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THE GALAXIID FISHES OF AUSTRALIA (PISCES: GALAXIIDAE)

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INTRODUCTION

The family Galaxiidae comprises mostly small, scaleless fishes (to about 600 mm long, usually less than 250 mm) that are frequently benthic and cryptic in habit. Most species are elongate and fusiform, often with broad, somewhat depressed heads and thick fleshy fins. Some species are free-ranging in pools and lakes. These tend to have more membranous fins, are more slender in form, and are sometimes slightly compressed. Cryptic species usually have truncate to rounded caudal fins while the more open-living species may have forked tails.

The family is confined largely to the southern temperate zone, occurring in temperate and sub-tropical western and eastern Australia, Tasmania, Lord Howe Island, New Caledonia, New Zealand, the Chatham, Auckland and Campbell Islands, Chile, Patagonian Argentina, Tierra del Fuego, the Falkland Islands and the southern tip of South Africa. A species of *Galaxias* was described from India by Day (1888) but the identity of the fish has never been adequately established and *Galaxias indicus* Day (1888) is regarded as a *nomen dubium* by McDowall (1973a).

Diversity of galaxiid fishes is greatest in Australia with 20 species in three genera; there is one endemic species in the uplands of New Caledonia (McDowall, 1968a), and another widespread species at Lord Howe Island. Two genera and 13 species occur in New Zealand and its outlying islands (McDowall, 1970a, 1972a), four species in two genera in South America and the Falkland Islands (McDowall, 1971), and a single species in South Africa (McDowall, 1973b). Most species are endemic to one of the major geographical areas within this range, although *G. maculatus* (Jenyns) is known from Western Australia, eastern Australia (from southern Queensland south and west to South Australia), Tasmania, Lord Howe Island, New Zealand, the Chatham Islands, South America and the Falkland Islands. *G. brevipinnis* Günther occurs in eastern Australia, from central coastal New South Wales, south and east to South Australia, Tasmania, New Zealand, the Chatham, Auckland and Campbell Islands. *G. truttaceus* (Valenciennes) is found in Western Australia, eastern Australia (Victoria), and Tasmania.

Most galaxiid species are confined to fresh waters but several are known to be diadromous with the larval, post-larval and juvenile phases occurring in the sea (McDowall et al., 1975). One species, *G. maculatus,* is known to spawn in tidal, estuarine waters (McDowall, 1968b) but all others are believed to spawn in fresh water, movement to sea in diadromous species probably taking place soon after hatching in fresh water (e.g. Ots and Eldon, 1975). Very little is known about the natural history of galaxiid fishes, except for *G. maculatus* which has been the subject of intensive study — it has considerable commercial importance in New Zealand and is taken in small fisheries in Tasmania and Chile (McDowall, 1968b; Scott, 1938; Campos, 1970, 1973, 1974). Other species have also been studied in less detail. Benzie (1968a) examined the life history of a New Zealand species, *G. vulgaris* Stokell; Cadwallader (1975a, b, 1977) added to knowledge of this species and also examined aspects of the natural history of *Neochanna burrowsius* (Phillipps), another New Zealand form (Cadwallader, 1975c). Hopkins (1971) described the life history of *G. divergens* Stokell (New Zealand), and Eldon (1968, 1971, 1978) discussed varied aspects of the natural history of *Neochanna apoda* Günther (New

Zealand). Campos (1972b) described parts of the life history of the Chilean *Brachygalaxias bullocki* (Eigenmann).

Little work has been done on Australian species although Walford (1928, 1941, 1942) studied the life cycle of *G. olidus* Günther (identified as *G. coxii* Macleay) and Scott (1941) looked at aspects of the natural history of *G. truttaceus* in Tasmania. Pollard (1971-1974) in a long series of papers made an intensive study of the biology of a landlocked population of *G. maculatus* in Victoria, while Chessman and Williams (1975) studied salinity tolerance in this species. Berra (1973) studied home range in *G. olidus* Günther (referred to as *G. bongbong* Macleay), and Tilzey (1974, 1976) has reported on effects of trout invasion on populations of this species. Despite an apparently substantial series of publications on galaxiid fishes, little remains known about most species.

The family Galaxiidae constitutes a major proportion of the freshwater fish fauna of southern Australia, and is, by far, the largest family in cool and cold waters of the area. Although some galaxiids are present in Western Australia north of Perth, and in southern Queensland, greatest diversity and abundance occur in southern waters, particularly in Tasmania. Of the 20 species recognised in this revision 15 are present in Tasmania and 11 are restricted to the island. Western Australia has a small galaxiid fauna of five species, three endemic.

The systematics of galaxiid fishes have always been a problem; detailed and intensive studies of the Australian species have been few, and some have been redescribed repeatedly. Thus *G. maculatus* is known in the literature under 17 names in Australia alone and a further nine names in other parts of its range. *G. brevipinnis* has been described under seven names in Australia and a further eight in New Zealand. *G. olidus* has a total of eight synonyms in Australia. It is therefore not difficult to imagine the confusion that has developed. Misidentifications have been common and populations from a given area have been given a variety of names by various authors. The 20 Australian galaxiids recognised in this revision have a total of 58 names.

The family Galaxiidae was revised by Regan (1905). In this, the only comprehensive revision of the family ever attempted, 14 species were attributed to Australia of which only seven are recognised here. E.O.G. Scott began work on the Tasmanian galaxiid fauna in the 1930's, described several species as new, and revised the Tasmanian galaxiid fauna in 1936. He has continued to study and revise various parts of the fauna, describing new species and subspecies, or discussing variation and natural history of diverse galaxiid species (Scott, 1934-1974).

Whitley (1935, 1956a, b, 1964) published name lists and synopses based largely on knowledge of the literature. Stokell (1966) proposed some nomenclatural modifications that have generally been rejected by other workers for various reasons (McDowall, 1967a; Scott, 1968). On the whole the galaxiid species of mainland Australia have received scant attention, with only a few publications seeking to distinguish species belonging to particular states, e.g. Mack (1936) — Victoria; Whitley (1944) — Western Australia; Waite (1933), Scott (1962), Scott et al. (1974) — South Australia; McCulloch (1921) — New South Wales. Munro (1957) published a synopsis of the Australian species but his contribution is no more than a rather superficial literature assessment of the fauna introducing few nomenclatural changes, none of which is adequately documented.

The description in 1961 of a so-called scaled galaxiid — *Lepidogalaxias salamandroides* Mees — created much interest, but osteological studies have indicated that the fish is not a galaxiid (Frankenberg, 1969; McDowall, 1969; Rosen, 1974), and this strange little fish is not dealt with further here.

Frankenberg (1967) described two new species of *Galaxias* from the Lake Pedder region of Tasmania, species that became noticed when controversy developed over the modification and ultimate inundation of the lake to form a water storage reservoir. In a recent listing of Australian galaxiids Lake (1971) recognised 25 species of which only 13 are recognised here; he omitted to list two valid and previously described species, and had no knowledge of five species which were not then described (McDowall and Fulton, 1978a, b; Fulton, 1978a, b; McDowall, 1978a).

Andrews (1976) revised the Tasmanian galaxiid fauna, recognising ten species; all of these are recognised in the present study, although certain name changes are proposed. It is shown, in one instance, that Andrews' description is based on three distinct species — Andrews' *Paragalaxias shannonensis* Scott represents *P. dissimilis* (Regan) and two further, then undescribed species of *Paragalaxias*. Since the completion of Andrews' revision these two further species have been described (McDowall and Fulton, 1978a) and three additional galaxiids have also been discovered (Fulton, 1978a, b; McDowall and Fulton, 1978b).

Material examined from Western Australia revealed a new species belonging to the species group widely recognised in the literature as *"Brachygalaxias"*. The new genus *Galaxiella* was described for these species, and the new species from Western Australia described (McDowall, 1978a).

From the foregoing discussion it is clear that a comprehensive revision of the Australian Galaxiidae is long overdue, the Australian section of the family being the only part not subject to revision in recent times. As long ago as 1935, Whitley claimed (correctly), that systematics of Australian galaxiids were in "a parlous state", while Lake (1959:4) stated that there was "still some disagreement and confusion regarding some species" — a substantial under-statement. Later, Lake (1971:20) added "I do not believe that, even at the specific level, one can justify all species which have been described".

The present study therefore seeks to establish and redescribe the galaxiid species of Australia. The work has a dual origin. In the late 1960's Frankenberg wrote a Ph.D. thesis on galaxiid fishes (Frankenberg, 1969), in which a variety of problems related to their systematics and relationships was examined, including a partial resolution of the taxonomy of Australian members of the group. Of particular relevance to the present study, species groups were identified and diagnosed and nominal species in each group were analysed. The origin and evolution of species within each species group were explored, and informal taxonomic arrangements, based on these analyses, prepared. However, there were no formal synonymies or descriptions and no keys for identification or diagnoses. Frankenberg's work remains unpublished. McDowall was invited to spend a period at the Australian Museum, Sydney, under a grant from the Interim Council of the Australian Biological Resources Study, to resolve the taxonomy of Australian Galaxiidae. During tenure of this grant, a substantial amount of additional material was collected and examined by McDowall, extensive morphometric data on these fishes accumulated and much additional meristic data added to extensive data already available in Frankenberg's thesis. In addition six new species were identified. The present publication represents a synthesis of these two independent studies, and forms the logical sequel to McDowall's (1968a, 1970a, 1971, 1972, 1973a, b, c) studies of New Caledonian, New Zealand, South American and South African galaxiids.* It is restricted to a treatment of taxonomy; relationships of the species and their zoogeography will be discussed in subsequent papers.

*The taxonomic arrangement reflects the opinions of the senior author and does not, in every case, coincide with those of the second author.

MATERIAL EXAMINED

Prior to Frankenberg's study, galaxiid material in Australian museums and other institutions was very sparse, and in most instances also very old. During the period of Scott's studies of Tasmanian galaxiids (1930's onwards), a small but valuable collection of fishes was built up at the Queen Victoria Museum in Launceston. A small collection was also established at the Division of Fisheries and Oceanography, Commonwealth Scientific and Industrial Research Organisation, Cronulla. Before his major investigation of the fauna, Frankenberg collected widely in Australia and deposited a substantial collection of galaxiids in the National Museum of Victoria, Melbourne. Andrews (1976) also made a collection of galaxiids and the Tasmanian Museum, Hobart, has a useful collection of Tasmanian species. In 1969, D. E. Rosen and G. J. Nelson, of the American Museum of Natural History, New York, in the company of W. H. Butler, of Perth, Western Australia, collected fishes in a broad area of Western Australia, including a substantial collection of galaxiids. These collections are housed in the American Museum of Natural History, New York. Increased collecting activity by ichthyologists at the Western Australian Museum has added substantially to the collection of galaxiid fishes in that museum, and reconnaissance survey work by biologists at the Arthur Rylah Institute for Environmental Research, Division of Fisheries and Wildlife, Ministry of Conservation, Victoria, has produced a small but valuable collection of galaxiids. A similar, small collection is being assembled by the Tasmanian Inland Fisheries Commission, Hobart. Material collected by biologists of the New South Wales State Fisheries over the past 20 years, including some galaxiids, has been deposited in the Australian Museum, Sydney, and more recently, a survey of New South Wales freshwater fishes, conducted jointly by the Australian Museum and New South Wales State Fisheries under the financial support of the Australian Biological Resources Study, has substantially added to the collection of galaxiid and other fishes in the Australian Museum. Small collections are also housed in the Queensland Museum, Brisbane, the South Australian Museum, Adelaide, and in the zoology departments of some universities. A small collection is held by the Fisheries Research Division of the Ministry of Agriculture and Fisheries, Christchurch.

Material from all these collections was examined during preparation of this revision, as well as some very old type material housed in the museums of Europe. For most species large series of specimens were examined from a wide range of geographical localities. Samples from which morphometric and meristic data were taken are listed in Appendix 1. The material examined with distributional data is listed in a typescript available from the authors, and a copy has been deposited in the Fish Department, Australian Museum, Sydney.

Museum abbreviations: In listings of type and other material, institutions at which types are held are indicated by the following abbreviations:—

AIAC — Australian Institute of Anatomy, Canberra, A.C.T., Australia.
AMNH — American Museum of Natural History, New York, New York, U.S.A.
AMS — Australian Museum, Sydney, New South Wales, Australia.
BMNH — British Museum (Natural History), London, England.
FRD — Fisheries Research Division, Ministry of Agriculture and Fisheries, Christchurch, New Zealand.
FWDM — Fisheries and Wildlife Division, Ministry of Conservation, Heidelberg, Victoria, Australia.
MHNH — Museum National d'Histoire Naturelle, Paris, France.
MMS — Macleay Museum, University of Sydney, Sydney, New South Wales, Australia.
MNUB — Zoologisches Museum, Humboldt Universität, Berlin, Germany.
NMVM — National Museum of Victoria, Melbourne, Victoria, Australia.

NSWSF — New South Wales State Fisheries, Sydney, New South Wales, Australia.
QM — Queensland Museum, Brisbane, Queensland, Australia.
QVML — Queen Victoria Museum, Launceston, Tasmania, Australia.
RMNH — Rijksmuseum van Natuurlijke Historie, Leiden, Holland.
SAM — South Australian Museum, Adelaide, South Australia, Australia.
SMNS — Staatl Museum für Naturkunde, Stuttgart, Germany.
TIFC — Inland Fisheries Commission, Hobart, Tasmania, Australia.
TMH — Tasmanian Museum, Hobart, Tasmania, Australia.
WAM — Western Australian Museum, Perth, Western Australia, Australia.

Measurements and counts: Methods of measurement used were largely those described by Hubbs and Lagler (1958). Measurements were made with needlepoint dividers and determined to the nearest 0.25 mm, except when the limits of the structure being measured were difficult to determine, in which case measurements were to 0.5 mm. Measurements were taken as follows: total length — either length to caudal fork (L.C.F.), or if the caudal fin is rounded, to the posterior extremity of the fin (T.L.); standard length (S.L.); body depth at vent (B.D.V.) — used instead of greatest body depth because the latter is greatly affected by sexual maturity and distension of the stomach after feeding; depth of caudal peduncle (D.C.P.); length of caudal peduncle (L.C.P.) — measured from rear of anal fin base; predorsal length (PreD.); preanal length (PreA.); length of bases of dorsal and anal fins (L.D.B. & L.A.B.); greatest length of dorsal and anal fins (M.L.D. & M.L.A.); pectoral fin length (Pec.); pelvic fin length (Pel.); prepelvic length (PrePel.); pectoral-pelvic length (Pec.Pel.); pelvic-anal length (Pel.An.); head length (H.L.); head width (H.W.); head depth (H.D.) — taken vertically at the isthmus; snout length (Sn.L.); postorbital head length (P.O.H.L.); interorbital width (I.O.W.) — fleshy interorbital; diameter of eye (D.E.) — horizontal fleshy eye diameter; length of upper jaw (L.U.J.); length of lower jaw (L.L.J.); width of gape (W.G.).

The following structures were counted: fin rays in dorsal, caudal, anal, pectoral and pelvic fins; vertebrae; gill rakers; pyloric caeca. Counting fin rays in galaxiid fishes presents a minor problem since a variety of types of soft rays occurs. As in all salmoniform fishes, procurrent rays are present at the anterior ends of the dorsal, caudal and anal fins. Hubbs and Lagler (1958) recommended the inclusion of these procurrent rays in counts of the dorsal and anal fins in salmoniforms. This procedure was followed by Frankenberg, in his collection of data contributing to this revision. Many of his fin ray counts were taken from radiographs, and when these were not used, the counts were made by compressing the fins between microscope slides and examining them under a stereomiscroscope. For large and heavily pigmented specimens it was often necessary to expose the anterior rays of the median fins by dissection.

McDowall (1970a, 1972) has consistently used an alternative count. Because of the thick, fleshy nature of the fin bases in many galaxiids and because the anteriormost procurrent rays are in many instances extremely small, they are very difficult to count with any certainty. Alizarin stained preparations showed that there are from one to five such procurrent rays varying in size from a tiny, little-ossified splint to a strongly ossified but unbranched and unsegmented ray. Accordingly McDowall (1970a) adopted the technique of counting *only* and *all* segmented rays in the dorsal and anal fins, whether they branched or not. This procedure, which enables accurate and standardized counts, is more or less equivalent to a principal ray count (a count comprising all rays that reach the distal margin of the fin, and usually including one unbranched, segmented ray and all branched rays that follow). However, in the system adopted by McDowall (1970a) sometimes one or occasionally more unbranched, segmented rays are counted that do not reach the distal margin of the fin, (as they should to be counted in a principal ray count). This counting procedure establishes a definite and relatively easily determined starting point for counts on those species in which there is little or no branching of the fin rays. To enable comparison with results obtained by Frankenberg, and to also allow comparison with data obtained by McDowall in previous studies, counts of the dorsal and anal fin taken by McDowall in this study include both a total ray count, as used by Frankenberg, and a count of all segmented rays. Both sets of counts are presented in the tables of meristic data. The caudal fin ray count used was a standard principal ray count, i.e. a count of all branched rays plus the unbranched ray immediately above and below the branched rays. In paired fins all rays, except the very tiny, splint-like ray occasionally present, were counted, on one side only.

Vertebral counts were taken, usually, from radiographs, although sometimes from alizarin preparations; counts exclude hypural centra; i.e. the centrum carrying the parhypural, which forms the last haemal arch, was not included in the count. Gill rakers were counted on the first arch.

The disposition of laterosensory pores on the head, the number and size of the pyloric caeca, the occurrence of teeth on the tongue and mesopterygoids, and the presence or absence of enlarged canine teeth in the jaws were also determined.

All counts, whether of fresh material, alizarin preparations or radiographs, were made with a dissecting microscope.

Alizarin specimens were prepared using either the potassium hydroxide maceration technique of Hollister (1934) or the pancreatic enzyme digestion technique of Taylor (1967). In some instances cartilage was stained with toluidine blue (Burdi, 1965).

SYSTEMATICS

Family Galaxiidae: The family Galaxiidae was formed by Müller (1844) to contain the genus *Galaxias* Cuvier (1817). The following family diagnosis is modified from McDowall (1970a):

DIAGNOSIS: Medium-sized to small fishes (30-600 mm), with 0-6 rudimentary to well-developed pyloric caeca, usually two. Both gonads well developed, although the left may be larger than the right, ovaries gymnoarian. Urinogenital aperture on a papilla set in a post-anal depression. Sexes usually similar, male nuptial tubercles not present. All species but one are believed to breed in fresh water, the exception in tidal river estuaries; some species confined to fresh water, either lacustrine or fluviatile, others diadromous with marine juveniles. Land-locked populations of diadromous species widespread.

Scales lacking, lateral line well developed, an accessory lateral line present dorso-laterally in some species. Laterosensory pores present on head.

Pelvic fins abdominal, 4-8 rays, usually 7, or occasionally fins absent. Caudal fin emarginate to rounded, less often forked, usually 16 principal rays (14 branched), procurrent rays usually well developed along caudal peduncle and also anterior to dorsal and anal fins; dorsal and anal fins originate well back on trunk, usually about level with vent (above pelvic fins only in *Paragalaxias*). Vertebrae 37-66; branchiostegals 5-9.

Maxilla partly included in gape but toothless; teeth on premaxilla and dentary uniserial, mesopterygoidal, basihyal, and pharyngeal teeth developed (reduced or absent in *Neochanna*); no supramaxilla; no vomerine teeth.

Parietals large, uniting broadly in a median suture, supraoccipital not in contact with frontals, excluded from foramen magnum. Posterior myodome open. Orbitosphenoid, basisphenoid, and proethmoids absent; supraethmoid and ventral ethmoid usually present. Posttemporal simple; no mesocoracoid. Epipleural and epineural ribs usually present; neural and haemal arches usually autogenous, anterior uroneural not fused to terminal vertebra; none of terminal vertebrae upturned, usually a single hypural vertebra, occasionally two. Caudal neural and haemal spines usually much compressed (not in *Galaxiella* and occasional *Galaxias* spp.).

General and diagnostic characters. Fishes of the family Galaxiidae present a varied but distinctive facies. The first observers (Forster, 1778; Bloch and Schneider, 1801) saw a resemblance to the Northern Hemisphere pikes (family Esocidae), probably because of the extremely posterior position of the dorsal and anal fins, and the long-jawed appearance of the single species with which they were acquainted (*Galaxias argenteus* (Gmelin) from New Zealand). However, these similarities are largely superficial; galaxiid fishes are scaleless, with thick, highly mucigerous, rather leathery skins. The head is usually moderately large, with prominent jaws, the upper and lower varying in proportional development so that the lower may protrude, recede, or be equal to the upper in length. Lateral line pores on the head are well developed, their disposition fairly constant, and related to the supraorbital, infraorbital, mandibular, and hyomandibular branches of the lateral-line system of the head (see Lagler et al., 1962). Minor interspecific variation occurs in the relative positions of these pores. The lowermost in the preopercular series of four pores may be displaced anteriorly. The pair of pores beneath the eye, one in the infraorbital series, the other in the mandibular series, also vary in relative positions, the infraorbital pore sometimes anterior and sometimes posterior to the mandibular pore. The pore usually postero-medial to the eye sometimes migrates laterally to the margin of the orbit, and in some species tends to migrate forwards to be medial to the eye. Pore numbers are consistent in all Australian *Galaxias* species except *G. parvus* and *G. fontanus* (Fig. 47).

Variation is greater in *Paragalaxias* and *Galaxiella,* with pores lost and pore positions more variable. In particular the mandibular pores have been lost in *Galaxiella* and in two species of *Paragalaxias*. Various modifications of the generalized galaxiid pattern are shown for the species of these genera in Fig. 47. The very large pores in *P. dissimilis* are notable, as is the confluence of the posterior nostril with one of the supraporbital pore series in three species of *Paragalaxias*.

The lateral line is well developed on the trunk from the upper edge of the opercular aperture to the middle of the tail base. In some species groups there is a dorsal accessory lateral line along the dorso-lateral trunk, evident as a more or less distinct linear series of small, widely-separated papillae from the occiput to about the dorsal fin.

The nostrils are well developed, the anterior one set in a small depression and tubular. In some species the anterior nostril is especially well developed, and may project forwards beyond the upper lip. The posterior nostril is a simple aperture.

The form of the mouth varies, the profile of the jaws from the ventral aspect varying from deep and narrow, U-shaped, to broad and shallow with the depth much less than the breadth.

The dorsal and anal fins are posterior; in most species the dorsal originates about level with the vent although it may originate above the pelvic fins (*Paragalaxias*), or somewhat behind the vent (*Brachygalaxias* and *Galaxiella*). When depressed the dorsal and anal fins may overlie the base of the caudal fin. These fins are variable in shape and size, are usually short-based, sometimes high and rounded, but in other instances much lower, the hind rays short, and the fin not extending back far beyond the fin base, or rays subequal in length, the fin long and low. The caudal fin varies from well-forked to much-rounded. The pelvic fins are usually rounded in shape and expansive; they originate at or a little behind the mid-point of the standard length. The pectoral fins are more variable in length and position; they may be quite high laterally with the lamina of the fin vertical, or low lateroventrally with the fin lamina tending to be more horizontal. In many species all the fins are thick and fleshy, especially at the bases.

Teeth are present on the premaxilla, dentary, basihyal and mesopterygoid, the pharyngobranchial of the third, the epibranchial of the fourth and the ceratobranchial of the fifth branchial arches. The basibranchial plate is toothless. Teeth on all but the basihyal and pharyngeal bones are uniserial; sometimes there is a tendency for teeth to be displaced laterally from the primary row which then appears partly biserial. Mesopterygoidal teeth are reduced or absent in the neochannoid species. The teeth are usually conical but in *Neochanna apoda* Günther (New Zealand) the jaw teeth are peculiarly flattened and incisor-like. In many species the jaw teeth are enlarged laterally as opposing groups of canines; one species has slightly enlarged, fang-like teeth at the mandibular symphysis. Associated with the toothed bones are unattached or decumbent teeth, which usually lie freely in the tissue covering the bones.

The structure of the ovaries in the family Galaxiidae was described as gymnoarian by Hoar (1957). Kendall (1922) examined the "oviducts" of some salmonoids and concluded that they are shallow, open troughs and not entirely lacking, and that they are not radically different from those of other primitive fishes. However, the reduced condition of the oviducts, as in the Salmonidae, persists throughout the salmoniform fishes. The condition is sufficiently different for Hoar to distinguish them from other ovarian types. Breder and Rosen (1966:614) followed Hoar, stating that in the Galaxiidae and other salmoniforms, the "ova pass into the peritoneal cavity and thence through the pores to the exterior". Henderson (1967) concluded that the eggs of salmonids are discharged into the abdominal cavity, and that proper oviducts are lacking.

Galaxiid fishes exhibit considerable plasticity in form. Most characters were found to vary from species to species and even characters which vary little, like pelvic and caudal fin ray counts, or disposition of cephalic laterosensory pores, were found to differ from the norm in several phylogenetic lineages. Stokell (1945) considered vertebral number to be the most important taxonomic character for the New Zealand galaxiid fauna. This has proved to be a useful character, but it is important to bear in mind the effect of temperature during development on vertebral number; wide variation in vertebral number has been documented in some galaxiids, e.g. *G. maculatus* 52-66 (McDowall, 1972).

Apart from vertebral number, important meristic characters include number of caudal, anal, pelvic and to a lesser extent dorsal and pectoral fin rays. The number of gill rakers exhibits interspecific variation. The most important morphometric characters were the following: length and depth of caudal peduncle, relative positions of the dorsal and anal fins, and their basal and maximum lengths, lengths of the pectoral and pelvic fins, length of the pelvic-anal interval, head length, eye diameter, lengths of upper and lower jaws, width of gape. The degree of development of canine and mesopterygoidal teeth, pyloric caeca and gill rakers exhibits inter-specific variation.

In some species groups and many species, colour pattern is diagnostically important, in spite of individual variation. In other species groups specific distinctness is clearly indicated by fundamental differences in the life history pattern, some species being diadromous with a distinctive marine juvenile stage, similar and related species being entirely freshwater without a distinctive juvenile form.

Most of the taxonomic characters used are conventional in ichthyology, but the morphological plasticity of the Galaxiidae results in a considerable diversity in such characters. Some are stable and unimportant throughout much of the family but show significant variation in certain species or species groups; other characters vary widely throughout the family.

Relationships of galaxiid fishes. The relationships of the family Galaxiidae remained obscure for many years. Early authors pointed to similarities between galaxiids and the esocoid fishes (families Esocidae and Umbridae), and at times the family has been assigned, with these families to the so-called Haplomi or Esociformes. Inasmuch as the esocoids were formerly well separated from the salmoniform fishes in postulated fish phylogenies, this was an important matter. However, beginning with Berg (1940), there has been a growing concensus that esocoids and salmonoids are closely related, and both Gosline (1960) and Greenwood et al. (1966) followed Berg in placing the two groups as coordinate suborders with close affinities. Close salmonoid affinities for the Galaxiidae were indicated by Weitzman's (1967) study, and this view was further strengthened by a study of the osteology of the Galaxiidae and the other southern hemisphere salmoniform fishes found in fresh waters (Aplochitonidae, Retropinnidae, Prototroctidae), by McDowall (1969). McDowall suggested that these four families form two distinct groups — Galaxiidae-Aplochitonidae and Retropinnidae-Prototroctidae, the four forming a suborder Galaxioidei which was thought to be derived from an osmerid or salmonid-like ancestry. Patterson (1970), however, suggested that the Galaxiidae-Aplochitonidae pair has a derivation in primitive salmoniforms distinct from the origin in the salmoniforms of the Retropinnidae-Prototroctidae. Nelson (1972) from an examination of the occurrence and disposition of laterosensory pores and papillary rows on the head concluded to the contrary, that the four families are closely related and included all four families in the single family Galaxiidae, with two subfamilies Galaxiinae and Retropinninae. Then Rosen (1974), primarily on the basis of osteological evidence, agreed with Patterson (1970); Rosen suggested that the galaxiid and aplochitonid fishes have close affinities with the Salmonidae and the retropinnid and prototroctid fishes with the Osmeridae. Rosen recognised only the families Galaxiidae (including Aplochitonidae) and Retropinnidae (including Prototroctidae).

Although Rosen included *Aplochiton* and *Lovettia* in the Galaxiidae, these two genera stand apart from galaxiids (*sensu stricto*), and they have been excluded from the family in this account. Whatever the familial arrangement of these groups, the salmoniform relationships of the galaxiid fishes are generally agreed upon.

The genera of galaxiid fishes. Some general comment on the approach to generic classification of galaxiid fishes is appropriate here as a prelude to discussion of the actual classification. Early workers were conservative in their use of new generic names, and by 1900 only three valid names had been proposed, of which two were in general use (*Galaxias* Cuvier and *Neochanna* Günther). *Brachygalaxias* Eigenmann followed in 1928. In the 1930's, Whitley (1935) proposed three new generic names, one of these mentioned in the text, but undiagnosed, the other two simply listed in the caption to a figure as "gen. nov." Scott (1935, 1936), on the other hand, first described *Paragalaxias* and then followed with his complex classification based on broad assemblages of characters of diverse types, but without any apparent analysis of the significance of these characters to phylogenetic relationships. Scott (1966) later reasserted the validity of his generic arrangement, somewhat modified, possibly, in part, in response to Stokell's (1945) general rejection of it. Use of even such normally stable characters as disposition of laterosensory pores on the head, is fraught with problems. For example, the loss of the submandibular pores occurs in the South African *G. zebratus,* in two of four Tasmanian species of *Paragalaxias* and in the three Australian species of *Galaxiella*. Since two of the *Paragalaxias* species retain these pores, their occurrence presumably being a primitive character and their loss derived, either all those species lacking the pores are derived through the *Paragalaxias* which retain the pores and which are therefore likely to be more primitive than other *Paragalaxias,* or the loss of the pores has occurred in several, probably three distinct galaxiid lineages. The former alternative seems highly unlikely, being quite unsupported by any other morphological evidence, and suggests that loss of the submandibular pores has occurred convergently at least two and possibly three times.

Study of the broad spectrum of galaxiid fishes suggests that the diadromous species are more generalised and primitive, and that there is a tendency for freshwater limited species to be more derived and specialised. This is indicated by the fact that all of the proposed galaxiid genera, apart from the type genus *Galaxias,* and with the exception of *Austrocobitis* Ogilby, refer to entirely freshwater dwelling species. The association between restrictions to fresh water and specialisation could be taken to indicate that common morphological peculiarities shared by freshwater limited species may be related to independent development of adaptations to specialised freshwater habitats and habits.

Reduction in the number of pelvic fin rays has occurred in widely divergent phylogenetic lineages. The number of rays is stable at seven in most species, but in *Brachygalaxias bullocki* (Eigenmann) (Chile), *G. zebratus* (Castelnau) (South Africa), *Neochanna burrowsius* (Phillipps), *G. divergens* Stokell, *G. gracilis* McDowall (New Zealand), *Galaxiella* species, *Paragalaxias* species, *G. cleaveri* Scott (Australia), there is reduction from seven to six or fewer. The classification adopted here is intended to reflect phylogenetic relationships, and generic distinctions are based as far as can be determined on characters that are not obviously plastic or prone to rapid modification. We have sought to apply this approach to the generic classification of the Australian Galaxiidae.

The first fish that can certainly be associated with the family Galaxiidae came from Dusky Sound, New Zealand, and was referred to the genus *Esox* (Forster, 1778; Gmelin, 1789; Bloch and Schneider, 1801). The genus *Galaxias* was established by Cuvier (1817) without the nomination or inclusion of a valid species of *Galaxias* in the genus. For this reason the type species is determined by subsequent usage and *Galaxias fasciatus* Gray (1842) is the type species by subsequent monotypy (McDowall, 1967a). *Galaxias* Cuvier (1817) predates *Galaxias* Beck (1837) — Mollusca.

Jenyns (1842) described several species in the new genus *Mesites,* apparently in ignorance of the previously described genus *Galaxias,* the name *Mesites* being further invalidated by preoccupation for a genus of beetles (Schoenherr, 1838). *Mesites* was also used for a genus of birds by Saint-Hilaire (1838).

Ogilby (1899) regarded Jenyns' species (*G. maculatus, G. attenuatus* and *G. alpinus*) as sufficiently distinct to warrant a separate genus, and as *Mesites* was preoccupied he proposed the name *Austrocobitis.* Günther (1866) after describing the 12 then known species in the genus *Galaxias* subsequently described a new species lacking pelvic fins in the new genus *Neochanna* Günther, (1867).

Regan (1905) in his general revision of the family Galaxiidae dealt with 26 species, but did not recognise *Austrocobitis.* Eigenmann (1928), in a systematic work on freshwater fishes in Chile, established the genus *Brachygalaxias* for *Galaxias bullocki* Regan (1908). *G. pusillus* Mack (1936) was subsequently included in *Brachygalaxias* by Scott (1942). The genus *Paragalaxias* was proposed by Scott (1935) for a Tasmanian species. In 1935 Whitley proposed three new genera — *Nesogalaxias* for *Galaxias neocaledonicus* Weber and de Beaufort (1913) — New Caledonia; *Lyragalaxias* for *Galaxias oconnori* Ogilby (1912) — Queensland; and *Querigalaxias* for *G. dissimilis* Regan (1905) — "New South Wales". None of these three genera was described or diagnosed by Whitley. Although *Nesogalaxias* was sustained and diagnosed by McDowall (1968a), neither of the other genera has been used or diagnosed by serious students of galaxiid fishes; *Querigalaxias* is a junior objective synonym of *Paragalaxias* Scott.

Scott (1936), in a revision of Tasmanian galaxiids, proposed a complex infrafamilial classification of the Galaxiidae, including a subfamily Paragalaxiinae for the genus *Paragalaxias* and a subfamily Galaxiinae for the remainder of the family. The genus *Galaxias* was subdivided into two subgenera — *Galaxias* and *Agalaxis* — (the latter to contain the single South African galaxiid *G. zebratus*); the genus *Neochanna* was sustained by Scott, and a new genus *Saxilaga* proposed, with two subgenera — *Saxilaga* and *Lixagasa*. Subsequently in a revision of New Zealand galaxiid fishes, Stokell (1945) excluded *Paragalaxias* from the family Galaxiidae and listed *Mesites, Austrocobitis, Brachygalaxias, Querigalaxias, Lyragalaxias, Nesogalaxias, Saxilaga* and *Agalaxis* as "Not Recognised". Stokell (1950) subsequently readmitted *Paragalaxias* to the Galaxiidae and later (1954) recognised *Brachygalaxias* for both South American and Australian species. Whitley (1965a, b, 1957, 1960) consistently used *Brachygalaxias* for Australian species and this usage has been adopted by Scott (1966, 1971a), Frankenberg (1966a, b, 1968), Lake (1971), and others.

Scott's (1936) complex infrafamilial classification was never adopted by other workers, and was partly abandoned by Scott himself (Scott, 1966). McDowall (1973b) examined the South African galaxiid and concluded that there are no grounds for retention of the genus *Agalaxis* for this species. Subsequently McDowall (1973c) examined the limits of the genus *Brachygalaxias* in relation to the type species *B. bullocki* from Chile and the Australian species included by some in this genus. He concluded that although there are certain similarities between *Brachygalaxias* and the Australian species, there is little evidence to indicate that the similarities are a result of any close phylogenetic relationship. *Brachygalaxias* was therefore limited to the Chilean species.

Although the inclusion of Australian species in *Brachygalaxias* is regarded as inappropriate by McDowall (1973c), the three Australian species which would, under Scott's (1942, 1966) criteria, be included in *Brachygalaxias* nevertheless form a close-knit and compact species group that very obviously has a close common ancestry that relates them to each other more closely than to other galaxiids. They certainly stand apart from the general array of galaxiid fishes at about the same level of distinction as do the three New Zealand species of *Neochanna,* the single New Caledonian species of *Nesogalaxias,* or the four Tasmanian *Paragalaxias,* and for this reason the establishment of the distinct genus seemed justifiable. No name was available for such a genus, and the name *Galaxiella* was proposed, a diminutive of *Galaxias* (McDowall, 1978a).

The genus *Saxilaga* Scott (1936) was diagnosed by its five or six pelvic fin rays, dorsal and anal fin rays simple or a mixture of simple and branched, and mesopterygoid toothless. Andrews (1976) has shown that all these characters vary within populations to such an extent that some individuals of the species that Scott (1936) places in *Saxilaga* belong in *Galaxias* (i.e. have seven pelvic fin rays, dorsal and anal rays branched, mesopterygoids toothed), while others belong in *Saxilaga*. Thus the distinction between *Saxilaga* and *Galaxias* breaks down at the population level, and *Saxilaga* cannot be retained.

As a result of this and previous studies on galaxiid fishes, the following genera are recognised:

Galaxias Cuvier — Australia, New Zealand, South America, South Africa (includes *Agalaxis* Scott, *Saxilaga* Scott, *Austrocobitis* Ogilby, and *Mesites* Jenyns.

Neochanna Günther — New Zealand.

Paragalaxias Scott — Tasmania.

Brachygalaxias Eigenmann — Chile.
Nesogalaxias Whitley — New Caledonia.
Galaxiella McDowall — Australia.

KEY TO AUSTRALIAN GENERA OF GALAXIIDAE

1. Dorsal fin origin forward, above pelvic fin bases ....*Paragalaxias* p.569

   Dorsal fin origin, posterior, distinctly behind pelvic fin bases, more or less above vent 2

2. Dorsal fin origin distinctly behind anal origin; procurrent caudal fin rays reduced to 3-4; no laterosensory pores beneath lower jaw; less than 16 principal caudal rays, usually 13-14 ....*Galaxiella* p.552

   Dorsal fin origin usually above or a little in front of anal origin; procurrent caudal fin rays more than 3-4; laterosensory pores present beneath lower jaw; usually 16 principal caudal rays ....*Galaxias* p.455

Genus **Galaxias** Cuvier

Galaxias Cuvier, 1817: 183 (type species *Galaxias fasciatus* Gray, 1842, by subsequent monotypy).
Mesites Jenyns, 1842: 118 (type species *Mesites attenuatus* Jenyns, 1842, by subsequent designation, Jordan, 1919: 212, preoccupied by *Mesites* Schoenherr, 1838, Coleoptera).
Austrocobitis Ogilby, 1899: 158 (type species *Mesites attenuatus* Jenyns, 1842, by subsequent designation, Whitley, 1956a: 34).
Saxilaga Scott, 1936: 106 (type species *Galaxias cleaveri* Scott, 1934, by original designation).

DIAGNOSIS: Trunk cylindrical to a little compressed, naked; dorsal fin origin very posterior, about above vent. Pelvic fins present, six to eight rays, usually seven; pectoral fin positioned laterally to low lateroventrally. Caudal fin with 16 principal rays, occasionally fewer. Jaw teeth conical, uniserial, with or without enlarged lateral canines; mesopterygoidal teeth well developed to rudimentary, uniserial; lingual teeth biserial. Median supraethmoid and ventral ethmoid present; postcleithrum present or absent; epipleural and epineural ribs present.

KEY TO AUSTRALIAN SPECIES OF *GALAXIAS*

1. Caudal fin distinctly rounded...2.
   Caudal fin emarginate to forked...3.

2. Vertebrae 44-49; no pyloric caeca; 3 preopercular pores (Lake Pedder area, Tasmania) ....*G. parvus* p.523
   Vertebrae 56-60; 2 long pyloric caeca; 4 preopercular pores (Tasmania, low elevations in north, west and south-east) ....*G. cleaveri* p.519

3. Usually 5-6 pores in series from below eye to anterior nostril (Swan River, eastern Tasmania ....*G. fontanus* p.498
   Four pores in series from below eye to anterior nostril 4

4. Gill rakers short and stout; anal fin origin usually below middle of dorsal, or further back...5
   Gill rakers long and slender; anal fin origin below dorsal origin or as far back as mid-dorsal 7

5. 2 pyloric caeca of moderate length (Clarence Lagoon, Tasmania). G. johnstoni p.489
   0-1 pyloric caeca, occasionally 2 6
6. Head short and bluntly rounded; usually 14-16 pectoral fin rays (widespread in southeastern Australia) ....*G. olidus* p.469
   Head longer, flattened above and tapering to a slender snout; usually 12-13 pectoral fin rays. (Lake Pedder, Tasmania) ....*G. pedderensis* p.493
7. Pyloric caeca long; lower jaw shorter than upper (coastal drainage from about Sydney to Adelaide, also Tasmania) ....*G. brevipinnis* p.456
   Pyloric caeca reduced to vestiges, or lacking, jaws about equal.........................8
8. Caudal fin forked; pec./pec.pel. and pel./pel.an. ratios less than 50%; fish slender bodied..9
   Caudal fin truncate to emarginate; pec./pec.pel. and pel./pel.an. ratios more than 50%; chunky and deep bodied...11
9. Mouth small, reaching only to front of eyes (coastal drainages of New South Wales, Victoria, South Australia, Tasmania and southern coast of Western Australia) ....*G.maculatus* p.526
   Mouth larger, reaching distinctly below eyes...10
10. Small fangs at mandibular symphysis and lateral canines developed; distinct, bold, paired vertical bands along sides (southwestern Western Australia) ....*G. occidentalis* p.542
    No fangs or canine teeth; little pigmentation and no bands on sides. (Murray-Darling drainage) ....*G. rostratus* p.549
11. Dorsal, anal and pelvic fins with grey-black margins......................................12
    Dorsal, anal and pelvic fins without grey-black margins. (Arthurs Lake, Tasmania) ....*G. tanycephalus* p.516
12. Widely spaced, occellated, round spots along sides, distinct dark blotch, sometimes split into two, behind opercular opening and above pectoral fin base; vertebrae 56-62, usually more than 59 (Victoria and Tasmania, also southern Western Australia) ....*G. truttaceus* p.501
    Closely spaced, vertical occellated bars along sides, these becoming fragmented into vertical series of ovoid blotches; no distinct dark blotch behind opercular opening; vertebrae 53-56. (Lakes Sorell and Crescent, Tasmania) ....*G. auratus* p.512

Galaxias brevipinnis Günther

Fig. 1, 3

Galaxias brevipinnis Günther, 1866: 213 (syntypes: (3) BMNH 1853.2.14: 5-7, not seen; type locality; New Zealand); McDowall, 1970b: 18; 1971: 65; Lake, 1971: 20; Andrews, 1973: 104; Lynch, 1974: 11; Andrews, 1976: 312; Lynch, 1977: 14; McDowall, 1978c: 61; 1978d: 97; McDowall and Fulton, 1978b: 663; Fulton, 1978b: 3; Lake, 1978: 26; Backhouse and Vanner, 1978: 128.

Galaxias coxii Macleay, 1881: 45 (syntypes: (3) formerly MMS, now AMS I.16262-001,*

* Macleay's types were originally held in the Macleay Museum at Sydney University, and were listed by Stanbury (1969) as "Approx. 14", no. F 87. The collection at the Macleay Museum was transferred to the Australian Museum, and the label in the jar states "14? specimens, 2 jars". But all the specimens are in one jar and there are 21 fish. Amongst these 21 fish are presumably the three syntypes mentioned by Macleay as being "seven inches long". All of the 21 specimens appear to belong to the same species, although this will always remain uncertain owing to the very poor condition of some of them. The source of the 18 fish additional to the three syntypes is unknown. Regan (1905), when redescribing *G. coxii* stated that "The specimens (4) received from the Australian Musuem without name and without locality evidently correspond to Macleay's *Galaxias coxii* from Mount Wilson . . . and may probably be regarded as the types of that species". This cannot be correct as Macleay nominated only three types which were in the Macleay Museum in Regan's time.

