two as distinct.

Genus *DACTYLOSARGUS* Gill,1862
Dactylosargus arctidens (Richardson,1839)

Aplodactylus arctidens Richardson,1839, *Proc. Zool. Soc. Lond.*, 7, 96. Type locality, Port Arthur [Pembroke], Tasmania.

Dactylosargus arctidens Richardson. Scott 1960, *Pap. Proc. R. Soc. Tasm.*, 94, 91, (synonymy).

Material - With the inclusion of two examples noted in an earlier contribution (1960, 61) - those from Devonport and Bicheno - and the South Australian fish described and figured by Waite (1964, 480, pl. 29), five specimens provide the data in the next four paragraphs: (a) *Ls* 249, *Lt* 301, Green's Beach, Devon, January 1971, R.H. Green (Queen Victoria Museum Reg. No. 1971. 5. 38); (b) *Ls* 266, *Lt* 330, Binnalong Bay, Dorset, 1 January 1969, R. Vogelpoel (Q.V.M. Reg. No. 1969. 5. 5); (c) *Ls* 350, *Lt* 410, Devonport, Devon, February 1957, T. Williams (Q.V.M. Reg. No. 1957. 5. 5); (d) length, presumably standard length, 385, southern shore of South Australia, A.E. Waterman (Waite 1964); (e) *Ls* 460, *Lt* 549, Bicheno, Glamorgan, 26 August 1956 (Scott 1960).

Proportions - Values for the five fish, in ascending order of *Ls*, of the 10 body ratios noted by Waite are as follows. Head in *Ls* 4.0, 4.2, 4.7, 4.2, 4.3. Depth in *Ls* 3.8, 3.1, 3.4, 3.5, 3.2. Caudal in *Ls* 4.8, 4.0, 5.8, 5.2, 5.2. Eye in head 6.2, 6.1, 5.7, 5.8, 6.5. Interorbital in head 3.9, 3.2, 3.2, 3.8, 4.0. Snout in head 2.8, 2.9, 3.0, 3.3, 3.1. Depth of caudal peduncle in head 2.2, 1.7, 2.1, 'twice', 1.8. Longest dorsal spine in head 2.1, 2.2, 1.8, 1.7, 2.0. Longest anal ray in head 1.3, 1.3, 1.5, 1.3, 1.6.

Some important dimensions, not recorded by Waite, are here given for the four Tasmanian examples, expressed in *TLs*. Length to origin, termination of first dorsal 273, 293, 235, 257; 584, 626, 574, 585: of second dorsal 598, 650, 612, 617; 847, 904, 843, 860: of anal 687, 677, 696, 709; 775, 789, 774, 800: of pectoral 209, 195, 179, 180; 442, 421, 397, 420 (adpressed): of ventral 285, 320, 296, 291; 490, 527, 471, 480 (adpressed).

Meristic characters - Waite's counts are: D.xvi, i, 17; A. iii, 6; V. i, 5; P. 8, 6; C. 17; L. l. 103; L. tr. 20, 76. Differences exhibited by our material: two specimens have one dorsal spine fewer; one has an additional dorsal ray; anal rays 6, 7 (2), 5; pectoral counts include 8 + 6, 8 + 7, 8 + 8; l.l. *ca* 100 - 110; l.tr. 19 - 21, *ca* 65 - 74.

Non-metrical characters - Minor differences noted as existing between the two examples reported on in the 1960 paper and Waite's illustration (presence in our material of scaly sheath along base of soft dorsal; more extensive development of small scales on caudal rays; somewhat differently shaped pectoral, with some excavation of membrane) are found also in the Green's Beach and Binnalong Bay specimens (though the excavation of the pectoral membrane is less pronounced). Our fish further differ from the figure in having the first, steeper segment of the dorsal profile of the head extending farther back, reaching about to level of posterior, instead of anterior, nostril.

Fin patterns - The length-number patterns of the dorsal spines, anal spines, anal rays, pectoral rays, ventral spine and rays have been specified in the general note above on patterns in various species. In the subjoined summary of metrical data the Green's Beach, Binnalong Bay, Devonport specimens are designated (i), (ii), (iii), respectively. Data below are set out as follows (with punctuation as in this statement). Regression equation for (i): parameters (k, log b) for (ii): parameters for (iii). Values of t for (i):(ii):(iii). Measured (calculated) lengths of radial elements of (i):(ii):(iii). Values of t with $P \geq 0.05$ are enclosed in square brackets.

(D_1) . Log L = 1.7519 log N + 0.5871: 1.4419, 1.0256: 0.7749, 1.1469. t = 44.49: 37.32: 115.34. Lengths 3.9 (3.9), 12.5 (13.0), 26.9 (26.5): 6.0 (6.0), 12.9 (13.2), 21.2 (20.9): 14.0 (14.0), 28.7 (28.6), 43.1 (43.3).

(D_2) . Log L = 0.1487 log N^1+ 1.4213: 0.1639, 1.3824: 0.1857, 1.5096. t= 110.14: 8.12: 8.52. Lengths 26.0 (26.4), 29.5 (29.2), 30.9 (31.1): 24.1 (24.1), 26.9 (27.0), 29.3 (28.9), 30.0 (30.3): 32.0 (32.3), 37.8 (36.8), 39.0 (39.7), 41.8 (41.8).

(D_3) . Log L = 0.5114 log N^1+ 0.8865: 0.5016, 0.9010: 0.6282, 0.8470. t = 22.38: 29.94: 52.57. Lengths 7.5 (7.7), 11.0 (11.0), 13.5 (13.5), 16.1 (15.6), 17.9 (17.5), 19.6 (19.3), 21.6 (20.8), 22.0 (22.3), 23.1 (23.7), 24.0 (25.0): 8.0 (8.0), 10.9 (11.3), 14.0 (14.0), 16.7 (16.2), 18.9 (18.1), 19.7 (19.9), 21.6 (21.5), 22.1 (23.0): 7.1 (7.0), 10.0 (10.9), 13.9 (14.0), 16.4 (16.8), 19.0 (19.3), 21.3 (21.7), 23.9 (23.9), 27.1 (26.0).

(A) . Log L = 1.2324 log N + 0.5953: 1.2984, 0.6118: 1.3679, 0.4928. t = 29.48: 321.55: 83.74. Lengths 3.9 (3.9), 9.5 (9.3), 15.0 (15.3): 4.1 (4.1), 10.0 (10.1), 17.1 (17.1): 3.1 (3.1), 8.1 (8.0), 13.9 (14.0).

(a_1) . Log L = 0.1293 log N + 1.6001: 0.1054, 1.5832: 0.0731, 1.6745. t = 13.30: 457.30: 12.84. Lengths 39.8 (39.9), 43.9 (43.6), 45.8 (46.0): 38.3 (38.3), 41.2 (41.3), 43.0 (43.0): 47.2 (47.3), 49.9 (49.7), 51.1 (51.2).

(a_2) . Log L = 0.4968 log N^1+ 1.2804: 0.3975, 1.3284: 0.5213, 1.3251. t = 101.42: 55.92: 18.44. Lengths 19.1 (19.1), 26.9 (26.9), 33.0 (32.9), 38.0 (38.0): 21.0 (21.1), 28.1 (27.8), 32.9 (32.7), 36.3 (36.7): 21.1 (21.1), 29.9 (30.3), 37.9 (37.5), 44.0 (43.6).

(v_1) . Left fin. Log L = 0.4492 log N + 1.3973: 0.5259, 1.3773: 0.5094, 1.4683. t = 27.78: 31.13: 21.41. Lengths 25.2 (25.0), 33.4 (33.1), 41.0 (40.9), 46.9 (46.5):

23.9 (23.8), 33.9 (34.3), 43.3 (42.5), 49.0 (49.4): 29.7 (29.4), 40.9 (41.8), 51.7 (51.4), 66.0 (59.6).