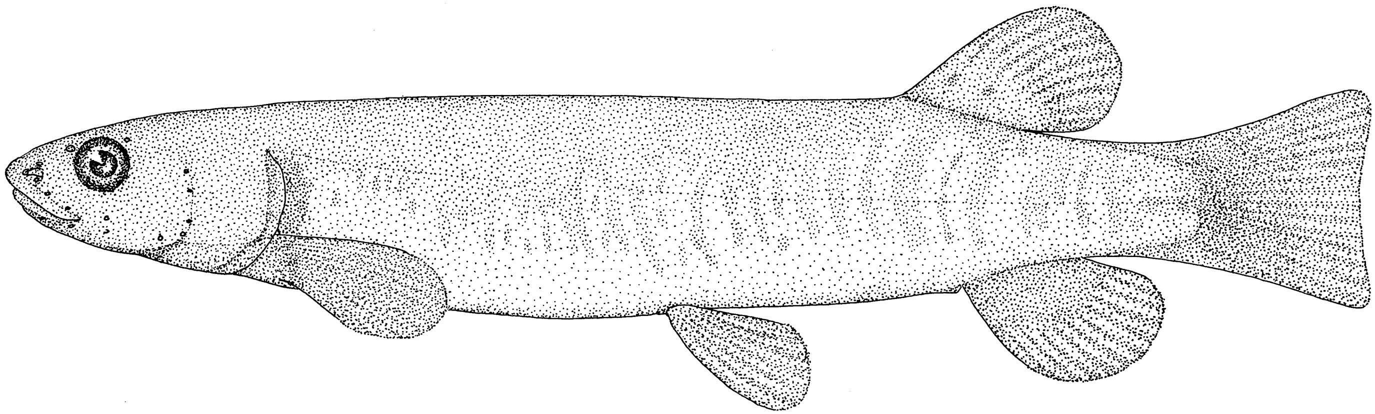

Fig. 1. *Galaxias brevipinnis* Günther; Gerringong Creek, Kangaroo Valley, N.S.W. 121 mm L.C.F.

seen; type locality: a small rivulet on or near the summit of Mount Wilson, Colo River, New South Wales); 1882: 232; Ogilby, 1886: 54; 1893: 176; 1896: 69; Waite, 1904: 16; Regan, 1905: 380; Stead, 1906: 50; 1908: 33; Zietz, 1908: 297; Gale, 1915: 16; Waite, 1921: 42; McCulloch, 1921: 28; 1922: 18; 1927: 18; 1929: 48; Mack, 1936: 99; Butcher, 1946: 9; Whitley, 1956a: 30; 1956b: 39; 1957a: 7; 1957b: 10 (*partim*); Munro, 1957b: 17; Littlejohn, 1962: 311; Whitley, 1964: 35; Williams, 1964: 14; Frankenberg, 1966a: 162; 1966b: 20; 1967: 22; McDowall, 1968c: 157; Stanbury, 1969: 205; Scott, 1971a: 8; Lake, 1971: 20; Green and McGarvie, 1971: 30; Dixon, 1972: 121; Frankenberg, 1974: 119; Tilzey, 1974: 12 *(partim?)*; Timms, 1974: 277; Tilzey, 1976: 555.

Galaxias weedoni Johnston, 1883: 131 (holotype: unknown — Whitley 1929, designated a figure of *G. weedoni* as the type but this is not a type of any recognised sort; type locality: Mersey River, Tasmania); Seal et al., 1883: lvi; Macleay, 1885: 56; Ogilby, 1896: 70; Regan, 1905: 371; Lord, 1923: 63; Lord and Scott, 1934: 33; McCulloch, 1929: 47; Whitley, 1929: 46; Scott, 1934: 46; Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 16; Gentilli, 1961: 488; Whitley, 1964: 35; Lynch, 1965: 13; 1966: 13; Stokell, 1966: 76; Scott, 1968: 26; Lynch, 1969: 23; McDowall, 1970a: 371; Scott, 1971b: 120; 1974: 254; McLean, 1974: 13.

Galaxias atkinsoni Johnston, 1883: 121 (holotype: unknown; type locality: Pieman River, Tasmania); Seal et al., 1883: lvi; Macleay, 1885: 56; Ogilby, 1896: 69; Whitley, 1956a: 34; 1964: 35.

Galaxias nigothoruk Lucas, 1892: 27 (syntypes: (4) NMVM A.408-411, seen, BMNH 1891.9.24:44 not seen*; type locality: Lake Nigothoruk = Lake Tali Karng, Victoria); Ogilby, 1896: 70; Dendy, 1919: 326; Stokell, 1947: 671; Whitley, 1956a: 34; 1956b: 39; 1964: 35.

Galaxias affinis Regan, 1905: 380 (*partim;* syntypes: (3) BMNH 1893.6.15. 12-14, seen; (1) AMS I.7435, seen; specimens I.7434 (2), not types; type locality: Lake St. Clair, Tasmania); Lord, 1927: 12; McCulloch, 1929: 48; Scott, 1934: 39; Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 17; Whitley, 1964: 35; Stokell, 1966: 76; Scott 1968: 7; Frankenberg, 1968: 272; Fryer, 1969: 52; Lake, 1971: 20.

Galaxias weddoni — Lord, 1927: 12 (mis-spelling of *G. weedoni* Johnston).

Galaxias (Galaxias) parkeri Scott, 1936: 99 (holotype: BMNH 1937.4.3:1, seen: paratypes (11) BMNH 1937.4.3: 2-10, seen; (6) QVML 1971.5: 20-23, seen; (4) AMS IA.6414, seen; Scott indicated that he intended sending paratypes to the Museo Argentina Ciencias Naturales, Buenos Aires, the Australian Institute of Anatomy, Canberra, the Musuem of the Department of Biology, University of Tasmania, and the Tasmanian Museum, Hobart; these were apparently never sent; type locality: Great Lake, off Howell's Neck, Tasmania) 1941: 60; 1942: 541.

Galaxias (Galaxias) affinis — Scott, 1936: 91; 1938: 120.

*Regan (1905:380), when synonymising *G. nigothoruk* and *G. coxii* stated that he had examined a specimen "(95 mm) one of the type(s?) of *G. nigothoruk,* Nigothoruk, Victoria", received from Professor A. Dendy. Dendy worked for a time in Victoria (with A. H. S. Lucas who described *G. nigothoruk),* before leaving for New Zealand. Whether the specimen he sent to Regan is, in fact, a type is unclear and Regan's comments on the status of *G. coxii* specimens he was sent suggest that he, in some instances, assumed that he was being sent type material. The status of the British Museum specimen of "*G. nigothoruk*" is indeterminate and is likely to remain so.

Galaxias (Galaxias) weedoni — Scott, 1936: 91; 1941: 60; 1942: 54.

Galaxias parkeri — Whitley, 1956a: 34; 1956b: 30; 1957a: 7; 1957b: 10; Munro, 1957b: 16; Gentilli, 1961: 488; Lynch, 1967: 20; Whitley, 1964: 35; Scott, 1968: 8; Frankenberg, 1974: 119; Green 1974: 3.

Galaxias truttaceus truttaceus — Scott, 1962: 68; (non *Galaxias truttaceus* Valenciennes).

Galaxias truttaceous — Scott, Glover and Southcott, 1974: 77; (non *Galaxias truttaceus* Valenciennes).

Additional synonyms from the New Zealand region:
Galaxias campbelli Sauvage, 1880: 229.
Galaxias lynx Hutton, 1896: 317.
Galaxias robinsoni Clarke, 1899: 89.
Galaxias bollansi Hutton, 1901: 198.
Galaxias huttoni Regan, 1905: 373.
Galaxias castlae Whitley and Phillipps, 1940: 229.
Galaxias koaro Phillipps, 1940: 35.
Galaxias kaikorai Whitley, 1956c: 34 (see McDowall, 1970a, 1976a).

TAXONOMY: *G. brevipinnis* is a relatively little known and infrequently collected species in continental Australia, although it is better known in Tasmania through the work of Scott (1936) and as a component of the Tasmanian whitebait fishery (Lynch, 1965, 1966, 1974).

Until 1970 (McDowall, 1970b) it was known as *G. weedoni* Johnston and *G. parkeri* Scott in Tasmania and as *G. coxii* Macleay in the mainland. The name *G. affinis* Regan (Tasmania) had not been assigned to any known species although Mack (1936) considered *G. affinis* to be doubtfully distinct from *G. coxii*. A tentative suggestion that *G. weedoni and G. parkeri* are synonyms of *G. brevipinnis* Günther (New Zealand — McDowall, 1970a) was supported by the study of additional material from Tasmania (McDowall, 1970b) and further supported by Andrews (1976) in a review of the Tasmanian galaxiid fauna. Andrews also assigned *G. coxii* (Australian mainland) and *G. affinis* to the synonymy of *G. brevipinnis.* However, Frankenberg (1974) retained the names *G. coxii* for diadromous populations and *G. parkeri* for lacustrine populations in Tasmania although he affirmed that these two species, with *G. brevipinnis,* form a closely related species group. The group is distinguished by the elongate, rather slender form; depressed head, distinct canines laterally in both jaws; moderate to large pectoral fins that are placed low on the body with the lamina directed ventrally; short dorsal and anal fins with the anal origin well behind the dorsal origin; caudal peduncle much longer than deep; two pyloric caeca; and, usually, a prominent blue-black patch above the pectoral fin base.

Extensive data on material from Australia do not reveal any significant differences in form or meristic characters between populations usually referred to as *G. coxii* in Australia and *G. brevipinnis* in New Zealand. Comparision of the Australian data with New Zealand figures (Table 1; Fig 2) shows that New Zealand counts of fin rays and vertebrae are a little higher than Australian ones, but overlap is broad, variation between Australian populations about as broad as differences between Australian and New Zealand ones, and the differences not more than could be expected from clinal variation along about 20½° of latitude (about 2,300 km).

Vertebral number in the Australian populations is lower than in New Zealand ones, but this difference is continuation of an observed northwards increase in vertebral counts in the New Zealand populations (McDowall 1970a) (Fig. 3).

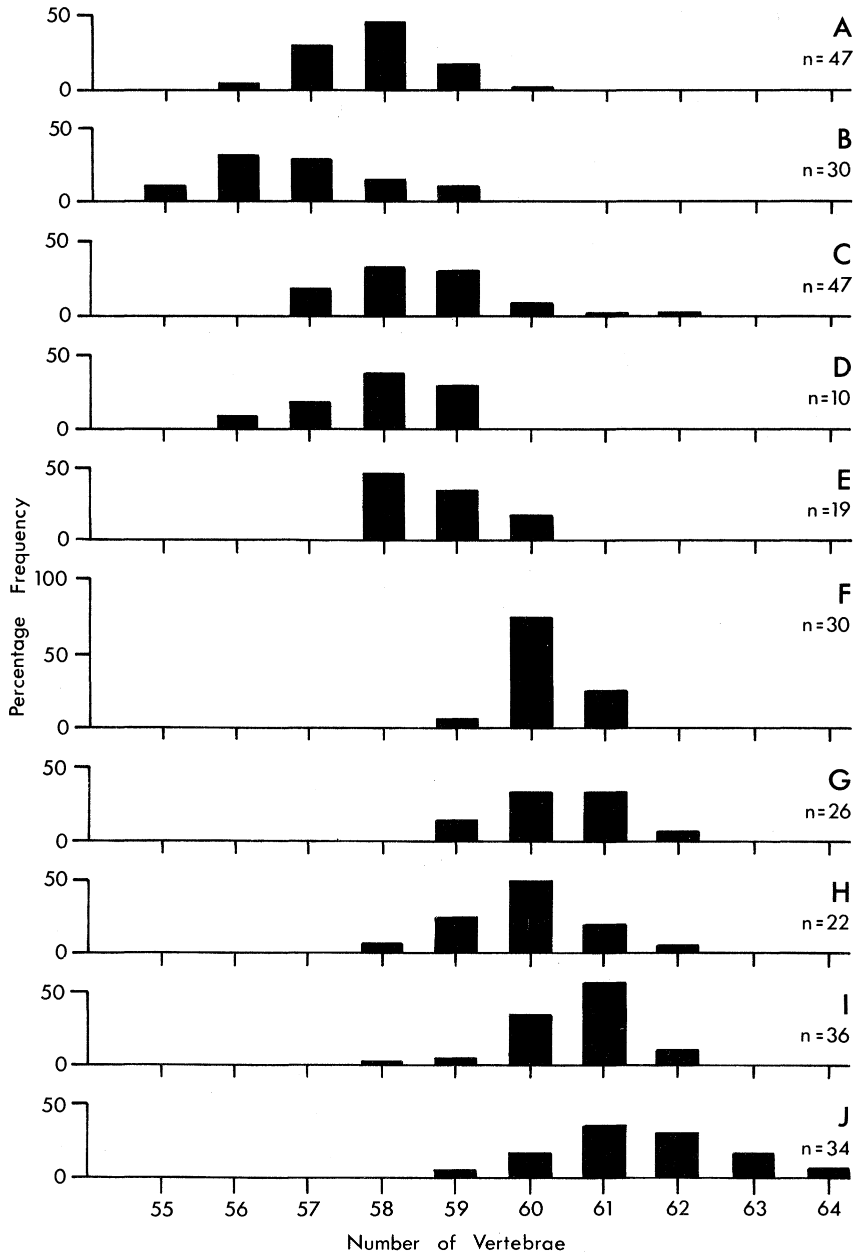

Fig. 2. Variation with latitude in the number of vertebrae in *Galaxias brevipinnis;* **a.** New South Wales; **b.** South Australia; **c.** Victoria; **d.** Flinders Island; **e.** Northern Tasmania; **f.** North Auckland, New Zealand; **g.** Wellington, New Zealand; **h.** Mid West Coast South Island, New Zealand; **i.** Haast, New Zealand; **j.** Auckland and Campbell Islands.

Body proportions in populations from the two areas are very similar, the most substantial differences being in the size of the pectoral fins and width of the interorbital. In most characters Australian and New Zealand forms are virtually inseparable. Although not evident in measurements, observations suggest that the jaws tend to be more equal in length in Australian populations, particularly those in the Blue Mountains.

Colouration of Australian populations is more variable. In most areas there is the prominent blue-black patch above the pectoral fin. Juveniles have distinctive chevron-shaped bands across the sides. In all populations these bands tend to become fragmented into irregular blotching or patching, but remain in some fish in all areas until adult size is reached. In New Zealand, colour development goes no further than this. In Tasmanian populations there is a tendency in some fish for the chevron bands to fragment into round spots rather than irregular blotching, and it appears that with the decrease in latitude, this tendency is accentuated, fish in populations from the north being more often spotted than blotched. However, colouration is immensely variable, a single population containing a very wide range of colour patterns (Fig. 2). It appears that in New Zealand, at the southern limits of the species' range, development of colour pattern is abbreviated and less variable than in more northern Australian populations.

There seems little justification for treating *G. brevipinnis* and *G. coxii* as distinct, and the view of Andrews (1976) is adopted here, with *G. brevipinnis* the senior synonym.

Regan's (1905) name *G. affinis* was treated as a junior synonym of *G. brevipinnis* by Andrews (1976:313), although he commented only that "results of the present study confirm . . . *G. coxii* and *G. affinis* are also synonyms of *G. brevipinnis*". Several characters in Regan's (1905) description clearly indicate the identity of *G. affinis* — distinct lateral canine teeth, small eyes (18.2-23.1% of head length), rather short dorsal and anal fins (total rays 10-12 and 12-14 respectively), anal origin below middle of dorsal fin, large pectoral and pelvic fins, long, slender caudal peduncle (D.C.P./L.C.P. 66.7-75.1%), and the "dark vertical bar above the base of the pectoral fin" (Regan, 1905:380). Examination of the syntype of *G. affinis* in the Australian Museum confirms its identity as *G. brevipinnis*.

In addition to the types from Lake St Clair, Regan (1905) also examined two smaller fish (73 and 78 mm long) from "Tasmania" which are also in the Australian Museum (No. I 7434). These are listed as syntypes by Andrews (1976) but they were not designated as types by Regan, and they are not *G. brevipinnis*. They do not have enlarged lateral canines, have small pectoral (Pec./Pec.Pel 36.2-40.7%) and pelvic (Pel./Pel.An 40.0-46.8%) fins, and have only a single pyloric caecum. They belong to the *G. olidus* species group (see p.469).

As these specimens were not designated as types by Regan (1905), there is no problem as to the specific identity of the types of *G. affinis* and designation of a lectotype is not necessary.

Study of populations over a wide area of New South Wales, Victoria, South Australia and Tasmania gave little evidence of meaningful patterns of variation except for an increase in the number of vertebrae relating to increasing latitude (Fig. 3). Northern populations have fewer vertebrae than southern ones. The population in Great Lake (Tasmania) has distinctly fewer vertebrae. Reduced vertebral counts have also been reported in New Zealand landlocked populations and this is presumably the explanation for low counts in Great Lake *G. brevipinnis;* this species becomes landlocked very easily, lake populations being abundant in New Zealand, some of them established in historic times (McDowall, 1970a). Body proportions did not appear to vary in any regular fashion, although limitations in the amount of material available for study, and the great age of some of it, hindered a full analysis of variation patterns.

DIAGNOSIS: Characterised by large, low-placed pectoral and pelvic fins, anal fin origin being distinctly behind dorsal origin, thick fleshy fins, presence of enlarged canine teeth in the jaws, and of a large, dark patch above and behind the pectoral fin base.

Differs from *G. olidus* and *G. pedderensis* in having the bold dark patch above the base of the pectoral fin, in having large canine teeth laterally in the jaws, larger paired fins and two long pyloric caeca; differs from *G. johnstoni* in these characters, except that both have two pyloric caeca; differs from *G. truttaceus* and *G. auratus* in having anal fin origin well behind dorsal origin, a long and relatively slender caudal peduncle, and two long pyloric caeca.

DESCRIPTION: A large, elongate and slender bodied species, the trunk rounded in section, the belly slightly deepened, especially approaching sexual maturity, but dorsal and ventral profiles about parallel; depressed anteriorly on head and compressed behind vent. Caudal peduncle moderately long and slender, longer than deep. Head moderately long, flattened and broader than deep, cheeks broadening below eyes. Snout flattened and somewhat rounded, broad. Mouth slightly oblique, large, extending back well below eyes, lower somewhat shorter than upper. Eyes small, deep in lateral head, interorbital convex but flattened dorsally. Jaws with prominent canines laterally; mesopterygoidal and lingual teeth well developed; gill rakers of moderate length, stout (Fig. 43); two long pyloric caeca (Fig. 45). Laterosensory pores on head as in Fig. 47.

Fins well developed, thick and fleshy at bases; dorsal and anal fins short-based but high and rounded, extending back well beyond bases; anal origin set well back from dorsal origin. Pectoral fins expansive inserted low latero-ventrally with lamina of fin directed ventrally. Pelvic-anal interval short, pelvic fins long and expansive, inserted at about mid-point of standard length. Caudal fin truncated to slightly emarginate, fin tips somewhat rounded, fin depth about equal to body depth, peduncle flanges moderately developed.

Variation: meristic: see Table 1
morphometric: see Table 2.

COLOUR: Colour in life is a dark greyish-brown, darker on the back and paling somewhat on the sides, the belly a dull silvery-olive. There is a distinct blue-black blotch behind the opercular opening and above the pectoral fin base. In sunlight there is prominent golden iridescence along the back and sides in some fish. Colour pattern is highly variable and changes with growth (Fig 3). Juveniles have variable distinct chevron-shaped bands across the sides. These may persist with growth, be replaced with irregular and variable blotching, or may disappear and be replaced with fine mottling without a bold pattern. Or the fish may pass through a transition from chevron bars to round spots arranged along the chevrons, to irregularly dispersed spots, most prominent towards the tail.

In preservative the fish fade to a dull blue-grey with grey-white markings, the belly a silver-grey. After long storage they become a dull brownish colour.

SIZE: In Australia *G. brevipinnis* reaches a known maximum size of about 214 mm total length and commonly attains 150-170 mm. In New Zealand it has been recorded up to 278 mm.

HABITAT: *G. brevipinnis* is found most often in clear-flowing, rocky or bouldery streams, often deeply shaded, and often in the fast flowing water. It seems sensitive to

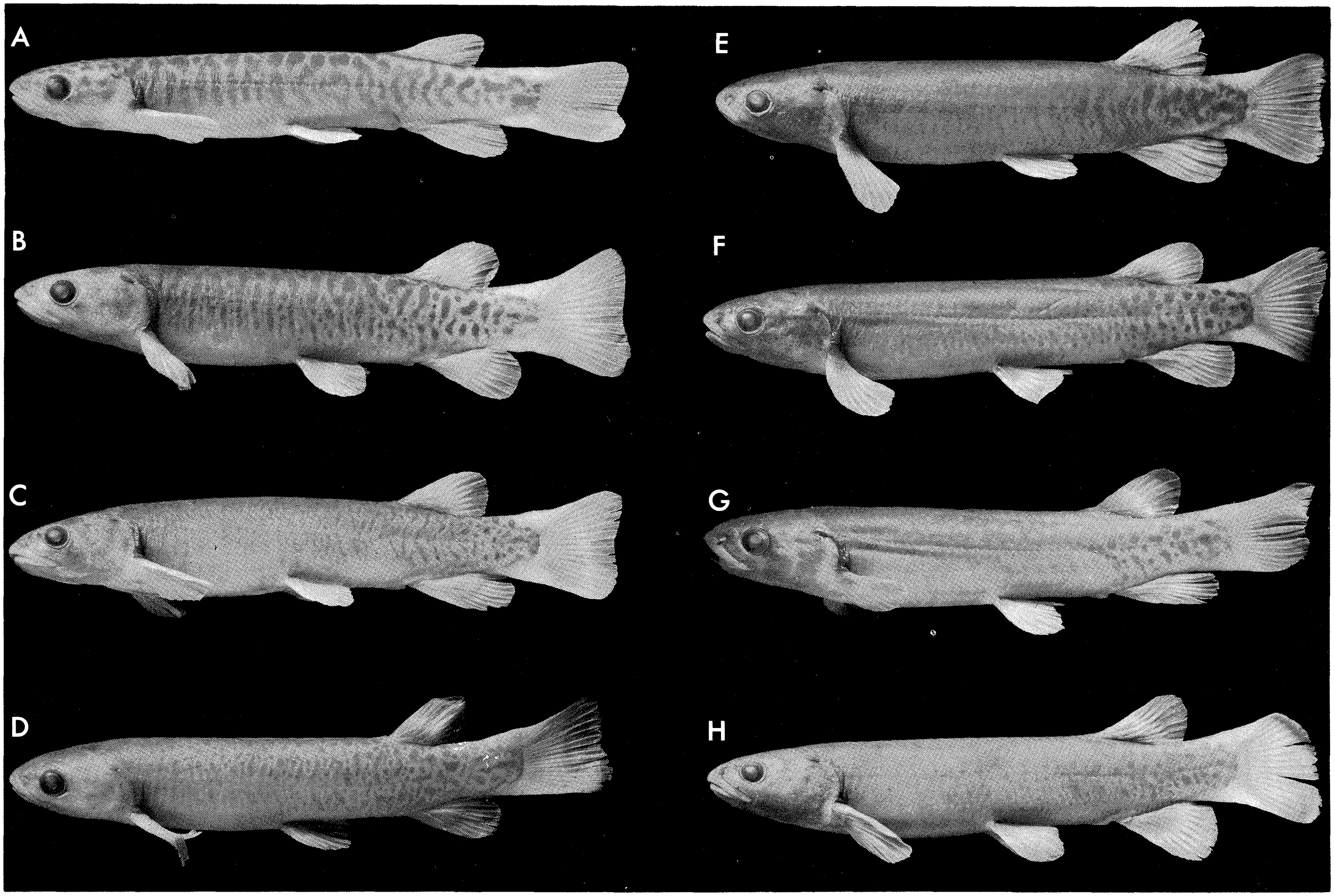

Fig. 3. Variation in colour pattern in *Galaxias brevipinnis* Gerringong Creek, Kangaroo Valley, N.S.W.: **a.** 86.5 mm L.C.F.; **b.** 102 mm L.C.F.; **c.** 115 mm L.C.F.; **d.** 122 mm L.C.F.; **e.** 123 mm L.C.F.; **f.** 124 mm L.C.F.; **g.** 135 mm L.C.F.; **h.** 133 mm L.C.F.

Table 1. Meristic variation in *Galaxias brevipinnis*.

		Ourimbah, N.S.W.	Blue Mountains, N.S.W.	Moss Vale, N.S.W.	South Australia	Buchan-Lang Lang, Vic.
Dorsal rays — segmented	9		2	9	6	
	10	7	8	15	6	
	11	2	3	3	3	
	12					
total rays	11				1	
	12		6	9	4	1
	13	4	5	31	7	6
	14	3	1	12	3	10
	15					
	16					
Anal rays — segmented	9		1			
	10		5	4	4	
	11	4	6	14	8	
	12	3	1	7	3	
	13			2		
total rays	12		2			
	13		2	3	4	2
	14	3	4	13	6	5
	15	4	4	23	4	9
	16		1	11		1
	17			2		1
Pectoral rays	12		1		1	
	13	1	6	4	5	4
	14	2	5	18	7	10
	15	4	1	3	2	2
	16					1
	17					
Gill rakers	11					
	12		1	5		
	13	6	6	12	3	
	14	2	5	9	10	
	15		1		2	
	16					
	17					
Vertebrae	52					
	53					
	54					
	55				3	
	56		2		10	
	57	2	3	9	9	7
	58	5	6	11	5	7
	59		4	4	3	5
	60			1		1
	61					1
	62					1
	63					
	64					

Otways, Vic.	Flinders Island	Cradle Valley, Tas.	Lake King William, Tas.	Pine Creek E. Tasmania	Lake Eucumbene, N.S.W.	Lake Tarli Karng, Vic.	Great Lake, Tas.	Lake Timk, Tas.	New Zealand
1	2						8	2	30
12	4				1		16	6	126
2	1				1		1	2	54
									7
1							2		
5	7		8		1	1	12	4	
20	5	3	1	5		1	8	5	
12	5	8		10	1	2	3	1	
2				2					
2									3
4	1						9	1	21
8	4				1		14	3	113
1	2				1		2	6	61
									18
1	3		1			1	12	1	
8	7		4	1	1	2	11	4	
17	6	9	3	8		1	2	4	
9	1	2	1	6	1			1	
5				2					
			1						
6	2		1	1	1		4		4
27	4	5	3	2	1		14		50
7	1	6	2	12			6	3	113
			2	2			1	7	48
									2
								1	
1								3	6
2	2							1	73
12	2							5	57
	3								22
									8
									1
									1
									2
							1		9
							2		16
	1					1	5		30
2	2		1	1		2	7		45
9	4	9	2	1		1	6		36
10	3	7	3	8	2		4	2	53
4		3	2	3				8	77
			0					5	63
			1						16
									5
									2

Table 2. Morphometric variation in *Galaxias brevipinnis*.
Figures are given as percentages of denominators in ratios.

		S.L./T.L.	B.D.V./S.L.	L.C.P./S.L.	D.C.P./L.C.P.	Pre D./S.L.	Pre D./Pre A	L.D.B./S.L.	M.L.D./L.D.B.	L.A.B./S.L.	M.L.A./L.A.B.
Ourimbah, N.S.W.	Mean	86.70	13.97	13.63	73.84	72.79	93.99	10.93	185.59	11.66	175.67
	S.D.	0.94	1.26	1.12	9.11	2.20	2.46	0.98	13.81	0.61	12.65
Blue Mountains, N.S.W.	Mean	87.48	14.54	11.78	84.71	74.76	94.95	9.65	195.32	11.18	179.94
	S.D.	1.22	1.11	0.91	8.44	1.27	2.41	0.83	8.36	0.96	12.59
Moss Vale, N.S.W	Mean	87.45	15.29	12.73	84.30	74.79	96.06	9.97	183.11	11.68	165.59
	S.D.	1.04	0.52	0.65	4.05	0.83	1.10	0.58	9.02	0.61	11.05
South Australia	Mean	87.18	12.72	13.06	72.11	74.05	93.71	9.79	187.79	10.53	179.12
	S.D.	1.04	0.82	0.77	6.83	1.41	1.81	1.13	12.99	0.88	10.23
Otways, Vic.	Mean	87.49	14.65	13.41	78.78	74.51	95.98	10.12	179.74	11.59	166.53
	S.D.	0.85	0.87	1.02	8.46	1.49	1.36	0.86	14.69	0.87	13.45
Flinders Island	Mean	87.00	12.79	13.06	73.19	73.21	94.00	9.44	196.31	11.34	175.97
	S.D.	0.73	0.77	0.75	5.74	1.52	1.74	0.46	15.55	0.67	9.18
Great Lake, Tas.	Mean	87.92	12.94	13.7	70.80	72.59	94.81	9.65	164.40	10.11	166.43
	S.D.	0.82	0.34	0.70	4.18	1.95	1.24	0.48	8.46	0.54	10.82
Lake Timk, Tas.	Mean	88.22	11.95	15.31	57.84	71.91	95.11	9.24	163.86	10.40	156.91
	S.D.	0.87	0.38	1.08	4.86	1.37	1.31	0.90	12.81	0.65	9.59
All data	Min.	84.7	11.6	10.3	50.0	69.9	89.8	7.1	138.5	8.5	136.4
	Mean	87.46	13.82	13.22	67.21	73.85	95.01	9.85	182.17	11.10	170.42
	Max.	90.2	16.3	17.1	96.9	78.3	99.6	11.4	216.7	13.3	197.1
New Zealand	Min.	84.8	11.0	11.8	59.5	68.5	90.9	7.8	141.0	8.8	137.0
	Mean	87.0	13.2	13.1	71.9	73.5	95.2	9.4	176.1	10.5	162.1
	Max.	89.3	15.3	15.8	88.5	81.3	99.0	10.8	210.1	12.2	200.0

Pec./PecPel	Pel/Pel. An.	PrePel/S.L.	PecPel/S.L.	Pel An./S.L.	H.L./S.L.	H.W./H.L.	H.D./H.L.	Sn.L./H.L.	P.O.H.L./H.L.	I.D.W./H.L.	E.D./H.L.	L.U.J./H.L.	L.L.J./H.L.	W.G./H.L.	N
53.44	64.32	54.36	31.87	24.99	23.69	58.40	52.49	31.46	53.86	42.17	21.14	44.60	39.90	38.27	7
5.23	9.36	1.27	1.58	2.68	1.00	4.44	5.93	2.11	2.48	2.77	3.32	3.25	2.20	3.66	
48.11	60.40	54.80	33.45	25.06	24.30	61.12	57.07	31.55	54.42	41.93	17.85	45.28	45.01	40.15	13
4.11	5.24	1.43	2.36	1.78	1.93	4.67	3.82	1.37	1.87	2.07	2.09	2.90	2.47	2.79	
52.06	58.96	54.13	32.10	24.73	24.47	67.08	58.18	32.77	52.90	43.04	18.91	45.02	41.23	43.07	20
6.64	4.26	0.99	1.69	1.14	0.89	2.48	2.64	1.22	1.55	1.85	1.28	1.84	2.18	2.35	
49.51	53.99	53.62	32.54	26.11	22.95	62.31	52.46	28.87	55.47	39.49	18.89	40.79	37.87	40.39	15
4.45	5.04	1.41	1.52	1.57	0.87	4.13	4.30	1.21	2.84	1.66	1.62	1.76	1.87	5.34	
50.89	59.23	53.47	32.35	25.21	23.58	66.25	55.35	31.48	54.00	41.32	18.05	42.24	38.74	42.05	15
3.25	3.65	1.44	1.50	0.91	0.59	3.75	2.82	1.76	3.64	1.43	1.53	2.59	2.22	3.41	
55.69	61.37	54.14	32.03	25.31	23.79	62.31	50.37	30.71	52.91	40.84	18.24	42.41	39.47	41.30	7
4.42	3.27	1.06	1.67	1.29	0.57	4.30	3.91	2.93	2.23	3.32	1.74	1.70	2.25	6.06	
53.08	59.12	52.35	30.42	23.49	25.38	64.80	50.93	34.21	52.52	37.05	17.59	41.52	36.92	37.43	10
4.76	3.19	1.62	1.79	1.29	0.71	2.65	1.78	0.62	1.96	1.01	0.72	1.31	1.12	2.35	
55.68	62.11	52.69	30.35	24.19	23.73	63.08	51.17	32.51	51.47	37.62	21.68	40.84	36.87	35.19	10
4.72	4.10	1.72	2.07	0.66	0.61	2.15	2.13	1.90	2,21	1.37	0.89	1.40	2.00	2.38	
39.6	43.3	49.6	26.6	21.9	21.1	51.7	45.3	26.4	48.0	35.4	15.1	37.3	32.0	32.7	
51.80	58.66	53.72	31.29	24.93	23.98	63.79	54.26	31.68	53.55	40.68	18.89	42.96	39.71	40.23	97
65.0	79.2	57.5	38.1	29.4	29.9	71.7	63.9	36.0	61.8	46.0	27.1	49.9	45.7	52.2	
43.1	44.4	46.3	27.2	20.9	20.7	56.2	41.7	26.3	48.5	32.5	13.9	37.3	32.5	40.0	
55.6	58.9	52.2	30.7	25.7	23.6	67.6	49.3	30.7	55.0	37.7	17.8	42.9	38.5	42.7	160
68.3	77.4	57.8	36.8	30.4	28.7	78.7	55.9	34.4	70.4	44.1	25.0	48.1	43.7	52.2	

habitat disturbance and the combination of rapid waters in bouldery streams of poor accessibility, secretive habits, and sensitivity to disturbance, mean that the fish is not often seen near densely populated areas. It is mostly found in mountainous country — the Blue Mountains, Wilson's Promontory, the Otway Ranges and widely in Tasmania. Andrews (1976: 317) reported that in lakes it is "fairly evenly distributed throughout the body of water", but in streams it is usually benthic, living amongst large rocks or under logs and other cover.

LIFE HISTORY: Little has been reported about the life history of *G. brevipinnis* (papers by Walford, 1928, 1940, 1941, reporting on *G. coxii* are, on the basis of material deposited by him in the Australian Museum, *G. olidus*).

G. brevipinnis is well-known to have a marine "whitebait" juvenile in New Zealand, and this has been reported for Tasmania also by Lynch (1965, 1966 — as *G. weedoni,* 1974); in both Tasmania and New Zealand it may form a significant proportion of the whitebait fishery (McDowall and Eldon, In Press). The whitebait juvenile of *G. brevipinnis* was first collected on the Australian mainland by J. Renowden from Browns Creek, Otway Ranges, Victoria on 2 December 1967. Juveniles with patterned pigmentation and of similar size to the Browns Creek whitebait were collected climbing the unlit pit wall of the Mount Ewan storage reservoir by D. D. Lynch (19 November 1959, pers. comm.). The existence of a marine whitebait stage is considered to be a facultative rather than obligatory phase in the life history of *G. brevipinnis*. Populations are known from lakes that are effectively isolated from the sea, e.g. Lake St. Clair and Great Lake in Tasmania and Lake Tali Karng in Victoria. A landlocked population in Lake Eucumbene probably dates from the formation of the lake by a dam across the Snowy River. Similar landlocked populations are numerous in New Zealand (McDowall, 1970a).

Specimens collected at Mossvale (Kangaroo River Valley) on 26 January, 1964 and 8 January, 1976 have immature gonads and a ripe male was taken from Roaring Megs Creek, Wilson's Promontory, in April 1964. A late autumn to early winter spawning season, as in New Zealand (McDowall, 1970a), is therefore likely.

G. brevipinnis is well-known for its ability to climb steep water falls and rocky faces. It adheres to the rock surface, out of the water flow, using its ventrally outspread pectoral and pelvic fins. This climbing ability enables it to penetrate great distances inland, moving upstream past formidable barriers. Thus in Rhodes Creek, Flinders Island (Frankenberg 1967), *G. brevipinnis* was recorded upstream from *G. truttaceus* with no overlap in range. An exposed granite incline, fairly steep at the base, apparently acted as a barrier, passable to *G. brevipinnis* but not to *G. truttaceus*.

Nevertheless, *G. brevipinnis* is widely reported in sympatry with *G. truttaceus,* and may occur with *G. maculatus* in more lowland waters. In the upper portions of streams overlap with *G. olidus* has been observed only once — in headwaters of Chapple Creek, Gellibrand River, Victoria. In Great Lake it is also in sympatry with *G. truttaceus* and *Paragalaxias dissimilis* and *P. eleotroides,* in the Julian Lakes, with *G. truttaceus and P. julianus* while Andrews (1976) recorded sympatry with *G. pedderensis* and *G. parvus* in the Serpentine River, Tasmania.

Because *G. brevipinnis* has been recorded so infrequently in the past, usually from only one or two specimens, it is difficult to determine any changes in the distribution and abundance of Australian populations. However, it is becoming increasingly evident that it occurs only in areas inaccessible to trout. Lake Tali Karng, a small high altitude lake in Gippsland, once contained an abundant population of *G. brevipinnis,* but recent expeditions have recorded only brown trout (*Salmo trutta*) from both the lake and a small inflowing stream (Williams, 1964; Frankenberg, 1966a; Timms, 1974). When Lake Eucumbene was formed in 1957, a population of *G. brevipinnis* was trapped and became landlocked, but as the trout population exploded, the population of *G. brevipinnis* has declined and the species is now very rare there (R. D. J. Tilzey, pers. comm.). Andrews (1976:316) reported that in Tasmania *G. brevipinnis* is "abundant in areas which have never been stocked with trout, and also in areas which are protected against invasion, by physical barriers". The same is true in New Zealand (McDowall, 1968d).

DISTRIBUTION: *G. brevipinnis* occurs in Australia, Tasmania, New Zealand, the Chatham Islands, and the Auckland and Campbell Islands. In Australia it is widespread in streams draining east and south from the Great Dividing Range, from the Hunter River in New South Wales, south and west to Kangaroo Island and the Fleuriau Peninsula in South Australia (Fig. 4). It is not known in the Murray-Darling system, nor in drainages into Port Phillip Bay. It is present on Flinders and King Islands in Bass Strait, and is widespread in Tasmania. Published records of *G. truttaceus* from South Australia, e.g. Scott et al. 1974, refer to *G. brevipinnis*.

On the Australian mainland it has apparently failed to become established in the Murray-Darling system, possibly due to the high summer temperatures on the northern and western slopes of the Dividing Range. The physical features of the lower parts of the Murray-Darling system are different from the typical montane habitat of *G. brevipinnis* and there are other competing fish in the system including two galaxiids. The species is also apparently absent from the Port Phillip Bay drainage but because of the proximity of a large city, it is unlikely that this is due to lack of collecting. Possibly suitable streams there have been sufficiently isolated, both by distance and adverse currents, from coastal streams, to limit marine distribution between the mouths of streams. Even at periods in the past when Port Phillip Bay was above sea level drainage conditions were probably of low relief, possibly analogous to the lower parts of the Murray-Darling system at present, and may have represented an unsuitable environment. There are extensive gaps in the known range in Tasmania, especially on the east coast; these gaps may be due to inadequate collecting, but may indicate that the species is poorly represented there.

Galaxias olidus Günther
Fig. 5, 8

Galaxias olidus Günther, 1866: 209 (holotype: BMNH 1866.2.13:24, seen; type locality: "?Queensland"); Krefft, 1871: 84; Macleay, 1881a: 46; 1881b: 230; Ogilby, 1886: 54; Regan, 1905: 381; Zietz, 1908: 297; Waite, 1921: 41; McCulloch, 1922: 18; Waite, 1924: 483; McCulloch and Whitley, 1925: 133; Hale, 1928: 25; McCulloch, 1929: 48; Whitley, 1933: 61; 1936: 34; Johnston and Mawson, 1940: 351(?); 1944: 64 (?); 1947: 548 (?); Whitley, 1955: 154; 1956b: 39; Lake, 1971: 20; Andrews, 1973: 105; Pollard, 1974: 117; Grant, 1975: 564; Andrews, 1976: 318; Jackson, 1976: 14; Cadwallader, 1976: 18; Bishop, 1977: 53; Lake, 1978: 24; Fletcher, 1978: 18; Backhouse and Vanner, 1978: 128.

Galaxias schomburgkii Peters, 1868: 455 (syntypes: (2) MNUB 6788, seen; type locality; near Adelaide, South Australia); Macleay, 1881: 47; Ogilby, 1896: 69; Regan, 1905: 382; McCulloch, 1929: 49; Stokell, 1947: 671; Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 17; Whitley, 1964: 35; Lake, 1971: 20; Scott, et al., 1974: 78 (new synonymy).

Galaxias ornatus Castelnau, 1873: 153 (holotype: MHNH A.5225, not seen; paratype: (1) MHNH A.6915, not seen; type locality: Cardinia Creek, Victoria); Macleay, 1881a: 47; 1881b: 237; Lucas, 1890: 36; Ogilby, 1896: 69; Regan, 1905: 381; Ogilby, 1912: 33;

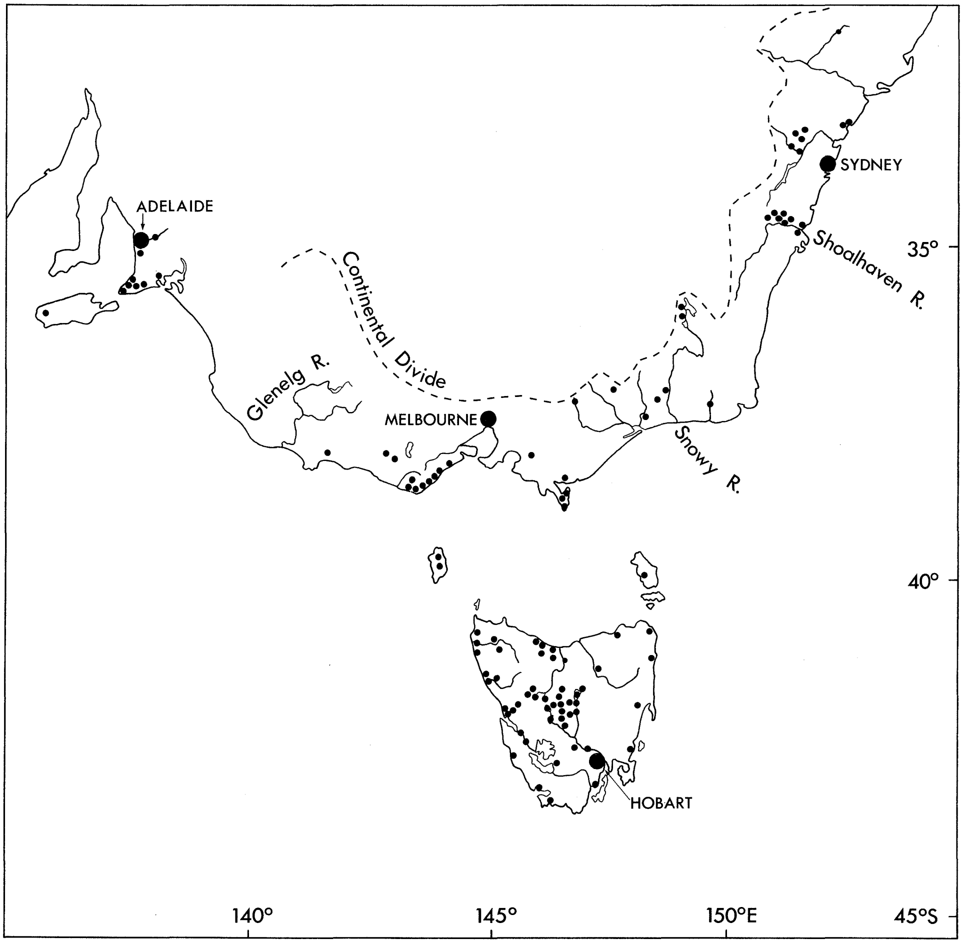

Fig. 4. Distribution of *Galaxias brevipinnis* in Australia. One symbol may represent more than one locality.

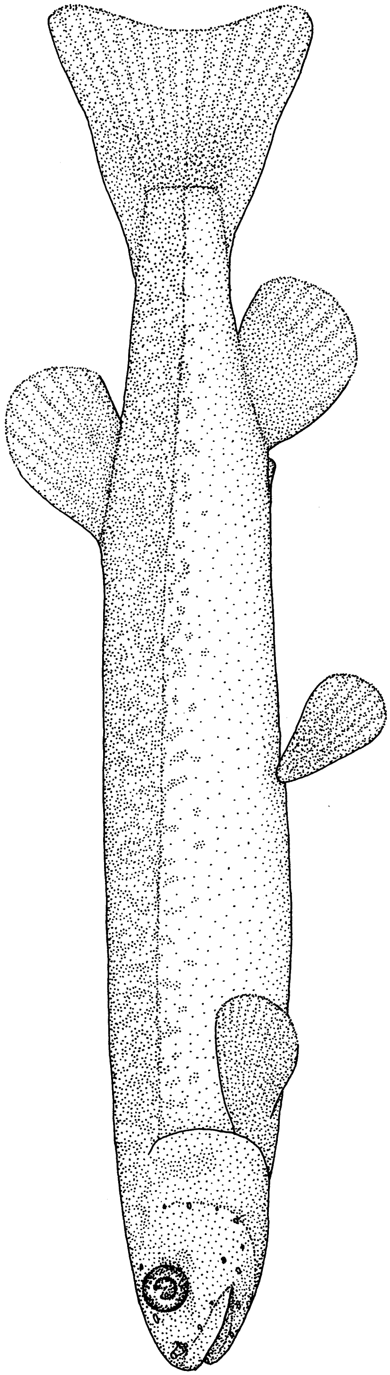

Fig. 5. *Galaxias olidus* Günther; Campbells River, N.S.W., 74 mm L.C.F.

McCulloch, 1929: 48; Whitley, 1934: 268 (partim, incl. *Galaxiella pusilla);* Scott, 1942: 56; Butcher, 1946: 9; Bertin and Esteve, 1951: 3; Whitley, 1955: 154; 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 17; Frankenberg, 1967: 226; Whitley, 1964: 35; Lake, 1971: 20; Frankenberg, 1971: 95 (new synonymy).

Galaxias bongbong Macleay, 1881b: 233 (originally syntypes: (10) MMS F.82; now lectotype: AMS I.16258.002, seen; paralectotypes: (6) AMS I.16258.001, seen; designation, Whitley, 1941; type locality: Mossvale and rivers at Bongbong, New South Wales); Tenison-Woods, 1882: 22; Ogilby, 1886: 55; 1896: 60; Waite, 1904: 17; McCulloch, 1921: 28; 1922: 18; McCulloch and Whitley, 1927: 18; McCulloch, 1929: 49; Whitley, 1934: 268; 1941: 4; 1954: 29; 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 16; Whitley, 1964: 35; Lake, 1967a: 14; 1967b: 196; Greenham, 1968: 846; Stanbury, 1969: 205; Llewellyn, 1969: 16; 1971: 3; Lake, 1971: 20; Berra, 1973: 363 (new synonymy).

Galaxias findlayi Macleay, 1883: 106 (holotype: unknown, probably lost; type locality: Mount Kosciusko); Ogilby, 1886: 55; 1896: 62; Waite, 1904: 17; Regan, 1905: 382; Stead, 1906: 50; McCulloch, 1914: 328; Gale, 1915: 16; McCulloch, 1919: 49; 1921: 28; 1922: 18; 1927: 18; 1929: 49; Tadgell, 1930: 230; Walford, 1940: 234; Stokell, 1945: 124; Costin, 1954: 97; Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 17; Whitley, 1959: 136; Littlejohn, 1962: 311; Whitley, 1964: 35; Tilzey, 1970: 27; Lake, 1971: 20; Thomson, 1974: 151; Baker, 1978: 822 (new synonymy).

Galaxias kayi Ramsay and Ogilby, 1887: 6 (syntypes: (5) AMS I.3-7, seen; type locality: Fifth Creek, South Australia); Ogilby, 1896: 69; Stokell, 1945: 25; 1947: 671; Whitley, 1956a: 34; 1957a: 7; 1957b: 57; Munro, 1957b: 17; Scott, 1962: 68; Whitley, 1964: 35; Scott, 1966: 250; Lake, 1971: 20; Scott et al. 1974: 77.

Galaxias oconnori Ogilby, 1912: 23 (holotype: QM I.421, seen — a specimen AMS I.11161, described in the AMS catalogue as a "cotype" cannot be a type as Ogilby stated that he had only one specimen; type locality: Lyra, near Stanthorpe); McCulloch and Whitley, 1925: 133; Duhig, 1931: xvi; Whitley, 1956a: 34; 1956b: 39; Munro, 1957b: 17.

Galaxias coxii — Walford, 1928: 274; Gray, 1929: 140; Walford, 1940: 234; 1942: 56; Whitley, 1957a: 10 (partim); Garnet, 1959: 213; Breder and Rosen, 1966: 132; Tilzey, 1974: 7 (non *Galaxias coxii* Macleay, 1881).

Lyragalaxias oconnori — Whitley, 1935: 42.

Galaxias fuscus Mack, 1936: 100 (holotype: NMVM A.96, seen; paratype: (1) NMVM A.99, seen; type locality: Rubicon River, Victoria); Stokell, 1945: 126; Whitley, 1956a: 32; 1956b: 39; 1957a: 7; Munro, 1957b: 17; Whitley, 1964: 35; Lake, 1971: 20; Dixon, 1972: 121 (new synonymy).

TAXONOMY: There has been some controversy over the name *Galaxias olidus* Günther, and its use therefore requires some justification. Stokell (1947) stated that he found it "impossible to identify any fish" with the type specimen on account of the uncertain type locality and abnormalities in the vertebral column that are apparent in a radiograph of the type. Stokell's conclusion is not accepted here. Dr P. H. Greenwood (Curator of Fishes, British Museum (Natural History)) examined the pyloric caeca of Günther's type in the British Museum and has informed us (pers. comm.) that "I can find only one caecum, a short, broad structure, approximately 5 mm by 3 mm". Such a single, short caecum is known only in the species from the upland-subalpine streams of eastern Australia, and this alone is good evidence of the identity of the fish. A combination of characters in Günther's (1866) description supports this, viz. high pectoral ray count (14), relatively short head (22% of S.L.), lower jaw a little shorter than upper, mouth extending back to almost the middle of eye, small eyes, small pectoral and pelvic fins, and slender caudal peduncle. Regan (1905) redescribed *G. olidus* from the holotype, and additional specimens, including two specimens listed as "types", although Günther had only one fish. Regan's addition of characters such as teeth subequal without distinct canines, maxillary extending to below middle of eye, anal origin behind middle of dorsal, all indicate that the mountain galaxiid here under description is correctly known as *G. olidus*. The only species with which confusion might be possible is *G. brevipinnis* Günther, but this species has two, long pyloric caeca, distinct lateral canines, and much larger pectoral and pelvic fins.

The data suggest that although the holotype has deformities in the vertebral column, and although the type locality is uncertain, the name *G. olidus* is applicable to the eastern Australian mountain galaxiid.

There are two specimens in the jar in the British Museum, labelled as types of *G. olidus*. Stokell (1947) became involved in considering the relation of the second "headless" specimen to the holotype, and he found that it is probably not conspecific with the holotype. However, since Günther (1866) had only one specimen, the second specimen in the jar is not a type and its identity becomes irrelevant.

From examination of a very wide range of specimens from southern Queensland to South Australia, along the mountain ranges, it is our conclusion that none of the seven species listed in the synonymy above is distinct from *G. olidus*. There is a single, rather variable species, variable both in meristic and morphometric characters, and in colouration. Samples from populations throughout the known range of the species have been examined for a wide range of characters, and although there is quite broad variation in some characters there is no indication that more than one species is represented. In no instance is bimodality of characters, which might indicate cryptic species, evident in the data.

Some populations have deviated from the usual seven-rayed pelvic fin of the genus *Galaxias*, to an eight- or even occasionally nine-rayed fin. Eight-rayed pelvic fins appear sporadically in populations from Queensland to South Australia, and this must be seen as mosaic evolution in an already variable species (Table 4).

Synonyms of *G. olidus* are listed above. From an examination of as many of the types as possible, and from study of the original descriptions, it is evident that all these nominal species come within the range of variation of *G. olidus*.

G. schomburgkii: The syntypes of *G. schomburgkii* are in good condition, considering their age; however, they are very stiff, preventing fin ray counts being made. Their identity with *G. olidus* is clearly evidenced by the dorsal fin being almost wholly in advance of the anal fin. One of the specimens was opened and the single pyloric caecum also indicates *G. olidus*.

G. ornatus: Data from Castelnau's (1873) original description of this species, and from Regan's (1905) redescription of the holotype, are consistent with data presented here for *G. olidus*. The origin of the anal fin is described by Regan as being "slightly in advance of the posterior end of the base of the dorsal", and the short paired fins (pectoral 40% of pectoral-pelvic interval and pelvic 40% of pelvic-anal interval) indicate that *G. ornatus* is a junior synonym of *G. olidus*. The failure of both Castelnau (1873) and Regan (1905) to mention the dark post-pectoral blotch characteristic of and described for the *G. brevipinnis* — *G. coxii* — *G. affinis* group by Regan indicates that *G. ornatus* is unlikely to belong to this group of species.

G. bongbong: The types of *G. bongbong* — the lectotype and paralectotypes of Whitley (1941) — were examined, and again fall within *G. olidus* as described here, in every respect. The lectotype has one pyloric caecum of moderate length and one that is very short (a not uncommon condition in *G. olidus*), the pectoral fins are very short (36.4% of the pectoral-pelvic interval), and there are no enlarged canine teeth in the jaws.

G. findlayi: The types of *G. findlayi* are lost, and the vague type locality which is unspecified other than "captured . . . on Mt Kosciusko", prohibits the collection of material that can be regarded with certainty as topo-typical. Mount Kosciusko drainages flow into both the Snowy (coastal) and Murrumbidgee (inland) drainages. Ogilby (1896) elaborated on Macleay's account and stated that the types came from the Snowy watershed. Ogilby gave the pelvic fin ray count as nine. It is nine very occasionally in *G. olidus* populations with a modal count of eight (Ogilby's material is still in the Australian Museum, and data from his specimens are included in Table 3). Ogilby does not indicate the authority upon which he based his information about the type locality; it may be doubted that he was correct and it may be questioned whether Ogilby's material is truly topotypical. In addition to there being populations in the upper Snowy with eight or more pelvic fin rays, there are also populations with eight rays in the Murrumbidgee, and populations in both systems, in the vicinity of Mt Kosciusko with only seven rays.

Characters described by Macleay, that indicate the identity of his fish as *G. olidus* include pectoral fin less than half pectoral-pelvic interval, pelvic fin less than half pelvic-anal interval, dorsal fin situated almost entirely in front of anal. There are numerous populations of *G. olidus* in the Mt. Kosciusko area which agree with both *G. olidus* and the fish described by Macleay as *G. findlayi.*

Galaxias kayi: G. kayi was described from the western extremity of the range of *G. olidus,* in South Australia. Specimens typical of *G. olidus* occur in South Australia as far west as the Mount Lofty Ranges and the types of *G. kayi* agree with these in all general characters. In three of the syntypes examined there is one well-developed pyloric caecum and one short caecum. Ramsay and Ogilby (1886) described the pelvic fin ray count as eight, which is true of only one of the syntypes, the remainder having seven rays, as is typical of most populations of *G. olidus*. We follow Regan (1905) in treating *G. kayi* as a synonym of *G. olidus*.

G. oconnori: The holotype of *G. oconnori* has disintegrated almost completely and its characters can no longer be established. *G. olidus* occurs at higher elevations in the hills of southern Queensland, in the vicinity of the type locality, and there is nothing in Ogilby's (1912) description that distinguishes *G. oconnori* from *G. olidus,* as construed here.

G. fuscus: As described by Mack (1936) *G. fuscus* differs in no way in its meristic or morphometric characters from *G. olidus* as described here. Mack listed no diagnostic characters, and the only apparent distinctive feature is the presence of "four prominent dark blotches on each side between base of pectoral and origin of dorsal". Colouration in *G. olidus* is highly variable. A sample from the Yea River drainage, near Kinglake, has specimens with very marked vertical dark blotches along the sides, as illustrated for *G. fuscus* by Mack, but there is wide variation in the Yea River fishes — between 0 and 7 such blotches occur and there is no consistency from side to side in any given fish. One fish had seven blotches on one side and two on the other, another had four on one side and none on the other. The significance of this colour pattern and its variation are not understood, but it is regarded as not precluding inclusion of *G. fuscus* in the synonymy of *G. olidus*. Study of a wide range of material suggests a gradation from the barred condition in "*G. fuscus*" to the more usual irregular blotching pattern. The types of *G.*

fuscus have become completely dehydrated and are of no use; attempts to obtain topotypical material failed.

The inclusion of references by Walford (1928, 1940, 1941) to *G. coxii* in the synonymy of *G. olidus* is on the basis of material described by Walford as *G. coxii* and deposited in the collections of the Australian Museum. These fish are *G. olidus*. Their identity as *G. olidus*, rather than *G. coxii*, could have been predicted from the life history pattern, with Walford observing the larval fish following hatching, and their growth to maturity in fresh water streams. (Larval growth in *G. brevipinnis* (= *G. coxii*) occurs in fresh water only in landlocked lake populations).

Because of the wide range of material available, and the considerable variability in the characters of *G. olidus*, study was undertaken of the nature of this variation.

Most populations have predominantly seven rays in the pelvic fins, but in a few there are eight rays (Table 3). Eight rays are characteristic of the highest altitude population on the slopes of Mt Kosciusko (Snowy River), but there is no consistent association of eight pelvic rays with altitude, even in the Snowy River. The Native Dog Creek population is eight-rayed, but the Kiandra population at a higher altitude is seven-rayed. Additional eight-rayed populations are widespread from southern Queensland to Victoria in both internal and coastal drainages (Table 3).

Pectoral fin ray counts were found to increase with altitude and as a result regional differences tend to be obscured in comparisons of populations from different river systems. Highest pectoral ray counts occur at Smiggin Holes, near Mt Kosciusko (Snowy River), and the lowest at Scotts Creek, Grampians, western Victoria (Glenelg River), (Table 4a, b).

Dorsal fin ray counts also increased with altitude, but no such trend was found for anal fin rays. Nevertheless in series from similar altitudes in the same region or river system, it was found that dorsal and anal fin ray numbers tend to vary together.

There is wide variation in vertebral numbers, between series. Those at the extreme high and low values may have completely disjunct ranges although there is a complete range of intermediate values. The Mt Kosciusko series is unusual in having a great range (9 vertebrae), but this range may be related, in part, to the very large sample examined (123 counts).

Vertebral number tends to rise with altitude (Fig. 6); however, series from relatively flat but high altitude regions (Bogong, Bennison and Dargo High Plains), provide exceptions, and have counts more typical of lower elevation populations (Fig. 6). Virtually the entire range for the species is represented in samples from the Kiewa River system. Two series from similar and high altitudes, one from a steep locality (56-58 vertebrae) and the other from a relatively flat locality (49-53 vertebrae) have extreme and disjunct values. Each series is from a different branch of the river, the two branches meeting at low altitude (ca. 400 m) where there are populations with intermediate values (52-55 vertebrae).

The relative positions of the dorsal and anal fins were examined by subtracting the predorsal length from the preanal length and dividing this difference by the length of the dorsal fin base (PreA. — PreD./L.D.B.). Values for this ratio show an increase with altitude, i.e. the anal fin becomes relatively more posterior with respect to the dorsal fin (Fig. 7). Nevertheless there is considerable variation, particularly between lowland populations.

Table 3. Variation in pelvic fin ray number in *Galaxias olidus*.
Listed in order of increasing mean value.

	6	7	8	9	Mean
Near Major Ck, Shoalhaven R, NSW	1	6			6.86
Parker R, Vic	1	6			6.86
First Ck, nr Adelaide, SA	1	24			6.96
Seymour Ck, Otways, Vic		10			7.00
Macquarie Rivulet, Shoalhaven R, NSW		10			7.00
Accommodation Ck, Severn R, NSW		10			7.00
Mountain Ck, nr Kinglake, Goulburn R, NSW		10			7.00
Dundurrabin, Clarence R, NSW		4			7.00
Cordeaux R, Hawkesbury R, NSW		18			7.00
Near Delegate, Snowy R, NSW		8			7.00
Near Kiandra, Snowy R, NSW		25			7.00
Bennison High Plains, Vic		13			7.00
Jeeralong Ck, Latrobe R, Vic		6			7.00
Chapple and Charlies Cks, Gellibrand R, Vic		15			7.00
Scott Ck, Glenelg R, Vic		9			7.00
Bogong High Plains, Vic		24	1		7.04
Glen Stuart, SA		14	1		7.07
Clearwater Ck, Port Phillip, Vic		11	1		7.08
Ann R. NSW		9	1		7.10
Megalong Ck, Katoomba, NSW		9	1		7.10
Bells Ck, Moruya R, NSW		7	1		7.13
Condobolin, NSW		6	1		7.14
Fifth Creek, SA		5	1		7.17
Lake George, NSW		9	2		7.18
Myponga R		4	1		7.20
Belair National Park		12	3	1	7.31
Wallangara, Qld		4	2		7.33
West Branch, Kiewa R		5	3		7.38
Canobolas		8	2		7.20
Goomburra District, Qld		8	6		7.43
Crooked Ck, E. of Tenterfield, NSW		5	5		7.50
Wallaby Ck, Clarence R, NSW		2	4		7.67
Tooma R tributary, NSW		4	11		7.73
Running Ck, Kiewa R, Vic		1	3		7.75
Headwaters Buchan R, Vic		3	9		7.75
Woody Yallock R, Vic		1	3		7.75
Four Mile Creek, NSW?		6	19		7.76
Tributary Tumut R, NSW		2	8		7.80
Snowy River Pools, Vic		3	22		7.88
Smiggin Holes, Mt Kosciusko, NSW		1	24		7.96
Warwick, Qld			4		8.00
Blue Lake, Mt Kosciusko, NSW			5	3	8.38
Mt Kosciusko, NSW			3	2	8.40

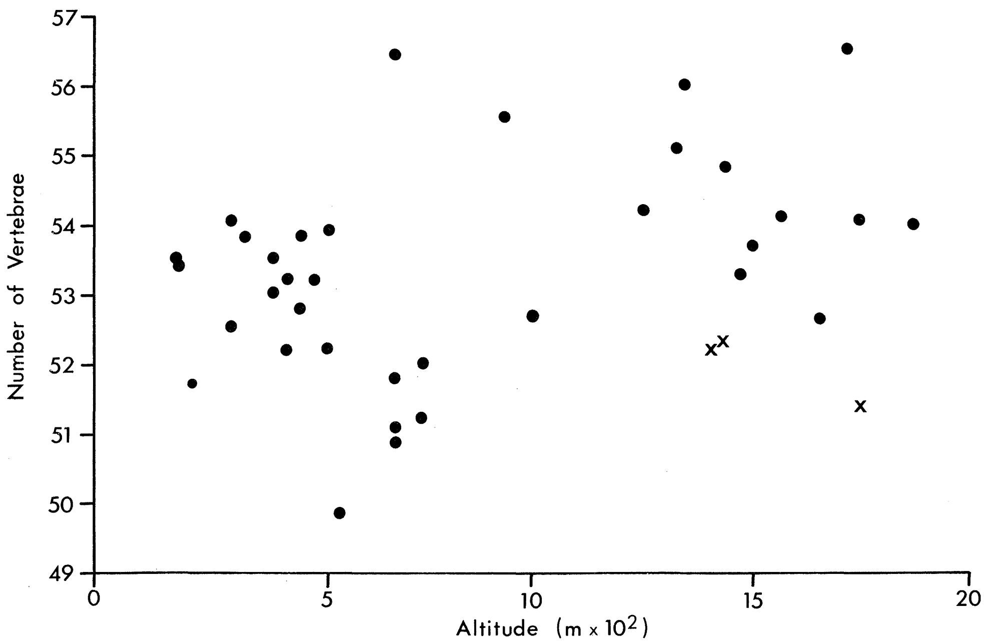

Fig. 6. Variation with altitude in the number of vertebrae in *Galaxias olidus* (crosses indicate populations on high altitude plateaux).

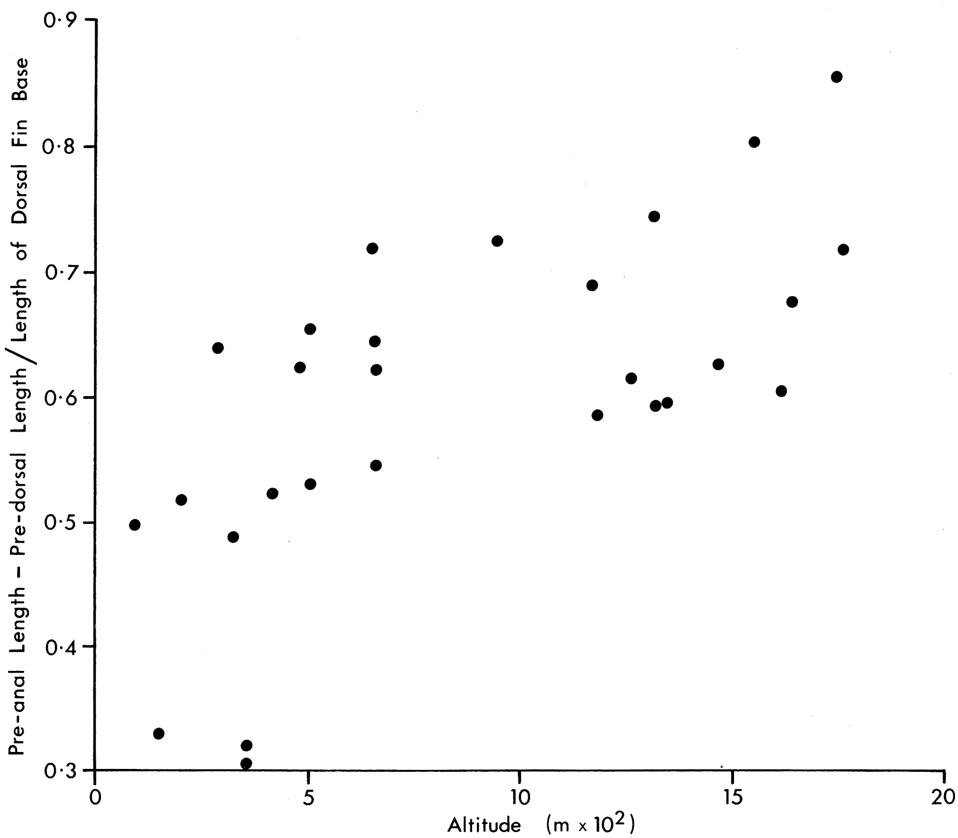

Fig. 7. Variation with altitude in the relative positions of the dorsal and anal fins in *Galaxias olidus*.

In Murray River tributaries at low altitudes there is a high degree of concordance over a fairly wide geographical range between series from the Wimmera, Loddon, Campaspe, Ovens and Kiewa Rivers, and to a slightly lesser extent, the Woady Yallock River (internal drainage to Lake Carangamite). The characteristic features of this group include the fact that the pyloric caeca are vestigial or absent (except Wooragee), the difference between the dorsal and anal fin ray counts is relatively high, and the anal fin usually originates anterior to the mid-point of the dorsal fin base (about under the mid-point in the Loddon and Campaspe River series). This group, however, differs to no great extent from series from the Murrumbidgee basin at low altitudes and southern Victorian coastal rivers, in which there is generally less difference between the dorsal and anal fin ray counts; also southern Victorian fish tend to have relatively more barred colour pattern, and in Murrumbidgee fish the anal fin is relatively more posterior with respect to the dorsal fin.

The only other morphological-geographical groups which can be established occur within large river systems and are associated with the *"fuscus"* and *"findlayi"* colour patterns. The *fuscus* colour pattern in its typical form (bold vertical bars, variable in number) is restricted to two series of fish (Rubicon and Yea Rivers) from the Goulburn River basin, and occasional specimens from the adjacent Ovens River. A somewhat intermediate stage in the development of the *fuscus* pattern occurs in the Ovens River, a tributary of the Murray River near Walwa, and is represented by narrower and more numerous vertical bars. Outside these rivers the pattern is not recognisable. The *findlayi* pattern is represented by a series of dark, irregular blotches, but this pattern grades into the more typical speckled or vermiculated pattern; it is typical of some populations in the upper Snowy and Buchan Rivers.

Certain populations have characteristics which set them apart from most others, and each of these can often be associated with a high degree of isolation and/or peculiarities in the physical environment. The population in Snobs Creek for instance, is located above a waterfall about 26 m high, in a continuously flowing stream with virtually no still pools or backwaters. This population is characterised by high fin ray and vertebral counts. The Dargo High Plains sample was collected from a relatively high altitude lava plain and the fish tended to be uniformly melanistic on the back and upper sides, and lack any form of colour pattern.

DIAGNOSIS: Characterised by anal fin origin usually being below or behind the middle of the dorsal fin, small pectoral and pelvic fins, small eye, and, very often, only a single pyloric caecum.

Differs from *G. brevipinnis* in characters listed in the diagnosis of that species (p.462). Differs from *G. johnstoni* in often having only a single pyloric caecum, more pectoral fin rays, shorter pelvic fins, and usually a somewhat shorter head. Differs from *G. pedderensis* in being generally stouter in build, and in having more pectoral fin rays, shorter pelvic fins, and usually a somewhat shorter head. Lateral pigmentation tends to become fragmented below the lateral line in *G. pedderensis* but not in *G. olidus*. Differences between *G. olidus*, *G. johnstoni* and *G. pedderensis* are relatively slight and the three species appear to be closely related. Differs from *G. fontanus* in lacking lateral canine teeth, in having one pyloric caecum and only four pores in the row below the eyes.

DESCRIPTION: A smallish, and variable but moderately stout species. Trunk rounded in section, often with the belly deepened, dorsal and ventral trunk profiles only slightly and evenly arched, tapering anteriorly to a blunt snout, and posteriorly to a long and slender caudal peduncle, the peduncle much longer than deep. Head short, somewhat flattened dorsally, much broader than deep; snout of moderate length, bluntly rounded, broad. Mouth slightly oblique, large, reaching back well below eyes;

jaws subequal, lower sometimes a little shorter than upper. Eyes small, deep in lateral head, interorbital convex but flattened dorsally. Jaws with little or no enlargement of canine teeth laterally; mesopterygoidal and lingual teeth well developed. Gill rakers short and stout (Fig. 43); pyloric caeca variable, usually one short caecum, but sometimes none, occasionally two (Fig. 45). Laterosensory pores on head as in Fig. 47.

Fins small, thick and fleshy at bases; dorsal and anal fins short-based and rounded, hindmost rays of moderate length. Anal fin origin below middle of dorsal fin base or further back, sometimes below rear of dorsal. Pectoral fins small and paddle-shaped, inserted low lateroventrally, with lamina of fin often facing ventrally. Pelvic fins also small, inserted at or a little behind mid-point of standard length. Caudal fin weakly forked to truncate, fin tips rounded; fin depth about equal to body depth. Caudal peduncle flanges well developed.

Variation: meristic: see Table 4a, b.
morphometric: see Table 5.

COLOUR: Colour of *G. olidus* is widely variable (Fig. 8). When alive it is variably yellowish-green through brown, the belly lighter olive to whitish. The back and upper sides and the head are variably and profusely covered with darker grey-olive speckling, spotting, blotching or banding. The fins are transluscent and olive-gold to greyish and the eyes silvery-olive.

In preservative it is grey-white to brownish-olive on the back with patterning, in its generalised form, consisting of irregular bars or fasciae of various widths which tend to become more irregular and broken dorsally. In the caudal region, in particular, the bars may be chevron-shaped, following the myomeres, but in general the chevron pattern is never very prominent, and may be overlaid on the flanks by a more constrasting pattern bearing no relation to the myomeres. Lateral pigment pattern is very often restricted to the area of the side above the lateral line, any pigmentation below the lateral line often being very pale.

An unusual pattern characterises fish described by Mack (1936) as *G. fuscus,* and observed in fish from a tributary of the Yea River (Goulburn River basin). In these series varying numbers of dark, vertical, and somewhat ovoid bars occur along the flanks anterior to the dorsal fin. In certain series from the adjacent Ovens River basin, (a tributary of the Murray River near Walwa) a pattern of prominent vertical bands also occurs along the flanks, but these are narrower and more closely spaced than in the typical *"fuscus"* pattern, and are also more evenly distributed along the length of the fish. In some other series there is a tendency for markings along the lateral line to be accentuated, but not as prominently as in the above-mentioned Goulburn and Ovens River fishes. There is therefore a gradation from the typical *"fuscus"* pattern to the more generalised pattern.

A pattern of dark irregular blotches is characteristic of series from the upper Snowy and Buchan Rivers, although in a number of Snowy River specimens (Smiggin Holes), scarcely any pattern is developed. Pattern is also essentially lacking in series from Snobs Creek, the Wimmera River and Dargo High Plains; the last mentioned is characterised by a very dark-coloured upper body.

Chevron-shaped, but somewhat indistinct bars are often evident in fish from southern Victoria, but in southwestern Victoria and much of the Murray-Darling basin a finer more marbled or fasciated pattern is characteristic.

Fig. 8. Variation in colour pattern in *Galaxias olidus;* **a.** Swanbrook Creek, N.S.W., 58 mm L.C.F.; **b.** Watchbox Creek, Vic., 64 mm L.C.F.; **c.** Running Creek, Kinglake, Vic., 67.5 mm L.C.F.; **d.** Campbell River, N.S.W., 74 mm L.C.F.; **e.** Macquarie Rivulet, N.S.W., 70 mm L.C.F.

Table 4a. Meristic variation in *Galaxias olidus* (coastal drainages).

		Dundurrabin Clarence R., N.S.W.	Cordeaux Ck Hawkesbury R., N.S.W.	Macquarie Rivulet Shoalhaven R., N.S.W.	N. Majors Ck Shoalhaven R., N.S.W.	Bells Ck Moruya R., N.S.W.	nr. Delegate Snowy R., N.S.W.	Near Kiandra Snowy R., N.S.W.	Smiggin Holes Snowy R., N.S.W.	Mt Kosciusko Snowy R., N.S.W.	Native Dog Ck Snowy R., N.S.W.
Dorsal rays — segmented	8			1							
	9			4							1
	10			4							1
	11			8							8
	12										
total	10										
	11		1	4		2	1	1			
	12		2	5	3	4	3	16	1		
	13	1	12	1	4	2	3	8	6	2	1
	14	3	3				1		5	13	8
	15								4	9	2
	16								1	1	0
	17										1
Anal rays — segmented	9			1							
	10			5							
	11			4							2
	12										7
	13										1
total	11										
	12			5		1					
	13	1	1	3	3	3	1		2	3	
	14	2	5	2	2	3	3	13	10	8	1
	15	1	11		2	1	3	10	4	11	5
	16		1				1	2	1	3	6
Pectoral rays	12										
	13	1	2	4		2	1			1	
	14	2	14	5	4	5	5	1		1	
	15	1	2	1	3	1	2	9	2	7	6
	16							13	4	16	4
	17							2	9		2
	18								2		
Gill rakers	11			2							1
	12			7							6
	13			1							2
	14										1
Vertebrae	49		1		1	3					
	50		4		7	3	5				
	51		13	4	7	2	7			2	
	52	1	5	10	7		9	3	1	8	
	53	1	2		2		3	7	4	42	2
	54				1			11	10	37	7
	55							3	2	14	1
	56							1	3	10	0
	57									6	1
	58									3	
	59									1	

Dargo High Plains Mitchell R., Vic.	Bennison High Plains MacAlister R., Vic.	Jerralong Ck Latrobe R., Vic.	Clearwater Ck Pt Phillip, Vic.	Parker R., Vic.	Chapple & Charlies Cks Gellibrand R., Vic.	Seymour Ck Otways, Vic.	Scotts Ck Glenelg R. Grampians, Vic.	First Ck S.A.	Myponga R., S.A.	Fifth Ck S.A.	Glen Stuart S.A.
						1					1
						5				1	8
						4				4	6
										1	
											1
	3		2	1		4		1		1	1
12	5		6	6	4	4	7	6	5	1	11
12	5		4		10	2	2	15		4	2
1		3			1			3			
		3									
						2				6	9
						7					6
						1					
1										1	1
8	5					3		5	1	4	4
13	7		3	4	2	6	5	16	4	1	9
3	1	4	9	3	7	1	3	4			0
		2			6		1				6
		1				2	4				
	4	2		4	3	6	5	12		3	4
12	6	2	4	2	6	2		10		2	9
12	2	1	6	1	6			3	3	1	2
1	1		2						2		
						5					1
						5				4	11
										2	3
									1		
				1					1		
4	3		4	1	3		3	3	3		
12	4		14	4	4		6	12			
9	5	3	6	1	5			9			
	1	3	1					1			

Table 4b. Meristic variation in *Galaxias olidus* (inland drainages).

		Condamine R. Warwick, Qld.	Crooked Ck E. of Tenterfield, N.S.W.	Accommodation Ck Severn R., N.S.W.	Ann R., N.S.W.	Condobolin, N.S.W.	Canobolas, N.S.W.	Megalong Ck Katoomba, N.S.W.	Towney's Ck Molonglo R., N.S.W.	Burra Ck Queenbeyan R., N.S.W.	30 km S. of Rules Point Goodradigbee R., N.S.W.	Happy Jacks Ck Tumut R., N.S.W.
Dorsal rays — segmented	8						1					1
	9			4		3	5	3				6
	10		2	3	8	4	4	7				2
	11		7	4	2							1
	12		1									
total	10									1		
	11	1		2			3		1	0		
	12	3		2		2	5	2	9	3		3
	13		4	3	5	5	2	7	2	8	6	13
	14		5	3	4			1		3	9	7
	15		1		1					3	3	2
	16											
	17											
Anal rays —segmented	9						1	1				
	10				4	5	5	4				1
	11		5	10	5	2	4	5				9
	12		4		1							
	13		1									
total	11											
	12				1			1				
	13	1	4	4	2	5	6	2	1	1	2	1
	14	2	3	5	3	1	4	7	6	5	7	9
	15	1	3	1	4	1			5	6	7	
	16									3	1	
	17										1	
Pectoral rays	11											
	12											
	13	1		1				1				2
	14	2	4	5	3	2	1	6		2		5
	15	1	6	2	5	3	8	2	4	4		11
	16			1	1	2	1	1	7	8	8	6
	17								1	1	7	1
	18										3	
Gill rakers	10											
	11											1
	12		4		2	2	2					8
	13		2	4	5	3	6	5				1
	14		4	3	3	1	2	5				
	15			3		1						
Vertebrae	49											
	50											
	51	3							2	5		3
	52	1							4	8		3
	53								3	2	2	8
	54								2		10	8
	55								1		6	1
	56										5	2
	57										2	
	58											
	59											

West Branch Kiewa R.	Lake George, A.C.T.	Cobungra R. Mitta Mitta Syst.	Middle Ck Mitta Mitta Syst.	Pretty Valley Kiewa R., Vic.	Yackadandah Ck Kiewa R., Vic.	Mt Buffalo Ovens R., Vic.	27 km S.E. of Wangaratta Ovens R., Vic.	Scrubby Ck nr Alexandra Goulburn R., Vic.	Mountain Ck nr Kinglake Goulburn R., Vic.	Strath Ck Goulburn R., Vic.	Seven Cks Goulburn R., Vic.	Near Tooboree Campaspe R., Vic.	Blackjack and Barkers Cks Loddon R., Vic.
											1		
									2		5		
									6		4		
									2				
	4						6				6	2	6
1	4	1	1	1	8	3	6	5	9	4	3	8	6
1	3	6	9	6	1	12	2	9	14	19	1	3	
6		2	1	5		8		11	2	2			
				4		0							
				1		2							
									1				
									5		2		
									4		6		
											2		
	3		2	5		5			4	2			
4	5	4	8	8	2	13	3	4	2	7	2	2	1
3	3	3	0	4	2	7	9	14	4	15	7	2	7
2		2	1		4		2	6		1	1	6	4
					1			1				3	
						1						2	1
	4		1	2	4	3	6	2		6	8	9	6
2	5	3	4	6	5	12	8	8	2	13	2	2	5
5	2	5	4	6		9		9	17	6			
3		1		3				6	6				
											1		
									1		2		
									1		3		
									5		3		
									3		1		
				1									
	3			3									
	6		1	10				1					
	0		4	7	4	1	3	1	2	7			2
	1		4	4	10	4	5	5	18	11		4	0
			1		6	14	4	12	5	3		5	9
			1		4	4	2	5		4		4	1
5					1	2		1					
2													
1													

Table 5. Morphometric variation in *Galaxias olidus*.
Figures are given as percentages of denominators in ratios.

		S.L./T.L.	B.D.V./S.L.	L.C.P./S.L.	D.C.P./L.C.P.	Pre D./S.L.	Pre D./Pre A.	L.D.B./ S.L.	M.L.D./ L.D.B.	L.A.B./ S.L.	M.L.A./ L.A.B.	Pec./ Pec. Pel.
Tenterfield	Mean	88.30	12.43	14.35	64.32	69.78	91.70	11.33	152.18	11.34	145.06	46.40
N.S.W.	S.D.	0.80	0.50	0.54	3.00	1.14	2.64	0.64	12.37	0.58	11.67	3.11
Ann R.	Mean	88.99	12.02	14.37	56.45	69.55	92.64	10.79	150.74	11.62	143.84	44.51
N.S.W.	S.D.	0.79	1.26	0.97	4.34	0.95	1.01	0.74	10.54	0.58	6.74	3.65
Severn R.	Mean	89.97	11.83	12.82	72.03	72.34	91.66	10.06	156.53	10.00	164.56	40.46
N.S.W.	S.D.	2.57	0.71	0.53	4.25	1.03	1.19	0.97	20.36	0.65	7.22	4.43
Canobolas	Mean	89.23	12.22	13.84	62.77	70.41	92.63	9.49	161.32	10.53	155.02	41.71
N.S.W.	S.D.	1.01	0.75	0.48	5.41	1.43	2.12	0.82	12.01	0.61	8.53	2.69
Condobolin	Mean	89.56	11.33	13.46	58.41	69.58	90.96	9.81	146.81	10.58	142.53	36.31
N.S.W.	S.D.	1.48	0.48	0.40	3.32	1.64	1.82	1.16	14.38	1.34	10.04	6.88
Katoomba	Mean	88.90	11.31	14.97	57.74	68.25	91.59	10.42	163.39	10.67	157.72	46.73
N.S.W.	S.D.	1.07	0.91	0.78	5.02	1.23	2.31	0.84	10.85	0.89	7.43	2.65
Macquarie Rivulet	Mean	89.39	13.68	13.94	70.34	71.51	92.96	9.23	158.59	10.23	154.83	37.80
N.S.W.	S.D.	0.99	0.94	1.14	6.64	1.50	1.32	0.66	13.38	0.49	8.81	5.65
Seven Creeks	Mean	88.82	13.11	14.08	59.08	69.42	94.01	8.90	171.99	12.36	140.25	40.92
N.S.W.	S.D.	0.70	1.08	0.52	3.27	2.98	1.17	0.64	8.32	0.80	3.73	2.62
Native Dog Creek	Mean	89.89	11.47	12.80	67.07	70.32	91.08	10.23	152.20	11.49	138.62	40.08
N.S.W.	S.D.	0.80	0.74	0.72	5.51	1.00	1.49	0.92	11.70	0.78	10.86	2.77
Tumut Creek	Mean	89.56	11.96	14.36	62.59	68.65	91.10	8.66	164.36	10.23	153.72	44.68
N.S.W.	S.D.	0.82	0.97	0.65	3.57	1.21	1.95	0.78	13.47	0.57	6.50	2.08
Kinglake	Mean	88.06	12.49	15.23	62.58	68.41	90.87	9.96	161.29	11.22	154.94	45.25
Vic.	S.D.	0.49	0.62	0.53	3.39	1.94	1.31	0.63	13.55	0.47	8.34	6.33
Fifth Creek	Mean	88.85	13.32	13.07	72.30	70.75	90.65	10.55	163.46	10.86	153.62	40.07
S.A.	S.D.	0.48	0.65	0.60	4.26	1.33	1.49	1.32	8.70	0.76	7.19	4.00
Glen Stuart	Mean	88.35	11.84	13.47	67.59	71.73	92.32	9.70	162.82	10.54	155.65	42.13
S.A.	S.D.	1.18	1.04	0.97	7.00	1.56	1.47	0.60	10.68	0.71	12.34	3.29
Seymour Creek	Mean	89.36	11.24	14.42	58.00	70.28	92.35	9.47	158.64	11.03	152.76	40.02
Vic.	S.D.	2.00	0.52	0.75	3.87	0.81	1.60	0.56	10.26	0.34	7.45	3.48
All Data	Min.	85.6	9.9	11.5	51.6	66.7	87.2	7.4	123.1	8.4	121.4	30.6
	Mean	89.09	12.16	13.94	63.66	70.07	91.89	9.90	158.88	10.91	150.94	41.93
	Max.	95.0	15.0	16.4	80.0	73.6	95.3	12.2	184.0	13.3	176.0	53.0

Pel/ Pel. An.	Pre Pel./ S.L.	Pec.Pel./ S.L.	Pel.An./ S.L.	H.L./S.L.	H.W./H.L.	H.D./H.L.	Sn.L./ H.L.	P.O.H.L./ H.L.	I.O.W./H.L.	E.D./H.L.	L.U.J./H.L.	L.L.J./H.L.	W.G./H.L.	N
53.54	52.11	30.04	23.51	22.97	65.02	56.59	33.14	54.71	42.63	19.98	39.90	36.43	41.77	
2.52	0.87	1.26	0.91	0.50	2.74	2.54	1.68	2.66	3.00	1.47	1.06	1.92	1.57	10
51.94	52.11	31.41	23.07	22.68	60.23	54.60	29.34	52.50	37.30	20.38	37.04	33.65	32.96	
3.55	3.18	1.20	0.87	0.47	3.28	2.33	1.43	2.40	1.38	1.29	1.47	1.48	2.35	10
49.17	55.28	32.34	23.33	23.37	60.61	53.67	30.60	53.58	38.21	21.44	42.49	40.71	38.63	
4.80	1.69	1.70	1.36	0.55	2.36	3.69	1.41	1.39	1.33	1.31	2.29	1.53	2.90	10
42.81	52.43	32.33	25.40	21.50	60.85	55.98	29.94	56.21	40.13	17.59	38.94	34.92	35.57	
3.51	1.47	1.44	0.95	1.17	2.55	3.40	2.57	3.74	1.33	1.52	2.47	1.39	2.32	10
42.44	54.23	33.74	25.70	21.34	60.18	54.93	28.67	56.47	38.31	18.10	36.23	31.66	37.56	
5.38	1.81	2.64	0.32	1.17	1.92	4.73	2.28	3.98	1.68	1.99	1.75	1.82	3.00	7
53.39	51.48	29.71	22.32	22.72	58.83	53.13	30.07	50.60	37.49	23.83	38.61	36.72	34.06	
6.41	1.52	1.36	1.78	0.92	3.98	4.07	3.01	3.38	2.28	1.89	1.49	1.50	2.95	10
43.00	53.92	33.08	24.05	22.64	67.86	59.74	31.13	53.80	40.93	17.92	38.85	35.12	42.84	
4.13	1.62	2.58	1.27	0.67	3.84	3.93	1.48	4.01	1.52	1.17	2.34	2.58	3.75	10
47.81	50.96	32.14	23.91	20.49	61.07	56.46	31.31	53.65	40.79	19.15	37.73	34.71	36.15	
3.55	1.91	1.87	1.39	0.84	3.71	4.33	1.87	1.96	1.50	1.22	1.87	1.63	1.60	10
48.37	54.44	34.09	23.72	21.16	65.19	54.47	32.05	55.91	41.98	17.32	38.28	34.17	41.12	
3.47	0.97	1.23	1.25	0.76	2.49	2.58	1.62	1.50	3.21	1.63	2.41	1.94	1.43	10
50.87	50.77	30.81	23.62	21.66	68.47	55.66	33.31	56.39	40.11	17.43	38.80	34.41	40.81	
5.18	1.22	1.25	0.52	0.94	2.51	2.29	1.45	2.07	1.53	1.40	2.53	2.50	2.23	10
54.27	51.92	30.66	23.63	24.13	64.88	53.47	31.35	53.13	40.84	17.88	41.40	38.29	39.82	
4.21	1.03	2.29	1.09	0.54	2.00	2.84	1.93	1.63	2.02	1.62	2.06	1.30	3.04	10
46.15	53.58	33.25	25.50	20.75	62.85	60.32	29.35	56.90	39.17	19.90	37.97	36.15	38.58	
2.30	0.97	1.09	1.17	0.61	2.27	2.22	0.77	1.76	0.80	0.92	0.37	1.10	2.78	6
47.91	53.76	31.62	23.98	22.86	58.82	50.99	29.81	55.34	37.72	20.46	38.28	36.03	36.93	
2.96	1.74	2.03	0.97	0.86	2.90	1.85	2.79	2.54	1.93	1.13	1.98	2.31	2.29	15
46.93	52.58	32.12	23.93	22.34	63.58	55.48	31.58	54.04	40.25	18.39	39.62	35.47	42.00	
4.99	1.04	0.81	1.18	0.99	3.23	3.23	2.05	3.03	2.13	1.65	3.50	1.95	1.96	10
35.2	46.2	27.8	19.8	18.6	54.1	47.5	23.1	44.0	33.3	15.2	33.3	28.6	29.2	
48.47	52.83	31.95	23.98	22.19	62.74	55.39	30.83	54.52	39.70	19.27	38.87	35.67	38.48	
66.7	57.7	37.6	26.8	25.1	73.2	69.1	37.5	61.5	45.8	27.5	45.7	42.9	47.6	138

Colour pattern is, to some extent, associated with features of the environment. Contrasting blotched or spotted patterns simulate the shadow patterns in small, clear exposed streams with gravel or stony beds, such as often occur above the snowline. On the Dargo High Plains, however, the fish occur in still, shallow pools with a dark, almost black substrate, and such fish are very dark in colour with little or no colour pattern. Light coloured fishes with little or no pattern are typical of streams with paler coloured substrates, even though deeply shaded, and also of streams that are relatively deep or turbid. Where there is deep shade and a dark substrate, relatively broad markings occur and the general ground colour is dark.