(v_1) . Right fin. Log L = 0.4615 log N + 1.3907: 0.5452, 1.3699: 0.5234, 1.4678. t = 43.75: 29.66: 53.15. Lengths 24.6 (24.6), 34.0 (33.8), 40.3 (40.8), 47.0 (46.6): 23.5 (23.4), 33.7 (34.2), 43.6 (42.7), 49.8 (49.9): 29.5 (29.4), 41.9 (42.2), 51.8 (52.2), 61.2 (60.6).

(v_2V) . Left fin. Log L = – 0.4254 log N + 1.9301: – 0.4383, 1.9581: – 0.4377, 2.0437. t = 29.78: 18.91: 38.38. Lengths 46.9 (47.2), 43.3 (42.9), 31.9 (32.0): 49.0 (49.2), 45.4 (44.8), 33.0 (33.1): 60.0 (60.0), 55.0 (54.7), 40.3 (40.4).

(v_2V) . Right fin. Log L = – 0.4206 log N + 1.9280: – 0.4556, 1.9692: – 0.5270, 2.1098. t = 27.94: 69.31: 16.08. Lengths 47.0 (47.3), 43.4 (43.1), 32.1 (32.2): 49.8 (49.5), 44.9 (44.7), 32.6 (32.6): 61.2 (62.0), 56.1 (55.1), 38.1 (38.3).

(p_1) . Left fin. Log L = 0.5901 log N + 1.3420: 0.2889, 1.4943: 0.3384, 1.5678. t = [12.02]: [10.04]: 75.07. Lengths 22.0 (22.0), 33.0 (33.1), 42.1 (42.0): 32.0 (31.2), 39.5 (38.1), 44.0 (42.9): 37.0 (37.0), 46.6 (46.7), 53.7 (53.6).

(p_1) . Right fin. Log L = 0.5243 log N + 1.3654: 0.5554, 1.4930: 0.3859, 1.5558. t = 20.9: 392.78: 71.35. Lengths 23.1 (23.2), 33.7 (33.4), 41.0 (41.3): 26.9 (26.9), 39.6 (39.6), 49.5 (49.5): 36.0 (36.0), 46.8 (47.0), 55.0 (54.9).

(p_2) . Left fin (specimen (i) only). Log L = 0.2542 log N + 1.5002. t = 42.49. Lengths 42.1 (41.8), 44.8 (45.0), 47.3 (47.6), 49.8 (49.9), 52.0 (51.9), 53.9 (53.7), 55.3 (55.3).

(p_2) . Right fin. Log L = 0.3213 log N + 1.4584: 0.1736, 1.6163: 0.3210, 1.5863. t = 28.87: 17.36: 17.70. Lengths 41.0 (40.9), 45.0 (44.9), 48.0 (48.2), 50.4 (51.1), 54.1 (53.7), 56.3 (56.0): 49.5 (50.0), 52.1 (52.6), 54.1 (54.7), 56.0 (56.4), 58.5 (57.9), 60.0 (59.3), 61.5 (60.5): 55.0 (54.9), 61.1 (60.2), 64.5 (64.7), 67.0 (68.6), 71.1 (72.0), 75.0 (75.2), 80.0 (78.1).

(p_1) U (p_2) . Left fin, (specimens (ii) and (iii) only). Log L = 0.2929 log N + 1.5070: 0.3361, 1.5960. t = 75.50: 131.49. Lengths 32.0 (32.1), 39.5 (39.7), 44.0 (44.0), 48.4 (48.2), 52.2 (51.5), 54.4 (54.3), 57.1 (56.8), 58.8 (59.1), 60.5 (61.2): 37.0 (37.1), 46.6 (46.8), 53.7 (53.6), 59.1 (59.0), 64.1 (63.6), 68.1 (67.6), 70.5 (71.2), 74.3 (74.4), 77.2 (77.4).

(p_3) . Left fin. Log L = o.5272 log N^1 + 1.2963: 0.4239, 1.4234: 0.4784, 1.4853. t = 15.19: 53.21: 68.77. Lengths 20.0 (19.8), 27.9 (28.5), 34.9 (35.3), 41.0 (41.0), 46.4 (46.2), 51.1 (50.9), 56.1 (55.2): 26.4 (26.5), 36.0 (35.6), 42.0 (42.2), 47.4 (47.7), 52.6 (52.4), 56.7 (56.7), 60.5 (60.5): 30.9 (30.6), 42.1 (42.6), 51.0 (51.7), 59.6 (59.3), 66.1 (66.0), 73.1 (72.0), 77.1 (77.6).

(p_3) . Right fin. Log L = 0.5209 log N^1 + 1.3066: 0.5754, 1.2625: 0.4092, 1.5591. t = 68.53: 74.64: 55.81. Lengths 20.4 (20.3), 29.0 (29.1), 35.3 (35.9), 42.0 (41.7), 46.9 (46.9), 51.5 (51.5), 56.1 (55.8): 18.0 (18.3), 27.9 (27.3), 34.1 (34.4), 41.6 (40.7), 45.9 (46.1), 51.1 (51.3), 56.0 (55.8), 60.0 (60.5): 36.0 (35.5), 48.1 (48.1), 57.0 (56.8), 65.0 (63.9), 70.4 (70.0), 74.8 (75.4), 79.5 (80.1).

Remarks - It will be seen that some of the subsets have different numbers of entries for different individuals. Members of subsets have been specified earlier in the general treatment of fin patterns.

Family THUNNIDAE

The Handbook (Munro 1958, 111, fig. 744) credits Tasmania with two species: *Thunnus thynnus maccoyii* (Castelnau, 1872) (southern bluefin tuna), *Thunnus alalunga germo* (Lacépède, 1800) (Albacore). A third species, *Neothunnus macropterus* (Temminck & Schlegel, 1844) (yellowfin tuna) is here reported. *Allothunnus fallai* Serventy, 1948, an unornamented New Zealand species, not keyed below, has been reported from Tasmania (Olsen, 1962), since the Handbook was issued.

Key to Thunnidae recorded from Tasmania

1. Preoperculum rounded. Pectoral usually not reaching origin of second dorsal................................*Thunnus thynnus maccoyii*
   Preoperculum angular. Pectoral usually reaching beyond origin of second dorsal................................2

2. Dorsal rays 15. Dorsal finlets 8. Lateral line $<$ 240 (about 210). Gillrakers on lower line of anterior arch. $<$ 26 ($\doteq$ 19 - 22). Longest anal ray $\leq$ combined eye and snout. Dark greenish blue above, silvery below. Dorsal finlets yellowish; other finlets and fins greyish. No subvertical light lines on lower part of trunk..................*Thunnus alalunga germo*
   Dorsal rays 13, 14. Dorsal finlets 9. Lateral line $>$ 240 (about 270). Gillrakers on lower limb of anterior arch $>$ 26 (about 31 - 35). Longest anal ray $>$ combined eye and snout. Blackish blue above, passing, through yellowish, to silvery below. Dorsal, anal fins and finlets, external border of caudal fin, primary caudal keel yellow. Lower part of trunk with about 20 slender subvertical broken pale lines..........................*Neothunnus macropterus*

In standard diagnoses and illustrations the pectoral of *Neothunnus macropterus* is noted and shown as being as long as head or longer, and as reaching, when adpressed, to below second dorsal or even above anal: this long pectoral, commemorated in the second binomen, has been regarded as a point of distinction, appropriate for use in a key, between this species and the albacore, *Thunnus alalunga germo*, in which the fin ends below first dorsal or interdorsal. In the specimen reported below (*Ls* 1200 mm), the pectoral, originating 300 behind snout-tip, and having a length of 270, would, if adpressed, fall short of level of second dorsal origin by about 30 mm; fin is, however, 0.95 length of head [in the newspaper photograph right pectoral is clearly seen to be imperfect; left pectoral considered here]. The dorsal fins are usually stated to be united basally - 'virtually united' (Munro 1967, 201) - in contrast to those of *Thunnus alalunga germo*, described as being separated slightly. In our example, the last dorsal spine is separated from the first dorsal ray by an interval of 37 mm, but the spine is followed by a sliver of membrane reaching, as preserved, to within 16 of next fin, possibly, but improbably, having extended further in life. The postero-inferior angle of the preoperculum is here less acute than it is conventionally figured as being (cf. Munro 1958a, fig. 744).