There are no distinctive colour pattern changes associated with stages of development, such as occur in *G. truttaceus* and *G. brevipinnis,* although the colour pattern does tend to become more fragmented with growth.

SIZE: *G. olidus* is amongst the "typical" moderate-sized galaxiids, reaching a known maximum length of 135 mm L.C.F. The size attained varies widely from population to population; in some the fish appear to reach no more than 60-70 mm, in others fish exceeding 80-90 mm are not uncommon.

HABITAT: *G. olidus* occurs most commonly in flowing waters and is typically taken in small, gravelly or sand-bedded streams, from sea level to about 1800 m altitude (near the summit of Mt Kosciusko). It is also found in small mountain tarns. It is sometimes cryptic but may live openly in shallow pools in loose shoals. Although McCulloch (1915) claimed that the fish at high altitude on Mt Kosciusko descend to lower elevations during the winter, they have been observed at an altitude of about 1700 m on the Bogong High Plains, in small tarns surrounded by thick snow.

LIFE HISTORY: The whole life cycle of *G. olidus* is completed in fresh water. A marine whitebait stage is not known, and fish from Pretty Valley, Bogong High Plains, suffered dehydration and failed to acclimate to sea water diluted to one-third of normal salinity. Spawning commonly occurs in the spring months (September to November), but in alpine populations, at least, it may extend to April. No significant spawning migration is known. Aspects of the life history of *G. olidus* were examined by Walford (1928, 1940, 1941) — identified as *G. coxii* (syn. *G. brevipinnis*). Walford studied populations in both natural conditions (near Katoomba, Blue Mountains, New South Wales) and in a garden pond, and he found that two main hatches of fry occurred each year — in September and November, except that the September hatch was missed if the spring was unusually cold. The garden pond population bred regularly over a period of 13 years. Newly hatched larvae grew from 5 mm to about 25 mm in six weeks, and to 32 mm in eight weeks. The maximum size recorded was 127 mm. Individual specimens were reportedly kept for 15 years, and an estimated age of 19 years was given for one of Walford's specimens by Whitley (1964). These ages seem unlikely considering known growth rates and longevity in other galaxiid species (Cadwallader, 1977; Eldon, 1978; Hopkins, 1971).

In Pretty Valley (and the neighbouring Rocky Valley), on the Bogong High Plains in Victoria, galaxiids and introduced brown trout (*Salmo trutta*) display an essentially complementary distribution; overlapping ranges were recorded on only one occasion. Trout occupy the main body of the stream, while galaxiids are usually found only in situations apparently inaccessible to trout, such as above waterfalls, or in small tarns adjacent to the main stream. Assuming that the galaxiids were once continuously distributed, trout appear to have fragmented the range of *G. olidus* into small, isolated populations.

Tilzey (1974) presented a preliminary report on the effects of rainbow trout *(Salmo gairdnerii* on *G. olidus* (misidentified as *G. coxii*), noting that where both trout and *G.*

olidus "occurred together, the galaxiids were extremely scarce. . . . Sampling of one feeder stream in 1971 and 1974 spanned the invasion by rainbow trout of water previously occupied by *Galaxias coxii (sic)* and showed the latter species to be completely exterminated, although the biomass of *G. olidus* above a natural waterfall barrier remained unaltered". Tilzey (1976) has since more fully documented this event, demonstrating quite clearly that invasion of a stream by trout has led to the extermination of *G. olidus* which is shown, like other galaxiids (McDowall, 1968d) to be susceptible to decline in the face of competition from trout. Fletcher (1978) has presented similar observations.

DISTRIBUTION: *G. olidus* is generally distributed in upland and sub-alpine areas of southeastern Australia from southern Queensland to eastern South Australia, in systems draining to the coast from the Great Dividing Range as well as those draining into the inland Murray-Darling drainage (Fig. 9). It is not known from coastal drainages in northern New South Wales between the Macleay and Hawkesbury Rivers; this may represent either a gap in knowledge or a real distributional gap — existing data do not suffice to determine which. Nor is the species known from the low elevation, flat, and dry area between the Grampian Mountains at the western end of the Great Dividing Range and the hills of the Flinders Range as they extend south into the Fleuriau Peninsula. One specimen has been identified from Kangaroo Island (South Australia — SAM No. F.1115 collected in 1883) but further confirmation of the occurrence of *G. olidus* on the island is desirable.

Altitudinal range is extensive, the species being recorded from near sea level to an altitude of 1800 m.

Galaxias johnstoni Scott

Fig. 10, 12

Galaxias (Galaxias) johnstoni Scott, 1936: 91 (holotype: QVML HT.948, (type no. 70) seen; paratypes: (2) QVML type no. 71, seen; (1) BMNH 1966.5.6.: 3, not seen; Scott (1936) stated that he intended to send paratypes to AMS and AIAC; it appears that neither institution received type material; type locality: Brown's Marsh Rivulet, Clarence River, Tasmania); 1941: 60; 1942: 54.

Galaxias johnstoni — Whitley, 1956a: 34; 1956b: 39; Munro, 1957b: 17; Whitley, 1964: 35; Frankenberg, 1966a: 164; 1966b: 23; 1967: 227; 1968: 270; Scott, 1968: 8; Andrews, 1973: 105; Frankenberg, 1974: 121; Andrews, 1976: 317; Lake, 1978: 22.

TAXONOMY: As Andrews (1976) notes, the listing by Munro of the Nive River as the type locality is incorrect.

Material of *G. johnstoni* has been very meagre in the past. Frankenberg (1974) reported that only seven specimens were then known, to which Andrews (1976) added two while noting that three of Frankenberg's (1974) fish could not be located. Additional material was obtained by Mr W. Fulton, Tasmanian Inland Fisheries Commission, from Clarence Lagoon, near the mouth of the Clarence River, enabling the status of *G. johnstoni* to be assessed more adequately. Description here is based on 20 newly examined specimens as well as data on the types.

G. johnstoni is similar and obviously closely related to another Tasmanian galaxiid — *G. pedderensis* Frankenberg. Frankenberg (1967) noted that "The lower number of vertebrae (given as 49-52 in *G. pedderensis* and 54 in *G. johnstoni*), the single pyloric caecum (cf. 2 in *G. johnstoni*), the narrower caudal peduncle (32.5-37.0, mean = 34.6% of

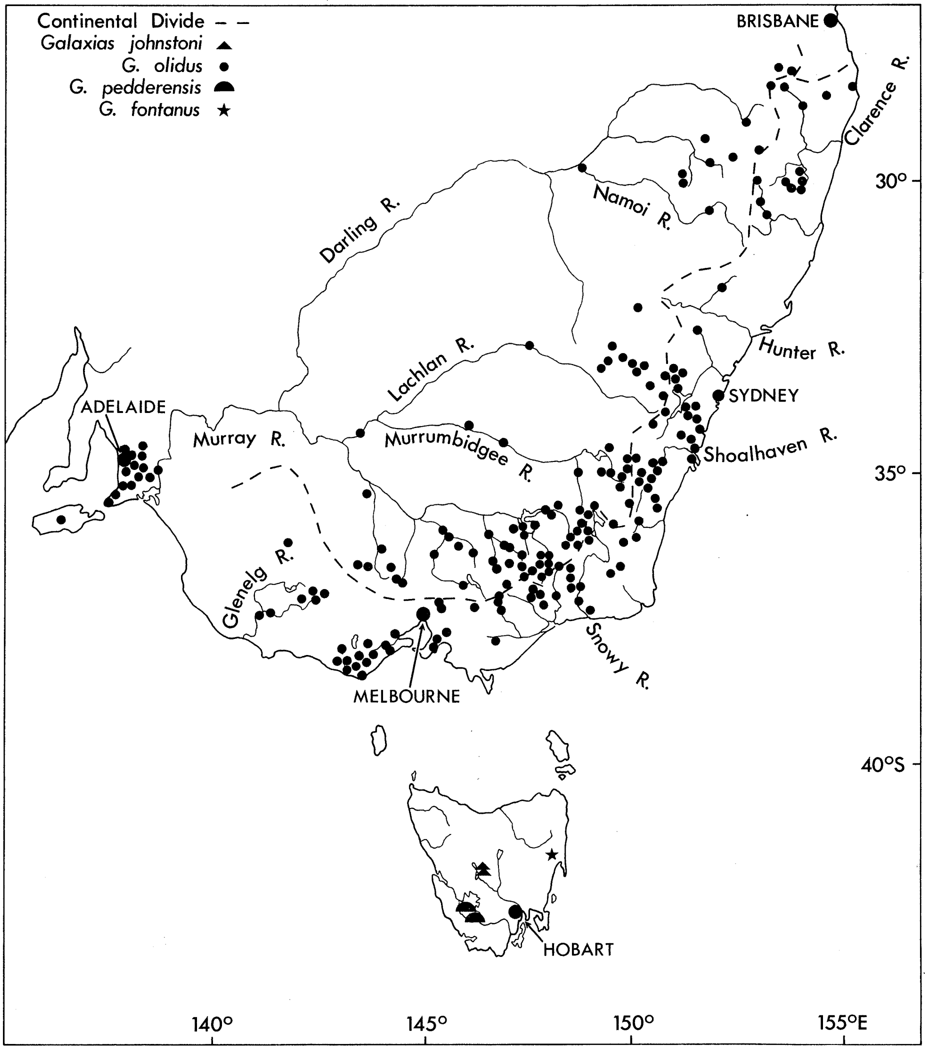

Fig. 9. Distribution of *Galaxias olidus, G. johnstoni, G. pedderensis* and *G. fontanus.* One symbol may represent more than one locality.

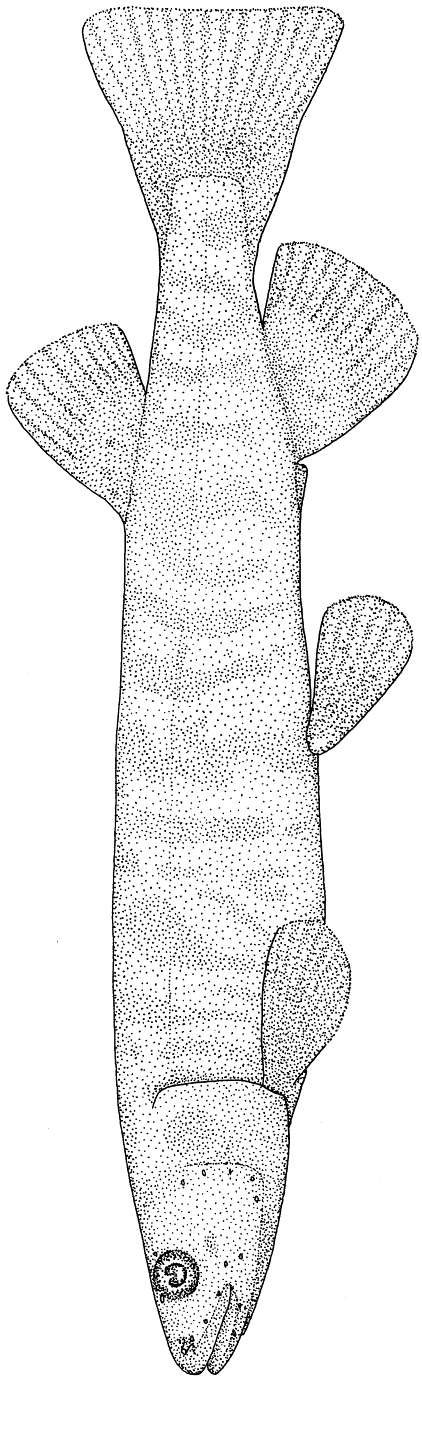

Fig. 10. *Galaxias johnstoni* Scott; Clarence Lagoon, Tas., 86.5 mm L.C.F.

the dorsal length, cf. 39.0-47.0, mean = 43.1%) and the larger head (23.1-26.0, mean = 24.0% of S.L. cf. 21.0- 23.0, mean = 22.0%) serve to distinguish *G. pedderensis* from *G. johnstoni*". Frankenberg's data were based on small examples of both species (40.5-60.0 mm S.L. in *G. johnstoni* and 32.0-51.5 mm S.L. in *G. pedderensis)* and on only three examples of *G. johnstoni*. Andrews (1976: 317) distinguished the two species as follows: *G. johnstoni* "differs from *G. pedderensis* in having a slightly smaller head, smaller ventral fins, and a shorter ventral-anal interspace".

Differences between *G. johnstoni* and *G. pedderensis* are slight. The difference in vertebral count noted by Frankenberg (1967) is shown to be much less when additional material is incorporated (51-54 in *G. johnstoni,* 49-52 in *G. pedderensis* – Table 6). Differences of this degree are common between discrete, conspecific populations of many galaxiid species (see McDowall, 1970a, 1971, 1972a). No differences of any taxanomic significance are evident in fin ray counts (Table 6). Frankenberg (1967) reported only one pyloric caecum in *G. pedderensis* but two in *G. johnstoni*. Andrews (1976:320) however, reported "Pyloric caeca variable, 0, 1 or 2" in *G. pedderensis* but did not mention their occurrence in *G. johnstoni*. Our observations show that *G. johnstoni* usually has two, occasionally three moderately long caeca while *G. pedderensis* may have none, one or two as Andrews has indicated.

In body proportions *G. johnstoni* is generally considerably stouter in build (Table 7), having a deeper caudal peduncle and broader and deeper head; the predorsal distance is somewhat greater in *G. johnstoni* and the pectoral fins are shorter.

Colouration differs. *G. johnstoni* has bold and contrasting dark bars or vermiculations dorsolaterally and laterally, these tending to coalesce on the back, making the back dark in colour. *G. pedderensis* tends, rather to have discrete, well separated darker brownish blotches on the back and passing over on to the upper sides, but below the lateral line these abruptly fragment to form a fine reticulum, or vermiculations, that extend latero-ventrally but fail on the belly. *G. johnstoni* has a few small spots on the bases of the unpaired fins but in *G. pedderensis* these are much more numerous and extend well out onto the fins. All the individual and quantifiable differences between these two species are small, but they combine to give *G. johnstoni* a very different appearance from *G. pedderensis*. The two species are therefore retained as distinct.

DIAGNOSIS: Characterised by tubular trunk, bluntish snout, large mouth, the gape reaching back well below the eye, and the anal origin below the middle to rear of dorsal fin.

Differs from *G. brevipinnis* and *G. olidus* in characters discussed in the diagnoses of these two species (pp.462 and 479 respectively); differs from *G. pedderensis* in regularly having two pyloric caeca of moderate length (often 0-1, sometimes 2 in *G. pedderensis*), in being stouter in build, and in having the lateral pigmentation not fragmented below the lateral line, as it frequently is in *G. pederensis; G. johnstoni* tends to be more darkly pigmented than *G. pedderensis*. The differences are generally small. Differs from *G. fontanus* in having four pores in row below eyes, and having two pyloric caeca.

DESCRIPTION: A moderate-sized species, the trunk tubular, the back and belly little arched, body deepest in front of pelvic fins at about mid-abdomen, tapering to a moderately slender caudal peduncle, which is much longer than deep. Head of moderate length, somewhat depressed, broader than deep. Snout tapering and bluntly pointed; mouth large, slightly oblique, reaching back as far as middle of eye; jaws equal. Eyes small, set a little below upper head profile, interorbital broad and slightly convex. Jaws with slight enlargement of lateral canines; mesopterygoidal and lingual teeth strong. Gill rakers short and stout (Fig. 43). Two pyloric caeca of moderate length (Fig. 45). Laterosensory pores as in Fig. 47.

Fins small, thick and fleshy at bases. Dorsal and anal fins short-based, high and rounded, posterior rays long, the fins extending well back beyond fin bases. Anal fin origin below or behind mid-point of dorsal fin base. Pectoral fins small to moderate, oval-shaped, insertion low lateroventrally, fin lamina more or less horizontal. Pelvic fins of moderate size, inserted somewhat behind mid-point of standard length. Caudal fin slightly forked to truncated, fin tips rounded, fin depth a little less than body depth, caudal peduncle flanges well-developed.

Variation: meristic: see Table 6
morphometric: see Table 7

COLOUR: Colour when alive, described by Andrews (1976: 317) as "dark greenish-black on the back and sides, light silvery fawn below, back and sides of head and body marked with irregular brownish-black patches, ventral surface unmarked. A sharp line of demarcation running below and parallel to the lateral line separates the marked dorsal surface from the unmarked ventral surface. In live specimens numerous spots of bright metallic gold are visible over the entire body, with a conspicuous patch on the operculum. . . . all the fins clear. . . ."

In preservative grey-olive with boldly contrasting broad, dark brown vermiculations to bands across the back and sides, extending forwards also on to the head. Bases of unpaired fins somewhat spotted. Belly creamish-grey.

SIZE: *G. johnstoni* is known to reach a length of 98 mm L.C.F. Specimens over 70 mm are well represented amongst the few known specimens.

HABITAT: Little is known about the habitat of *G. johnstoni;* it has been taken both in a lacustrine habitat in Clarence Lagoon, and in flowing waters both entering and draining the lagoon. Too few specimens have been collected to properly characterise the habitat.

LIFE HISTORY: The life history is unstudied. There is no evidence to suggest a marine phase, or any migration of significance.

DISTRIBUTION: *G. johnstoni* is known only from Clarence Lagoon, its tributaries, and the upper reaches of the Clarence River, which drains Clarence Lagoon, and which is a tributary of the Nive River, a part of the Derwent River system, Tasmania (Fig. 9).

Galaxias pedderensis Frankenberg

Fig. 11, 12

Galaxias pedderensis Frankenberg, 1967: 268 (holotype: TMH D.941, seen; paratypes: (9) NMVM 379-387, seen; type locality: Lake Pedder, southern Tasmania, near the mouth of the inflowing stream from Lake Maria — the type locality has since been obliterated by the flooding of Lake Pedder and its environs to form a water storage lake); Andrews, 1971: 1; Lake, 1971: 20; Bayly et al., 1972: 46; Dixon, 1972: 121; Lynch, 1972: 14; Johnston, 1972: 43; Andrews, 1973: 106; Lake, 1974: 449; Frankenberg, 1974: 123; Andrews, 1976: 319; Lynch, 1977: 14; Lake, 1978: 22.

TAXONOMY: The similarity between, and problems in the separation of *G. pedderensis* and *G. johnstoni* are discussed in the taxonomy section of *G. johnstoni* (p.489), to which the reader is referred.

Table 6. Meristic variation in *Galaxias johnstoni*, *G. pedderensis* and *G. fontanus*.

		G. johnstoni	*G. pedderensis*	*G. fontanus*
Dorsal rays				
— segmented	7			4
	8	4	4	11
	9	12	19	5
	10	4	13	
	11		1	
total	9			7
	10	5	3	8
	11	9	14	5
	12	5	14	
	13	1	6	
Anal rays				
— segmented	9	3	3	4
	10	11	6	11
	11	6	24	5
	12		3	
	13		1	
total	11	3		1
	12	5	5	8
	13	8	20	10
	14	4	9	1
	15		2	
	16		1	
Pectoral rays	10			12
	11	1	2	8
	12	7	20	
	13	12	10	
	14		5	
Vertebrae	49	1		
	50	7		1
	51	9	9	9
	52	1	4	8
	53		6	2
	54		2	
Gill rakers	9	1		
	10	1	2	
	11	3	13	2
	12	5	7	7
	13	6	4	9
	14	3	3	2
	15	1	6	
	16		1	
	17		1	

Table 7. Morphometric variation in *Galaxias johnstoni, G. pedderensis* and *G. fontanus*. Figures are given as percentages of denominators in ratios.

	G. johnstoni				*G. pedderensis*				*G. fontanus*			
	Min.	Mean	Max.	S.D	Min.	Mean	Max.	S.D.	Min.	Mean	Max.	S.D.
S.L./T.L.	85.6	87.96	89.3	1.08	86.4	87.94	89.8	0.91	85.3	86.76	88.4	0.89
B.D.V./S.L.	11.0	12.03	13.1	0.59	8.7	11.82	14.8	1.60	13.1	14.36	16.3	0.92
L.C.P./S.L.	11.4	14.16	16.5	1.14	13.4	15.51	17.2	0.96	14.7	16.40	17.9	0.96
D.C.P./L.C.P.	57.7	64.74	75.9	5.06	44.7	59.04	64.6	9.89	59.4	65.02	73.0	4.15
PreD./S.L.	67.0	70.37	74.5	2.05	65.7	68.29	71.1	2.08	68.8	71.24	73.4	1.15
PreD./PreA.	89.5	92.85	96.7	1.65	90.9	93.76	96.7	1.48	94.8	97.91	100.0	1.38
L.D.B./S.L.	8.0	9.34	10.8	0.64	7.3	9.91	12.8	1.37	9.2	10.06	11.8	0.59
M.L.D./L.D.B.	154.5	172.69	193.3	9.14	135.7	161.11	191.7	12.51	159.1	176.87	192.6	8.54
L.A.B./S.L.	10.0	10.91	12.7	0.72	10.4	12.35	14.3	1.06	12.0	13.66	15.3	0.92
M.L.A./L.A.B.	142.9	153.38	172.2	8.61	120.0	144.18	166.7	9.37	137.0	146.99	154.5	6.18
Pec./Pec.Pel.	44.7	52.67	63.2	4.74	40.7	50.90	74.3	6.78	48.0	55.11	65.7	4.39
Pel./Pel.An	55.1	61.48	70.3	4.82	56.8	66.32	79.2	5.47	57.9	65.63	71.8	3.85
PrePel/S.L.	49.0	54.01	57.3	1.79	51.0	53.82	58.9	2.09	49.2	51.50	53.7	1.29
Pec.Pel./S.L.	27.0	30.98	32.7	1.45	27.2	30.47	34.1	1.59	27.2	29.47	31.1	1.08
Pel.An./S.L.	20.0	22.75	24.5	1.09	18.40	20.44	21.9	1.21	19.9	21.84	23.8	0.95
H.L./S.L.	23.0	25.09	27.1	1.15	21.4	24.93	26.8	0.96	23.4	24.65	25.8	0.68
H.W./H.L.	55.8	62.21	69.2	3.90	43.5	55.08	65.3	5.64	59.6	62.57	66.7	1.95
H.D./H.L.	52.6	55.91	61.3	2.20	43.5	50.83	59.7	3.53	48.9	52.99	57.7	2.18
Sn.L./H.L.	28.1	32.28	37.5	2.27	26.1	30.75	34.9	1.92	31.7	34.03	37.8	1.64
P.O.H.L./H.L.	48.9	52.82	56.5	2.05	45.9	51.61	59.4	2.40	44.7	50.95	55.0	2.48
I.O.W./H.L.	34.1	37.75	42.5	2.32	26.7	33.94	38.9	3.29	38.3	41.93	44.9	2.03
D.E./H.L.	17.1	20.85	25.6	2.55	15.7	20.90	28.8	2.34	20.3	22.89	25.5	1.40
L.U.J./H.L.	37.2	42.21	46.8	2.40	35.6	41.23	47.6	3.18	42.5	45.20	47.4	1.65
L.L.J./H.L.	34.9	39.30	44.1	2.36	32.5	38.44	44.4	2.72	39.7	43.46	45.6	1.45
W.G./H.L.	34.9	38.38	43.2	2.71	22.5	34.51	47.2	5.95	34.0	38.57	43.6	2.44
N		20				37				20		

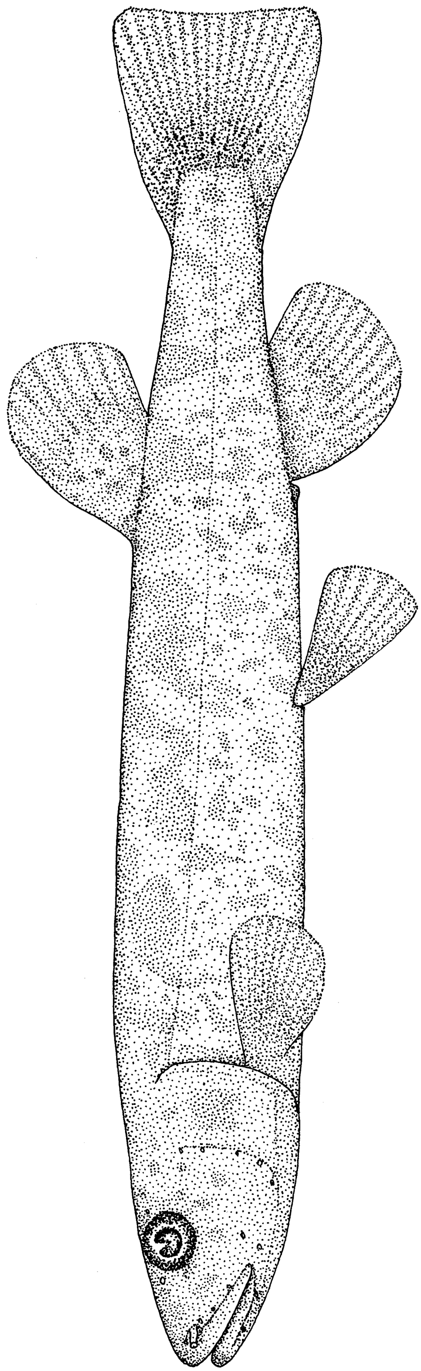

Fig. 11. *Galaxias pedderensis* Frankenberg; Lake Pedder, Tas., 87 mm L.C.F.

G. pedderensis is known only from Lake Pedder and its environs, and no examination of variation between populations was undertaken.

DIAGNOSIS: Characterised by very elongate, slender form and large strongly depressed head, the eye more or less at the dorsal head profile and the interorbital flat. The anal fin is well back from the dorsal fin origin.

Differs from *G. brevipinnis*, *G. olidus* and *G. johnstoni* in characters discussed in the diagnoses of these three species (pp.462, 479 and 492 respectively). Differs from *G. fontanus* in having only four pores in row below eyes, in having only slight enlargement of canine teeth in jaws, and usually fewer pectoral fin rays.

DESCRIPTION: A moderate-sized and very slender species, the trunk rounded in section or slightly compressed, the dorsal and ventral trunk profiles about parallel, little arched, greatest body depth behind head, strongly depressed anteriorly on head, becoming increasingly compressed behind vent. Caudal peduncle long and slender, much longer than deep. Head moderately long, dorsally flattened, much broader than deep, snout long and flattened, tapering to a slender, rounded point. Mouth slightly oblique, large, extending back well below eye, jaws about equal. Eyes small, set at about upper head profile, interorbital broad and flat. Jaws with slightly enlarged lateral canine teeth; mesopterygoidal and lingual teeth strong. Gill rakers very short (Fig. 43) and stout; 0-2 pyloric caeca of moderate length (Fig. 45). Disposition of laterosensory pores as in Fig. 47.

Fins mostly small, somewhat thickened and fleshy at bases. Dorsal and anal fins short-based, but high and rounded, posterior rays long, the fins extending back well behind fin bases; anal origin set well behind dorsal origin, often below middle of dorsal base or further back. Pectoral fins small and rounded, inserted low lateroventrally with lamina of fin tending to face downwards. Pelvic fin insertion somewhat behind mid-point of standard length. Caudal fin emarginate to truncate, fin tips rounded, fin depth about equal to body depth, peduncle flanges moderately developed.

Variation: meristics: see Table 6.
morphometric: see Table 7.

COLOUR: Colour when alive variable, often extremely bold and contrasting brown and off-white bands on the back and sides, the pattern very irregular and extending forwards on to the head. The darker areas on the back and trunk are about as large as the paler areas. Belly a pale off-white. Dark pattern extends onto fleshy fin bases.

Colour in preservative boldly contrasting and very irregular grey-brown and creamish-white vermiculations, coarse above lateral line but becoming suddenly fragmented at lateral line and much finer below it; fin bases spotted, belly unmarked.

SIZE: *G. pedderensis* grows to a maximum known length of 110.5 mm L.C.F. and commonly reaches a length exceeding 70 mm.

HABITAT: *G. pedderensis* was taken from amongst rocks and boulders, less often from amongst submerged vegetation around the shores of Lake Pedder. It is also found amongst cover in streams flowing into Lake Pedder. The water of Lake Pedder is deeply stained brown and is likely to have low pH.

Frankenberg (1967) reported the species from Lake Pedder, prior to its inundation following construction of a large dam across the outlet river which resulted in raised water levels. Frankenberg found that the fish were abundant near the edge of the lake and in a stream flowing into it. Some fish were also found with *G. parvus* in a small pond near the shores of Lake Pedder. *G. pedderensis* remains abundant in the new enlarged lake.

LIFE HISTORY: No data are available on the life history of *G. pedderensis,* although Andrews (1976:321) speculated that spawning "would appear to take place during the late autumn or winter, presumably in the upper reaches of streams flowing into Lake Pedder and the upper Serpentine River. Mature females were taken from a pool below a man-made waterfall some 120 cm in height and their accumulation there may indicate an upstream migration".

DISTRIBUTION: *G. pedderensis* is known only from Lake Pedder and waters draining into the lake (Fig. 9).

Galaxias fontanus Fulton

Fig. 12, 13

Galaxias fontanus Fulton, 1978b: 2 (holotype: TMH D.1317, seen; paratypes: (4) TMH D. 1318-1321, seen; (4) QVML 1978/5/72 (type 254), seen; (4) AMS I.20157-001, seen; type locality: Swan River, eastern Tasmania, where State forestry MG road crosses this river).

DIAGNOSIS: An elongate, tubular, blunt-headed species with enlarged lateral canine teeth in the jaws, usually 5-6 open laterosensory pores in the series from beneath eyes to anterior nostril, and no pyloric caeca.

Differs from *G. brevipinnis, G. johnstoni* and *G. pedderensis* in characters listed in the diagnoses of these three species (pp.462, 492 and 497 respectively).

DESCRIPTION: A moderate-sized species, the trunk tubular, back and belly little arched, body deepest in front of pelvic fins, tapering to a moderately slender caudal peduncle which is longer than deep. Head of moderate length, depressed, much broader than deep. Snout bluntly pointed, mouth large, slightly oblique, reaching to about below middle of eyes; jaws about equal. Eyes small to moderate-sized, set at about upper head profile, interorbital broad and flat. Jaws with strong lateral canines; mesopterygoidal and lingual teeth strong; gill rakers very short and stout (Fig. 43); no pyloric caeca (Fig. 45); laterosensory pores as in Fig. 47, series from below eyes to anterior nostril usually with 5, sometimes 6, rarely 4 pores.

Fins small, thick and fleshy at bases. Dorsal and anal fins short-based, high and rounded, posterior rays long, the fins extending well back behind bases, anal origin below or a little behind dorsal origin. Pectoral fins short, oval-shaped, insertion low lateroventrally, fin lamina more or less horizontal. Pelvic fins of moderate size, inserted at about mid-point of standard length. Caudal fin slightly forked to emarginate, fin tips rounded, fin depth about equal to body depth, caudal peduncle flanges well developed.

Variation: meristic: see Table 6
morphometric: see Table 7

COLOUR: Colour when alive a dull greenish-olive with quite fine and irregular brownish markings, the belly a silvery-olive.

In preservative, brownish, the sides and back covered with dense and irregular vermiculations, fins without markings, dusky, the belly creamish-grey.

SIZE: *G. fontanus* is known to reach 96 mm L.C.F., and is not uncommonly 65 mm or more.

Fig. 12. Colour pattern in — **a.** *Galaxias johnstoni,* Clarence Lagoon, Tas. 89 mm L.C.F.; **b.** *G. pedderensis,* Lake Pedder, Tas., 64.5 mm; **c.** *G. fontanus,* Swan River, Tas., 64.5 mm L.C.F.

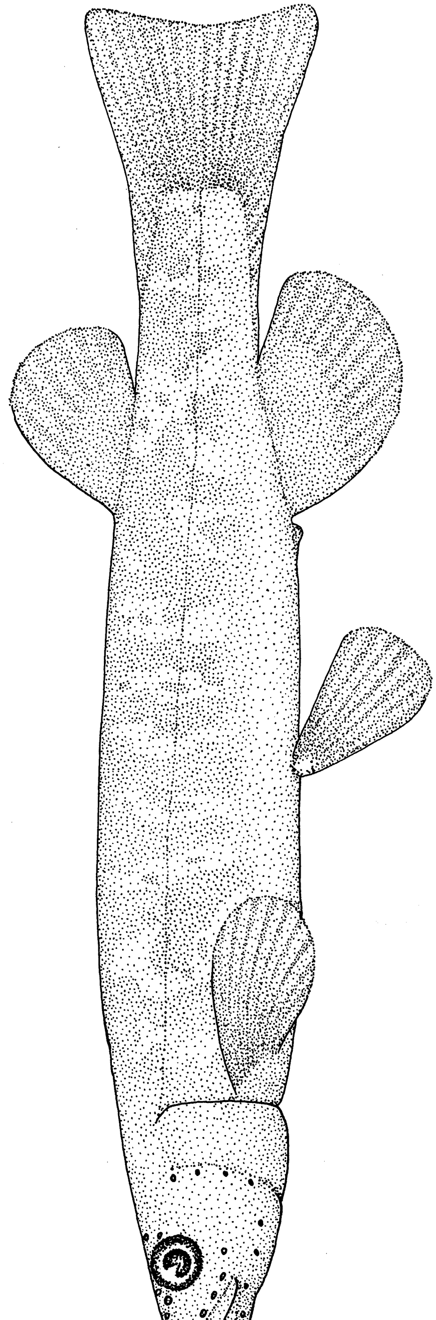

Fig. 13. *Galaxias fontanus*, Fulton; Swan River, Tas., 71 mm L.C.F.

HABITAT: The fish were collected free-swimming, or sheltering beneath rocks or marginal cover in gently to moderately swiftly flowing waters in a small, apparently spring-fed stream flowing through low, dry scrub. Numbers were much lower in the more swiftly flowing waters.

LIFE HISTORY: Juveniles 15-25 mm long were collected with the adults in January-February, indicating a spring-summer spawning and showing that the entire life cycle is completed in fresh water.

DISTRIBUTION: Known only from the upper reaches of the Swan River, eastern Tasmania (Fig. 9).

Galaxias truttaceus Valenciennes

Fig. 14, 15

Esox truttaceus Cuvier, 1817: 390 (*nomen nudum*).

Galaxias truttaceus Valenciennes, in Cuvier and Valenciennes, 1846: 344 (syntypes (3) MNHN A.5311-3, not seen; type locality: Tasmania); Richardson, 1848: 75; Kner, 1865: 320; Günther, 1866: 209; Krefft, 1871: 84; Günther, 1880: 625; Klunzinger, 1880: 412; Macleay, 1881: 47; 1882: 209; Johnston, 1882: 130; Seal et al. 1883: lvi; Johnston, 1883: 130; 1891: 27; Ogilby, 1893: 177; 1896: 64 (*partim*); Regan, 1905: 378; Stead, 1906: 49; Fletcher, 1907: 567; Ogilby, 1908: 6; Johnston, 1909: iv; Anon, 1913: xvi; McCulloch, 1919: 49; Lord, 1923: 63; Lord and Scott, 1924: 33; Lord, 1927: 12; Walford, 1928: 274; Iredale and Whitley, 1932: 95; McCulloch, 1929: 48; Whitley, 1929: 46; Scott, 1934: 44; Whitley, 1935: 44; Mack, 1936: 99; Scott, 1936: 113; Blackburn, 1950: 160; Bertin and Esteve, 1950: 3; Whitley, 1956a: 30; 1956b: 39; 1957a: 7; 1957b: 8; 1964: 35; Lynch, 1965: 13; Scott, 1966: 244; Frankenberg, 1966a: 20; 1966b: 19; Lynch, 1966: 13; McDowall, 1967a: 842; 1968c: 177; Lynch, 1968: 9; Anon. 1968: 26; Scott, 1968: 1; McDowall, 1969: 804; Lynch, 1969: 23; 1970: 15; Whitley, 1970: 54; McDowall, 1970a: 420; 1970b: 18; 1971: 68; Scott, 1971a: 8; 1971b: 120; Lynch, 1971: 13; Dixon, 1972: 121; Andrews, 1973: 104; McDowall, 1973b: 97; Rosen, 1974: 317; McLean, 1974: 13; Scott, 1974: 254; Whitley, 1975: 64; Andrews, 1976: 305; Lynch, 1977: 13; Fulton, 1978a: 109; 1978b: 3; McDowall, 1978c: 209; McDowall and Fulton, 1978b: 663; Lake, 1978: 25; Backhouse and Vanner, 1978: 128.

Galaxias forsteri — Kner, 1867: 320 (*partim* — non *Galaxias forsteri* Valenciennes, in Cuvier and Valenciennes, 1846: 531, syn. *Galaxias argenteus* (Gmelin, 1789), New Zealand).

Galaxias ocellatus McCoy, 1867: 18 (holotype: unknown; type locality; Yarra River near Studley Park, Victoria); Castlenau, 1872: 175; Macleay, 1881: 47; 1882: 235; Lucas, 1890: 35; Ogilby, 1896: 68; Whitley, 1956a: 34.

Galaxias truttaceous — Anderson, 1900: 25; Butcher, 1946: 9; Lake, 1971: 20; Anon. 1974a: 13; 1974b: 12; (mispelling of *Galaxias truttaceus*).

Galaxias (Galaxias) truttaceus — Scott, 1936b: 89; 1938: 126; 1941: 55; 1942: 56.

Galaxias (Galaxias) scopus — Scott, 1936b: 95 (holotype: QVML HT. 949, seen; Scott indicated that he intended sending a paratype to the British Museum, but this fish was apparently never received by the museum and there is no paratype; type locality: small brackish stream, Clarke Island, Bass Strait); 1941: 60.

Galaxias scopus — Whitley, 1944: 264; 1956a: 34; 1956b: 39; 1957a: 7; 1957b: 34; 1964: 35; Stokell, 1966: 79; Scott, 1968: 8; Green, 1974: 2.

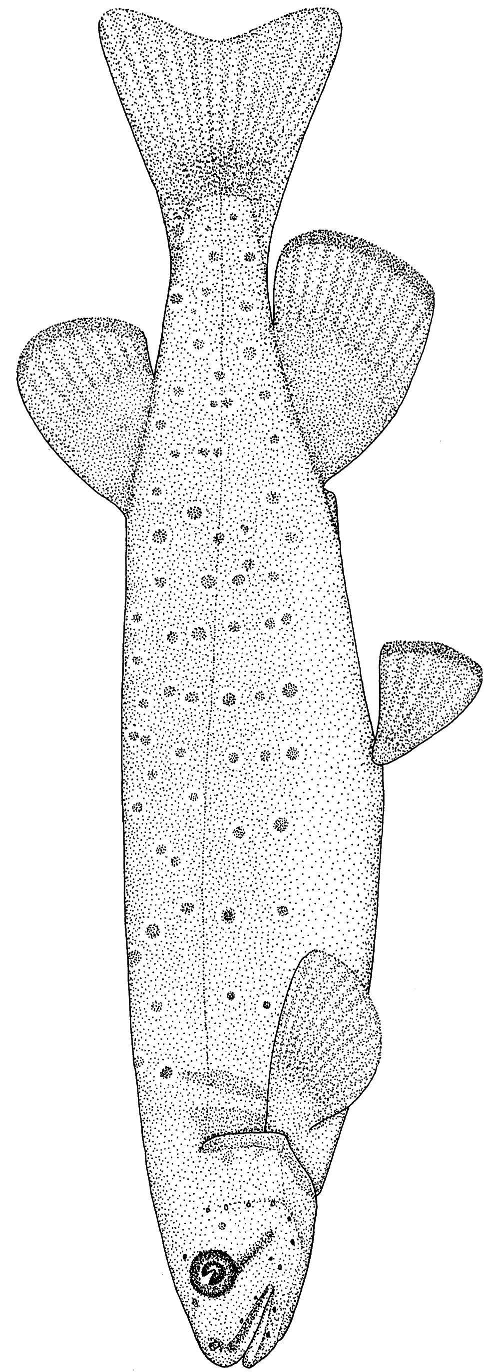

Fig. 14. *Galaxias truttaceus* Valenciennes, Triabunna, Tas., 135 mm L.C.F.

Galaxias truttaceus hesperius Whitley, 1944: 263 (holotype: WAM P. 2580 seen; paratypes: (2) AMS I.13280, seen; type locality: creek flowing into Taylors Inlet, Albany District, Western Australia); Whitley, 1947: 53; 1948: 11; 1956b: 39; 1957a: 7; Munro, 1957b: 16; Mees, 1961: 38; Gentilli, 1961: 488; Whitley, 1964: 35.

Galaxias hesperius — Whitley, 1956b: 34.

Galaxias truttaceus scopus — Munro, 1957b: 16; Gentilli, 1961: 488; Green, 1969: 27.

Galaxias truttaceus truttaceus — Munro, 1957b: 16; Gentilli, 1961: 488; Frankenberg, 1967: 226; Green and McGarvie, 1971: 30; Frankenberg, 1974: 123.

TAXONOMY: The name *truttaceus* was first used in the combination *Esox truttaceus* by Cuvier, (1817) as a footnote to his diagnosis of the genus *Galaxias.* It was based on material collected in Tasmania in the late 18th century. Because Cuvier published no description, the 1817 usage is a *nomen nudum*, and the name is attributable to Valenciennes, in Cuvier and Valenciennes (1846) where the species is described for the first time.

Stokell (1966: 78) claimed that "The name *truttaceus*, which is universally applied to the common black spotted species of Tasmania and Victoria, is of very doubtful validity. . . . The application of the name *truttaceus* to the Tasmanian fish appears to be a misidentification of a type species, and a new name or the reinstatement of a synonym to be necessary". However, whether or not the name *E. truttaceus* Cuvier (1817) is the result of a misidentified type species, it is *nomen nudum* and therefore has no taxonomic standing. The name *G. truttaceus* Valenciennes is the original name applied to this species, and its application is supported by the presence of syntypes in the Museum National d'Histoire Naturelle, Paris.

Stokell (1966) in seeking a replacement name for *truttaceus* incorrectly classified the junior synonym *G. ocellatus* McCoy (1967) as a *nomen oblitum*. However, since a *nomen oblitum*, prior to changes in the International Code of Zoological Nomenclature in 1972, was an unused senior synonym which endangered nomenclatural stability in the use of a long recognised more junior name, there is no way that *G. ocellatus* McCoy can properly be regarded as a *nomen oblitum* relative to *G. truttaceus.* It is simply a *junior* synonym of *G. truttaceus.*

Galaxias scopus Scott (1936) was described from Clarke Island, Bass Strait, and was said to differ from *G. truttaceus* (p. 98) "mainly in the relative positions of the anal and dorsal . . . it at once being distinguished by the origin of the anal being below or very slightly behind the level of the dorsal origin . . . and in the more lavish spotting". Our observations indicate that the anal origin in *G. truttaceus* is usually slightly behind the dorsal origin (predorsal/preanal ratio 93.7-100.6%), and in view of this variation there is no reason to regard *G. scopus* as distinct. Munro (1957b), Stokell (1966) and Andrews (1976) are all of this opinion.

Whitley (1944) described *G. truttaceus hesperius* from Western Australia; he considered it (p. 264) "advisable to provide a distinctive name for the Western Australian form as it differs from the Tasmanian type in fin counts and inasmuch as the pectoral and anal fins do not extend back so far". Material from Western Australia, including the types, a series from the Goodja River and one fish from the Kalgan River indicated that differences between populations in Western Australia and those in the east are very minor. The number of anal fin rays is a little lower in the west, but not as low as the landlocked population in Great Lake, Tasmania (Table 8). The pectoral count is slightly higher (Table 8), and the vertebral count is lower (58.47, compared with 59.44 in the population at Wilsons Promontory, Victoria), but not as low as in Great Lake (58.14 — Table 8). Thus if the Western Australian population is to be given taxonomic recognition on the basis of the few evident differences, so too should the Great Lake population. However, in view of the differences demonstrated between populations in a wide range of galaxiid species, particularly in *G. brevipinnis* Günther (McDowall 1970a, b, present study) and *G. maculatus* (Jenyns) (McDowall 1972), it is suggested that there is little reason to regard the Western Australian population as taxonomically distinct but rather to recognise only that there are small differences between populations on the basis of existing rather meagre information on relatively few specimens. It is possible that the Western Australian population is restricted to freshwaters (like the Great Lake population), and that observed differences between these fish and typically diadromous populations in eastern Australia and Tasmania are related to the elimination of the marine juvenile stage and thus changed environmental conditions experienced during embryonic and larval development.

The landlocked population in Great Lake is likewise treated as an ecological race of *G. truttaceus*; the observed differences, primarily those noted above in the discussion of the status of the Western Australian populations (Tables 8, 9), are relatively minor and may be attributable to the wholly freshwater life cycle.

Andrews (1976) reported a further landlocked population in Bronte Lagoon, Tasmania, but found nothing supporting separate taxonomic recognition of this population. He also reported a population in a cave stream (Andrews, 1973, 1976), and found (1976: 309) that "In comparison with typical *G. truttaceus* the subterranean population appears to differ only in colouration . . . the characteristic body markings of the species are entirely absent and the background colour is reduced to a uniform pale grey".

Apart from differences noted in the preceding discussion between populations in Western Australia and in Great Lake, differences between populations of *G. truttaceus* are small, as tends to be true of other diadromous galaxiids (McDowall, 1970a).

DIAGNOSIS: Characterised by stout build, growth to a large size, the anal fin origin being only slightly behind the dorsal origin, the presence of dark to black fringes on the dorsal, anal and pelvic fins, of numerous, distinctly round spots each surrounded by a halo on the trunk, and of two (occasionally one) dark, vertical bars just behind and above the pectoral fin base.

G. truttaceus most closely resembles *G. auratus,* from which it can be distinguished by its fewer and distinctly round spots on the trunk and its post-pectoral dark bars. It has more dorsal and anal rays, although overlap is broad, and has more vertebrae (56-62, usually 59 or more in *G. truttaceus* compared with 53-56 in *G. auratus*). There are differences in body proportions (Table 9), but overlap is broad.

It also resembles *G. tanycephalus*, but can be distinguished by most of the same characters that are used to distinguish it from *G. auratus*.

DESCRIPTION: A large, stout-bodied species, the trunk tubular anteriorly, becoming compressed at about the pelvic fins, the back somewhat arched, the belly rather more deepened, tapering to a moderately long and deep caudal peduncle, the peduncle somewhat longer than deep. Head of moderate length, broad and deep, breadth about equal to depth. Snout rounded; mouth large, moderately oblique, reaching back behind front of eye, sometimes as far as anterior third. Jaws about equal. Eyes moderate to large, set distinctly below upper head profile, interorbital broad and convex, not flattened dorsally. Jaws with enlarged lateral canine teeth; mesopterygoidal and lingual teeth strong. Gill rakers of moderate length, slender (Fig. 43); pyloric caeca reduced to vestiges (Fig. 45). Laterosensory pores on head as in Fig. 47.

Fins well developed, thick and fleshy at bases. Dorsal and anal fins short-based, high and rounded, posterior rays long, extending well back beyond fin bases. Anal fin origin below or a little behind dorsal origin. Pectoral fins of moderate size, rounded, fin insertion lateral, fin lamina lateral. Pelvic-anal interval short, pelvic fins of moderate size, inserted somewhat behind mid-point of standard length. Caudal fin emarginate to slightly forked, fin tips rounded, fin depth rather less than body depth, caudal peduncle flanges moderately developed.

Variation: meristic: see Table 8
morphometric: see Table 9

COLOUR: Colour when alive brownish to a deep olive-grey, or almost black, sometimes a deep purplish-grey, paling to olive-grey on the sides, and silvery-olive on the belly. The trunk is covered with round spots, these tending to occur in vertical rows, especially anteriorly and in smaller fish, each spot surrounded by a paler halo. There is a distinct, dark, blue-black post-pectoral bar separated from a second, similar bar by a narrow, pale vertical line, the second bar sometimes fragmented to form a dense mass of spots. The fins are generally brownish to dark olive, but the dorsal, anal and caudal fins are golden to bright orange on the distal halves; the outer fringes of the dorsal, anal and pelvic fins are black. The eyes are a dark olive-gold. There is a distinct, diagonal, dark stripe passing from the eye backwards and downwards across the cheeks, almost parallel to the heavily pigmented upper lip.

The juvenile "whitebait" stage, at migration upstream from the sea, is very weakly pigmented, with only a few melanophores on the top of the head, along the back and belly and at the base of the tail. Pigmentation develops as a series of melanophores arranged along the myosepta, thus being chevron-shaped, with rather more and large melanophores along the back. Subsequently a series of broader, dark, vertical, straight to slightly chevron-shaped bars develop across the sides of the trunk. With growth, these bars become fragmented, initially in the caudal region, but increasingly so towards the head, the bars initially replaced by vertical series of spots, but the spots ultimately becoming non-linear and more randomly distributed. Scott (1941) has described the ontogenetic changes in colouration of *G. truttaceus* in considerable detail.

SIZE: *G. truttaceus* is one of the largest galaxiids, reaching a reported maximum size of 172 mm S.L. (about 197 mm L.C.F.) (Andrews, 1976). Andrews (p. 307) reported that "most populations sampled yielded individuals within the range 100-120 mm S.L.". (120-137 mm L.C.F.) Specimens about this size are common in collections.

HABITAT: *G. truttaceus* occurs in rivers and streams, mostly amongst cover at the margins. It was taken around the shore of Great Lake from amongst submerged terrestrial vegetation, and from beneath debris and rocks on the lake bed. It appears to be largely a species of still to gently flowing waters, although its ability to move upstream is greater than that of *G. maculatus,* which is mostly confined to waters not far inland. Salinity tolerances were demonstrated by Scott (1941:59) who showed that the fish tolerated "direct transference from tap water to sea water of salinity 35 gm per 1000 gm; in no instance has the fish manifested any noteworthy symptoms of distress".

LIFE HISTORY: *G. truttaceus* has long been known to have a marine juvenile phase (Scott, 1941: Blackburn, 1950). Specimens were taken from the sea by Andrews (1976). The young make their way upstream from the sea during the spring and summer at a length of between about 45 mm and 65 mm L.C.F. The shoals of juveniles move into fresh

Fig. 15. Variation in colour pattern in *Galaxias truttaceus*; **a.** Shelly Beach, Vic., 63 mm L.C.F.; **b.** Nubeena, Tas., 150 mm L.C.F.

Table 8. Meristic variation in *Galaxias truttaceus, G. auratus* and *G. tanycephalus.*

		G. truttaceus									*G. auratus*	*C. tanycephalus*
		Shelley Beach Otways, Vic.	Wilsons Promontory, Vic.	King Island	Flinders Island	Wynyard Tasmania	Dover Tasmania	Cox Bright Tasmania	Great Lake Tasmania	Western Australia	Lakes Sorell & Crescent	Arthurs & Woods Lakes
Dorsal rays — segmented	7										2	
	8										10	3
	9			4				3		3	10	13
	10	8		6	8			5		5	1	4
	11	2			2			2		2		
total	9										1	
	10										2	
	11			3					1		9	11
	12	3		2		1	1	4	15	6	2	8
	13	5	4	5	8	7	7	6	6	11	4	1
	14	1	5		15	16	5			3		
	15	1			1	1	2					
Anal rays — segmented	11										10	8
	12	1		3	1			2		5	10	12
	13	5		5	6			4		4		
	14	3		2	3			4		1		
	15	1										
total	13										1	2
	14								6	1•	13	8
	15	1			1			1	9	4	20	9
	16	2	1	5	2	3	6	3	6	14	6	1
	17	4	6	4	9	16	6	3		4		
	18	3	2	1	12	6	2	3				
	19						1					
Pectoral rays	13		1		2			1		1		
	14	5	5	4	10	7	7	3	10	4	1	2
	15	5	3	6	10	14	8	5	11	13	20	10
	16				2	4		1	1	2	15	7
	17										1	1
	18										1	
Gill rakers	13	1						3				
	14	6		4	2			2				
	15	2		5	6			3		1		
	16	1		1	2			1		5	1	1
	17							1		4	3	7
	18										5	5
	19										8	4
	20										3	2
	21											1
Vertebrae	53										1	2
	54										13	6
	55										5	16
	56								2		1	5
	57								1			
	58		1			1			12	10		
	59		4	1		2	4		6	6		
	60		3	3	11	9	8		1	1		
	61		1	2	12	12	3					
	62				1							

Table 9. Morphometric variation in *Galaxias truttaceus, G. auratus,* and *G. tanycephalus.* Figures are given as percentages of denominators in ratios.

		S.L./T.L.	B.D.V./S.L.	L.C.P./S.L.	D.C.P./L.C.P.	Pre D/S.L.	Pre D/Pre A	L.D.B./S.L.	M.L.D./L.D.B.	L.A.B./S.L.	M.L.A./L.A.B.	Pec/PecPel
G. truttaceus												
Shelly Beach, Victoria	Mean	87.63	17.34	12.54	79.67	73.28	98.33	10.93	175.14	15.34	141.72	52.70
	S.D.	0.96	0.85	0.70	6.21	1.30	1.16	0.63	10.46	0.73	9.93	4.70
Rhodes Creek, Kangaroo Island	Mean	87.00	17.17	13.13	75.41	71.70	96.96	10.72	182.60	14.87	149.25	55.54
	S.D.	0.66	0.82	0.68	5.20	1.28	1.82	0.56	8.52	0.61	4.90	3.73
King Island, Bass Strait	Mean	87.31	17.98	12.97	79.07	72.83	98.48	10.50	180.32	14.75	147.20	51.39
	S.D.	0.71	1.02	0.38	4.29	1.23	1.32	0.70	11.99	0.53	4.42	4.05
Cox Bight, Tasmania	Mean	87.51	16.32	15.84	73.46	73.30	97.11	10.61	174.91	15.15	141.55	54.87
	S.D.	0.87	1.02	1.48	6.74	0.66	0.78	0.93	17.51	0.93	8.55	4.84
Nanarup, Western Australia	Mean	86.91	15.61	13.47	70.00	72.28	96.84	10.12	175.44	13.56	144.67	51.12
	S.D.	0.52	0.74	0.84	5.33	1.23	2.14	0.58	12.54	0.65	9.15	5.17
Great Lake, Tasmania	Mean	87.10	16.05	14.95	60.85	73.15	98.18	10.10	172.60	12.45	152.28	53.63
	S.D.	0.38	0.79	0.88	1.89	0.97	0.88	0.24	3.32	0.65	7.48	4.02
All data	Min	85.8	13.7	11.8	59.5	70.01	93.7	9.4	146.7	11.6	130.3	42.9
	Mean	87.26	16.82	13.69	74.44	72.71	97.59	10.54	177.31	14.56	145.53	54.11
	Max	89.3	19.4	15.9	88.7	75.1	100.6	12.6	211.1	16.7	163.0	63.3
G. auratus	Min	86.8	14.9	10.8	68.3	71.5	90.9	7.4	180.0	10.8	147.7	41.8
	Mean	88.26	16.29	12.49	77.51	73.60	93.53	8.59	197.41	12.37	157.99	47.26
	Max	89.8	18.6	13.6	87.1	76.3	96.8	9.8	225.0	13.8	176.9	50.7
	S.D.	0.72	0.96	0.65	5.43	1.16	1.56	0.74	11.09	0.88	8.12	2.88
G. tanycephalus	Min	86.7	13.3	12.9	48.1	68.8	94.1	8.1	125.0	10.6	125.0	37.8
	Mean	89.13	14.53	15.03	56.58	71.89	96.46	9.56	159.28	12.54	136.98	47.48
	Max	91.1	15.8	16.7	72.0	74.6	99.1	11.4	181.0	13.3	161.0	54.2
	S.D.	1.06	0.76	1.06	6.39	1.63	1.49	0.91	14.69	0.82	9.45	3.91

Pel/Pel An	PrePel/S.L.	PecPel/S.L.	Pel An/S.L.	H.L./S.L.	H.W./H.L.	H.D./H.L.	Sn.L./H.L.	P.O.H.L./H.L.	I.O.W./H.L.	E.D./H.L.	L.U.J./H.L.	L.L.J./H.L.	W.G./H.L.	N
61.85	54.38	30.45	21.40	25.54	59.96	60.35	32.79	50.34	42.46	21.57	42.11	39.44	35.76	10
4.11	1.13	1.56	1.06	0.92	3.68	3.23	1.47	2.30	1.02	1.84	2.32	2.39	2.84	
60.90	52.49	29.70	22.89	23.82	54.03	56.82	30.11	51.58	41.67	21.65	38.90	38.45	29.80	10
2.02	0.85	1.23	0.93	0.61	2.52	2.61	1.66	3.31	2.69	1.57	0.98	1.04	1.99	
59.54	53.43	29.95	21.77	24.82	57.96	59.80	30.43	51.16	40.65	21.96	39.27	37.67	33.27	10
2.47	0.93	1.22	0.96	0.73	4.38	4.30	1.76	1.29	1.70	1.61	1.99	1.21	2.54	
63.37	55.00	28.81	21.30	27.12	57.11	57.96	31.82	49.63	40.93	21.53	43.03	40.75	35.37	10
6.19	1.34	1.39	1.37	0.96	3.01	2.45	1.56	1.86	1.48	1.87	1.85	2.48	3.02	
56.17	52.07	28.84	23.27	25.44	54.98	54.55	29.80	50.84	39.61	21.46	39.17	37.43	31.57	10
3.94	1.29	1.71	1.01	1.08	3.55	3.42	1.99	2.52	1.71	2.22	2.88	2.19	3.67	
62.45	53.95	29.70	20.83	26.03	57.73	56.58	33.23	48.68	38.23	18.55	39.20	36.43	32.13	4
4.26	1.53	1.78	1.07	2.14	2.55	1.63	1.24	2.07	2.13	1.99	2.41	2.49	2.14	
51.1	50.6	26.2	19.1	23.0	48.8	48.8	26.7	48.8	37.2	15.9	35.6	34.1	24.4	
60.52	53.51	29.56	22.03	25.40	56.88	57.80	31.16	50.56	40.78	21.41	40.40	38.58	33.08	54
72.1	57.7	32.6	24.9	29.2	67.3	65.8	35.4	54.9	47.6	25.0	46.6	45.0	42.5	
52.8	52.8	29.8	19.3	24.9	50.8	52.5	26.9	50.8	33.1	16.2	30.0	29.9	27.5	
57.14	57.82	31.65	21.73	26.56	56.05	56.38	29.24	54.03	35.99	17.85	33.96	32.88	30.79	20
67.5	60.3	34.1	22.8	28.6	61.5	60.0	31.8	57.2	38.3	20.0	36.7	36.6	35.2	
3.38	1.72	1.44	1.01	0.92	2.59	2.23	1.33	1.77	1.31	1.06	1.65	1.72	2.22	
59.0	53.5	28.3	17.3	24.6	46.7	49.2	29.2	50.0	30.1	15.0	31.0	31.0	24.8	
64.07	55.80	30.69	19.60	26.98	51.52	52.54	32.47	52.57	33.94	19.53	35.71	34.98	27.16	20
79.5	58.2	33.3	22.7	31.9	57.9	56.5	35.1	55.2	36.7	21.1	40.0	36.9	29.2	
4.76	1.51	1.25	1.26	1.70	3.04	2.32	1.67	1.55	2.06	1.55	1.97	1.40	1.16	

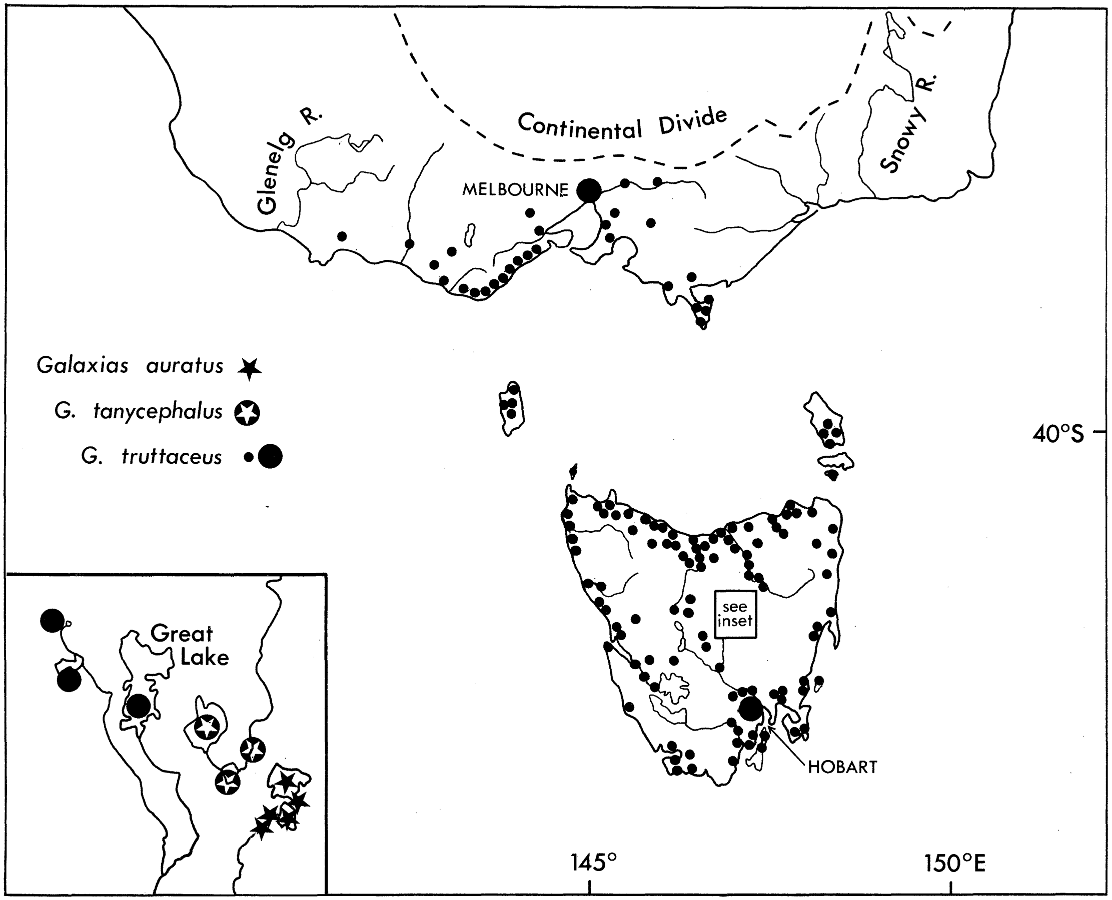

Fig. 16. Distribution of *Galaxias auratus*, *G. tanycephalus* and *G. truttaceus* (Eastern Australia). One symbol may represent more than one locality.

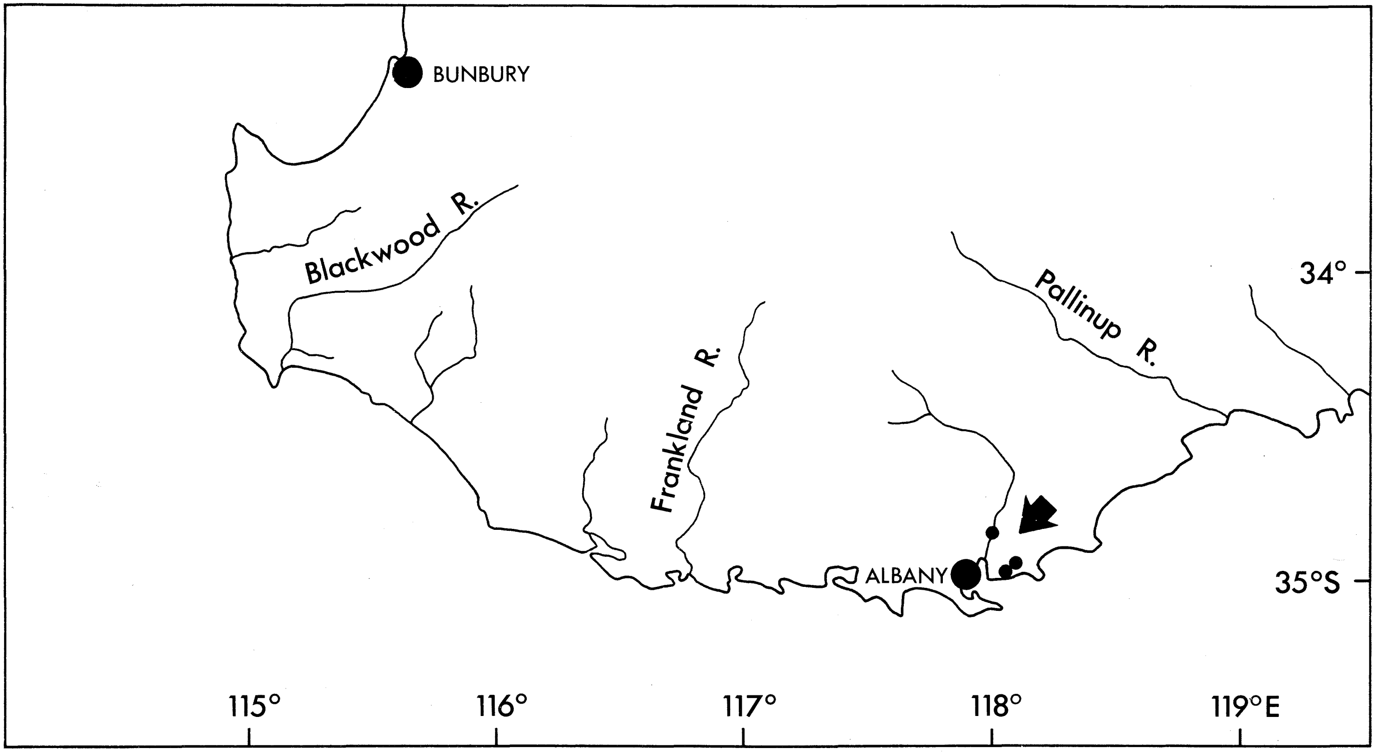

Fig. 17. Distribution of *Galaxias truttaceus* (Western Australia).

water where they grow, passing through the colour phases discussed above ("Colour"); at the same time they become much more stoutly built, soon attaining the generally stocky build of the adults. Both Scott (1941) and Andrews (1976) reported spawning during the autumn, Scott stating that a fish of 113 mm S.L. (129 mm L.C.F.) carried 5634 ova 1.0-1.3 mm in diameter. Thus the eggs like those of most diadromous galaxiids are relatively small and numerous (McDowall, 1970a). Nothing is known of spawning behaviour or the whereabouts of the eggs when laid, although Scott (1941: 68) speculated that "it seems not unlikely that, where circumstances permit, this species migrates to brackish water, possibly even to the sea to spawn". The truth of this remains unconfirmed from observation.

The population in Great Lake once had freedom to move downstream and the young to move upstream into the lake from the river system draining the lake. Since closure of the outflow of Great Lake through the Shannon River and the Derwent River to the sea by construction of a dam in 1916 movement to and from Great Lake has been prevented; the population in the lake has thus eliminated the marine life history phase. This is known to have occurred in landlocked stocks of several other diadromous species, e.g. *G. maculatus, G. fasciatus, G. brevipinnis* (McDowall, 1970a, 1972).

DISTRIBUTION: *G. truttaceus* is known from southern Victoria, King, Flinders and Clarke Islands in Bass Strait, from Tasmania, and from a very restricted area in the south of Western Australia (Fig. 16, 17). Apart from the moderate altitude inland populations in Great Lake, Julian Lakes, and Bronte Lagoon, Tasmania, it is found primarily at low elevations and close to the sea.

Scott, Glover and Southcott (1974: 77) report this species from South Australia, stating that it is "not common in our State, but is occasionally found in the mountain rivers and streams". We have been unable to authenticate any records of *G. truttaceus* from South Australia, and believe that the species involved is *G. brevipinnis*, which these authors do not record from South Australia, although it is present and occurs in collections in the South Australian Museum.

Galaxias auratus Johnston

Fig. 18, 19

Galaxias auratus Johnston, 1883: 131 (holotype: unknown; type locality: "the neighbourhood of Great Lake at an altitude of about 4,000 feet", Tasmania — the type locality is sometimes stated to be Great Lake, but *G. auratus* does not occur in Great Lake, and the type locality is probably Lake Sorell, see Whitley, 1929; Andrews, 1976); Seal et al. 1883; lvi; Macleay, 1886: 56; Johnston, 1891: 27; Anderson, 1900: 25; Regan, 1905: 379; Lord, 1923: 63; Lord and Scott, 1924: 33; Lord, 1927: 12; Whitley, 1929: 47; McCulloch, 1929: 48; Whitley, 1956a: 30; 1956b: 39; 1957a: 7; 1957b: 8; Munro, 1957b: 16; Whitley, 1964: 35; Frankenberg, 1966a: 162; 1966b: 23; Scott, 1968: 7; Lynch, 1972: 8; Andrews, 1973: 104; Frankenberg, 1974: 119; Andrews, 1976: 309; Fulton, 1978: 114; Lake, 1978: 22.

Galaxias (Galaxias) auratus — Scott, 1936: 91.

TAXONOMY: There are no taxonomic problems associated with the identity and nomenclature of *G. auratus*. Only two populations are known and the population in Lake Crescent was derived (when the lake was formed by man) from that in Lake Sorell; no comparisons between the populations were made. *G. auratus* is clearly distinct from *G. truttaceus*, which it most closely resembles.

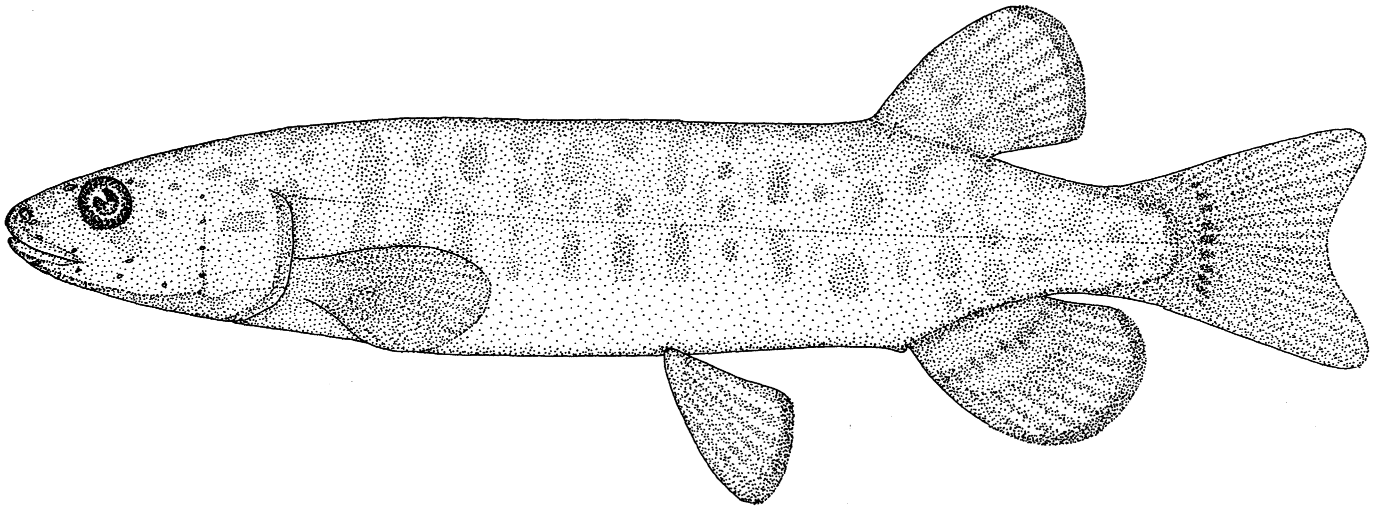

Fig. 18. *Galaxias auratus* Johnstone; Lake Crescent, Tas., 123 mm L.C.F.

Fig. 19. Variation in colour pattern in *Galaxias auratus;* **a.** 73.5 mm L.C.F.; **b.** 80 mm L.C.F.; **c.** 103 mm L.C.F.; **d.** 118.5 mm L.C.F.; all specimens from Lake Crescent, Tas.

DIAGNOSIS: Characterised by moderate to large size, somewhat compressed form (although generally stout) and golden colour when alive. It differs from *G. truttaceus* and *G. brevipinnis* in characters discussed in the diagnoses of these two species (pp.504 and 462 respectively). It differs from *G. tanycephalus* in being generally stouter, with a shorter, deeper caudal peduncle, broader and deeper head, wider gape, smaller dorsal and anal fins, and in colouration.

DESCRIPTION: A large stout-bodied species, the trunk slightly compressed from behind the head, becoming more compressed on caudal peduncle, dorsal and ventral trunk profiles slightly and evenly arched; somewhat depressed anteriorly on head. Caudal peduncle short and deep, a little longer than deep. Head of moderate length, about as deep as broad, flattened dorsally. Snout long tapering to a rounded point. Mouth moderately oblique, reaching back to about front of eyes, jaws sub-equal. Eyes small, set below dorsal head profile, interorbital convex, dorsally flattened. Jaws with enlarged canine teeth laterally; mesopterygoidal and lingual teeth well developed. Gill rakers of moderate length, stout (Fig. 43). Pyloric caeca reduced to one or two weak shoulders or lacking (Fig. 45). Laterosensory pores on head as in Fig. 47.

Fins well developed, somewhat fleshy at bases. Dorsal and anal fins short-based but high and rounded, posterior rays extending well back beyond fin bases; anal origin set back a little from dorsal origin. Pectoral fins small and rounded, lateral to latero-ventral, fin lamina more or less vertical. Pelvic-anal interval short, pelvic fins of moderate size, inserted well behind mid-point of standard length. Caudal fin emarginate, fin tips rounded, fin depth rather less than body depth; caudal peduncle flanges moderately developed.

Variation: meristic: see Table 8
morphometric: see Table 9.

COLOUR: Colour when alive gold to olive-green on the back paling to bronze-gold on the sides and silvery-grey on the belly, the back and sides profusely covered with vertical grey-olive to black bands in smaller fish, these bands becoming fragmented to form a series of roundish spots along the back and distinctly oval spots along the sides in two series, one above and one below the lateral line, sometimes a series of much smaller, round spots along the lateral line; Andrews (1976: 311) described the bars and spots on the sides as "reddish-purple". The fins are amber to distinctly pinkish-orange, the fringes of the dorsal, anal and pelvic fins being black. The eyes are silvery-olive.

In preservation it is a dull buff-brown, the spots darker brown, the belly a paler buff; the fringes of the dorsal, anal and pelvic fins are black. The colour pattern varies with growth. Juveniles less than about 50 mm L.C.F. have about 10 more or less distinct vertical bars. As the fish grow these bars break up into vertical rows of oval spots which become increasingly circular. In some fish the bars and spots are surrounded by distinct, paler halos.

SIZE: *G. auratus* is one of the larger galaxiids, reaching at least 237 mm L.C.F. (Johnston, 1883); the largest we have seen was 230 mm L.C.F. It commonly reaches 130-140 mm L.C.F.

HABITAT: *G. auratus* occurs in lakes and associated streams and rivers, forming shoals in open water when small, the larger ones tending to move into cover around the margins. It is essentially a still water species.

LIFE HISTORY: Andrews (1976) reported that he found post larval specimens in December, and concluded that spawning takes place in winter or early spring. This was supported by his collection of adults with immature gonads in January-March. Juveniles 40-45 mm L.C.F. are chunky little fishes, quite unlike the migratory "whitebait" juveniles of *G. truttaceus*.

Unlike many galaxiids, *G. auratus* seems to have been little affected by the introduction of trout; it forms an important food for trout in Lakes Sorell and Crescent, but remains very abundant in both lakes.

DISTRIBUTION: *G. auratus* occurs only in Lake Sorell (Fig. 16), Lake Crescent, a tributary of Lake Crescent at Interlaken, and the Clyde River, which drains Lake Crescent. Lakes Crescent and Sorell, which are on the central plateau of Tasmania southeast of Great Lake, are connected by a canal and it seems likely that the fish invaded Lake Crescent from Lake Sorell, through this canal.

Galaxias tanycephalus Fulton

Fig. 20, 21

Galaxias tanycephalus Fulton, 1978: 110 (holotype: TMH D.1266, seen; paratypes: (3) TMH D.1267-9; (2) QVML 1976/5/183 (type 227); (3) AMS I.19334-001; type locality: from amongst rocks around the shore near pumping station, Arthurs Lake, Tasmania); McDowall and Fulton, 1978: 106; Lake, 1978: 22.

TAXONOMY: *G. tanycephalus* is only recently described and no taxonomic discussion is necessary; only one population is known.

DIAGNOSIS: Characterised by relatively stout, but tapering build, large mouth, the gape reaching to about margin of small eye, the lower jaw sometimes protruding slightly, the large head, tapering , pointed snout, and the distinctly forked caudal fin. Differs from *G. truttaceus* and *G. auratus* in characters discussed in the diagnoses of these two speices (pp.504 and 515 respectively).

DESCRIPTION: A moderate-sized, bullet-shaped species, the trunk moderately compressed, the back and belly evenly arched, tapering to a short and slender caudal peduncle, the peduncle much longer than deep. Head long, rather slender, a little deeper than broad. Snout long and pointed, mouth large, moderately oblique, reaching back to about front of eye. Jaws equal or lower protruding slightly. Eyes small, set a little below upper head profile, interorbital broad and slightly convex. Jaws with slight enlargement of canine teeth laterally; mesopterygoidal and lingual teeth strong. Gill rakers of moderate length, strong (Fig. 43); pyloric caeca reduced to indistinct shoulders, or lacking (Fig. 45). Laterosensory pores on head as in Fig. 47.

Fins small somewhat thick and fleshy at bases. Dorsal and anal fins short-based, high and rounded, posterior rays long, the fins extending well back beyond fin bases. Anal fin origin a little behind dorsal origin. Pectoral fins small, paddle-shaped, insertion lateral, fin lamina vertical. Pelvic fins also small, inserted distinctly behind mid-point of standard length. Caudal fin distinctly forked, fin tips rounded, fin depth less than body depth, caudal peduncle flanges well developed but not extending far forwards on peduncle.

Variation: meristic: see Table 8.
morphometric: see Table 9.

COLOUR: Colour when alive grey-black to green-olive on the back with saddle-like greyish bars across the back and sides, the belly silvery-olive. There is a distinct purplish sheen along the sides in some specimens, and some are spotted rather than barred. Small fish have broad irregular blotches on the back and sides. The fins are olive to amber, usually lacking black fringes (cf. *G. truttaceus* and *G. auratus*).

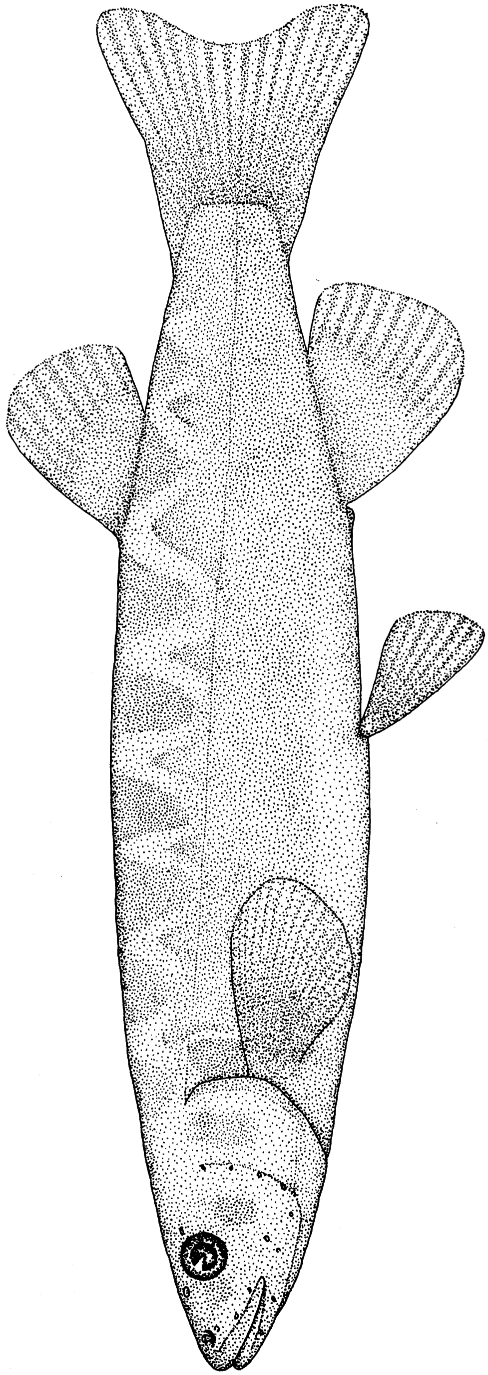

Fig. 20. *Galaxias tanycephalus* Fulton; Arthurs Lake, Tas., 123 mm L.C.F.

Fig. 21. Variation in colour pattern in *Galaxias tanycephalus;* **a.** 68 mm L.C.F.; **b.** 105 mm L.C.F.; both from Arthurs Lake, Tas.

In preservative, greyish-brown with a row of large ovoid blotches dorso-laterally, extending down about as far as lateral line, the blotches surrounded by paler halos and giving the saddle-like appearance; lower sides dull grey and the belly greyish-white. The fins are dusky at the bases.

SIZE: *G. tanycephalus* is known to reach 147 mm L.C.F., although few fish have been collected and most of these are less than 70 mm L.C.F.

HABITAT: This species was collected from amongst rocks and boulders of man-made groynes around the margins of Arthurs Lake, and seldom from amongst extensive macrophyte beds adjacent to the groynes.

LIFE HISTORY: Nothing is known about the life history of *G. tanycephalus* although its occurrence only in Arthurs Lake, at considerable altitude and distance from the sea, implies that the entire life cycle is spent in fresh water.

DISTRIBUTION: *G. tanycephalus* is known only from Arthurs Lake on the high elevation central plateau of Tasmania (Fig. 16).

Galaxias cleaveri Scott

Fig. 22

Galaxias cleaveri Scott, 1934: 44 (holotype: formerly QVML HT.983, now lost; type locality: West Ulverstone, northwest coast, Tasmania); 1935: 45; McDowall, 1970a: 427; Green, 1974: 2; Andrews, 1976: 327; Lynch, 1977: 13; McDowall, 1978c: 208; Lake, 1978: 21.

Saxilaga (Saxilaga) cleaveri — Scott, 1936: 106; 1938: 120; 1941: 60.

Saxilaga (Saxilaga) auguilliformis Scott, 1936: 106 (holotype: QVML HT.951, seen; paratype: (1) BMNH 1966.5.6:2, not seen; type locality: Cox's Creek, running into Inglis River at Wynyard, northwestern Tasmania); 1938: 121; 1941: 60.

Galaxias (Galaxias) upcheri Scott, 1942: 51 (holotype: formerly QVML 1940. 361: 1, now lost; paratypes: (1) BMNH 1966.5.6:4, not seen; (6) formerly QVML unregistered, now lost*; type locality: Dover, southeastern Tasmania, in swampy country — Andrews (1976: 328) has added "anabranch of the Dover Rivulet . . . approximately 182 m northeast of the bridge where Beach Road crosses Dover Rivulet", on information supplied by Mr R. R. Upcher, who collected Scott's (1942) specimens.

Galaxias upcheri — Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 15; Gentilli, 1961: 488; Whitley, 1964: 35; Lake, 1971: 20; Green, 1974: 3.

Galaxias anguilliformis — Stokell, 1945: 113; McDowall, 1970a: 427; 1978c: 208.

Lixagasa cleaveri — Whitley, 1956a: 34.

Saxilaga cleaveri — Whitley, 1956b: 39; 1957a: 6; 1957b: 10; Munro, 1957a: 18; Whitley, 1960: 30; 1964: 35; Frankenberg, 1966a: 163; 1966b: 22; Scott, 1966: 251; McDowall, 1969: 804; Lake, 1971: 20; Scott, 1971a: 5; Frankenberg, 1974: 114.