Neothunnus macropterus (Temminck & Schlegel, 1844)

Thynnus macropterus Temminck & Schlegel, 1844, *Faun. Japon.*, *Pisc.*, 98, pl. 51. Type locality, south-western Japan.

<u>Tasmanian record</u> - This species does not appear in any published Tasmanian faunal list, and is not credited to Tasmania in the Handbook (Munro 1958, 111), which gives the (Australian) range as Queensland, New South Wales, Western Australia, and probably Northern Territory (date of species cited, in error, as 1842). The Launceston *Examiner* of 2 March 1972 carried a report, accompanied by a photograph, of a specimen noted as being 4 ft 9 in. (1.45 m) in length, 2 ft 11½ in. (0.9 m) in girth and weighing 75 lb (34 kg), taken 20 miles off the east coast of Flinders Island by Mr Gordon Smith, Whitemark, on 27 February. The newspaper report stated one other example has been caught in Tasmanian waters; however, Mr T. Charlton, through whose courtesy I was able to examine the present fish, preserved by refrigeration, on 8 March, informs me the yellowfin tuna has been previously taken here on two occasions.

<u>Fin counts</u> - D. XIII, 13; finlets 9. A.8 (9?); finlets 9. P.33. C. *ca* 50 (short median rays damaged).

<u>Some dimensions as *TLs*</u> - (Standard length 1200 mm). Total length 1169 *TLs*, length to

end of middle caudal rays (slightly imperfect) 1022. First dorsal: length to origin 281, to termination 488 (spine), 505 (membrane); lengths of spines I - XIII 127, 112, 102, 87, 65, 53, 48, 43, 40, 35, 30, 23, 17. Interdorsal: spine to ray 31, end of membrane to ray 14. Second dorsal: length to origin 518, to termination 588; greatest oblique length 154 (imperfect; perfect, estimated 190 - 200); vertical height (as is) 71. Dorsal finlets to, base, horizontal length (to tip of pennon), interval to next finlet: 3.3, 6.7, 33; 6.7, 21, 39; 6.7, 21, 36; 5.0, 23, 29; 4.2, 30, 27; 4.2 26, 27; 3.3, 24, 39; 3.3, 23, 29; 2.1, 14, - . Anal: length to origin 583, to termination 629; oblique length 231. Vent: length to anterior border 558, to posterior border 567. Pectoral: length to origin 250, length 225; base, oblique, 567, between parallels 458. Caudal: longest ray 221, spread of fin 267. Depth: maximum 250, at vent 208; of caudal peduncle 24. Girth 740. Length of midlateral trunk ridge originating above pectoral base 250. Caudal keels: primary (midlateral) originating 158, terminating 38, in advance of end of caudal peduncle; secondary (paired oblique, flanking primary, but beginning and ending behind its beginning and end) originating 63 before end of caudal peduncle, oblique length 38, distance apart anteriorly 21, posteriorly 6.7. Head 238. Snout from tip of upper jaw 81, of lower jaw 92. Mouth, oblique length to end of maxilla 92. Greatest oblique length of expanded end of maxilla 17. Eye 33. Interorbital 96.

Other features - Maxilla to midway between anterior borders of iris and pupil, or about 1/7 eye. Interorbital strongly convex. About 36 teeth in left ramus of lower jaw, the anterior larger, recurved, about 2 mm long; teeth in upper jaw more or less similar; other teeth not observed. Adpressed pectoral not reaching to origin of second dorsal. Lateral line almost straight from caudal base forward to level of anal base, curving up rather quickly to level of origin of second dorsal, thereafter running forward (as far as can be traced in specimen to within 120 - 130 *TLs* of head) in a gently upwardly convex arc, exhibiting slight, but distinct, waviness. Small scales on most of body. Corselet in the form of a subtriangular area beneath pectoral base, approximately 70 x 70 *TLs*, apex downward, smooth, whitish with some purplish, marked out by light pinkish brown lines into a lattice, comprising about 15 rows of quadrilaterals (at times pentagons, hexagons), the largest about 15 mm long, 10 mm high, the smallest forming several rows adjacent to fin base, 3 - 5 mm long, 1 - 2 mm high. Main keel on caudal peduncle thick basally, thinning distally to 1 - 2 mm; its greatest height, one-seventh of its length, in its anterior half. Hind border of preoperculum broadly subvertical, gently proconcave in its upper one-third and lower one-third, gently proconvex in middle one-third, its general course at an angle of about 110° to that of adjoining part of inferior border, but postero-inferior angle somewhat rounded.

Coloration after preservation - General color bluish black down to, or near to, lateral line, there briefly becoming slightly yellowish; thereafter silvery. First two dorsal spines somewhat yellowish, others dark amber gradually becoming greyish distally; most briefly tipped with yellowish; membrane hyaline or more or less extensively clouded with smoky grey. Dorsal and anal finlets uniform yellow, approaching sulphur. Second dorsal mostly greyish brown and dirty yellowish, with some proximal reddish in short posterior rays. Anal largely warm flesh color, becoming yellowish flesh along much of preaxial border and in whole width of distal half. Pectoral dark slate grey above, somewhat dusky yellowish white below. Caudal chiefly dark brownish; lighter, tending to white, round most of posterior border. Caudal keel somewhat greenish blue proximally; yellowish along distal border of fleshy lobe. Most of head below a line from upper jaw drawn horizontally through eye yellowish flesh, streaked and marbled with reddish brown; some bluish on operculum: above this line more or less concolorous with dorsum of trunk, with in parts some purplish tinge. Expanded end of maxilla pale purplish, with a large antero-inferior patch of pinkish. Iris red in front, golden dashed with red behind. Lower half of flank with subvertical, somewhat forwardly convex lines, about 5 mm wide, interspaces about 15 mm; 12 lines clearly traceable in advance of vent.

Fin pattern - The formulae for dorsal spines have been given earlier. For (D_1) ,

$\log L = 0.4280 \log N^1 + 1.8795$; $t = 26.96$; measured (in parentheses calculated) lengths 75 (76), 104 (106), 122 (121), 134 (137), 152 (151). For (D_2) , $\log L = 0.5576 \log N^1 + 1.2908$; $t = 75.06$; measured (calculated) lengths 20 (25), 28 (29), 36 (36), 42 (42), 48 (48), 52 (53), 58 (58), 64 (62).

Family ODACIDAE

The family Odacidae, also spelt Odaciidae - a section of which, accommodating the Australian genus *Neoodax* Castelnau,1875 and its allies, is sometimes distinguished [e.g. by Lord (1923, 1927), Lord and Scott (1924), and earlier in these Observations; in Johnston's lists (1883, 1891) subsumed in Labridae] as Neoodacidae - is represented in Tasmanian waters by seven species: (a) *Olisthops* Richardson,1850, (1) *O. cyanomelas* Richardson,1850; (b) *Haletta* Whitley,1947, (2) *H. semifasciatus* (Valenciennes,1840) [in Check-list as *Neoodax*]; (c) *Neoodax* Castelnau,1875, (3)*N. balteatus* (Valenciennes, 1838), (4) *N. radiatus* (Quoy & Gaimard,1835), (5) *N. frenatus* (Günther,1862), (6) *N. beddomei* (Johnston,1885), (7) *N. attenuatus* (Ogilby,1897).

Species (1) appears in the local lists of Johnston (1883, 1891) as the synonymic *Olistherops brownii* Johnston 1884 (*Olistherops*,Günther 1862 a synonym of *Olisthops* Richardson,1850), with type locality Table Cape [Wellington], Tasmania; in later local lists entered as above. Species (2), the type locality of which, 'Mers des Indes' (Peron) is identified in the Check-list as Tasmania, appears in both Johnston's lists as the synonymic *Odax richardsonii* Günther,1862 (rendered *Richardsoni* by Johnston); in later local lists as Valenciennes' species, referred to *Neoodax*. Species (3), with no type locality recorded (Peron)(Tasmania nominated in the Check-list) is entered [as *Odax* or *Neoodax* - misspelt *Neoodox* in Lord (1927, 15)] in all Tasmanian lists. Species (4) and (5) were first reported from this State in these Observations (1964, 1966). Species (6) is placed,under *Odax* or *Neoodax*, in this family in Tasmanian lists published since its discovery. However, in the Check-list it is transferred to Siphonognathidae, being ascribed to *Siphonognathus* Richardson,1858. This action was taken by McCulloch after perusal of R.M. Johnston's memoranda - redacted by Whitley (1929) in this journal - led him to believe Johnston's fish lacked ventrals, no mention of these fins being made in the original account, and no indication of them being present in a sketch by Johnston of his specimen (see Whitley 1929, pl. iv, fig. 6). In 1969 the writer gave a description and figure of a fish, *Ls* 65, dredged in the vicinity of Flinders Island, Bass Strait, which, except for the possession of inconspicuous ventral fins, agreed very satisfactorily with the description of *Odax beddomei*, and was with little hesitation determined as that species. Species (7) has remained unrecognized since its discovery, some three-quarters of a century ago. Ogilby notes 'Type in Tasmanian Museum, Hobart': Lord & Scott (1924, 76) observe 'We have been unable to trace Johnston's type, which was apparently not preserved, nor have we been able to secure further specimens'; this item is not included in the recent list of fish types in the Museum (Andrews 1971). A fish forwarded by Mr D.C. Wolfe, who recognized its unusual character, has been determined as Ogilby's long-lost *Odax attenuatus*, and an account and a figure of it are here given.

The subjoined key supersedes a key provided in Part XII (1964, 97) covering the species then recorded from Tasmania. In that key the acceptance at its face value of an entry in Ogilby's 1897 paper (anal 19, in error for i, 9) led to the inclusion of an invalid clause in couplet 4.

Key to Odacidae recorded from Tasmania

1 Cheek without scales. Deep notch between spinous and soft dorsals; height of last spine < ½ (usually ≤ 1/3) height of longest ray. Caudal lunate; its outer rays somewhat (female), considerably (male) produced.................*Olisthops cyanomelas*

Cheek with scales. No deep notch between spinous and soft dorsals; height of last spine > ½ (usually ≐) height of longest ray. Caudal rounded or pointed................2

2 Lateral line > 50 (about 53 - 63). Size larger; to about 16 inches..*Haletta semifasciata*
Lateral line < 50 (about 37 - 46). Size smaller; to about 12 inches, or less..............................3

3 First dorsal spine produced (to about 1½ length of second spine). Outer ray, or rays, of ventral produced. A black longitudinal stripe along base of dorsal, covering some posterior spines and some anterior rays; above this 4 - 5 thin light subparallel lines.................*Neoodax radiatus*
First dorsal spine not produced (subequal to second spine). Outer ray, or rays, of ventral not produced. No such stripe or lines on dorsal.............................4

4 Depth of body < 7 (about 5 - 6) in standard length........5
Depth of body > 7 (about 8 - 11) in standard length.......6

5 Combined dorsal and anal rays < 30 (usually 28 - 29). Vertical limb of preopercular border denticulate. Lateral line 37 - 39. Pectoral ≥ pelvic; ≥ 2 in head. Snout > 1 3/4 (about 1.9 - 2.1) eye. Eye ≤ (about 0.7 - 0.9) mouth......................................*Neoodax balteatus*
Combined dorsal and anal rays > 30 (usually 31 - 32). Vertical limb of preopercular border entire. Lateral line 40 - 42. Pectoral < pelvic; < 2 in head. Snout < 1 3/4 (about 1.1 - 1.5) eye. Eye > (about 1.4) mouth..*Neoodax frenatus*

6 Snout produced, > 1 3/4 (about 2.2 - 2.8) eye; > 1 (about 1.3) postorbital head. Head < 3½ (about 2.9 - 3.0) in *Ls*; < 1½ (about 1.0) in trunk. Anal ending in advance of dorsal termination by < 5 (about 1 - 2) dorsal rays..*Neoodax beddomei*
Snout not produced, < 1 3/4 (about 1.1 - 1.4) eye; ≤ 1 (about 0.6 - 1.0) postorbital head. Head > 3½ (about 4.3 - 4.4) in *Ls*; > 1½ (about 1.8) in trunk. Anal ending in advance of dorsal termination by > 5 (about 7 - 10) dorsal rays..................................*Neoodax attenuatus*

Genus *NEOODAX* Castelnau,1875

Neoodax attenuatus (Ogilby,1897)

(fig. 2)

Odax attenuatus Ogilby,1897, *Proc. Linn. Soc. N.S.W.*, 22, 1, 83. Type locality, Tasmania.

Record - As noted above, the species has not hitherto been recognized since its establishment, and the unique type has been lost. A fish dredged in 30 m at Promise Bay, Glamorgan on 13 October 1970 by Mr D.C. Wolfe is here determined as Ogilby's long-missing species.

Dimensions - The most improtant dimensions are here given, expressed as *TLs* (absolute dimensions in millimetres in parentheses). Standard length (75.0), total length 1229 (92.2). Length to origin, termination (base of last spine) of first dorsal 241 (18.1), 595 (44.6); of second dorsal (base of first ray) 613 (46.0), 847 (63.5); of anal 660, (49.5), 760 (57.0). Pectoral: length to origin 213 (16.0); length of longest (8th) ray 139 (10,4), of whole fin 164 (12.3). Ventral: length to origin 267 (20.0); lengths of spine 80 (6.0), of longest (second from spine) ray 92 (6.9), of whole fin 105 (7.9). Length to vent 647 (48.5). Lengths of 1st, 2nd, 20th dorsal spines 57, 72, 65; of 1st, 7th, 15th dorsal rays 65, 68, 73; of 1st, 2nd anal spines 27, 53; of 1st, 3rd, 8th anal rays 72, 80, 40. Head, with opercular flap 231 (17.3), without flap 213 (16.0); snout 67 (5.0); eye 61 (4.6); orbit 67 (5.0); interorbital, soft 51 (3.8), bony 35 (2.6). Depths at front of eye 64 (4.8), back of eye 80 (6.0), operculum 83 (6.2), vent 81 (6.1); maximum depth 93 (7.0); caudal peduncle 53 (4.0). Widths at same points 65 (4.9), 65 (4.9), 80 (6.0), 45 (3.4); maximum 76 (5.7), caudal peduncle 13 (1.0).

General description - D. XX, 15. A. II, 8. V. I, 4. P. 13/13. C. 20 (13 reaching at least halfway to tip). L. lat. 45. Sc. tr. 4/6. Br. 5.

Head 4.34, trunk 2.31, tail (without caudal) 2.83 in *Ls*.

Elongate, greatest depth of body 10.7, of head 12.1, in *Ls*. Subcylindrical anteriorly, becoming progressively compressed caudad; depths at dorsal origin, vent, caudal base 1.0, 1.8, 3.5 widths at these points. Caudal peduncle long, a little shorter than caudal fin; slender, length 2.88 its least depth.

Trunk and tail wholly covered with cycloid scales, which extend also on to caudal base, and cover almost whole pectoral base. On dorsum of head, extending forward almost to middle of interorbital; several largish scales across upper part of operculum; a patch of small scales on preoperculum, bordering orbit, in about three rows above, decreasing to one row below middle of eye. Lateral line with a short anterior segment high on the flank, its distance from ventral profile about thrice its distance from dorsal profile at origin of pectoral, about twice at end of adpressed pectoral; the distances becoming subequal about an eye-diameter farther back, and thereafter remaining so; last tubule on caudal base.