Saxilaga anguilliformis — Whitley, 1956b: 39; 1957a: 6; Munro, 1957b: 15; Whitley, 1960: 30; 1964: 35; Scott, 1966: 251; McDowall, 1969: 809; Lake, 1971: 20; Scott, 1971a: 8; Green, 1974: 3; Frankenberg, 1974: 114.

TAXONOMY: Three Tasmanian galaxiids, described as *Galaxias cleaveri* Scott (1934), *Saxilaga anguilliformis* Scott (1936), and *Galaxias upcheri* Scott (1942), were united under

*Scott (1942) advised that he intended sending paratypes to AIM, AMS, and the Museum of Zoology at the University of Michigan, but we can find no evidence that they were ever sent.

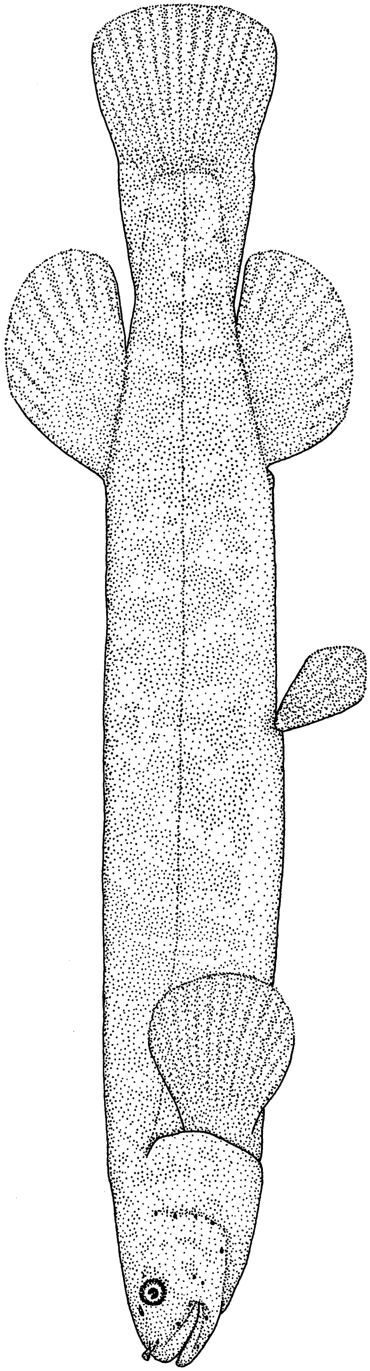

Fig. 22. *Galaxias cleaveri* Scott; Pieman River. Tas., 79 mm T.L.

the senior synonym *G. cleaveri* by Andrews (1976). *G. cleaveri* was originally described on the basis of one specimen (now lost) from West Ulverstone, northwestern Tasmania; *S. anguilliformis* was described from two specimens, from Cox's Creek, Inglis River, northern Tasmania; and *G. upcheri* from eight specimens (all but one lost) from near Dover, southeastern Tasmania. Scott (1936) placed *G. cleaveri* in the genus *Saxilaga* and noted (p. 109) that *S. anguilliformis* differs from *G. cleaveri* "chiefly in having the dorsal and anal rays more numerous and all simple instead of mixed; markedly more forward placed anal . . .; larger eye; shorter snout and perhaps also in the rather stouter body and rather shorter head". *G. upcheri* was distinguished from *G. cleaveri* and *S. anguilliformis* only by having mesopterygoidal teeth and seven-rayed pelvic fins (Scott, 1942).

In his examination of substantially greater numbers of specimens than Scott (1934, 1936, 1942) had studied, Andrews (1976) found that the characters Scott used to distinguish these three species are not diagnostic. Specimens from the north and north-western coasts of Tasmania, which Andrews considered to represent *G. cleaveri* and *S. anguilliformis,* and topotypical material of *G. upcheri,* were found to vary within samples in the number of pelvic fin rays, the presence of mesopterygoidal teeth, and in the presence and number of unbranched rays in the fins. Of most importance, material representing *G. cleaveri* and *S. anguilliformis,* which species Scott (1934, 1936) reported as lacking mesopterygoidal teeth and having only six pelvic fin rays, was shown by Andrews (1976) to vary, with mesopterygoidal teeth either present or absent and pelvic fin rays varying from five to seven, with an overall mean of 6.67 from 30 counts.

Our observations support Andrews' view. Data on 27 specimens showed seven pelvic rays to be present in all but one fish, and that several mesopterygoidal teeth are usually present, although often difficult to see. Material from the northern west coast of Tasmania (Pieman River and Queenstown) which may represent the *G. cleaveri* of Scott (1934, 1936, 1942), samples from the southwest coast (Port Davey), and samples from the southern east coast (Dover), the latter representing *G. upcheri* of Scott (1942), give no indication that more than one species is present. A small sample from Punchbowl Creek, Tamar River, near Launceston in northern Tasmania, differs somewhat from other samples, having slightly lower vertebral counts, longer dorsal and anal fins bases, and slightly larger pectoral and anal fins (Table 10, 11). These differences are not great and the Punchbowl Creek population is also regarded as being *G. cleaveri.*

Inclusion of *G. cleaveri* in the genus *Galaxias,* rather than *Saxilaga,* which is in agreement with Andrews (1976) but at variance with the view of Scott (1936, 1966), is discussed under the definition of the genus *Galaxias* (p.455).

DIAGNOSIS: *G. cleaveri* differs from all other Australian galaxiids in its combination of very small eyes, strongly developed caudal flanges reaching almost to the rear of the very low dorsal and anal fins, very small, paddle-shaped pectoral fins and small pelvic fins, presence of two long pyloric caeca, and long tubular anterior nostrils. The species most likely to cause confusion is *G. parvus,* which has long nostrils, but has no pyloric caeca, has much larger pectoral and pelvic fins (usually more than half of the pectoral-pelvic and pelvic-anal intervals, respectively) and has only three pores in the preopercular series. *G. parvus* is known only from Lake Pedder and its environs and *G. cleaveri* only from lowland localities near the coast.

DESCRIPTION: An elongate, tubular species, the trunk rounded in section, dorsal and ventral trunk profiles parallel tapering somewhat and compressed behind vent. Caudal peduncle short and deep, length a little more than depth. Head short, depth subequal to width, snout bluntly rounded and broad. Mouth moderately oblique and of moderate size, broad, reaching variously to front of eyes or beyond, no further than below middle of eyes, jaws subequal, lower if any a little longer. Eyes very small, upper margins below profile of head, interorbital convex, but eyes sometimes towards upper head profile and interorbital flat. Jaws with slight to moderate development of lateral canine teeth; mesopterygoidal teeth few (sometimes absent); lingual teeth strong; gill rakers short and stout (Fig. 43); two long pyloric caeca (Fig. 45). Laterosensory pores on head as in Fig 47; distinctive in that the anterior pore in the preopercular-suborbital series is usually further forwards than the posterior pore in the supramaxillary series.

Fins small, dorsal and anal fins low and rounded, posterior rays long, the fins extending back moderately beyond fin bases; fin bases moderately fleshy; anal fin origin set back a little from dorsal origin. Pectoral fins small and paddle-shaped, insertion clearly lateral, fin lamina vertical. Pelvic fins also very small, inserted at about mid-point of standard length. Caudal fin usually rounded, tending towards truncate; peduncle flanges very strongly developed, more or less confluent with rear of dorsal and anal fin bases.

Variation: meristic: Table 10.
morphometic: see Table 11.

COLOUR: Described, in life, by Andrews (1976: 328) as follows: "Uniform dark greenish brown on back and sides with a narrow dark bluish grey unpigmented stripe along the abdominal surface. Bases of dorsal, anal and caudal fins liberally speckled with small dark brown spots, paired fins clear and hyaline." This differs from Scott's (1934) account; Scott (p. 45) reported the sides "heavily barred and blotched with dark brown . . . Dorsal surface like lateral surface but with more brown. . . ."

Specimens from Dover were brown to golden-brown, sometimes blackish, the back and sides with profuse, irregular, and very variable grey-brown markings and speckling.

In preservative the back and sides of the head and trunk are covered with fine and profuse dark and pale irregular mottling to vermiculations, these sometimes resolving into irregular, vertical bands which may be irregularly chevron-shaped, particularly in small fish. The mottling extends on to the fleshy bases of the dorsal and anal fins, and on to the tail base. The belly is a paler grey to buff-brown.

SIZE: Andrews (1976) reported that this species reaches 125 mm S.L. (about 141 mm L.C.F.); the largest seen during this study was 119.5 mm L.C.F. with specimens over 80 mm not uncommon.

HABITAT: *G. cleaveri* was first collected (Scott, 1934: 41) from within a cavity in a tree root when a stump was "blown out of the ground by explosives" the locality about 0.5 km from the nearest running water, but in an area where "through the winter there is water lying in ponds close to where the stump stood in swampy ground". Scott (1936:109) reported that *S. anguilliformis* occurred in "swamps near the mouths of the Forth River and the Clayton Rivulet, being known locally as the 'mud-trout'. . . . It is generally found when drains are being cleaned out, and seems to be actually dug out of the mud. In swamps and drains that have completely lost all trace of water they can be found in damp mud. I have often got them by turning over logs and stones where they are to be found in mud" (quoted by Scott from a Major R.E. Smith of Launceston). Habitats described by Scott (1942) for *G. upcheri* in southeastern Tasmania are consistent with the above; Scott (p. 54) quotes Mr R. R. Upcher, who collected the fish "in swampy Titree country . . . in dry periods it can be found thriving in quite thick mud." Scott (1934) demonstrated its ability to survive for many hours in the absence of free water.

G. cleaveri resembles the New Zealand species of *Neochanna* (McDowall, 1970a) which are known to live in creeks, drains and swamps and bogs, and which are able to aestivate during periods of drought.

LIFE HISTORY: The life history of *G. cleaveri* is unstudied and virtually unknown; Andrews (1976: 331) reported a female with "almost fully developed eggs of 1.3-1.5 mm diameter," collected during May, "which would indicate a late winter spawning." It seems likely that the entire life cycle is spent in freshwater and there is no evidence of a "whitebait" juvenile.

DISTRIBUTION: *G. cleaveri* is known from low-lying areas along the northern, western and south-eastern coasts of Tasmania (Fig. 23), but is, as yet, not known from the east coast, despite searches for it (Frankenberg, 1974).

Galaxias parvus Frankenberg

Fig. 24

Galaxias parvus Frankenberg, 1968: 270 (holotype: TMH D.940, seen; paratypes: (16) NMVM A.392-407, seen; type locality: pond on the east bank of Lake Pedder, about 400 yards south of the stream entering Lake Pedder from Lake Maria — the type locality is now obliterated by the flooding of Lake Pedder and its environs to form a water storage lake); Andrews, 1971: 1; Lake, 1971: 20; Bayly et al., 1972: 46; Dixon, 1972: 121; Lynch, 1972: 14; Johnson, 1972: 23; Andrews, 1973: 106; Frankenberg, 1974: 123; Andrews, 1976: 321; Lynch, 1977: 14; Lake, 1978: 22.

TAXONOMY: There appear, at present, to be no problems related to the taxonomy of *G. parvus;* the species is quite distinct from all other galaxiid species, and has uncertain relationships to them.

Few populations of *G. parvus* are known. However, populations in the Lake Pedder — Serpentine River system have fewer vertebrae, pelvic fin rays and dorsal fin rays than those in the upper Huon River, and are more variable in the number of caudal fin rays Table 10; (Fig. 25). These variations would appear to be the result of mosaic evolution in geographic isolates, and they represent the type of variation evident in other freshwater limited galaxiids, e.g. *Neochanna apoda* Günther and *Galaxias divergens* Stokell, in New Zealand (McDowall, 1970a) and *G. platei* Steindachner in Patagonian South America (McDowall, 1971).

DIAGNOSIS: *G. parvus* is distinctive in its combination of 5-6 pelvic fin rays, a rounded caudal fin, short gill rakers and 44-49 vertebrae. It differs from all other species of *Galaxias* in having only three pores in the preopercular series (usually four spores in other *Galaxias* — Fig. 47).

The elongate tubular, anterior nostrils are characteristic and unusual, although present also in *G. cleaveri*.

DESCRIPTION: A small, stocky species, the trunk tubular, dorsal and ventral profiles about parallel, head a little flattened dorsally, trunk compressed behind caudal peduncle which is long and slender, much longer than deep. Head of moderate length, as deep as broad, snout blunt and rounded. Mouth slightly oblique, of moderate size, extending back to about level of eye or a little further, jaws about equal in length or lower projecting slightly. Eyes of moderate size, towards upper head profile, interorbital flat. Jaws without lateral canines. Mesopterygoidal teeth well developed; gill rakers short and stout (Fig. 43); pyloric caeca lacking (Fig. 45); anterior tubular nostrils very long, projecting forwards over upper lip; only three laterosensory pores in preopercular series (Fig. 47).

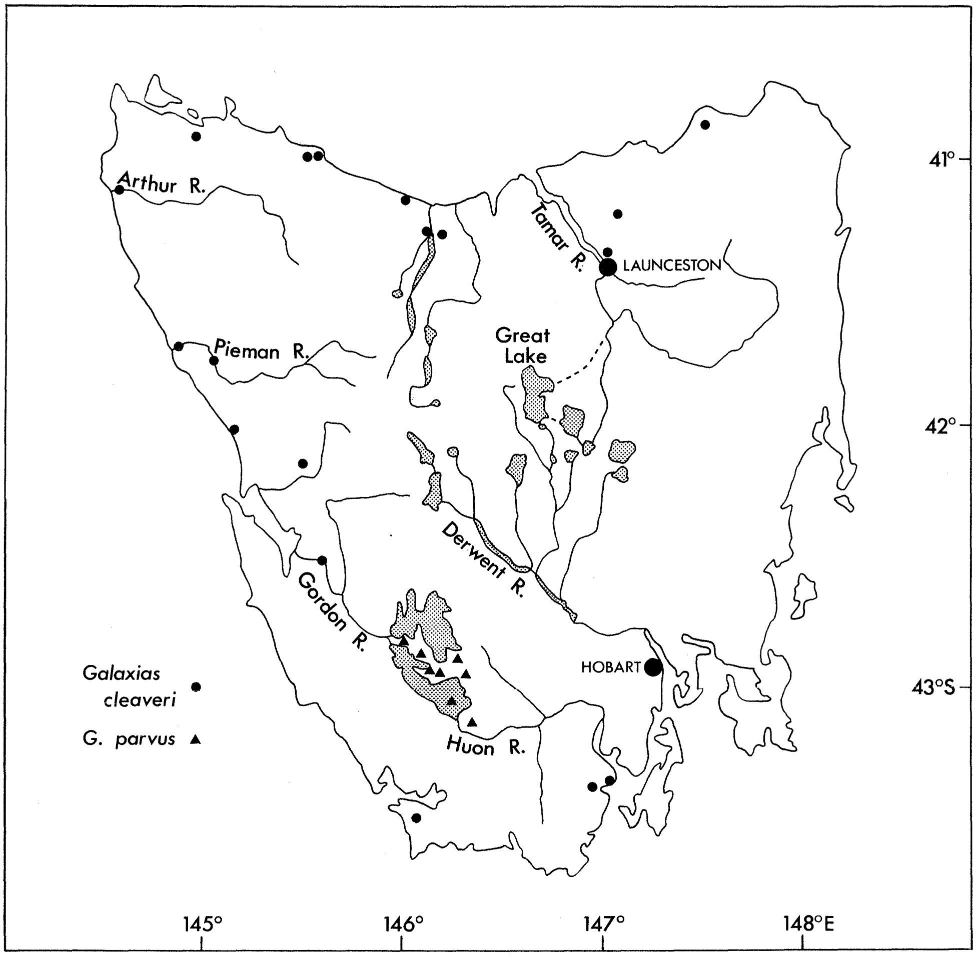

Fig. 23. Distribution of *Galaxias cleaveri* and *G. parvus*.

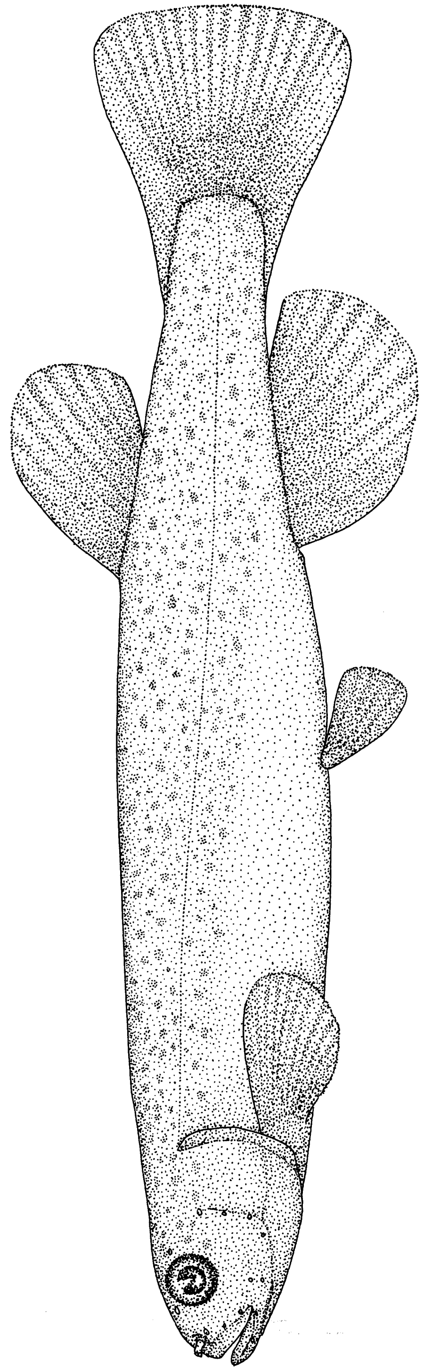

Fig. 24. *Galaxias parvus* Frankenberg; Lake Pedder, Tas., 63 mm T.L.

Fins well developed, somewhat fleshy-based, dorsal and anal fins short-based but high and rounded, the fins extending back moderately behind fin bases; anal fin origin set back a little behind dorsal origin. There is a low, ray-less, fleshy ridge in front of the dorsal fin. Pectoral fins small and fan-shaped, especially in small specimens, pedunculate, insertion moderately low laterally, lamina of fin vertical. Pelvic fins well developed, triangular, with outer rays longest, inserted a little behind mid-point of standard length. Caudal fin rounded, its depth about equal to body depth, caudal peduncle flanges strongly developed, especially ventrally.

Variation: meristic: See Table 10.
morphometric: see Table 11.

COLOUR: Live specimens have the back and sides greyish to yellowish-brown, becoming grey-green on the lower sides and whitish on the belly. The back and sides have numerous small and irregular dark grey-brown spots and blotches. There may be more or less conspicuous salmon-pink to gold colouration on the belly in front of the pelvic fins, especially in small fish. The operculum has a greenish iridescence. The fins are yellow-brown proximally becoming transparent distally.

Preserved specimens are dusky-brown on the back and sides with many small brown-black blotches and spots, irregular in size and spacing, the sides below the lateral line paler with melanophores forming lines along the myotomes. The belly is greyish-white to yellow. The fins are dusky at the bases but otherwise transparent.

SIZE: Andrews (1976) reported that *G. parvus* reaches a length of 75 mm S.L., or about 86 mm T.L. Fish larger than about 70 mm T.L. are uncommon.

HABITAT: *G. parvus* was collected from swamps, still pools, and backwaters, mainly by sweeping a dip net through vegetation at the margins of pools. Juveniles were collected in open, shallow water on the edge of Lake Pedder, together with adults and juveniles of *G. pedderensis*.

LIFE HISTORY: Some female *G. parvus* collected in February-March had immature gonads, others had ovaries showing marked development, although they were far from maturity. Andrews (1976) found juveniles 25-35 mm S.L. to be "abundant around the edges of Lake Pedder during early January" and he concluded that "it would appear that spawning takes place following the winter rains when surface water is abundant". The entire life cycle is spent in fresh water.

DISTRIBUTION: *G. parvus* is found only in the uplands of south-western Tasmania, in headwaters of the Gordon River, flowing north-west, and the Huon River, flowing south-east from a relatively small common divide (Fig. 23).

Galaxias maculatus (Jenyns)

Fig. 26

Mesites maculatus Jenyns, 1842: 119 (holotype: BMNH 1917.7.14:6, not seen; paratypes: (3) BMNH 1917.7.14:7-9, not seen; type locality: Freshwater brook, Hardy Peninsula, Tierra del Fuego — senior synonym, Stokell (1966), first revisor).

Mesites attenuatus Jenyns, 1842: 121 (holotype: BMNH 1917.7.14:11, not seen; type locality: freshwater, Bay of Islands, New Zealand).

Galaxias attenuatus — Valenciennes, in Cuvier and Valenciennes, 1846: 348; Kner, 1865: 320; Günther, 1866: 210; Krefft, 1869: 103; 1871: 84; Castelnau, 1872: 176; Klunzinger, 1880: 412; Macleay, 1881: 46; 1882: 230; Seal et al. 1883: lvi:

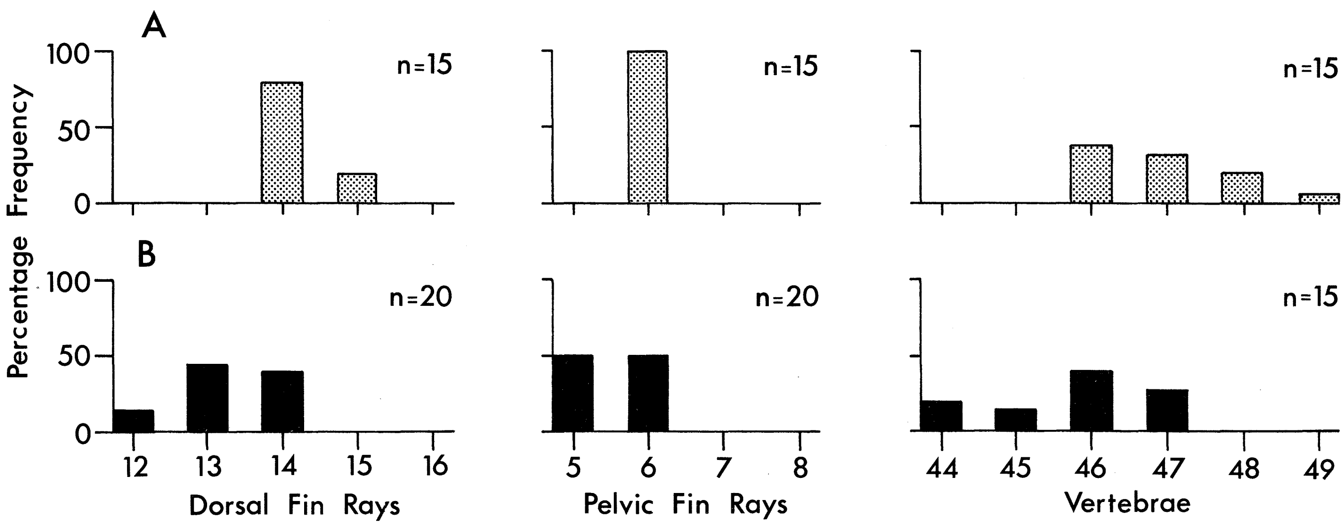

Fig. 25. Variation in the number of dorsal fin rays, pelvic fin rays and vertebrae in *Galaxias parvus;* **a.** Huon River; **b.** Serpentine River.

Table 10. Meristic variation in *Galaxias cleaveri* and *G. parvus*.

		G. cleaveri				*G. parvus*	
		Launceston, Tas.	West Coast Pieman-Queenstown, Tas.	Port. Davey, Tas.	Dover, Tas.	Serpentine R., Tas.	Huon R., Tas.
Dorsal rays — segmented	9		3	3	1	6	5
	10	1	4	1	6	3	7
	11	2	3	2	1		
total	10					3	
	11		2	3	1	9	
	12	1	4	1	6	8	12
	13	2	4	1	1		3
	14			1			
Anal rays — segmented	10			1		3	
	11	1	7	1	4	5	8
	12	2	2	3	4	1	4
	13		1	1			
total	11					2	
	12					5	
	13	1	4	2	3	6	5
	14	2	5	3	5	5	7
	15		1	1		2	3
Caudal rays	14					2	
	15					8	
	16	3	9	6	8	9	14
	17		1			1	1
Pectoral rays	11					1	
	12					8	7
	13	1	2	5	6	8	7
	14	2	7	1	2	3	1
Pelvic rays	5					10	
	6			1		10	15
	7	3	10	5	8		
Gill rakers	9		2			1	
	10		1		1	4	3
	11		4	1	1	3	5
	12	2	3	5	5	1	3
	13	1		1			1
Vertebrae	44					3	
	45					2	
	46					6	6
	47					4	5
	48						3
	49						1
	56	1	2		1		
	57	1	12	1	5		
	58		9	4	4		
	59		4	1	1		
	60		1		1		

Table 11. Morphometric variation in *Galaxias cleaveri* and *G. parvus*. Figures are given as percentages of denominators in ratios.

	G. cleaveri										*G. parvus*			
	Launces-ton, Tas.	West Coast Pieman-Queenstown, Tas.		Port Davey, Tas.		Dover, Tas.		All data						
	Mean	Mean	S.D.	Mean	S.D.	Mean	S.D.	Min.	Mean	Max.	Min.	Mean	Max.	S.D.
S.L./T.L.	86.70	88.60	1.24	88.57	2.34	88.75	1.12	84.2	88.42	91.1	85.2	87.22	89.0	0.82
B.D.V./S.L.	12.23	11.55	1.28	11.07	0.99	11.61	1.25	10.0	11.54	14.2	11.6	13.34	15.4	0.83
L.C.P./S.L.	13.70	12.37	0.34	11.48	0.15	12.06	0.76	11.0	12.23	15.0	14.0	16.09	18.7	1.31
D.C.P./L.C.P.	71.00	69.71	6.75	71.92	5.37	75.55	8.06	63.6	72.07	92.3	48.3	55.30	63.4	5.14
Pre D./S.L.	71.07	72.57	1.21	74.28	0.55	72.80	1.48	70.6	72,85	76.1	66.3	68.31	70.5	1.33
Pre D./Pre A.	94.57	94.60	2.03	97.02	0.58	94.23	1.07	91.9	95.02	97.9	91.0	95.22	98.4	2.09
L.D.B./S.L.	13.30	10.79	1.02	10.77	0.55	10.86	1.02	9.0	11.08	13.6	9.9	11.31	13.0	0.90
M.L.D./L.D.B.	147.60	163.08	7.19	162.73	11.29	159.18	6.95	144.0	160.10	175.0	145.0	162.73	185.7	11.81
L.A.B./S.L.	14.17	12.14	0.95	11.95	0.78	12.96	0.79	10.7	12.57	14.6	11.5	13.19	14.7	0.93
M.L.A./L.A.B.	140.83	147.53	7.50	151.85	10.93	140.54	4.81	133.3	145.67	170.0	123.3	144.93	172.2	11.11
Pec./Pec.Pel.	45.13	34.01	3.41	37.68	3.14	37.06	3.81	27.2	36.96	51.0	37.0	42.98	50.0	3.65
Pel./Pel.An.	48.00	38.88	6.93	39.42	4.34	42.05	4.37	27.3	40.95	52.9	51.0	61.15	72.0	6.30
Pre.Pel/S.L.	51.97	52.82	1.75	52.25	1.14	53.29	1.28	49.7	52.74	55.6	51.0	53.46	55.5	1.23
Pec.Pel/S.L.	31.40	33.96	1.65	33.02	1.38	33.40	0.83	30.1	33.30	36.6	28.4	31.80	36.5	1.78
Pel.An./S.L.	22.93	24.42	1.01	24.68	0.89	23.74	1.17	21.5	24.11	26.6	16.1	18.45	20.4	1.15
H.L./S.L.	22.33	20.11	1.18	19.88	0.67	20:95	1.13	18.7	20.55	23.3	22.3	23.39	24.7	0.66
H.W./H.L.	59.60	56,51	4.80	60.27	3.10	59.14	4.81	50.0	58.47	65.5	50.0	54.90	62.1	4.03
H.D./H.L.	55.53	54.08	3.36	54.27	2.88	53.09	3.98	48.1	53.99	62.1	52.2	57.10	62.1	2.99
Sn.L./H.L.	30.67	28.03	2.14	27.48	0.99	27.30	1.90	23.7	27.98	31.6	25.0	27.93	31.0	1.94
P.O.H.L./H.L.	60.43	61.36	3.42	60.92	1.88	60.46	2.68	55.1	60.89	65.7	47.7	52.90	59.0	2.97
J.O.W./H.L.	40.27	37.70	2.79	37.75	2.15	35.35	1.66	31.6	37.30	41.3	28.3	36.66	44.2	3.87
D.E./H.L.	16.20	15.67	1.48	14.75	1.55	16.41	1.66	12.5	15.74	18.8	19.4	22.84	26.3	1.98
L.U.J./H.L.	34.63	33.89	1.62	34.67	1.50	33.89	2.00	30.2	34.14	37.5	32.4	34.24	37.9	1.62
L.L.J./H.L.	33.93	32.60	2.04	34.20	0.86	33.29	1.46	29.7	33.31	35.9	29.2	32.30	36.1	1.84
W.G./H.L.	32.27	33.30	2.40	37.10	3.02	35.39	1.61	30.0	34.65	37.9	29.7	33.19	36.4	2.01
N	3	10		6		8			27			21		

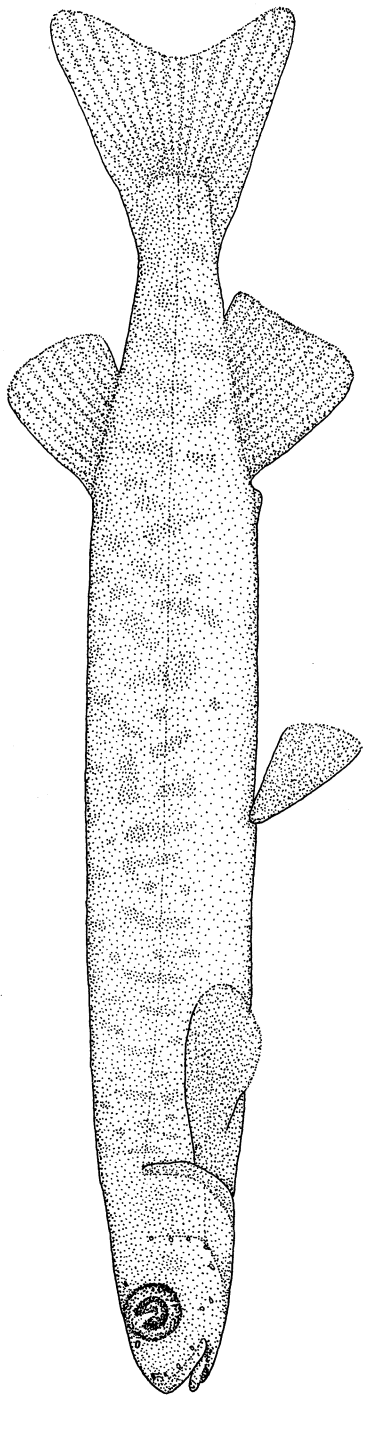

Fig. 26. *Galaxias maculatus* (Jenyns); Gulpa Creek, N.S.W., 89 mm L.C.F.

Tenison-Woods, 1883: 14; Johnston, 1883: 118; Lucas, 1890: 35; Ogilby, 1896: 64; Anderson, 1900: 25; Spencer, 1900: 161; Zietz, 1902: 267; Johnston, 1902: 55; Boulenger, 1903: 84; Regan, 1905: 368; Zietz, 1908: 297; McCulloch, 1914: 328; Gale, 1915: 16; Meek, 1916: 147; McCulloch, 1915: 47; Phillips, 1919: 211; Waite, 1921: 40; McCulloch, 1921: 28; 1922: 18; Lord, 1923: 63; Lord and Scott, 1924: 33; Waite, 1924: 483; McCulloch, 1925: 687; Nettlebeck, 1926: 65; Paradice, 1926: 43; Lord, 1927: 12; McCulloch, 1927: 18; Hale, 1928: 25; Waite, 1928: 4; Marshall, 1928: 189; Whitley, 1928: 59; McCulloch, 1929: 47; Mahony, 1935: 73; Scott, 1936: 113; Mack, 1936: 99; Johnston and Mawson, 1940: 350; Mack, 1941: 108; Anon. 1944: 2; Johnston and Mawson, 1944: 65; Crowcroft, 1945: 65; Stokell, 1945: 124; Butcher, 1945: 24; 1946; 9; 1947: 12; Butcher and Thompson, 1947: 15; Fairbridge, 1949: 73; Blackburn, 1950: 162; Stokell, 1950: 4; Bertin and Esteve, 1950: 3; Bleakley and Grant, 1954: 24; Stokell, 1953: 50; Manter, 1955: 67; Munro, 1957b: 15; Thompson, 1959: 306; Gentilli, 1961: 488; Scott, T., 1962: 67; Scott, E.O.G., 1963: 26; Stokell, 1964: 45; Lynch, 1965: 13; 1966: 13; Frankenberg, 1966a: 20; 1966b: 163; Breder and Rosen, 1966: 132; Frankenberg, 1967: 226; Lynch, 1967: 12; Lake, 1967: 193; Pollard, 1967: 9; Anon, 1968: 26; Lynch, 1968: 9; Bañarescu, 1968: 155; Lynch, 1969: 23; Green, 1969: 27; Scott, E.O.G. 1971a: 8; 1971b: 120; Green and McGarvie, 1971: 30; Munday and Green, 1972: 2; Grant, 1972: 405; McLean, 1974: 13; Scott, 1974: 254; Grant, 1975: 564; Baker, 1978: 822;

Galaxias scriba Valenciennes, in Cuvier and Valenciennes, 1846: 347 (holotype: MNHN A5217, not seen; type locality: Port Jackson and Port Darwin); Richardson, 1848: 76; Baird, 1861a: 269; 1861b: 207; Krefft, 1864: 182; Kner, 1865: 320: Günther, 1866: 212; Steindachner, 1866: 470; McCoy, 1867: 14; Macleay, 1881: 47; 1882: 232; Tenison-Woods, 1883: 22; Ogilby, 1886: 54; 1896; 68; Waite, 1904: 16; Stead, 1906: 50.

Galaxias krefftii Günther, 1866: 211 (syntypes: (1) BMNH 1861.3.25:3, not seen; (1) AMS I.7437, seen, sent to AMS by Regan; type locality "Sydney" and "Murray River"); Krefft, 1871: 84; Macleay, 1881: 47; 1882: 231; Tenison-Woods, 1883: 22; Ogilby 1886: 54; 1896: 69; Waite, 1904: 16; Whitley, 1956a: 34.

Galaxias punctatus Günther, 1866: 212 (holotype: BMNH 1864.7.22:49, not seen; type locality: "Eastern Creek, Australia"); Krefft, 1871: 84; Macleay, 1881: 47; 1882: 234; Tenison-Woods, 1883: 22; Ogilby, 1886: 54; 1896: 69; Waite, 1904: 16.

Galaxias pseudoscriba McCoy, 1867: 14 (holotype: unknown; type locality: Yarra River, Victoria).

Galaxias waterhousei Krefft, 1867: 943 (syntypes: (5) AMS I. 11384-8, seen; type locality: Creeks in South Australia); Macleay, 1881: 47; 1882: 253.

Galaxias forsteri — Kner, 1867: 320 *(partim;* non *Galaxias forsteri* Valenciennes, in Cuvier and Valenciennes, 1846: 532; syn *Galaxias argenteus* (Gmelin, 1789) New Zealand, see McDowall 1970a).

Galaxias cylindricus Castelnau, 1872: 177 (holotype: unknown; type locality: Lower Yarra River); Macleay, 1881: 47; 1882: 235; Lucas, 1890: 35; Ogilby, 1896: 69.

Galaxias delicatulus Castelnau, 1872: 178 (holotype: unknown; type locality: Yarra River); Macleay, 1881: 47; 1882: 235; Spencer, 1888: 164; Lucas, 1890: 35; Ogilby, 1896: 69.

Galaxias versicolor Castelnau, 1872: 176 (holotype: unknown; type locality: "in marsh near St. Kilda, Victoria"); Macleay, 1881: 47; 1882: 235; Lucas, 1890: 36; Ogilby, 1896: 69; McCulloch, 1921: 47.

Galaxias amoenus Castelnau, 1872: 178 (holotype: unknown; type locality: Yarra River); Macleay, 1881: 47; 1882: 235; Lucas, 1890: 36; Ogilby, 1896: 69; McCulloch, 1929: 49; Whitley, 1956a: 34.

Galaxias obtusus Klunzinger, 1872: 41 (lectotype: AMS I.19743-001, formerly SMNS 1599, seen; paralectotype (1) SMNS 1599, seen; type locality: Yarra Lagoon): Macleay, 1881: 47; Lucas, 1890: 36.

Galaxias nebulosa Macleay, 1881: 234 (syntypes: (5) formerly MMS F.83A, now AMS I.16260-001; type locality: Long Bay, near Sydney); Tenison-Woods, 1883: 22; Ogilby, 1886: 55; 1896: 69; Stanbury, 1969: 205.

Austrocobitis attenuatus — Ogilby, 1900: 158; 1908: 6; Iredale and Whitley, 1932: 96; Whitley, 1935: 44; Walford, 1941: 234; Whitley, 1956a: 33; 1956b: 39; 1957a: 6; 1957b: 9; 1960: 28; 1962: 52.

Galaxeus attenuatus — Noetling, 1911: 253 (mis-spelling of *Galaxias*).

Galaxias attenuata — Gray, 1930: 23.

Austrocobitis attenuatus scriba — Whitley, 1933: 61; 1964: 35; Scott, 1966: 246.

Galaxias (Galaxias) attenuatus — Scott, 1936: 90; 1938: 111; 1941: 59; 1942: 56.

Galaxias parrishi Stokell, 1964: 46 (holotype: NMVM A.242, seen; paratype: (1) NMW 3961, seen; type locality; Lake Bullen Merri, Victoria); Pollard, 1971b: 127; Dixon, 1972: 121.

Galaxias maculatus ignotus Stokell, 1966: 78 (holotype: none deposited; type locality: not formally designated although "Tasmania").

Galaxias maculatus — McDowall, 1967a; 841; 1969: 804; Lynch, 1970: 15; McDowall, 1970a: 378; 1970b: 18; 1971: 49; Lake, 1971: 20; Lynch, 1971: 13; Pollard, 1971a: 91; 1971b: 125; 1971c: 26: 1972a: 17; 1972b: 39; McDowall, 1972: 335; Lynch, 1972: 12; Andrews, 1973: 103; Pollard, 1973: 281; Timms, 1973: 13; Campos, 1973: 301; Chessman and Williams, 1974: 168; Scott, et al., 1974: 76; Rosen, 1974: 315; Pollard, 1974: 105; Frankenberg, 1974: 85; Grant, 1975: 564; Chessman and Williams, 1975: 135; Thompson, 1974: 150; Frankenberg, 1974: 121; Cassidy and Lake, 1975: 27; Nelson, 1976: 102; Glover and King, 1976: 188; Andrews, 1976: 305; Lynch, 1977: 13; Cadwallader, 1977: 22; Lake and Bennison, 1977: 59; McDowall 1978c: 69; 1978d: 97; Lake, 1978: 23; Williams, 1978: 29; Bishop and Bell, 1978: 545.

Galaxias attenuatus scriba — Scott, 1968: 1.

Galaxias maculatus scriba — Frankenberg, 1971: 95.

Additional synonyms from New Zealand and South America (from McDowall, 1971, 1972):

Mesites alpinus Jenyns, 1842, (South America).

Galaxias maculatus attenuatus (Jenyns, 1842) (New Zealand).

Galaxias minutus Philippi, 1858 (South America).

Galaxias punctulatus Philippi, 1858 (South America).

Mesites gracillimus Canestrini, 1864 (South America).

Galaxias forsteri Kner, 1867 (South America).

Galaxias coppingeri Günther, 1881 (South America).

Galaxias variegatus Lahille, 1923 — non *Stomias variegatus* Lesson, 1830, (South America).

Galaxias titcombi Eigenmann, 1928 (partim — South America).

Galaxias usitatus McDowall, 1967c (New Zealand).

TAXONOMY: The taxonomy of *G. maculatus* has been the subject of prolonged, extensive, and frequent discussion. Some of this discussion has centred upon the taxonomy of isolated populations in Australia, New Zealand and South America (Stokell, 1966: McDowall, 1967a, 1972; Scott, 1968), and some concerns the relationship of landlocked populations to diadromous ones (Stokell, 1964; McDowall, 1967a, 1972, 1976b; Pollard, 1971a; Campos, 1974). It is our view that populations of diadromous *G. maculatus* in mainland Australia, Tasmania, Lord Howe Island, New Zealand, the Chatham Islands, Chile, Argentina, Tierra del Fuego, and Falkland Islands, represent the single species *G. maculatus* (Jenyns) (McDowall, 1972). The name *G. maculatus* (Jenyns, 1842) has priority over *G. attenuatus* (Jenyns, 1842) (Stokell, 1966, first revisor). This view is held by most workers (see synonymy), although Scott (1968, 1971b, 1974) continues to use the name *G. attenuatus*.

Stokell (1966) recognised three subspecies, one each in Australia (*G. maculatus ignotus* Stokell), New Zealand (*G. maculatus attenuatus* (Jenyns)) and South America (*G. maculatus maculatus* (Jenyns)), but subsequent examination of larger samples has shown that differences recognised by Stokell are due to the very limited size of the samples he examined (McDowall, 1967a). Populations of this species, separated by wide expanses of ocean, are indistinguishable by standard morphometric and meristic characters. Campos (1972) examined karyotypes of this species from Australia and Chile, and found them identical, but Merriless (1975) found that New Zealand material he studied had differences in the number of chromosome arms although the chromosome number was the same. Merriless did not suggest taxonomic separation on this basis. If subspecies should be recognised for Australian populations, the name *ignotus* Stokell is a junior synonym of many others, of which *scriba* Valenciennes, in Cuvier and Valenciennes (1846) is the oldest.

The question of the status of landlocked populations is complex. *G. alpinus* (Jenyns, 1842), described from Peninsula Hardy, Tierra del Fuego, probably came from a lacustrine population (McDowall, 1971). Stokell (1964) described *G. parrishi* from Lake Bullen Merri, Victoria, and McDowall (1967c) described two species (*G. gracilis* and *G. usitatus*) from New Zealand lakes. The discovery of many more landlocked populations in Australia, New Zealand, and South America prompted a re-evaluation of the taxonomic status of these populations (McDowall, 1972), with the outcome that *G. alpinus, G. parrishi* and *G. usitatus* were treated as synonyms and no more than landlocked races of *G. maculatus*. Pollard (1971a) agreed with this view but Campos (1974) did not. He studied populations of *G. maculatus* in the Rio Calle Calle and its tributaries in central-southern Chile, and suggested that freshwater-limited populations in upper reaches of this river system should be recognised as a distinct species, for which he used the name *G. alpinus* (Jenyns). Campos based his view primarily on differences in vertebral counts which he assumed to indicate reproductive isolation. That there are serious practical and theoretical problems involved in the use of *G. alpinus* for the Rio Calle Calle populations was pointed out by McDowall (1976b). Following Campos' criteria, Australian and New Zealand landlocked populations should also be included in *G. alpinus,* but Campos does not discuss the implications of this. The position adopted here is that all freshwater-limited populations of *G. maculatus* in Australia should be "regarded as no more than isolated "ecological race(s)" of *G. maculatus* (Pollard, 1971b: 125, writing of the population in Lake Modewarre, Victoria).

Landlocked populations in Australia are known from Lakes Colac and Bullen Merri (Stokell, 1964), Modewarre (Pollard, 1971a), Corangamite, Rosine, Gnarpurt (Chessman and Williams, 1974), Wurdibolac, Purrumbete, Windimere, and others. These populations differ from diadromous *G. maculatus* in characters discussed at length by McDowall (1972), primarily in the marked reduction in vertebral number (low 60's in diadromous populations and mid 50's in lacustrine ones), and a variable increase in the number (Table 12) and length of the gill rakers.

Populations of *G. maculatus* are reported here for the first time from Western Australia (much material of this species in the collections of the Western Australian Museum has been misidentified as *G. truttaceus*). *G. maculatus* occurs as apparently freshwater-limited populations in rivers draining to the south coast of Western Australia as far west as the Goodja River, at which point its range overlaps the eastern fringes of *G. occidentalis* (Fig. 28). In general form and appearance the Western Australian populations of *G. maculatus* are typical of the species except that pigmentation is usually weakly developed. Like freshwater populations elsewhere, they have somewhat longer heads than diadromous ones (Table 13), slightly lower dorsal and anal fin ray counts but counts comparable with lake populations in Victoria (Table 12), Vertebral counts are reduced, in one population to a mean of 51.48 (Fitzgerald River), but there is broad overlap between Western Australian and Victorian populations (Table 12). For this reason it seems that taxonomic recognition of the Western Australian populations in spite of the great geographical isolation from other populations, is not justified.

There seems little evidence of clinal variation in the characters of diadromous populations studied. McDowall (1972) showed that there is evidence for a rise in vertebral number in more southern populations of *G. maculatus;* our data support this for Australian populations, although the differences are small (Table 12).

DIAGNOSIS: Characterised by slender form, small pectoral and pelvic fins, forked caudal fin, the absence of pyloric caeca on stomach and of lateral canine teeth in jaws, and high anal fin ray count. It resembles *G. rostratus* in these characters, but has a smaller mouth that only just reaches the front of the eyes. *G. rostratus* is found only in the inland Murray-Darling River system and is sympatric with *G. maculatus* only at the mouth of this river system.

Differs from *G. occidentalis* in lacking lateral canine teeth and fangs at the mandibular symphysis. The mouth is smaller in *G. maculatus,* the jaws equal (lower protrudes in *G. occidentalis)* and there are more anal fin rays. *G. maculatus* lacks the distinctive dark bars on the sides of *G. occidentalis.*

DESCRIPTION: A small to moderate-sized, elongate, and slender-bodied species, somewhat compressed along the whole trunk, belly little to moderately deepened, trunk profiles slightly to moderately and evenly arched; body deepest at about pelvic fins. Trunk tapers to a slender caudal peduncle that is longer than deep. Head short to moderate in length, about as deep as broad, cheeks not broadening below eyes. Snout bluntly pointed. Mouth slightly oblique, small, extending to below about anterior eye margins, jaws subequal. Eyes moderate to large, towards upper head profile, interorbital flat to slightly convex. Jaws with lateral canines. Mesopterygoidal teeth well developed; gill rakers of moderate length and quite stout (Fig. 43). No pyloric caeca or occasionally blunt shoulders at pyloric end of intestine (Fig. 45). Laterosensory pores on head as in Fig. 47

Fins small, not fleshy at bases. Dorsal fin short-based, fin extending somewhat behind base; anal fin origin below dorsal origin, much longer based and lower than dorsal, hindmost rays much shorter than anterior ones, fin extending little behind fin base. Pectoral fins small and paddle-shaped, insertion distinctly lateral; pelvic-anal interval long, pelvic fins very short, inserted at about mid-point of standard length. Caudal fin with a distinct but shallow fork, fin tips rounded, fin depth about equal to body depth peduncle flanges weak.

Variation: meristic: see Table 12.
morphometric: see Table 13.

COLOUR: When alive a translucent grey-olive to amber, with the back and upper sides covered by irregular and variable darker greenish-grey spots, blotches or bands. Colouration tends to be paler and the pattern indistinct in smaller fish, becoming bolder with growth. Sometimes little pattern. Lower sides, gill covers and eyes bright silvery. Fins largely unpigmented, with a few melanophores along rays.

In preservative a pale creamish-white to grey, the back and sides covered with darker greenish-grey to dark grey markings; these fail latero-ventrally and ventrally where the trunk is whitish. Colour darkens to brown after long storage in alcohol.

SIZE: *G. maculatus* is known to grow to at least 190 mm. Diadromous populations commonly contain fish reaching about 100 mm, and fish much larger than this are exceptions. Landlocked populations vary greatly in maximum size but Pollard (1971a) reported a mean L.C.F. of 112 mm (range 81-135 mm) for the Lake Modewarre population.

HABITAT: *G. maculatus* is found in a wide variety of habitats, but is most commonly found and is most abundant in still or gently flowing waters, mostly in streams, rivers and lakes at low altitudes and short distances from the sea. Chessman and Williams (1974, 1975) have shown that this species has a very wide range of salinity tolerances. It occurs naturally in waters with salinities up to 49°/00 and experiments showed that with acclimation the LD_{50} value was 62°/00; the LD_{50} value for direct transfer from water of 30°/00 was 45°/00. Euryhalinity in *G. maculatus* enables it to inhabit some of the many saline lakes of Victoria.

LIFE HISTORY: Because of its economic importance in New Zealand the natural history of *G. maculatus* has been much studied there (see McDowall, 1968b: McDowall and Eldon, 1981). Less work has been done on Australian and South American populations (see however, Pollard, 1971a, b, c, 1972a, b, 1973, 1974, Campos, 1972, 1974).

Reproduction in diadromous stocks of *G. maculatus* in New Zealand has been shown to be as follows: during autumn, shoals of mature to ripe adults migrate downstream into estuaries at about the time of the full and new moons (spring tides). The fish swim amongst dense terrestrial vegetation inundated at the high spring tide and deposit their eggs there. For the following two weeks the eggs develop out of water in the humid atmosphere around the vegetation, and they hatch when a second series of spring tides again inundates the vegetation. The newly hatched larvae are washed out to sea (Phillipps 1924; Hefford, 1931a, b, 1932; Burnet, 1965; Benzie, 1968b; McDowall, 1968b). It is generally assumed that reproduction of the species in Australia is comparable (Phillipps, 1919; Whitley, 1935; Pollard, 1971a; Andrews, 1976).

The spring upstream migrations of the juveniles are better known in Australia (McCulloch, 1914; Scott, 1938; Blackburn, 1950) although the factors that affect these migrations remain unstudied. Apart from the studies of Pollard (1971a, b, c, 1972a, b,

Table 12. Meristic variation in *Galaxias maculatus* (Part 1).

		Hawkesbury R., N.S.W.	Tuross R., N.S.W.	Koo-wee-rup, Vic.	Wilsons Promontory, Vic.	Cardinia-Toomuc, Vic.	Otways, Vic.	Port Lincoln, S.A.	Port Macleay, S.A.	Kangaroo Is., S.A.	Flinders Is.	Northern Tasmania	Nelson Bay R., Tas.
Dorsal rays — segmented	7												
	8												
	9	5	2	2			2					1	2
	10	3	6	5			6					6	6
	11	1	2	3			2					3	2
total	9												
	10	1				2							
	11	1	2	1	1	7	14						1
	12	4	6	3	3	13	16	4	5	9	3	6	2
	13	2	2	5	5	3	5	6	12	13	6	3	6
	14	1		0	1				1	3	1	1	1
	15			1									
Anal rays — segmented	10												
	11												
	12											1	
	13											0	1
	14	3	4	2			3					1	3
	15	6	3	5			4					7	4
	16		3	3			3					0	1
	17											1	1
	18												
	19												
total	12												
	13												
	14												
	15				1							1	
	16	1	1	1	1	2	3	1				0	1
	17	4	4	3	1	5	9	5	8	7	5	3	3
	18	4	3	4	6	13	18	3	7	13	4	5	4
	19		2	2	1	5	4	1	3	4	1	0	1
	20						1			1		1	1
	21												
Pectoral rays	10												
	11			1			1				1		
	12	5	1	2	3	12	14	4	2	3	2	4	4
	13	4	5	7	7	13	17	4	7	16	7	4	6
	14		4				2	2	3	6		2	
	15						1						

Southern Tasmania	L. Windermere, N.S.W.	L. Corangamite, Vic.	L. Modewarre, Vic.	L. Bullen Merri, Vic.	L. Colac, Vic.	L. Purrumbete, Vic.	Wurdiboluc Res., Vic.	L. Bongbong, Vic.	Near L. Wangery, S.A.	Pallinup R., W.A.	Gairdner R., W.A.	Fitzgerald R., W.A.	Hamersley R., W.A.	Jerdacuttup R., W.A.	Dalyup R., W.A.	Shark L., W.A.	Sandy Ck, W.A.
		4	1		1							1					
		4	4	14	10							1			7		
3	6	2	9	6	6						4	7			7		
12	2		6		2						6	1			1		
15	2																
		3										1	1	1	2		
		8	6		12	1				1	1	6	7	7	6		3
1	5	20	13	7	20	3	1	2	3	3	11	18	16	9	18	1	9
9	3	3	18	20	9	13	4	12	6	6	8	7	1	7	10	6	5
8	2	1	6	11	2	8	1	6	1	2		3		1	4	1	
2			2		1												
		1															
		1			1							1			1		
		7	6		7							3			4		
	4	1	6	6	10							5			7		
5	1		7	12	1						7	0			2		
9	4		1	2							3	1			1		
3	1																
2																	
1																	
												1			1		
		3										2	2		1		
		3			2							10	13	5	6		1
		16	10		15				3	4	2	14	9	13	7	2	6
1	4	11	12	7	16	4	1	3	2	8	12	7	1	4	11	3	5
4	3	2	14	19	9	12	2	11	5		5	0		3	6	3	4
10	2		7	11	1	8	2	5			1	1					1
2	1		2	1	1	1	1	1									
2																	
1																	
																—	
2		4	1												2	—	3
5		16	18	8	2	4		1	3	2	7	9	15	10	23	—	9
12	3	14	19	14	19	18	5	11	5	7	12	16	10	14	14	—	5
1	6	1	7	13	14	3	0	7	2	3	1	10		1	1		
	1			3			1	1									

Table 12. Meristic variation in *Galaxias maculatus* (Part 2).

		Hawkesbury R., N.S.W.	Tuross R., N.S.W.	Koo-wee-rup, Vic.	Wilsons Promontory, Vic.	Cardinia-Toomuc, Vic.	Otways, Vic.	Port Lincoln, S.A.	Port Macleay, S.A.	Kangaroo Island, S.A.	Flinders Island	Northern Tasmania	Nelson Bay R., Tas.	Southern Tasmania	L. Windermere, N.S.W.
Caudal Rays	14														
	15	1										1	1		
	16	8	9	10	10	0						9	9	20	9
	17		1												1
Pelvic Rays	6														1
	7	9	10	10	8							10	10	18	9
	8				2									2	
Gill Rakers	13											1			
	14		1		2							3			
	15	2	3	7	4							4	5		1
	16	4	6	3	3							1	3		5
	17	2			0								1	1	4
	18	1			1								1	2	
	19													3	
	20													3	
	21													1	
Vertebrae	50														
	51														
	52														
	53														
	54														
	55														5
	56														10
	57	1*			1	2									5
	58	2	3†		1	10	1		1	1	1		2		
	59	6	8†		4	12	7	6	6	5	4		11		
	60	2	3		3	1	8	4	10	13	2		13		
	61	1			1		7		2	5			10		
	62						2		1	1			3		

*Northern New South Wales
†Southern New South Wales

L. Corangamite, Vic.	L. Modewarre, Vic.	L. Bullen Merri, Vic.	L. Colac, Vic.	L. Purrumbete, Vic.	Wurdiboluc Res., Vic.	L. Bongbong, Vic.	Near L. Wangary, S.A.	Pallinup R., W.A.	Gairdner R., W.A.	Fitzgerald R., W.A.	Hamersley R., W.A.	Jerdacuttup R., W.A.	Dalyup R., W.A.	Shark L., W.A.	Sandy Creek, W.A.
1													1		
9		20	20						10	8			14		
										2					
													1		
10		20	19						10	10			14		
			1												
1													1		
0	2		1										6		
6	3	1	1						2				4		
6	6	3	10						2	4			2		
5	4	4	8						2	4			2		
1	3	7							2	2					
1	2	4													
		1													
										3					
									1	9	9	2			
			1						2	11	6	11	1		
			0					4	6	2	7	9	6		2
9		2	9	5				5	1		3	3	7	1	1
15	4	8	18	10				3					10	4	8
1	5	22	12	8			1						1	3	5
	19	13	3	2		8	4								1
	11	1	0		1	5	4								
	4		2		2	6	1								
	1		1		3	1									
	1														

Table 13. Morphometric variation in *Galaxias maculatus*.
Figures are given as percentage of denominators in ratios.

		S.L./T.L.	B.D.V./S.L.	L.C.P./S.L.	D.C.P./L.C.P.	PreD./S.L.	PreD./Pre A.	L.D.B./S.L.	M.L.D./L.D.B.	L.A.B./S.L.	M.L.A./L.A.B.	Pec./Pec.Pel
Hawkesbury R.	Mean	88.86	11.80	11.36	57.32	75.46	98.82	9.37	165.9	13.76	132.13	42.49
N.S.W.	S.D.	1.74	1.24	0.78	5.59	2.36	1.00	0.69	14.27	0.76	7.32	5.20
Gulpa C.,Tuross R.	Mean	90.11	11.35	11.31	57.46	75.42	99.85	9.13	157.01	14.11	123.52	39.77
N.S.W.	S.D.	0.91	0.77	0.67	4.72	1.13	1.29	0.87	14.33	0.63	4.51	2.63
Koo-wee-rup	Mean	89.67	11.78	10.81	61.99	75.95	99.49	9.35	159.80	14.56	122.70	40.68
Vic.	S.D.	0.62	0.54	0.76	6.94	1.94	1.38	0.63	8.47	0.61	5.13	3.19
Otways	Mean	89.43	11.82	10.84	61.96	74.75	99.13	8.93	160.84	13.71	125.94	41.13
Vic.	S.D.	0.65	1.13	0.91	6.37	2.07	0.9	0.51	11.08	0.88	6.44	4.23
Northern	Mean	89.16	11.83	11.57	57.24	74.63	99.21	10.17	149.59	14.86	120.92	45.09
Tasmania	S.D.	0.37	1.00	0.61	3.45	1.11	1.6	1.06	13.62	1.33	6.66	4.96
Nelson Bay R.	Mean	89.56	12.11	11.27	58.53	75.29	99.31	9.17	157.11	14.45	118.8	40.90
Tasmania	S.D.	0.61	0.64	0.65	5.02	0.92	1.16	0.79	13.33	0.46	2.06	2.77
Southern	Mean	88.97	13.30	11.81	62.77	76.02	99.51	10.49	151.04	14.25	129.49	44.80
Tasmania	S.D.	0.65	0.71	1.24	6.13	1.38	1.41	0.97	8.67	1.45	5.19	0.33
L. Windermere	Mean	88.49	9.87	11.09	53.14	75.06	99.70	9.09	146.90	13.32	126.02	46.93
N.S.W.	S.D.	0.69	0.62	1.15	5.58	1.00	1.21	0.99	15.61	1.36	11.08	3.47
L. Corangamite	Mean	88.68	11.48	12.17	57.46	73.66	98.58	7.73	174.79	11.77	130.46	43.23
Vic.	S.D.	0.80	1.07	1.48	5.54	3.55	1.56	0.52	12.25	1.37	6.73	3.32
L. Modewarre	Mean	88.95	11.85	11.40	58.66	75.77	98.77	9.24	164.67	12.45	129.58	41.43
Vic.	S.D.	0.90	0.75	0.53	2.72	1.07	1.47	0.40	11.86	1.38	6.73	3.16
L. Bullen Merri	Mean	87.36	11.49	11.34	60.08	76.14	99.28	9.16	160.08	12.45	129.29	48.60
Vic.	S.D.	1.29	0.86	0.59	6.12	1.10	1.35	0.71	11.09	0.88	6.43	3.31
L. Colac	Mean	88.58	11.85	12.13	57.36	75.44	98.71	8.89	161.50	13.29	126.62	43.88
Vic.	S.D.	0.53	0.61	0.34	4.37	0.95	0.50	0.52	8.24	0.46	9.52	1.66
Fitzgerald R.	Mean	88.27	11.40	11.36	60.61	75.87	98.00	8.83	175.40	12.35	139.46	48.10
W.A.	S.D.	0.53	1.00	0.87	7.33	1.43	1.09	0.96	14.24	0.96	5.66	3.21
Gairdner R.	Mean	89.13	11.72	10.38	62.86	75.96	98.62	8.97	157.65	13.86	126.05	41.24
W.A.	S.D.	0.90	0.43	0.55	4.50	0.92	1.07	0.60	10.78	0.72	6.00	2.00
Dalyup R.	Mean	88.46	11.91	12.27	64.44	74.33	98.15	9.11	161.21	12.68	136.77	43.46
W.A.	S.D.	1.18	0.92	0.11	5.49	1.25	1.70	1.02	12.40	1.14	6.17	2.53
All data	Min	85.3	8.7	9.4	41.9	67.3	95.2	6.6	127.3	9.1	112.8	33.8
	Mean	88.91	11.70	11.41	59.46	75.32	99.01	9.18	160.23	13.46	127.85	43.45
	Max	91.4	14.2	15.4	76.1	80.7	102.7	12.3	200.0	16.6	152.0	54.3

Pel./Pel An	PrePel./S.L.	Pec.Pel./S.L.	Pel.An/S.L.	H.L./S.L.	H.W./H.L.	H.D./H.L.	Sn.L/H.L.	P.O.H.L./H.L.	I.O.W./H.L.	E.D./H.L.	L.U.J./H.L.	L.L.J./H.L.	W.G./H.L.
40.67	48.82	29.52	27.81	20.10	49.53	52.69	28.83	53.09	38.04	22.79	33.82	32.17	28.87
4.90	1.31	1.73	1.55	1.29	2.17	3.33	2.25	1.94	3.20	2.34	2.03	2.03	2.74
38.62	49.22	29.84	28.11	20.23	50.28	53.05	30.11	52.21	38.12	21.98	34.08	32.59	28.52
2.60	0.98	1.49	1.48	0.53	3.58	2.59	1.58	1.19	1.42	1.90	1.70	1.80	2.80
41.40	50.10	29.95	28.16	20.41	52.36	53.48	30.02	52.94	37.98	21.87	32.69	30.14	31.40
3.01	1.32	1.10	1.00	0.63	1.76	2.32	1.29	2.12	2.12	1.67	1.20	2.18	2.30
40.55	49.58	30.33	28.35	19.79	52.99	55.98	30.67	53.49	37.40	24.13	35.83	34.05	29.64
3.82	1.36	1.62	2.06	0.65	3.34	2.12	1.84	2.68	2.03	2.83	2.68	2.51	1.95
40.83	47.72	27.48	27.60	20.76	50.69	52.42	28.34	51.50	36.68	22.96	33.30	31.29	28.36
2.60	0.99	1.46	1.48	0.76	3.24	2.49	2.04	1.64	1.29	2.34	1.60	1.73	3.17
41.56	49.56	29.98	27.39	20.89	52.87	55.37	28.48	52.82	39.37	22.00	33.69	30.72	29.39
2.54	0.76	1.14	1.07	0.64	1.82	1.38	0.85	2.32	1.69	2.05	1.70	2.08	1.50
44.00	49.74	28.89	26.99	21.64	51.08	48.84	27.77	52.00	37.26	23.28	32.20	31.40	30.33
5.35	1.17	0.92	0.97	1.00	2.19	3.14	0.92	1.86	1.86	1.15	1.29	0.98	2.44
46.52	50.91	27.85	24.57	23.88	45.59	45.43	28.52	53.92	32.53	25.54	35.63	35.37	24.86
3.80	1.84	1.79	1.06	0.81	1.56	1.85	2.41	2.49	1.38	2.70	2.16	2.07	1.84
42.74	49.99	27.93	26.16	22.16	48.54	51.58	28.03	53.27	35.08	22.81	32.14	31.59	28.47
2.94	2.37	1.84	2.09	1.50	2.03	2.62	1.00	2.04	2.56	3.08	1.39	1.29	1.91
39.20	49.36	30.01	27.73	20.44	50.35	51.20	29.07	55.34	39.20	19.76	33.03	31.74	29.47
3.45	1.17	1.42	1.26	0.84	2.97	1.51	1.40	2.38	1.80	1.98	1.87	1.50	1.23
44.27	50.83	27.78	25.45	23.32	47.11	48.58	26.43	54.56	34.12	20.81	31.61	30.67	27.04
3.27	1.06	1.20	0.79	1.10	2.04	2.40	1.62	2.26	0.97	2.08	2.87	1.49	0.67
44.91	49.85	29.10	26.75	21.01	49.65	51.87	28.10	53.12	35.67	22.23	33.15	31.52	28.20
3.38	0.72	0.88	1.21	0.49	1.69	2.88	1.49	0.99	2.41	1.49	1.70	1.50	1.69
44.16	51.36	28.17	27.15	23.28	50.53	51.20	28.48	55.85	34.19	20.07	36.78	35.28	29.10
4.59	1.29	1.78	1.90	0.62	2.97	3.26	2.05	1.57	1.88	1.48	1.94	2.40	2.98
39.85	51.05	29.37	27.65	22.61	46.12	49.36	29.01	53.51	34.37	20.42	35.88	35.66	28.15
2.33	1.01	1.19	1.13	0.60	1.90	2.30	1.03	2.18	0.92	2.00	1.74	2.08	2.96
44.57	50.55	29.51	25.83	22.27	50.14	52.80	28.46	56.11	35.02	22.46	35.19	35.05	28.17
3.65	1.07	1.30	1.04	0.56	3.17	3.04	2.09	2.51	2.65	2.17	2.61	2.88	2.61
31.7	45.6	24.2	21.8	17.7	42.1	42.3	22.8	47.8	30.8	16.7	28.4	27.7	22.0
42.26	49.91	29.05	27.05	21.52	48.86	51.57	28.69	53.58	36.34	22.21	33.93	32.62	28.70
53.3	53.3	32.9	31.5	25.3	61.5	59.1	33.3	60.5	43.2	30.8	40.0	40.0	38.3

1973, 1974), the natural history of *G. maculatus* in Australian fresh waters remains poorly known.

Pollard studied the landlocked population of *G. maculatus* in Lake Modewarre in Victoria. He showed that during the spring, spawning adults migrate upstream from the lake into flooding tributary streams and that they deposit their eggs on flooded stream-bank vegetation. The eggs are stranded when the flood subsides but survive and hatch when a subsequent flood re-immerses them two or more weeks later. The newly hatched larvae are washed downstream into the lake where they grow to maturity. Thus this landlocked population has reversed the direction of the spawning migration (upstream instead of downstream) and altered the season (spring instead of autumn), while retaining "terrestrial" deposition of the eggs and the essentially annual life cycle.

DISTRIBUTION: *G. maculatus* is found in Australia, Tasmania, Lord Howe Island, New Zealand, the Chatham Islands, Chile, Argentina, Tierra del Fuego and the Falkland Islands (McDowall, 1972; McDowall and Gosztonyi, 1975). It is one of the most widely distributed freshwater fishes. In Australia diadromous populations are known from coastal flowing streams and rivers east and south of the main dividing range from southern Queensland to eastern South Australia, also from islands in Bass Strait, and from Tasmania. It appears to be uncommon north of about the Hawkesbury River in New South Wales. Landlocked populations are known from New South Wales (L. Windimere), Victoria (many lakes) and South Australia (few). Populations that are probably freshwater-limited (they most closely resemble Victorian landlocked populations) occur in rivers draining to the south coast of Western Australia from the Goodja River eastwards to about Esperance.

Localities from which *G. maculatus* is known in Australia are indicated in Fig. 27, 28.

Galaxias occidentalis Ogilby

Fig. 29

Galaxias occidentalis Ogilby, 1900: 157 (holotype: QM I.779, seen; paratypes: (2) AMS I.4175-6, I.4175 missing, other, seen; (1) BMNH 1905.7.29:10, not seen; type locality: streams south of Perth, Western Australia); Regan, 1905: 376; McCulloch, 1929: 47; Whitley, 1944: 265; 1947: 53; 1948: 11; Serventy, 1950: 165; Whitley, 1956a: 34; 1956b: 39: 1957a: 7; Munro 1957b: 15; Mees, 1961: 38; Gentilli, 1961: 488; Whitley, 1964: 35; Stokell, 1964: 46; Pollard, 1971b: 126; Lake, 1971: 20; 1978: 21.

TAXONOMY: There are no taxonomic problems associated with the identity and nomenclature of *G. occidentalis;* it is a valid species without any indication of more than one taxon being present. Although the species is widespread from north of Perth, south and east to the vicinity of Albany on the southern coast, there is little evidence of much regional variation (Tables 14, 15). The population from the Blackwood River has a somewhat higher vertebral count than that represented by samples from the vicinity of the Shannon River, but differences are in general small and difficult to interpret without much more extensive data and better understanding of the natural history of the species.

DIAGNOSIS: Characterised by elongate slender form, small, membranous fins, large mouth and distinctive broad dark vertical bars along sides. It differs from *G. maculatus* in characters listed in the diagnosis of that species (p.534). Differs from *G. rostratus* in having distinct lateral canine teeth in the jaws and a pair of fangs at the mandibular symphysis, a larger mouth and fewer anal fin rays.

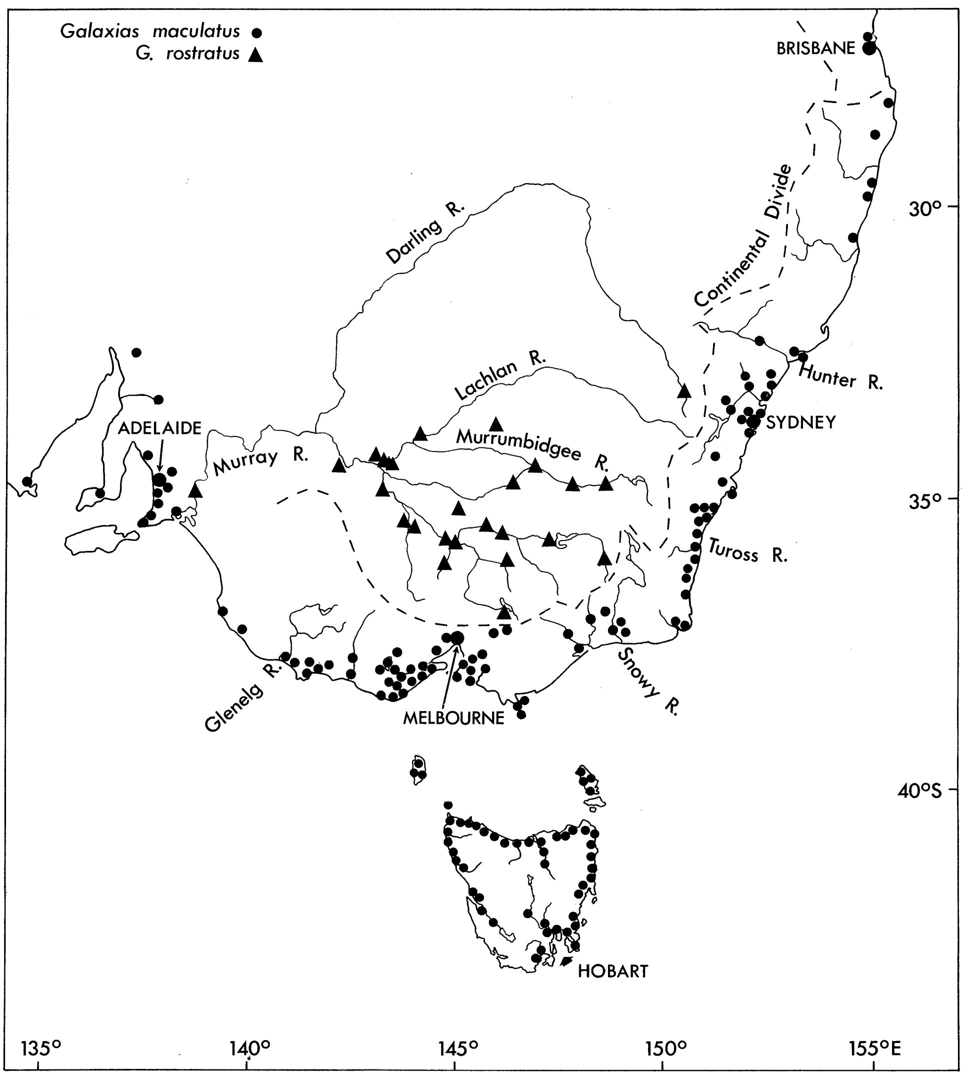

Fig. 27. Distribution of *Galaxias maculatus* (Eastern Australia) and *G. rostratus*. One symbol may represent more than one locality.

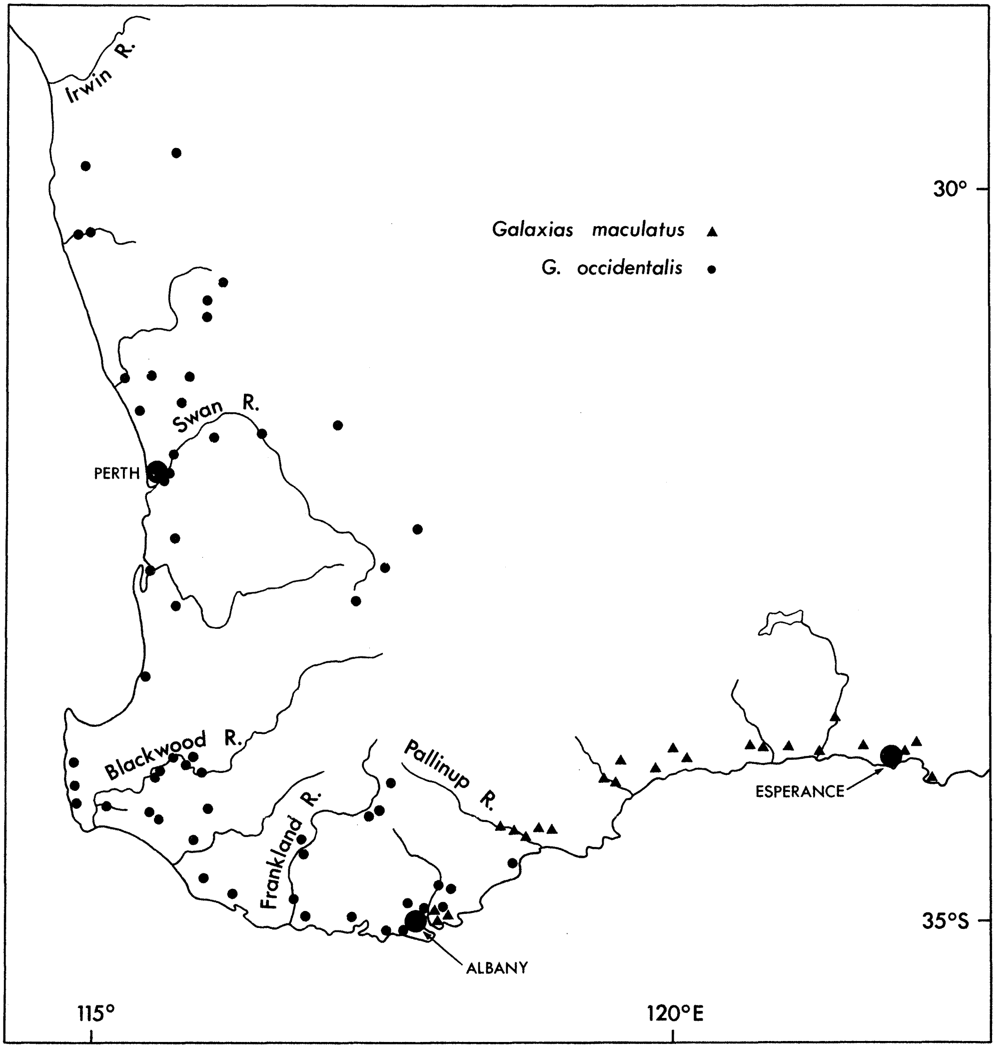

Fig. 28. Distribution of *Galaxias maculatus* (Western Australia) and *G. occidentalis*.

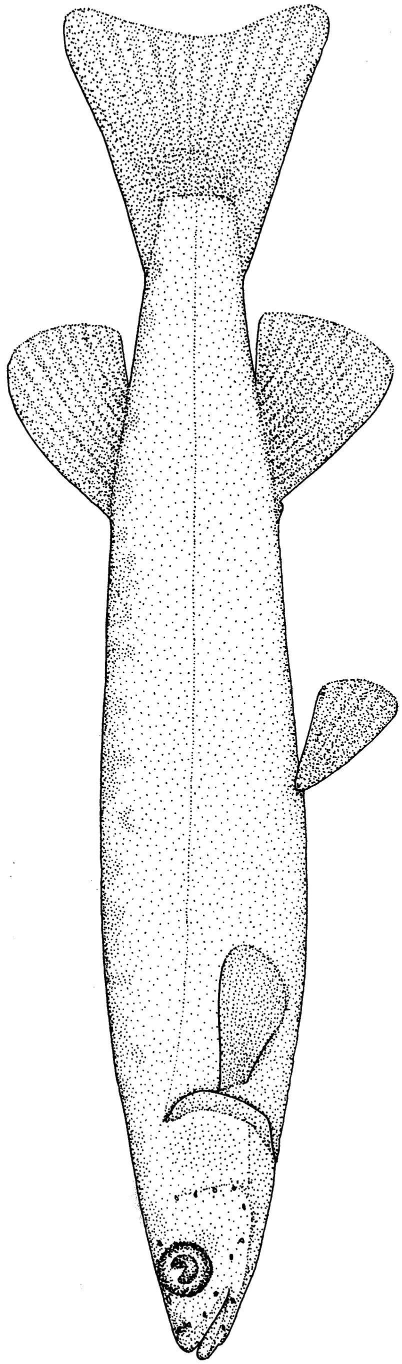

Fig. 29. *Galaxias occidentalis* Ogilby; Swan River, W.A., 73 mm L.C.F.

DESCRIPTION: A moderate-sized, elongate and slender-bodied species, somewhat compressed, with the dorsal and ventral trunk profiles slightly and evenly arched. Caudal peduncle of moderate length and very slender, depth much less than length. Head small, about as deep as broad, distinctly flattened dorsally. Snout long and tapering to slender, rounded point. Mouth moderate, oblique, large, reaching back to beyond front of eye, sometimes as far as middle of eye, lower jaw protruding slightly to distinctly. Eyes of moderate size, upper margins at about upper head profile, interorbital flat. Jaws with moderate to strong canines laterally, lower jaw with a pair of enlarged fangs at mandibular symphysis. Mesopterygoidal and lingual teeth very strong. Gill rakers long and relatively slender (Fig. 43); two short, round pyloric caeca (Fig. 45). Laterosensory pores on head as in Fig. 47; post-orbital pore has migrated antero-medially to lie in the interorbital.

Fins small and membranous. Dorsal and anal fins short-based, angular, maximum length of dorsal fin much greater than basal length but maximum length of anal little more than basal length; dorsal and anal origins about opposite or anal origin a little in front of dorsal. Pectoral fins very small, angular, with upper rays much the longest, fin tips rather pointed, insertion distinctly lateral, fin lamina vertical. Pelvic-anal interval long; pelvic fins very small, inserted at about mid-point of standard length. Caudal fin forked, fin tips only slightly rounded, fin depth rather less than body depth. Caudal peduncle flanges weakly developed.

Variation: meristic: see Table 14.
morphometric: see Table 15.

COLOUR: The back is greenish-olive, the sides similar with dark grey-black vertical bars, disposed in pairs, with the area between each of a pair somewhat paler than the area between pairs; the belly is silvery-white, the fins transluscent amber and the eye golden.

In preservative, greyish-white to brown, the back darker, the sides with very distinctive vertical markings which comprise narrow, unpigmented vertical bands bordered by dark bands, the broad area between the dark margins being somewhat paler. Thus there is a pigmentation sequence along the trunk of narrow, unpigmented band, dark margin, fading to grey, intensifying again to a dark margin followed by a further narrow, unpigmented band. Towards the tail these markings become less regular. The fins are largely unpigmented although the dorsal fin may be dusky at the base. The top of the head is darker, the belly unpigmented.

SIZE: *G. occidentalis* may reach a length of 166 mm L.C.F.; from material studied it evidently commonly reaches 80-100 mm.

HABITAT: Little has been reported on the habitat of *G. occidentalis*. In the Canning River, near Perth, it occurs "around submerged vegetation along the edges of pools or slow moving water, and also in rocky pools below small rapids in the faster flowing parts of the stream" (G. R. Allen, pers. comm.).

LIFE HISTORY: Nothing has been published, although it apparently spawns on vegetation in the headwaters of streams (A. R. Main, pers. comm.). There is nothing to indicate a marine stage in the life history of this species.

DISTRIBUTION: *G. occidentalis* occurs only in Western Australia, where it is widespread from about Winchester (250 km north of Perth) south and east to Waychinnicup Creek, 80 km north-east of Albany on the south coast (Fig. 28).

Table 14. Meristic variation in *Galaxias rostratus* and *G. occidentalis*.

		G. rostratus				*G. occidentalis*				
		Colbinabbin, Vic	L. Wandella, Vic.	Rankins Lagoon, N.S.W.	Third Reedy Lake, Vic.	Twin Swamps, W.A.	Swan R., W.A.	Blackwood R., W.A.	Northcliffe R., W.A.	Shannon R., W.A.
Dorsal rays — segmented	7						1			
	8	1	1	1			3	5	5	
	9	7	7	3			4	5	5	
	10	6	8	1			2			
total	10			1		2	1	3	5	1
	11	5	1	3	2	4	6	6	5	13
	12	9	12	0	5	1	3	1		
	13	6	12	1						
Anal rays — segmented	11	4	3	4			3	2		
	12	9	8	1			3	5	5	
	13	2	3				4	3	4	
	14		0						1	
	15		1							
total	13				1			1		
	14	1	4	4	3		4	1	2	
	15	8	7	1	1	4	1	4	4	
	16	9	11		2	2	4	4	3	9
	17	2	2			1	1		1	4
	18		1							1
Pectoral rays	11	5	1	1	2					
	12	9	12	3	5	1	3	4	1	
	13	6	12	1		6	6	3	5	2
	14						1	2	3	10
	15							1	1	2
Vertebrae	50									1
	51									1
	52					2				5
	53		3		1	4		4		5
	54	10	7		5	1		10		2
	55	8	12		1			7		
	56	2	3					3		
	57							1		
Gill rakers	14	1								
	15			1						
	16	8	3	1			2			
	17	5	9	2			2	2	2	
	18	1	3	1			5	5	1	
	19		1				1	1	3	
	20							1	3	
	21							1	1	

Table 15. Morphometric variation in *Galaxias rostratus* and *G. occidentalis*. Figures are given as percentages of denominators in ratios.

	G. rostratus — all data				*G. occidentalis* Swan R., W.A.		Northcliffe, W.A.		Blackwood R., W.A.		Combined data		
	Min.	Mean	Max.	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Min.	Mean	Max.
S.L./T.L.	87.6	89.14	91.4	0.84	89.99	0.63	89.65	1.03	88.84	0.85	87.8	89.46	91.0
B.D.V./S.L.	10.1	11.85	14.2	0.91	11.90	0.38	11.70	0.62	12.30	0.68	10.7	12.02	13.3
L.C.P./S.L.	10.6	12.86	14.6	0.96	14.11	0.70	13.22	0.69	13.96	0.45	11.6	13.76	15.4
D.C.P./L.C.P.	40.0	55.61	68.8	6.27	51.43	2.95	58.37	4.71	54.96	1.98	47.1	54.92	68.0
Pre. D./S.L.	71.6	73.86	77.3	1.33	73.47	1.42	74.35	1.19	75.33	0.93	71.3	74.38	76.9
Pre. D./Pre A.	92.7	96.14	99.3	1.65	99.90	1.95	100.60	1.67	101.15	1.51	96.3	100.55	103.6
L.D.B./S.L.	7.6	9.06	11.0	0.81	8.42	0.96	8.31	0.74	7.85	0.62	6.9	8.19	10.2
M.L.D./L.D.B.	128.9	157.77	200.0	14.03	177.81	18.55	172.44	11.99	177.90	13.32	150.0	176.05	211.1
L.A.B./S.L.	9.7	11.56	15.7	1.08	12.92	0.83	13.94	1.02	12.41	0.82	11.0	13.09	15.5
M.L.A./L.A.B.	112.8	130.23	164.3	12.05	128.30	6.09	124.47	6.80	132.06	6.18	111.9	128.28	146.7
Pec./Pec.Pel.	34.0	41.29	50.0	4.84	46.28	2.84	42.30	2.51	41.72	3.47	35.7	43.43	50.8
Pel./Pel.An.	31.7	40.33	47.1	3.11	49.17	2.63	44.14	4.05	43.83	3.24	36.5	45.71	51.9
Pre.Pel/S.L.	45.2	50.71	53.2	1.72	50.25	1.10	50.30	1.23	50.12	1.35	47.7	50.22	52.6
Pec. Pel./S.L.	24.6	28.23	31.2	1.34	27.63	0.94	29.14	1.25	29.19	1.50	26.3	28.65	31.5
Pel.An./S.L.	23.6	26.75	28.9	1.26	23.39	0.68	24.45	0.82	25.20	1.25	22.4	24.35	26.8
H.L./S.L.	21.8	23.06	24.4	0.69	22.89	0.92	21.28	0.56	22.22	0.46	20.1	22.13	24.4
H.W./H.L.	45.3	47.71	52.3	2.02	47.89	1.84	55.07	3.25	52.37	1.26	45.5	51.78	59.5
H.D./H.L.	44.6	49.86	54.5	2.41	50.40	1.80	54.53	2.45	52.69	2.28	48.3	52.54	58.3
Sn.L./H.L.	25.8	29.04	32.6	1.66	32.99	2.46	31.50	1.97	31.19	2.11	27.4	31.89	38.0
P.O.H.L./H.L.	50.0	53.76	58.1	1.85	51.75	1.85	51.94	2.04	52.59	2.98	48.7	52.09	57.1
I.O.W./H.L.	32.5	34.63	36.4	1.23	35.49	2.34	35.13	2.25	36.05	2.16	31.3	35.56	40.0
D.E./H.L.	18.8	20.82	25.0	1.38	25.48	2.00	22.77	2.88	22.93	1.86	18.6	23.73	30.0
L.U.J./H.L.	32.3	35.71	40.9	1.99	44.33	2.90	43.89	3.91	42.00	1.86	38.2	43.41	51.7
L.M./H.L.	31.0	34.48	39.7	2.12	45.05	3.83	45.29	3.02	43.83	2.11	37.9	44.72	50.0
W.G./H.L.	25.0	27.89	33.3	1.90	29.42	1.58	35.68	2.20	30.96	2.31	27.3	32.02	40.5
N		35			10		10		10			30	

Galaxias rostratus Klunzinger, 1872
Fig. 30

Galaxias rostratus Klunzinger, 1872: 41 (lectotype: AMS I.19743-001, formerly SMNS 1597, seen; paralectotypes: (2) SMNS 1597, seen, (1) AMS I.19743-002, formerly SMNS 1597, seen; type locality: Murray River); 1880: 412; Macleay, 1881: 47; 1886: 55; Ogilby, 1896: 69; Lucas, 1890: 46; Regan, 1905: 378; McCulloch, 1929: 48; Whitley, 1944: 264; Stokell, 1947: 67; Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 16; Lake, 1978: 24; Backhouse and Vanner, 1978: 128:

Galaxias planiceps Macleay, 1881: 233 (syntypes: formerly (9) MMS F.85, now (6) AMS I.16261-001, seen; type locality: Rankins Lagoon, near Bathurst, New South Wales); Tenison-Woods, 1883: 22; Ogilby, 1886: 54; 1896: 69; Waite, 1904: 17; McCulloch, 1921: 28; 1922: 18; 1927: 18; 1929: 49; Mack, 1936: 100; Whitley, 1956a: 34; 1956b: 39; 1957a: 7; Munro, 1957b: 15; Gentilli, 1961: 488; Whitley, 1964: 35; Lake, 1967: 14; Stanbury, 1969: 205; Llewellyn, 1969: 16; Lake, 1971: 20; Frankenberg, 1971: 95; Pollard, 1971b: 126; Llewellyn, 1971: 10; 1973: 91; 1974: 147; Chessman and Williams, 1974: 170.