Head moderate, 1.80 in trunk, 4.34 in *Ls*; in lateral aspect conical; in dorsal aspect subquadrangular in interorbital region, mostly flat here; snout flat in mesial half, gently rounded laterally, narrowing forward, but rather rounded terminally. Lips thickened, tumid, but not greatly so; jaws subequal. Mouth cleft small, moderately oblique, extending a trifle more than halfway to eye. Teeth in upper jaw fused, forming, except for a small median notch, a continuous cutting edge, its free margin entire anteriorly, minutely serrate posteriorly. Teeth in lower jaw fused, but some posterior ones with briefly free crowns projecting above the wall. Palate apparently edentulous. Eye large; 1.09 in snout, 3.76 in head; just cutting dorsal profile; its least distance from ventral profile about one-fourth its vertical diameter. Interorbital flattened, with slight longitudinal median depression; soft 1.21, bony 1.77, in eye. Branchiostegals 5; membrane continuous, with free border, across isthmus. Broadly rounded membranous opercular lobe. Preopercular margin entire. Smooth suborbital facet (apparently characteristic of the genus) extending between level of rictus and level of posterior border of orbit, its least distance from eye less than half its greatest width, which is about one-sixth of its length. Numerous small pores on several parts of head, largely or wholly the openings of neuromast tubules, forming series in well defined lines, sometimes simple, sometimes with short branches, usually of one tubule only; disposed much as in *Neoodax beddomei* (Johnston, 1885), as described in Part XVI (1969, 165).

Dorsal with 20 spines, 15 rays; rays simple, differing little in flexibility from spines, the posterior set closer together than the anterior; originating very shortly behind head, at level of base of lowest pectoral ray; length to origin 4.14 in *Ls*; terminating in advance of caudal base by almost two-thirds length of caudal fin, or by distance subequal to interval between front of eye and pectoral origin; base of spinous portion one and a half times base of soft portion; combined lengths of fins 1.65 in *Ls*, or equal to distance between vent and middle of snout; whole fin of approximately even height throughout, last rays somewhat produced. Anal with two spines, set very close together, first half length of second; and eight simple rays, first one-third as long again as second spine; originating below 23rd radial element of dorsal (third ray), ending below 28th (eighth ray); length to origin 1.52 in *Ls*, or 6.60 base, which is a little less than half length to pectoral. Only traces of the dorsal and anal membranes remain. Ventral with one spine and four rays; small, slender, bluntly pointed; rays simple, subequal, longest (second) 2.51 in head, 1.15 spine; inserted at 0.27 standard length, about below end of first one-third of pectoral; extending 0.36 of distance to vent. Pectoral with 13 mostly simple rays, longest (8th) 1.66 in head; rounded; adpressed, extending briefly beyond tip of adpressed ventral. Caudal

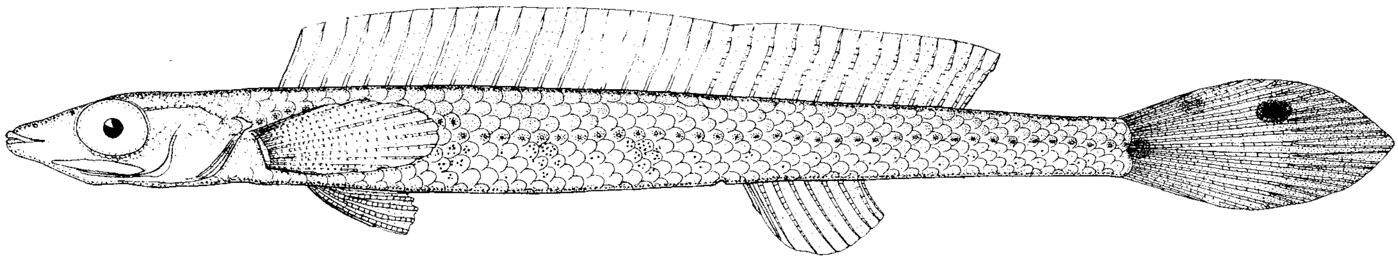

FIG. 2 - *Neoodax attenuatus* (Ogilby,1883), standard length 75.0 mm, total length 92.2 mm, Promise Bay, Glamorgan, Tasmania (Mr D.C. Wolfe); apparently the first example of the species reported since the (lost) holotype: twice natural size.

with 20 rays, with 13 reaching to, or almost to, hind border; broadly pointed; length from hypural equal to head.

Coloration - Ground color, after preservation in formalin, yellowish flesh, with, in places, a faint tinge of greenish. Above lateral line, in parts, especially anteriorly, almost wholly light brownish, in parts merely dappled brownish, the dappling arising from the restriction of the brown pigment to the posterior portion of some scales and its complete absence from others. Along the lateral line a stripe of darker brown, formed by the partial fusion of somewhat rounded, but obscurely delimited, patches of pigment, most intense centrally, one patch surrounding each light-colored pore; this feature best developed in a little more than the middle one-third of the length. On flank below lateral line and on whole of ventral surface yellowish flesh, here and there tinged faintly, but in last one-third of tail strongly suffused, with greenish; immaculate, except for some brownish flecks extending almost two-thirds down the flank under the front part of the pectoral fin, and for four small groups of dark brown peppering, first below middle of, second below tip of, pectoral, third just anterior to middle of standard length, fourth the postorbital length of the head farther back, and formed by a few scattered punctulations, barely observable without a lens. Head not markedly different from trunk; above level of middle of eye, opercle medium brown, snout somewhat lighter; below this level, much like, but a trifle less yellowish than, lower part of flank; a conspicuous dark, almost black, area between eyes, its anterior border barely proconcave, its posterior border intruded on by a median wedge of light body color, extending forward for rather more than half total anteroposterior extension of the marking, which is subequal to eye; occiput yellowish. Dorsal and anal rays whitish; membrane largely missing, so that presence or absence of patterning cannot be determined, remnants of membrane white or pale greyish. Pectoral rays silvery white, membrane hyaline or faintly greyish. Ventral whitish, somewhat silvery. Caudal largely greyish; with two small obscure dusky patches at and near base; at about three-fifths of the length a dark ovoid spot, its anteroposterior length about two-thirds an eye-diameter; distal to this, dusky, with several local intensifications of pigmentation.

Comparison with Ogilby's account - Numerical entries given in Ogilby's (1897b) description of the type - Ls 95, as against 75 in present specimen - are here followed in parentheses by values for our fish. D. XX, 15 (XX, 15). A. I, 9 (II, 8). V. I, 4 (I, 4). P. 13 (13/13). Sc. 43 4/6 (45 4/6). In the course of a comparison of his fish and Johnston's account of the type of his *Odax beddomei*, Ogilby observes (footnote, p. 85), 'Mr Johnston has recorded three spinous rays as being present in the anal fin of his example, but a most careful examination under the microscope, both by Mr Whitelegge and myself, has been unsuccessful in bringing to light more than a single spine in Mr Morton's fish.' In the present fish there are two anal spines, very closely approximately basally; in normal posture of spines, contiguous throughout whole length of first, which is small, half second, about one-third first ray.

Head 4 2/5 (4.34), depth of body 8 4/5 (10.7) in 'total length' (a comment later in Ogilby's paper makes it evident length without caudal is meant here and elsewhere). Depth of head 2 3/5 (2.79), width of head 2½ (2.58), of interorbital 5 3/4 (soft 4.55, bony 6.65), diameter of eye 3 2/5 (3.76) in length of head. Snout one-third of a diameter larger than eye (1.09 eye). Length of maxillary 5 3/4 (5.77) in head. Length to origin of dorsal 2 4/5 (3.13) in distance of origin from caudal base; longest ray 2¼ (3.15) in head. Length of ventral 1 7/9 (2.19) in head, and 2 2/3 (3.61) in space between its origin and vent. Longest pectoral ray 1 3/5 (1.66) in head. Depth of caudal peduncle 2 3/4 (2.88) in distance between dorsal and caudal (hypural joint).

The origins of the dorsal and ventral fins in our specimen are as described for the type. Other points of general agreement include: body elongate; upper profile of head convex; snout rounded in front; interorbital flat; maxillary halfway (in ours, a trifle more) to eye; preoperculum entire; ventral narrow; pectoral rounded; caudal peduncle long, slender. Ogilby reports anal origin, termination below 21st, 26th dorsal 'rays' (i.e. first and sixth soft rays); we find, below 23rd, 28th. In the entry 'an oblong deep blue spot near the distal extremity of the ventral fin' *ventral* would appear to be a *lapsus calami* for *caudal*.

Status - In spite of the existence of some discrepancies, rendered apparent by the above comparison, the general agreement of the chief features make it highly probable the present fish is to be referred to Ogilby's long-missing species. It certainly does not belong to any other described odacid species, and it is here determined as *Neoodax attenuatus* (Ogilby,1897).

Ogilby's species is a well differentiated one. The chief points of distinction between it and other described Australian forms are made clear by the key given above. The elongate body, with depth more than 8 in *Ls*, serves at once to set it apart from all our species other than *Neoodax beddomei* (Johnston,1885), from which it is trenchantly distinguished by the much shorter snout, less than the postorbital head, and by the ending of the anal well in advance of, instead of nearly below, the termination of the dorsal.

Family SCORPAENIDAE

Some observations on the representation of this family in Tasmanian waters are to be found in an earlier paper (1970, 234), and a key to the species then recorded was supplied in Part IX (1960, 93). *Neosebastes panticus* McCulloch & Waite, 1918, reported since that date (see further, below), enters that key at F. It may be distinguished from the species there specified, *N. pandus* (Richardson,1842), thus: adpressed pectoral reaches about to level of origin (cf. termination) of anal; lateral line 37 (cf. 45 - 46) ['L.lat' entries in the key are counts of rows of scales between scapular angle and caudal base]: further, the color patterns are markedly different.

Genus *NEOSEBASTES* Guichenot,1867
Neosebastes pandus (Richardson,1842)

Scorpaena panda Richardson,1842, *Ann. Mag. Nat. Hist.*, 9, 216. Type locality, Albroholos, Western Australia.

Distribution - The Check-list gives Western Australia, Queensland, Tasmania, Victoria. Scott (1962) adds South Australia, stating it is common there. It appears in the first published Tasmanian list (Johnston 1883, 114) - as *Scorpaena panda* - and had earlier been noted in the unpublished catalogue of Martin Allport.

Swimcart Beach specimen - An example, *Ls* 338 (*Lt* undeterminable), caught during a fishing contest at Swimcart Beach, Dorset, 9 May 1971 (see notes on fishing contests below), exhibits some noticeable differences from Richardson's figure (1848, pl. 41) of his *Erebus* & *Terror* specimen (*Ls*, estimated from plate, *ca* 140), the figure reproduced in Australian catalogues (e.g.,Scott 1962, 156). The existence of these differences raises the possibility that examination of additional local material might lead to the recognition of a Tasmanian (or eastern) subspecies.

D. XII; I, 8 (last split to base). A. III, 5 (last split to base). V. 1, 5. P. 21/21. C. 18 main rays. L. lat. 46. Scales between scapular angle and caudal base *ca* 59. Richardson records pectoral as 16 et IV: both fins here have an additional ray. In our specimen left pectoral has lowest two rays undivided, digitate;right has one undivided, five divided only once (in both fins, some of the singly divided rays barely nicked).

Ventral originates below dorsal spines I/II (contrast Richardson's figure, IV/V). Anal originates below interval between last spine of first dorsal and first spine of second; ends below fifth dorsal ray. Pectoral reaches to dorsal X/XI; ventral to VII/VIII, extending two-thirds of distance from its origin to vent. Maxilla to below 0.35 eye. Caudal peduncle decidedly shorter and stouter than as figured, some proportions (estimates from illustration in parentheses) being: length a trifle less than (about 1⅓) base of soft dorsal, 7.1 (about 4½) in *Ls*; depth 1.4 (about 2½) in its length.

Marked differences are found in armature of head, not merely in degree of development of spines in corresponding positions, a difference that might with some good probability be attributed to individual variation, but also, a divergence that may be of taxonomic significance, in the absence in our fish of some spines depicted in the illustration as conspicuous structures, as well as in the presence of some spines not figured.

The portion of free margin of preoperculum above uppermost (largest) of the four spines along the border, that is, as far as can be determined, entire in the figure here bears on left side two, on right six, small spines. In general, however, our fish is markedly less spiny that the Western Australian one. In figure a spine occurs on operculum between eye and lower of two spines near opercular border, its origin a little above and behind upper extremity of free margin of preoperculum: no sign of the presence of this spine can be found on either side of our specimen. The supraorbital border, shown as bearing, above about first one-fifth of eye, a well developed spine, followed after a short interval by about five closely set points, here presents, at least in its anterior three-fourths or more, a single even sweep, constituted anteriorly by general surface of head, in approximately its middle half by a low narrow smooth ridge, and in its posterior one-fourth partly by a short low recumbent spine, which scarcely serves to interrupt the general curve. The dorsal profile between tip of upper jaw and eye is virtually straight, with a slight convexity produced by a recumbent ridge-like spine above anterior nostril, much less prominent than the small angular projection at this point in the illustration. The lateral line, the anterior portion of which is in both figure and specimen distinctly spinous, has its anterior upwardly convex are located much farther forward in our fish, its highest point lying below dorsal spine III, instead of below, or behind, VI; at its nearest approach to dorsal profile it is several times more distant from it than as figured.

In addition to the general figure of his specimen, Richardson provided a sketch of the dorsum of the head. Comparison of the specimen with this shows complete absence in former of a forwardly convex arc that in latter delimits posterior part of interorbital space; together, of course, with absence, already mentioned, of line of supraorbital spines. The species is described as possessing a deep naked transverse groove across nape (the presence or absence of such a nuchal groove has been treated as a species differentia in several keys). In our specimen no such conspicuous groove occurs, all that is present in this region being, about midway between posterior border of orbit and dorsal origin, a very shallow groove, such as might be thought of as being made by drawing a needle, using considerable pressure, from side to side in a proconvex arc; its chord subequal to interorbital width: there is, however, a depression behind each orbit.

Fin patterns - The fin patterns, which agree with those of *N. panticus* McCulloch & Waite,1918, have been noted above: for typographical economy, the relevant metrical data are given below with those of that species.

Neosebastes panticus McCulloch & Waite,1918

Neosebastes pantica McCulloch & Waite,1918, *Rec. S. Aust. Mus.*, 1, 64, pl. 4, fig. 1. Type locality, Spencer Gulf, South Australia.

Distribution - The Check-list gives South Australia, Western Australia: first Tasmanian record by the writer (1970) on the basis of a specimen from Bridport, Dorset, determined by Mr G.P. Whitley, Honorary Associate, Australian Museum, Sydney, to whom it was submitted for identification after the infliction by another example of a poisonous wound (paper cited gives details of case and notes other instances of injuries caused by several Tasmanian fishes).

Additional records - Though the species is perhaps not uncommon in our waters, no further examples have hitherto been formally recorded. Two specimens are here reported: (a) *Ls* 165, *Lt* 208, Kelso, Tamar River, Devon, 28 November 1971, A. Brooks (Queen Victoria Museum Reg. No. 1972/5/573); (b) *Ls* 255, *Lt* 313, off Mersey Bluff lighthouse, Devonport, Devon (hook and line from boat), 16 January, E.H. Sherriff (Q.V.M. Reg. No. 1972/5/574).

Fin patterns - The length-number pattern exhibited by spines and rays of fins other than the caudal (not investigated) have been noted earlier in this paper. They are similar to those for *N. pandus* (Richardson, 1842). Metrical data for the two examples of the present species are set out below, the corresponding data for the Swimcart Beach example of *N. pandus* being incorporated, as a matter of typographical economy, as a third item in the schedule.

Fin Patterns of *Neosebastes panticus* McCulloch & Waite, 1918 and *Neosebastes pandus* (Richardson, 1842)

Data for each set or subset of (i), (ii) *N. panticus*, Kelso, Devonport, specimens respectively, (iii) *N. pandus*, Swimcart Beach specimen are here recorded as follows (with punctuation as in this statement). Regression equation for (i): parameters (k, log b) for equation for (ii): parameters for (iii). Values of t for (i):(ii):(iii). Measured lengths, mm (in parenthes calculated lengths) of radial elements of (i):(ii):(iii). Left pectoral of (iii) is imperfect and has not been measured.

(D_1) . Log L = 0.4353 log N + 1.5472: 0.6148, 1.5822: 0.5451, 1.6014. t = 73.82: 30.47: 73.46. Lengths 35.3 (35.3), 47.5 (47.7), 57.0 (56.9): 38.1 (38.2), 59.1 (59.9), 74.7 (75.1): 40.0 (39.9), 58.0 (58.2), 72.9 (72.7).

(D_2) . Log L = 0.2049 log N^1+ 1.5828: 0.2784, 1.6686: 0.1788, 1.7308. t = 26.17: 14.78: [7.60]. Lengths 38.3 (38.3), 44.0 (44.1), 48.0 (47.9): 46.8 (46.6), 55.7 (56.5), 64.0 (63.3): 54.1 (53.8), 60.0 (60.9), 66.1 (65.4).

(D_3) . Log L = 0.5947 log N^1+ 1.0574: 0.9073, 0.8982: 0.7543, 1.0823. t = 92.82: 70.21: 81.02. Lengths 11.5 (11.4), 17.0 (17.2), 21.9 (21.9), 26.1 (26.1), 30.0 (29.7), 33.0 (33.1): 7.9 (7.9), 15.0 (14.8), 21.0 (21.4), 28.1 (27.8), 34.1 (34.1), spine VII imperfect: 12.1 (12.1), 20.1 (20.4), 28.0 (27.7), 35.0 (34.4), 40.4 (40.7), 46.3 (46.6).

(d_2) . Log L = 0.2711 log N^1+ 1.2606: 0.2450, 1.4104: 0.2114, 1.5423. t = 85.41: 35.08: 68.18. Lengths 18.0 (18.2), 22.3 (22.0), 24.6 (24.5), 27.0 (26.5), 27.9 (28.2), 29.3 (29.6): 25.9 (25.7), 30.0 (30.5), 34.0 (33.7), 36.1 (36.1), 38.0 (38.2), 40.1 (39.9): 35.0 (34.9), 40.0 (40.4), 44.5 (45.0), 46.0 (46.7), 48.9 (48.9), 51.4 (50.9).

(a_2) . Log L = 0.2617 log N^1+ 1.3182: 0.2801, 1.4887: 0.2887, 1.5597. t = 6.33: 15.22: 32.49. Lengths 20.9 (20.8), 24.7 (24.9), 27.8 (27.7), 30.0 (29.9): 30.8 (30.8), 37.6 (37.4), 41.0 (42.0), 46.0 (45.4): 36.5 (36.3), 44.0 (44.3), 49.4 (49.8), (54.7), 54.1).

(v_1) . Left fin. Log L = 0.4607 log N + 1.3413: 0.4938, 1.4882: 0.4996, 1.5522. t = 89.6: 43.23: 28.91. Lengths 22.0 (21.9), 30.0 (30.2), 36.5 (36.4), 41.6 (41.6): 30.9 (30.8), 42.8 (43.3), 53.5 (54.3), 60.9 (61.0): 36.0 (35.7), 49.4 (50.3), 62.0 (61.7), 71.8 (71.3).

(v_1) . Right fin. Log L = 0.4351 log N + 1.3419: 0.4251, 1.5308: 0.5007, 1.5567. t = 54.16: 106.65: 59.88. Lengths 21.9 (22.4), 29.9 (29.7), 35.5 (35.4), 40.0 (40.2): 34.0 (34.0), 45.5 (45.6), 54.0 (54.2), 61.4 (61.2): 36.1 (36.0), 50.6 (51.0), 63.0 (62.2), 71.9 (72.1).

(v_2V) . Left fin. Log L = − 0.5166 log N + 1.9323: − 0.6198, 2.1577: − 0.9209, 2.4151. t = 42.00: 36.48: 40.87. Lengths 41.6 (41.8), 37.5 (37.3), 26.0 (26.0): 60.9 (60.9), 53.0 (53.0), 34.5 (34.5): 71.8 (72.6), 59.9 (59.1), 31.1 (31.2).

(v_2V) . Right fin. Log L = – 0.5046 log N + 1.9027: – 0.6204, 2.1770: – 0.9591, 2.4372. t = 37.95: 47.85: 56.91. Lengths 40.0 (39.7), 35.3 (35.5), 25.1 (25.0): 61.4 (58.9), 54.1 (55.5), 34.9 (36.0): 71.9 (72.4), 59.0 (58.4), 30.0 (30.1).

(p_1) . Left fin. Log L = 0.3146 log N + 1.5749: 0.3237, 1.7471: - . t = 35.83: [9.15]: - . Lengths 37.5 (37.6), 47.0 (46.7), 52.9 (53.1): 55.4 (55.9), 71.6 (69.9), 78.6 (79.7): - .

(p_1) . Right fin. Log L = 0.3621 log N + 1.5882: 0.3508, 1.7259: 0.3295, 1.8290. t = [9.57]: 12.73: 14.43. Lengths 38.4 (38.7), 51.0 (49.8), 56.8 (57.7): 53.5 (53.2), 66.7 (67.8), 79.0 (78.2): 67.1 (67.5), 86.0 (84.8), 96.0 (96.9).

(p_2) . Left fin. Log L = 0.04478 log N^1 + 1.6862: 0.06302, 1.8379: - . t = 48.6: 47.12: - . Lengths 48.6 (48.6), 50.0 (50.1), 51.0 (51.0), 51.7 (51.7), 52.2 (52.2): 68.9 (68.9), 72.0 (71.9), 73.5 (73.8), 75.1 (75.1), 76.2 (76.2), 77.0 (77.1), 77.9 (77.9): - .

(p_2) . Right fin. Log L = 0.03489 log N^1+ 1.7072: 0.05141, 1.8398: 0.04416, 1.9691. t = 31.92: 4.54: 6.30. Lengths 51.0 (51.0), 52.1 (52.2), 53.0 (52.9), 53.5 (53.5), 53.9 (53.9): 70.0 (69.0), 70.8 (71.5), 72.0 (73.0), 73.0 (74.1), 74.8 (75.0), 76.2 (75.7), 77.9 (76.3): 92.1 (92.1), 95.0 (94.9), 96.4 (96.7), 98.0 (97.9), 98.9 (98.9).

(p_3) . Left fin. Log L = 0.1612 log N^1+ 1.5582: 0.1374, 1.7495: - . t = 27.42: 40.65: - . Lengths 35.9 (36.2), 41.0 (40.4), 43.0 (43.2), 45.0 (45.2), 47.0 (47.3), 48.1 (48.9): 56.1 (56.2), 62.0 (61.8), 65.1 (65.3), 68.0 (67.9): - .

(p_3) . Right fin. Log L = 0.1034 log N^1+ 1.5739: 0.1108, 1.7607: 0.1748, 1.8263. t = 39.10: 27.60: 51.06. Lengths 37.5 (37.5), 40.0 (40.3), 42.3 (42.0), 43.1 (43.2), 44.5 (44.3), 45.0 (45.1): 58.1 (57.6), 61.1 (62.2), 65.5 (65.1), 67.5 (67.2): 67.1 (67.0), 75.5 (75.7), 81.0 (81.2), 86.0 (85.4), 88.9 (88.8), 91.4 (91.7).

(p_4) . Left fin. Log L = 0.3751 N^1+ 1.2559: 0.3769, 1.4260: - . t = 63.10: 27.22: - . Lengths 18.0 (18.0), 23.5 (24.4), 27.0 (27.2), 30.5 (30.3), 32.5 (32.8): 26.5 (26.7), 34.9 (34.6), 39.9 (40.3), 45.9 (45.0), 48.5(48.9), 52.8 (52.4), 55.0 (55.5): - .

(p_4) . Right fin. Log L = 0.3420 N^1+ 1.2952: 0.5037, 1.3169: 0.3731, 1.4749. t = 27.17: 47.81: 21.87. Lengths 20.0 (19.7), 25.0 (25.0), 28.0 (28.7), 31.0 (31.7), 34.9 (34.2), 37.0 (36.4): 20.5(20.7), 29.8 (29.4), 35.9 (36.1), 43.0 (41.7), 46.0 (46.7), 50.8 (51.2), 55.0 (55.3): 29.8 (29.8), 38.0 (38.7), 45.5 (44.9), 49.9 (50.1), 53.6 (54.4), 58.5 (58.2), 62.0 (62.3).

While in this and other species the set of pectoral rays can usually be analyzed into several more or less clearly delimited subsets, the overall curvature of the fin is at times of such a character that it becomes necessary to make a somewhat arbitrary choice as to whether, say, three or four subsets are most satisfactorily recognized (and, indeed, as to whether a flanking ray is best associated with one or other, or even with both, of two adjoining subsets): in the limit, the situation that could present itself would of course be that an approximate formulation of the circumference of a circle by the specification of the perimeter of a polygon with a number of sides appropriate to the degree of precision deemed acceptable. In the present material four pectoral subsets have been recognized, namely, (p_1) [rays 1 - 3] , (p_2) [rays 4 - 8 in specimens (i), (iii), 4 - 10 in (ii)], (p_3) [rays 9 - 14 in (i), 11 - 14 in (ii), 9 - 14 in (iii)], (p_4) [rays 15 - 19 in (i), 15 - 21 in (ii), (iii), thus including in all cases the last ray]. Note that the equation for (p_1) includes N, direct serial ray number, whereas equations for (p_2) , (p_3) , (p_4) include N^1, inverse serial number - this pattern is apparently a general one.

NOTES ON TWO FISHING CONTESTS HELD IN 1970 AND 1971

Brief notes on several angling contests have appeared earlier in these Observations (1965, 1967), and reference has been made to similar reports in U.S.A., e.g., Herald, Schneebeli, Green & Innes (1960). Some material obtained at these events has provided useful systematic data on several species, including *Raja whitleyi* Iredale,1936 (1967, 1970a, present contribution), *Scorpis lineolatus* Kner,1865 (1970a; first Tasmanian record), *Platycephalus bassensis bassensis* Cuvier,1829 (1970a), *Neosebastes pandus* (Richardson,1842) (present communication), *Notorhynchus cepedianus* (Peron,1807) (present communication).

Swansea Glamorgan November 1970

In the course of the 1970 competitions conducted by the Tasmanian Fishing Championship Association 8000 fish (exact recorded total) were taken by approximately 1200 registered entrants.

On the first of the two days, Saturday 21 November 1970, fishing was carried on in the lower reaches of the Swan River, the competition being confined to a single species, the Southern (Black, Silver) Bream, *Mylio butcheri* Munro,1949, endemic to Australia, being restricted to 'the temperate waters of the southern and south-western coastlines between latitudes 26° S. (west coast), 37° S. (east coast) and 43° S. (Tasmania)' (Munro 1949, 191): this bream is found in both Johnston's lists (1883, 1891) as *Chrysophrys australis* Gunther,1859, and in the Australian Check-list (McCulloch 1929) and in the local lists of Lord (1923, 1927) and Lord & Scott (1924) as *Sparus australis* (Gunther,1859). Few other species were taken, the only ones noted by the writer while making patrols of the river bank for some three miles inland being one example each of the Congolli (Freshwater Flathead, Sandy, Roach), *Pseudaphritis bursinus* (Cuvier,1830) and the Slender-spined Porcupine Fish (Globe Fish), *Atopamycterus nicthemerus* (Cuvier,1818). Total bream reported 353 (in 1969 650, in 1968 860). Weights (kg) of the first 20 entries on the prize list: 1.67; 1.59 (two examples); 1.56 (3); 1.46; 1.43; 1.36; 1.34; 1.33 (2); 1.30 (3); 1.26; 1.25 (2); 1.20; 1.19. However, it should be noted these weights are not necessarily those of the 20 heaviest fish brought to the control point, since in the event of a single competitor presenting more than one large fish the heaviest entry only was credited to him.

On the second day, Sunday 22 November, the programme comprised: (i) a Beach section (western end of Dolphin Sands, covering the western part of the approximately east-west sweep of the coast between Waterloo Point and Point Bagot); (ii) a Rocks and Boats section, held a little south of (i) (fishing on this occasion almost wholly from boats). Of the catch in section (i), the first 8 of 10 items, listed below in order of decreasing weight, were Blackback Salmon (Australian, Native, Colonial, Cocky Salmon), *Arripis trutta esper* Whitley,1951; the 9th entry was a Flathead (probably *Platycephalus bassensis bassensis*,Cuvier 1829), the 10th a Southern Bream, *Mylio butcheri* Munro,1949. Weights of these 10 fish (kg): 1.42; 1.40 (2); 1.20; 1.15; 1.09; 1.0; 0.81; 0.78; 0.74. Of the catch in section (ii), the 1st, 3rd, 5th, 9th items, with fish listed in descending order of weight, were Flathead (probably *Platycephalus bassensis bassensis*,Cuvier 1829), the rest being Rock Cod, *Physiculus barbatus* (Gunther,1863). Weights of these 10 fish: 1.57; 1.49; 1.45; 1.44; 1.29; 1.27 (2); 1.26; 1.22 (2). Elasmobranchs known to have been caught at Dolphin Sands were a young male seven-gilled Shark, *Notorhynchus cepedianus* (Peron,1807), noted elsewhere in the present paper, and a male Eagle (Bull, Whiptail) Ray, *Myliobatis australis* Macleay,1881, disc width 815 mm, length to vent 455 (tail removed). The former appears in both Johnston's lists as *Notidanus indicus*,Cuvier, in both Lord's lists and in Lord & Scott as *Notorhynchus pectorosus* (Garman,1884). The latter is entered in both Johnston's lists as *Myliobatis aquila* Linne; in Lord's first list (1923) and in Lord & Scott it appears as here, but in Lord's second list (1927) it is referred to the genus *Aetobatus* Blainville,1816.

Swimcart Beach Cornwall May 1971

At the St Helens (Dorset) Surf Angling Club's Championship, held near St Helens at Swimcart Beach, Cornwall, on 8 - 9 May 1971, the main catch consisted of the Common Sand Flathead, *Platycephalus bassensis bassensis* Cuvier,1829, Rock Cod, *Physiculus barbatus* (Gunther,1863), Purple Parrot Fish (Kelpie), *Pseudolabrus fucicola* (Richardson,1840), Blackback Salmon, *Arripis trutta esper* Whitley,1951. One Gurnard Perch (Saddle-skull Gurnet), *Neosebastes pandus* (Richardson,1842), the subject of some observations above, and one Dragonet (Horny) *Bovichtus variegatus* Richardson, 1846, were brought to the check point. The record board showed weights (kg) of the heaviest 16 scaled fish as follows: 1.96; 1.84; 1.83; 1.80; 1.78; 1.76; 1.74; 1.73 (4); 1.69; 1.67 (2); 1.66; 1.64.

Rays and sharks included two females (15.4 kg, 8.2 kg) and two males (3.46 kg, 3.1 kg) of the Melbourn (Great) Skate, *Raja whitleyi*, Iredale 1938; a School Shark (Tope), *Galeorhinus australis* (Macleay, 1881) (8.22 kg), a Swell (Draughtboard) Shark, *Cephaloscyllium isabella laticeps* (Duméril, 1853). Though described, twice under preoccupied names, certainly as far back as 1888 (by Ogilby as *Raja scabra*) and very probably still earlier (in 1872 by Castelnau as *Raja oxyrhynchus*), *Raja whitleyi* does not appear in any published local list, the first report for Tasmania apparently being that of the Handbook (Munro 1956), Whitley's volume on sharks and rays (1940, 184) admitting only Victoria: it is the commonest ray at Swimcart Beach (cf. 1967, 1970a, present contribution). The School Shark is listed by Johnston as the European Tope, *Galeus canis*, Rondeletti: the Swell Shark is entered by him as *Scyllium laticeps* Duméril, 1853, while other local lists have *Cephaloscyllium isabella* without recognition of a subspecies.

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