Galaxias waitii Regan, 1905; 376 (syntypes: (4) BMNH 1905.7.29: 2-5, seen; there are also 12 specimens AMS I.7411-14, labelled as syntypes, which were sent to the Australian Museum by Regan, in 1905. They are from the type locality but Regan explicitly stated that he based his description on four specimens which are therefore the only syntypes; type locality; Gulpa Creek, New South Wales); Whitley, 1956a: 34.

Galaxias (Galaxias) rostratus — Scott, 1936: 90.

Galaxias planiceps waitii — Whitley, 1964: 35.

TAXONOMY: The syntypes of *G. rostratus* were re-located at the Staatl Museum für Naturkunde by Dr J. R. Paxton, in 1976. Hitherto they were unknown to ichthyologists interested in galaxiid fishes, and placement of the species in synonymies had been uncertain. Most authors ignored the species but Munro (1957b) regarded it as "Possibly the same as" *G. planiceps*, and Lake (1971) listed both *G. rostratus* and *G. planiceps*. The specimens were taken to Sydney by Dr D. F. Hoese and some of them re-deposited in the Australian Museum.

Examination of the syntypes of *G. rostratus* has shown that Munro's (1957b) opinion was correct. They have large mouths reaching well below the eye, slightly to distinctly protruding lower jaws, long snouts, distinctly flattened heads and low vertebral counts (53 vertebrae — 2 fish, 55 — 2 fish), this combination of characters agreeing with the syntypes of *G. planiceps* and with the species hitherto known by that name in Australia. One of the syntypes (113.5 mm S.L.) has been chosen as lectotype and re-deposited in the collection of the Australian Museum, with the approval of the Director of the Staatl Museum für Naturkunde.

Samples of *G. rostratus* are relatively few and mostly old. Examination of existing material from the Murray-Darling system, including that described by Regan (1905) as *G. waitii*, does not indicate the presence of more than one species. The *G. waitii* of Regan are indistinguishable from *G. rostratus;* Regan (1905) made no reference to *G. rostratus*, or, for that matter, to *G. planiceps*, in his revision of the family and was apparently unaware of their descriptions.

DIAGNOSIS: *G. rostratus* is characterised by the combination of flat head, large mouth reaching below eyes, very small pectoral and pelvic fins, forked caudal fin, the absence of pyloric caeca and lack of lateral canine teeth in the jaws. It most closely

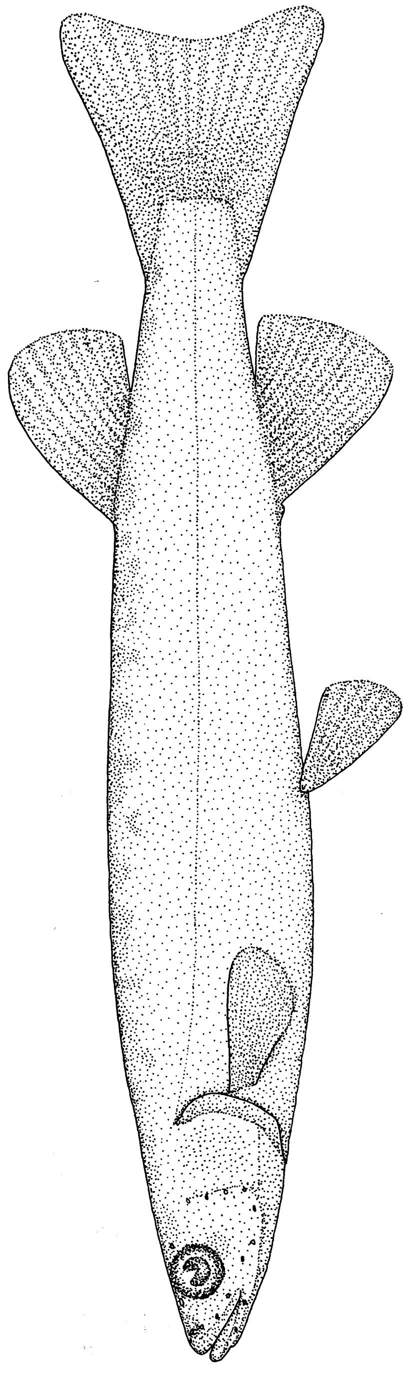

Fig. 30. *Galaxias rostratus* Klunzinger; Wandella Lake, Vic., 79 mm L.C.F.

resembles *G. maculatus* and *G. occidentalis* and differs from these species in characters listed in their diagnoses (pp.534 and 542 respectively.

DESCRIPTION: A moderate-sized elongate and slender-bodied species somewhat compressed along whole trunk, belly little deepened, trunk profiles about parallel in front of dorsal fin but tapering to a slender caudal peduncle which is longer than deep. Head of moderate length, flattened dorsally but about as deep as broad, cheeks not broadening below eyes. Snout flattened and slender, moderately pointed. Mouth slightly oblique, large, extending to below about middle of eyes, lower jaw variable in length, equal to upper or slightly to distinctly protruding. Eyes of moderate size, towards upper head profile, inter-orbital flat. Jaws without lateral canines; mesopterygoidal teeth well developed; gill rakers of moderate length and quite stout (Fig. 43); no pyloric caeca (Fig. 45). Laterosensory pores on head as in Fig. 47.

Fins small, not fleshy at bases. Dorsal fin short-based, rather angular, fin extending well back from base; anal fin origin below or a little behind dorsal origin, longer-based and lower than dorsal, hindmost rays much shorter than anterior ones, fin extending back little beyond base. Pectoral fins small and paddle-shaped, insertion distinctly lateral; pelvic-anal interval long, pelvic fins very short, inserted at about mid-point of standard length. Caudal fin with a distinct but shallow fork, fin tips rounded, fin depth about equal to body depth, peduncle flanges well developed.

Variation: meristic: see Table 14.
morphometric: see Table 15.

COLOUR: When alive greenish-olive on the back and sides, with irregular darker grey-green blotches, the sides below the lateral line bright silvery; the fins are colourless and the eyes silver.

In preservative the fish are dull cream to brown with irregular and rather indistinct blotching on the back and sometimes a strong dark line along the lateral line.

SIZE: *G. rostratus* grows to about 130 mm L.C.F. (Llewellyn, 1971) and not uncommonly exceeds 100 mm.

HABITAT: Little has been recorded, but *G. rostratus* seems to be taken mostly in still and gently flowing waters — lakes, lagoons, billabongs and backwaters, where it occurs in shoals, in midwater.

LIFE HISTORY: Llewellyn (1971) reported on the spawning of *G. rostratus* in ponds. He found that spawning occurs at relatively cool temperatures (9-14°C). The eggs are small (1.3-1.6 mm in diameter) and fecundity is several thousand eggs per female. The eggs are spawned randomly in midwater and settle to the bottom; development takes about 9 days and the larvae are 6-7 mm long at hatching. Llewellyn (p. 11) found that breeding "appears to continue for up to a month suggesting that only small numbers of eggs are shed by any one fish at a time". If true, this is different from what little is known of other galaxiids; however, Llewellyn did not document his findings.

DISTRIBUTION: *G. rostratus* is known only from the Murray-Darling River system, where it is widespread, although of intermittent occurrence (Fig. 27).

Galaxias scottii Krefft *Nomen nudum*

Galaxias scottii Krefft, 1871: 84 (types and type locality not indicated, no description given); Ogilby, 1886: 55; McCulloch, 1929: 55.

Genus **Galaxiella** McDowall

TYPE SPECIES: *Galaxias pusillus* Mack, 1936: 101, by original designation.

DIAGNOSIS: Small, stocky galaxiid fishes with dorsal fin origin posterior, behind vent and anal fin origin. Pelvic fins present, usually 4-6 rays (range 4-7); pectoral fins inserted high laterally. Caudal fin rounded, usually with 13-14 principal rays (range 12-15); caudal peduncle flanges very strongly developed but with very few procurrent rays. No submandibular laterosensory pores. No median ethmoid ossification. Postcleithrum present. Epipleural and epineural ribs present; no ossified interneurals. Caudal neural and haemal spines slender spikes, not laterally flattened. Vertebrae few, 38-43; branchiostegals few, 3-4.

KEY TO SPECIES OF GALAXIELLA

1. Usually 6 pelvic fin rays (range 5-7); usually 10-11 pectoral fin rays (range 9-12); gill rakers long and slender, 16-20; body depth at vent/standard length ratio 10.5-14.3%. (Western Australia from Albany to north of (Perth). ....*G. munda* p.565.

   Usually 5 pelvic fin rays (range 4-6); usually 12-13 pectoral fin rays (range 10-14; gill rakers of moderate length, 14-17; body depth at vent/standard length ratio 13.5-18.6%

2. Usually 9-10 segmented anal fin rays (range 8-11); usually 13 caudal fin rays (range 12-14); 8 pores in preopercular-suborbital-supramaxillary series; 3 distinct lateral longitudinal stripes. (Bass Strait coasts of South Australia, Victoria and Tasmania.) ....*G. pusilla* p.552.
   Usually 11-13 segmented anal rays (range 10-15); usually 14 caudal fin rays (range 12-15); 9 pores in pre-opercular-suborbital-supramaxillary series; 2 distinct lateral longitudinal dark stripes. (Western Australia along the south coast.) ....*G. nigrostriata* p.562.

Galaxiella pusilla (Mack)
Fig. 31, 32.

Galaxias pusillus Mack, 1936: 101 (holotype: NMVM A.97 seen; paratypes: (4) NMVM A. 98 and A.388-90, seen; type locality: Cardinia Creek, Victoria); Stokell, 1945: 126; McDowall, 1971: 37; 1973c: 193; Andrews, 1976: 324.

Brachygalaxias pusillus — Massola, 1938: 129; Scott, 1942: 55; Stokell, 1954: 412; Whitley, 1956a: 34; 1956b: 39; 1957a: 6; 1960: 29; 1964: 34; Scott, 1966: 246; Frankenberg, 1966a: 162; 1966b: 32; 1968: 162; Lake, 1971: 20; Dixon, 1972: 121; Chessman and Williams, 1974: 270.

Brachygalaxias pusillus pusillus — Shipway, 1953: 175; Munro, 1957a: 18; Frankenberg, 1971: 94; Scott, 1971a: 4.

Brachygalaxias pusillus tasmaniensis Scott, 1971a: 3 (holotype: QVML 1971.5.48a, seen; paratypes: (11) QVML 1971.5.48b, seen; BMNH 1972.1.27: 2, not seen; (1) AMS I.16159-001, seen; type locality: soak from dam flowing towards the coast (northward) on Marengo, Waterhouse Estate, Dorset, Tasmania); Green, 1974: 3; Frankenberg, 1974: 119.

Brachygalaxias pusillus flindersiensis Scott, 1971a: 6 (holotype: QVML 1969.5.25a, seen; paratypes: (14) QVML 1969.5.25b, seen; (1) BMNH 1972.1.27: 1, not seen; (1) AMS I.16158-001, seen; type locality: Lackrana, Flinders Island, Bass Strait); Frankenberg, 1974: 119.

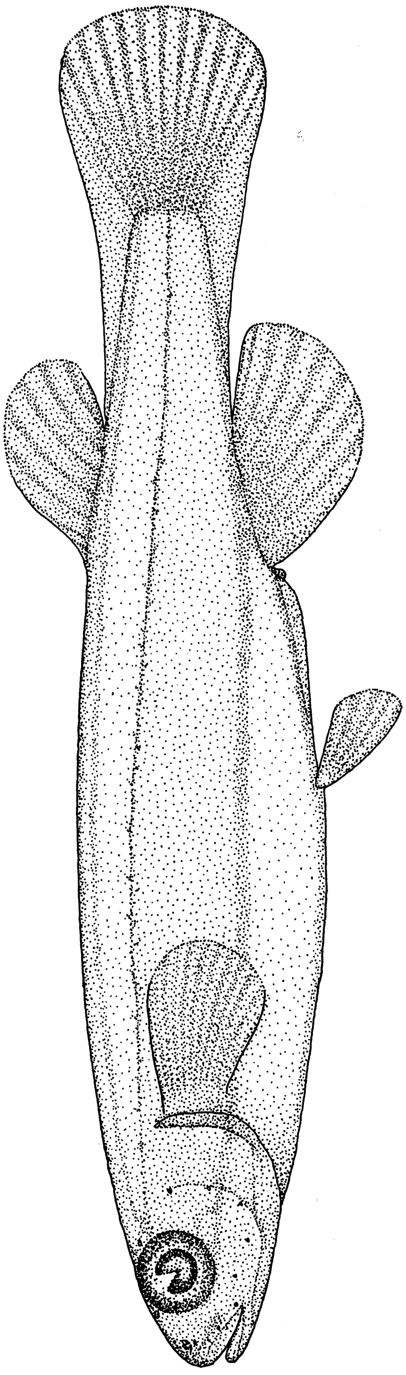

Fig. 31. *Galaxiella pusilla* (Mack), Narracan Creek, Vic., 28.5 mm T.L.

Fig. 32. *Galaxiella pusilla* (Mack), Narracan Creek, Vic., **a.** female — 36 mm T.L.; **b.** male — 25 mm T.L.

Galaxias nigrostriatus — McDowall, 1973: 197 (non *G. nigrostriatus* Shipway, 1953: 175 ??).

Galaxiella pusilla — McDowall, 1978a: 119; 1978b: 308; Lake, 1978: 26; Backhouse and Vanner, 1978: 128.

TAXONOMY: Inclusion of this and the subsequent two species in *Galaxiella* rather than *Galaxias* Cuvier or *Brachygalaxias* Eigenmann is discussed in the generic section on p.454.

Scott (1971a) described two new sub-species of *G. pusilla* as *Brachygalaxias pusillus tasmaniensis* and *B. pusillus flindersiensis* from Tasmania and Flinders Island respectively. Although Scott did not describe the nominate sub-species *B. pusillus pusillus* from Victoria, he did indicate the differences between it and the new sub-species. He reported differences in such characters as head length, snout length, eye diameter, vertebral count, etc., and showed that there are statistically significant differences between the populations he examined. That these differences have little taxonomic significance was shown by Andrews (1976). He examined more material from a greater range of geographical localities and found that rather than there being differences between sets of populations from the three geographical areas nominated by Scott (1971a) there are similar differences between populations within each of these geographical areas. When the more extensive range of material examined by Andrews is combined for each of Victoria, Flinders Island and Tasmania, the supposed differences between the sub-species from each of these areas largely disappear. Andrews treated all three sub-species as synonyms, and his arrangement is adopted here.

As an example of the sorts of differences used by Scott (1971a) we cite the following: Scott (1971a: 7) stated "Perhaps the nearest approach to a definitive criterion for the separation of individuals of, on the one hand, the Victorian forms, on the other hand the Tasmanian and Flinders Island forms, is that of number of ventral fin rays. This is specified in the description of *B. p. pusillus* as 5, and appears seldom to depart from that number whereas a count of 4 was obtained in 13 of the 14 Tasmanian fish and in all of the Flinders Island examples examined". However, we have found 5 rays to predominate in a sample of *G. pusilla* from Tasmania and 4 rays to predominate in some Victorian populations. Further, the population at Eumaralla, Victoria, has 36-38 vertebrae, that nearby at Tyabb 37-40, a population at Narracan Creek, Victoria 38-40, while that at Blackmans Lagoon, Tasmania has 37-40. Variation of this type, as discussed by Andrews (1976), appears to have no logical basis, and understanding of the reasons for it must await collection of more adequate and widely representative material. Recognition of sub-species on the basis of such variation would seem to have little meaning.

Reasons for the exclusion from *G. pusilla* of Western Australian populations of *Galaxiella* that are sometimes described as a sub-species of *G. pusilla* (see Shipway, 1953; Munro, 1957a) are given in the taxonomic discussion of *G. nigrostriata*.

DIAGNOSIS: Characterised by the dorsal origin behind the anal origin, small size, absence of laterosensory pores beneath the lower jaw, and presence of three longitudinal dark stripes along the sides, the lower two separated (in life) by a bright orange stripe in males. In the small size and lack of pores beneath the lower jaw it resembles species of *Paragalaxias*, but differs from them in having the dorsal fin above the anal (above the pelvics in *Paragalaxias*). *G. pusilla* closely resembles other species of *Galaxiella;* it differs from *G. nigrostriata* in having fewer caudal and pelvic fin rays (Table 16), and in having three rather than two longitudinal dark stripes. It has fewer laterosensory pores in the preopercular-supramaxillary series (Fig. 47). It differs from *G. munda* in being stouter, having a shorter based anal fin, fewer anal, caudal and pelvic fin rays, fewer gill rakers and vertebrae, and more pectoral fin rays (see Table 16). There are no really distinct lateral dark stripes in *G. munda* although there is a broader dusky band split by a narrow, pale (in preserved specimens), crenulate stripe along the lower sides.

DESCRIPTION: A tiny, fusiform species, compressed behind the vent, the dorsal and ventral body profiles moderately and evenly arched, body depth greatest at about mid-abdomen. Caudal peduncle long and deep, much longer than deep. Head short, broad and deep, about as broad as deep. Snout short and bluntly rounded. Mouth small, oblique, reaching back almost to front of eyes; jaws about equal. Eyes large, upper margin at about head profile; interorbital broad and flat. Jaws without enlarged lateral canines; mesopterygoidal teeth few but strong; lingual teeth well developed. Gill rakers long and slender (Fig. 44); pyloric caeca lacking (Fig. 46). Laterosensory pores on head as in Fig. 47. No submandibular pores; eight pores in preopercular-supramaxillary series with a distinct "dog-leg" in row beneath eye (fourth to seventh pores); pores in anterior nasal depression distinctly posterior to nostril.

Fins all small and membranous, dorsal and anal fins short-based, rounded, posterior rays extending back moderately behind fin bases; anal fin origin distinctly in front of dorsal origin. Pectoral fins broad-based, small and rounded, insertion high laterally, fin lamina distinctly lateral. Pelvic-anal interval very short; pelvic fins very small, inserted at about mid-point of standard length. Caudal fin long and rounded, depth about equal to length, somewhat less than body depth. Caudal peduncle flanges strongly developed and reaching forward to be more or less confluent with dorsal and anal fin bases; few procurrent caudal fin rays.

Variation: meristic: see Table 16.
morphometric: see Table 17.

SEXUAL DIMORPHISM: Sexual dimorphism has been described for *G. pusilla;* Massola (1938) pointed to differences in colouration between the sexes, but these differences were not mentioned by most subsequent workers (Scott, 1971; Andrews, 1976; McDowall, 1973c; 1978a — see however, Backhouse and Vanner, 1978), probably because of the meagre samples available. Observations of live material confirmed differences between the sexes in colour, and comparisons of measurements also indicated differences in size and in some body proportions (McDowall, 1978b) as follows: 1. Size: Males are smaller than females (Table 18, Fig. 32). 2. Body proportions: Ripe males are more slender-bodied than ripe females, this being primarily a reflection of the swollen abdomens of the ripe females, and this difference has little significance (Table 18). The pectoral-pelvic and pelvic-anal dimensions in males are less than in females (Table 18). Examination of plots of pectoral-pelvic length/standard length and pelvic-anal length/standard length suggested that there is allometric growth in this fish; the higher ratios in females are produced by allometry common to the two sexes, but which continues further in females than in males because the females grow to a greater size (Fig. 33). 3. Ventral keel and genital papilla: In both sexes there is a fleshy/horny keel along the ventral abdomen, beginning at about the pelvic fin bases, and extending back as far as the vent. The depth of the keel is slightly greater in males than in females, although the difference is slight. In the male, the vent is followed by a low fleshy genital papilla that projects slightly more than the vent; in the female the genital papilla is a distinct fleshy mound. 4. Colouration also varies between the sexes (see "Colour", below).

G. pusilla is the only species in the family Galaxiidae in which sexual dimorphism has been described, although it may occur in other *Galaxiella* species; existing material does not suffice to determine this.

Table 16. Meristic variation in *Galaxiella* species.

		G. pusilla	*G. nigrostriata*	*G. munda*
Dorsal fin rays — segmented	5	1		
	6	18	10	8
	7	24	10	24
	8	3		5
total	6	1		
	7	14	3	1
	8	23	11	18
	9	8	6	15
	10			3
Anal rays — segmented	7	13		
	8	24	2	
	9	9	11	1
	10	1	3	12
	11		3	19
	12			5
total	8	9		
	9	22		
	10	12	2	
	11	4	7	1
	12		6	5
	13		2	16
	14		1	13
	15		1	2
Caudal rays	12	8	1	
	13	39	4	1
	14	1	14	32
	15		1	2
Pectoral rays	9			1
	10	3		15
	11	8	3	9
	12	25	14	3
	13	9	4	
	14	2	1	
Pelvic rays	4	16		
	5	27	19	2
	6	1		33
	7			2
Gill rakers	12	3		
	13	2		
	14	8	1	
	15	5	4	
	16	8	9	5
	17	1	2	4
	18		2	3
	19			3
	20			1
Vertebrae	36	2		
	37	4		
	38	6	2	3
	39	25	22	7
	40	9	14	15
	41		8	18
	42		3	19
	43		2	4

Table 17. Morphometric variation in *Galaxiella* species.
Figures are given as percentages of denominators in ratios.

	G. pusilla				*G. nigrostriata*				*G. munda*			
	Min.	Mean	Max.	S.D.	Min.	Mean	Max.	S.D.	Min.	Mean	Max.	S.D.
Standard length/total length	83.1	86.59	89.2	1.52	83.7	85.88	90.3	1.75	82.2	84.91	87.7	1.29
Body depth at vent/standard length	13.8	15.51	18.6	1.35	13.5	16.48	18.5	1.21	10.5	12.83	14.3	1.12
Length of caudal peduncle/standard length	20.3	22.37	24.3	1.71	18.7	20.98	23.5	1.51	15.2	18.93	22.5	1.73
Depth of caudal peduncle/length of peduncle	41.7	49.19	55.5	4.98	46.4	55.78	61.9	4.31	40.7	47.30	54.5	4.69
Predorsal length/standard length	70.1	72.75	79.0	2.31	70.5	72.56	75.0	1.04	70.2	73.29	76.7	1.41
Predorsal length/pre anal length	101.5	107.06	112.1	2.81	104.7	107.82	112.5	1.98	105.0	108.30	111.9	1.87
Length of dorsal fin base/standard length	5.9	7.8	10.3	0.94	7.1	7.88	8.8	0.61	6.7	8.30	9.8	0.73
Maximum length of dorsal fin/basal length	155.6	184.62	200.0	14.85	155.6	175.32	188.2	10.33	150.0	174.47	200.0	13.91
Length of anal fin base/standard length	8.1	10.36	12.6	1.38	11.1	12.58	13.8	0.88	12.3	14.63	16.4	1.07
Maximum length of anal fin/basal length	133.2	155.49	190.0	16.36	128.6	144.09	166.7	10.40	125.0	137.17	154.5	7.84
Pectoral fin length/pectoral-pelvic length	42.9	51.75	61.5	6.42	41.2	47.84	51.6	3.06	39.1	45.17	52.9	3.58
Pelvic fin length/pelvic-anal length	42.9	51.87	68.8	7.11	50.0	60.38	68.8	5.03	50.0	60.34	70.0	5.66
Prepelvic length/standard length	45.5	49.93	53.7	2.23	46.1	50.63	52.8	1.64	40.5	49.12	52.6	3.04
Pectoral-pelvic length/standard length	23.7	29.61	34.8	3.31	27.4	29.51	31.8	1.19	23.2	29.41	33.3	2.38
Pelvic-anal length/standard length	16.2	19.54	22.2	1.52	15.0	16.55	17.9	0.90	15.5	17.60	19.7	1.08
Head length/standard length	21.4	22.73	24.7	0.83	20.9	22.38	23.9	0.82	17.4	19.90	22.8	1.16
Head width/head length	54.5	60.79	65.5	2.82	53.8	59.43	66.7	4.32	50.0	55.75	62.5	3.40
Head depth/head length	52.0	59.04	62.5	3.24	55.5	60.29	66.7	3.15	50.0	55.88	66.7	4.16
Snout length/head length	24.0	26.99	30.4	1.63	22.2	26.43	29.6	1.93	23.1	28.21	35.0	2.49
Post-orbital head length/head length	42.4	48.04	54.8	3.20	44.4	48.38	54.2	2.71	41.7	46.54	53.6	2.34
Interorbital width/head length	32.0	38.77	45.5	3.66	33.3	37.89	44.5	3.36	34.4	40.80	45.8	2.67
Diameter of eye/head length	25.8	29.49	34.8	2.66	25.0	28.26	30.8	1.57	26.5	30.40	35.0	2.41
Length of upper jaw/head length	24.0	28.72	33.3	2.57	26.9	29.14	33.3	2.26	29.2	32.49	40.0	2.22
Length of lower jaw/head length	21.3	25.59	29.2	1.99	25.0	27.23	29.6	1.87	26.7	30.48	35.0	2.18
Width of gape/head length	21.3	25.57	30.8	2.92	21.7	24.39	27.8	1.85	20.8	25.41	30.0	2.83
Number of fish measured		15				16				24		

Table 18. Sexual dimorphism in size and body proportions in *Galaxiella pusilla* (22 males, 21 females, Narracan Creek, Victoria).

		Range	Mean	S.D.
Size (total length — mm)	male	24.5 - 29.5	27.19	1.24
	female	31.0 - 39.0	34.20	1.86
Body depth/standard length (%)	male	16.8 - 21.5	18.70	1.27
	female	19.0 - 23.3	21.09	0.99
Pectoral-pelvic length/ standard length (%)	male	23.7 - 29.1	26.06	1.44
	female	26.7 - 34.7	30.79	1.87
Pelvic-anal length/ standard length (%)	male	15.9 - 19.3	17.40	0.83
	female	17.0 - 22.6	19.00	1.74

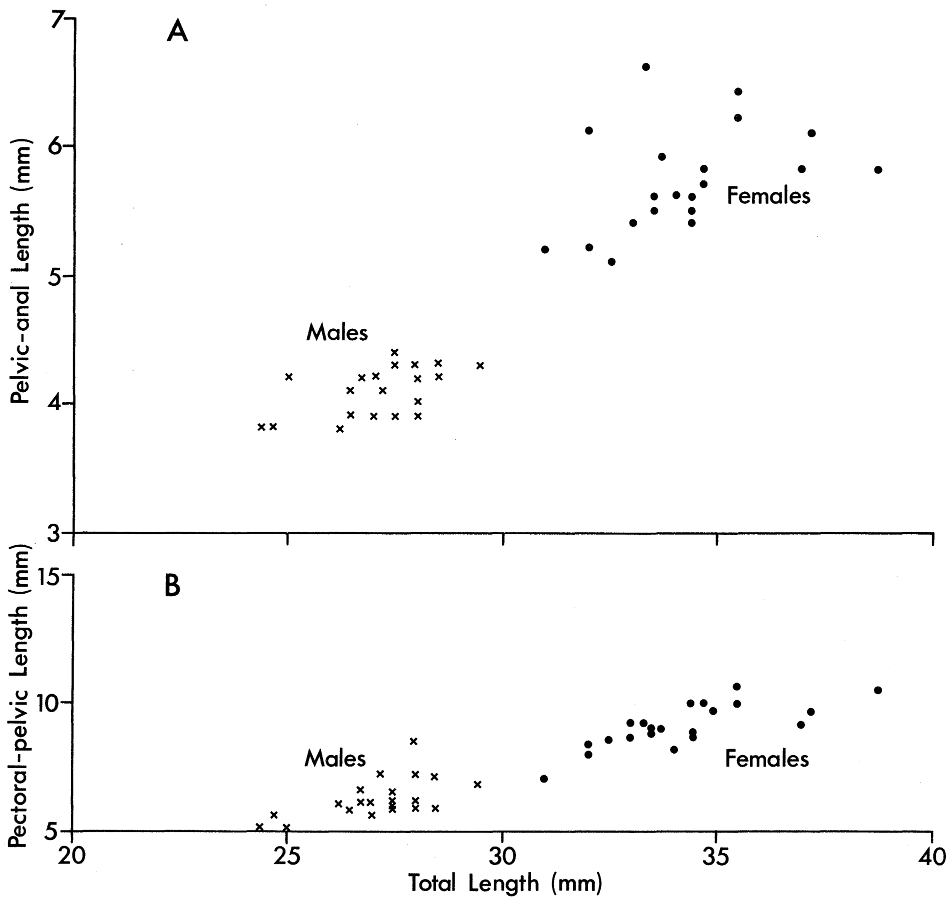

Fig. 33. Differences in body proportions between male and female *Galaxiella pusilla*.

COLOUR: The male of *G. pusilla* is characterised by a striking, narrow, orange-red stripe along its side, just below the lateral line. When alive, it is a dull olive-amber on the back and upper sides, with three black longitudinal stripes along the trunk; the upper stripe is weakest and merges medio-dorsally with darker pigment on the back. The middle stripe is much thinner and very distinct, and is positioned at about the lateral line, well-separated from the bright orange stripe along the abdomen but converging with it on the caudal peduncle. The lower dark stripe is strongly developed and forms the lower margin of the orange stripe. Ventrally there is a pair of black lines, originating together in the isthmus, diverging, and then running parallel along the belly to the pelvic fin bases; the pelvic-anal interval is more or less unpigmented but there are black lines along the anal fin base and the ventral margin of the caudal peduncle, becoming more or less confluent with the lowermost lateral dark stripe. The belly is silvery-white and the eyes silvery-gold, with small areas of bright orange, as a continuation of the lateral orange stripe.

The female differs from the male primarily in lacking the bright orange stripe. The longitudinal dark lines occur, but are a little less bold, and there is a lateral band of silvery iridescence comparable in position to the orange stripe in the female.

Juveniles lack the highly distinctive colouration, being dusky-olive on the back and sides with a silvery crenulate stripe along the lower sides.

SIZE: *G. pusilla* is a tiny species reaching a known maximum size of only 39 mm total length; it is often only 30 mm or less.

HABITAT: *G. pusilla* occurs mostly in still or gently flowing waters, usually in swamps, swampy lagoons, or small creeks and drains, mostly amongst thick aquatic vegetation.

LIFE HISTORY: Massola (1938) discussed aquarium spawning of the species which spends it entire life cycle in fresh water. He reported observations of a Mr H. W. Davey as follows: "On July 30th I noticed the male following the female about and the next day his attentions became more pressing . . . At frequent intervals of time he swam upside down before the female, but making contact with her ventral surface, rubbing himself along beneath her body, then swimming out in front of her and resuming his normal swimming position. On August 1st, egg laying commenced and continued most of the following day until I had counted 59 eggs . . . On August 5th the female died. The eyes of the embryos could easily been detected on the 11th, and on the 12th 2 eggs hatched out . . . by the 17th, 45 more had hatched out making a total of 53". Massola reported that he also had bred the species finding that the "female chooses the places to deposit the eggs" and that the "parents do not look after the eggs or young, but they don't seem to worry them either".

Further observations on the spawning of *G. pusilla* are reported by Backhouse and Vanner (1978) who have bred the species in captivity, and whose observations are in general agreement with those of Massola.

Spawning was occurring in a population in a farm drain entering Narracan Creek, near Yallourn, during August, 1977, and spawning fish were still present in the drain in October. Large numbers of larvae were present in August; spawning thus seems to occur through the spring.

G. pusilla is possibly able to aestivate during some life history stage. Miss J. Barclay (Department of Zoology, University of Melbourne) collected a sample from a swamp near the confluence of Diamond Creek with the Bunyip River. On returning to obtain more specimens at a later date the habitat had dried up and it was not until a further visit, after rains when water returned to the swamp, that further, mostly very small fish, were collected. These may either have invaded the area from elsewhere, or hatched from aestivating eggs. The small size of the fish caught is consistent with their having hatched recently from aestivating eggs.

DISTRIBUTION: *G. pusilla* is known in southeastern Australia, from Gippsland west to about Mount Gambier, and in northeastern Tasmania (Fig. 34).

Galaxiella nigrostriata (Shipway)

Fig. 35

Galaxias pusillus nigrostriatus Shipway, 1953: 175 (holotype: WAM P.3420, seen; paratypes: (4) AMS IB.3197-8, seen; type locality: "a small drain running into Marbellup Creek on a property owned by Mr Byland", Elleker, near Albany, Western Australia); Munro, 1957a: 18; Gentilli, 1961: 488; Anon. 1964: 34.

Brachygalaxias nigrostriatus — Whitley, 1956a: 34; 1956b: 39; 1957a: 6; 1960: 29; 1964: 35; Scott, 1971a: 2.

Galaxias nigrostriatus — McDowall, 1973c: 197.

Galaxiella nigrostriata — McDowall, 1978a: 118; 1978b: 308; Lake, 1978: 27; Backhouse and Vanner, 1978: 128.

TAXONOMY: As the synonymy indicates there is some conflict of opinion about the taxonomic status of *G. nigrostriata*. Scott (1971a) suggested that full specific rank should be assigned, and this view was supported by McDowall (1978a), where the problem is discussed in detail.

DIAGNOSIS: Characterised by its small size, dorsal origin behind anal origin, absence of laterosensory pores beneath the lower jaw, and presence of two longitudinal dark stripes separated (in life) by a bright orange stripe. It differs from *G. pusilla* in characters discussed in the diagnosis of that species (p.555). It differs from *G. munda* in having more anal fin rays and fewer pelvic fin rays, shorter and fewer gill rakers, and a different arrangement of laterosensory canals on the head (Fig. 47). *G. munda* has only one dark lateral band with a very narrow pale band above it.

DESCRIPTION: A tiny stocky fusiform species, compressed behind the vent, dorsal and ventral body profiles moderately and evenly arched; body depth greatest in front of pelvic fin origin. Caudal peduncle long and deep, much longer than deep. Head short, broad and deep, a little depressed dorsally, about as broad as deep. Snout short and bluntly rounded. Mouth small, oblique, reaching back to about front of eyes; jaws equal. Eyes large, set at about upper head profile, interorbital broad and flat. Jaws without enlarged lateral canines; mesopterygoidal teeth few but strong; lingual teeth well developed. Gill rakers long and slender (Fig. 44); pyloric caeca very small, no more than two well-formed shoulders (Fig. 46). Laterosensory pores on head as in Fig. 47; no submandibular pores; eight pores in preopercular-supramaxillary series, without a distinct "dog-leg" in row below eye (fourth to seventh pores); pores in anterior nasal depression virtually separated by nostril.

Fins all small and membranous; dorsal and anal fins short-based, rounded, posterior rays extending back moderately behind fin bases. Anal fin origin distinctly in front of dorsal origin. Pectoral fins broad-based small and rounded, inserted high laterally, fin lamina distinctly vertical. Pelvic-anal interval very short, pelvic fins very small, inserted at

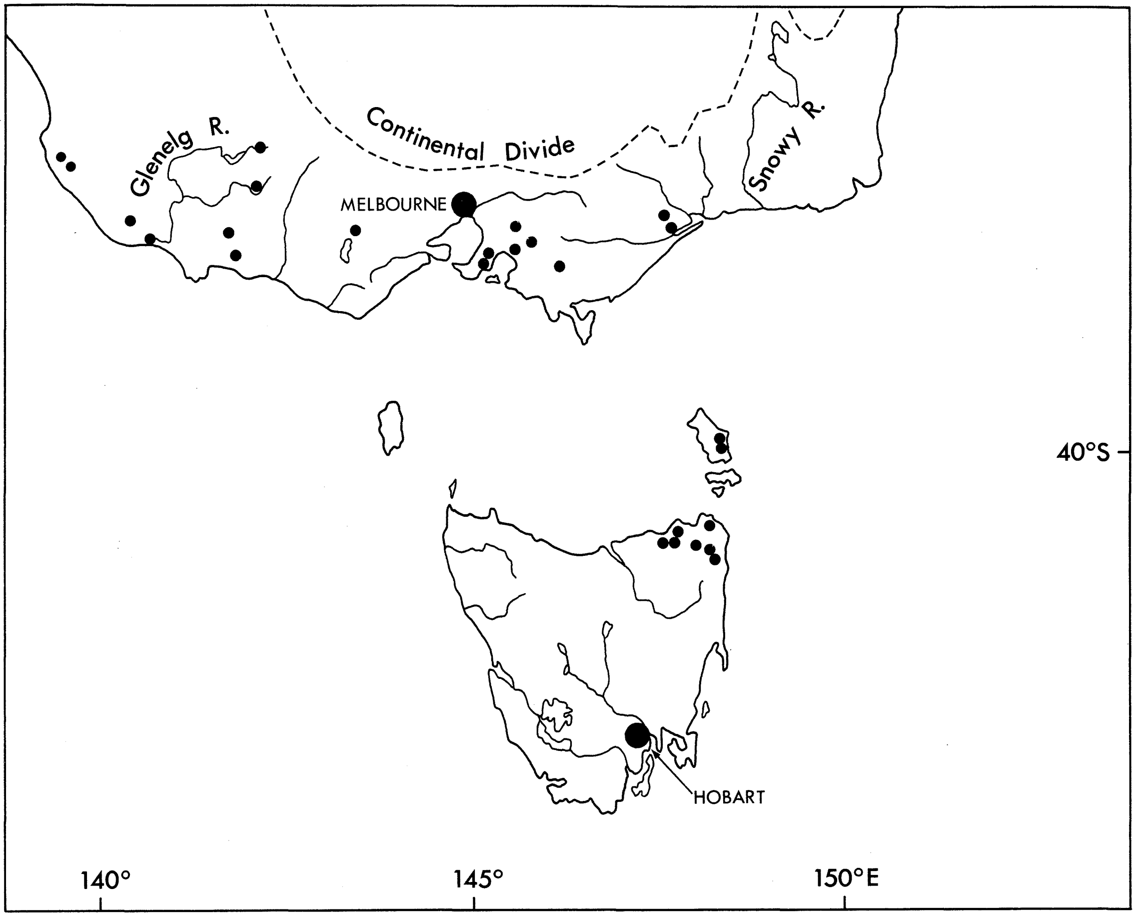

Fig. 34. Distribution of *Galaxiella pusilla*.

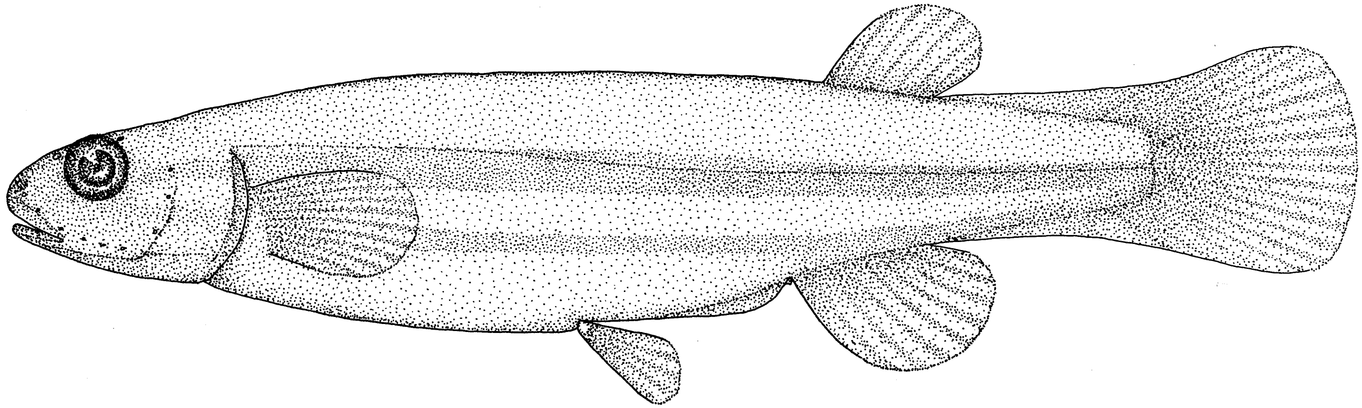

Fig. 35. *Galaxiella nigrostriata* (Shipway); swamp near Elleker, W.A., 35.5 mm T.L.

about mid-point of standard length. Caudal fin long and rounded, depth about equal to length, a little less than body depth. Caudal peduncle flanges very strongly developed and reaching forward to dorsal and anal fin bases; few procurrent caudal fin rays.

Variation: meristic; see Table 16.
morphometic: see Table 17.

COLOUR: Shipway (1953: 175) described the colour of *G. nigrostriata*, when alive, as follows: "Olivaceous above the lateral line, a black stripe below; an orange stripe below that and then another black stripe above a white ventral surface. A black spot on the dorsal portion of the posterior section of the caudal peduncle".

In preservative it is grey to brown on the back with a broad horizontal black band running mid-laterally from the mid tail-base, a little below the lateral line, across the operculum to the eye. Below this is a pale band equal in width to the darker band above, and below the pale band a second dark band, narrower than the upper one and running along the ventral surface of the caudal peduncle, along the anal fin base, and then along the lateroventral abdomen, the operculum and below the eye. The belly is unpigmented, as are all the fins. Juveniles lack the longitudinal bands.

SIZE: *G. nigrostriata* is one of the smallest galaxiids, reaching a known maximum size of only 39.5 mm total length; few specimens examined exceeded 35 mm.

HABITAT: *G. nigrostriata* is typically found in swamps, backwaters, and slow-flowing streams. Shipway (1953) collected the type series from a small drain.

LIFE HISTORY: It seem likely, from general characters of *G. nigrostriata* and from comparison with *G. pusilla*, that the life history of *G. nigrostriata* is restricted to freshwater, lacking any marine stage. The natural history of the species is unstudied.

DISTRIBUTION: *G. nigrostriata* is known only from Western Australia, where it has been colleced from streams and swamps between about Esperance and west to Albany, on the south coast (Fig. 36). In the vicinity of Albany its range overlaps that of *G. munda*, which is distributed further to the west and north.

Galaxiella munda McDowall
Fig. 37

Galaxiella munda McDowall, 1978a: 119 (holotype: WAM P.25736-001; paratypes: (39) WAM P.5225; (5) AMS I.19522-001; type locality: pool in jarrah forest about 8 km north of Scott River, south of Canebreak Yards, between Nanup and Augusta, Western Australia, 115°29′59″ E. 34°13′50″ S.) 1978b: 308; Lake, 1978: 26; Backhouse and Vanner, 1978: 128.

TAXONOMY: Examples of this species were present among samples labelled "*Brachygalaxias nigrostriatus*" in collections in the Western Australian Museum, Perth, the National Museum of Victoria, Melbourne, the Rijksmuseum van Naturlijke Historie, Leiden, and the American Museum of Natural History, New York; although *G. munda* is better represented in collections than *G. nigrostriata*, it had escaped recognition as a distinct species.

DIAGNOSIS: Characterised by small size, the dorsal fin origin being behind the anal origin, the absence of laterosensory pores beneath the lower jaw, and the presence of a broad, dusky, longitudinal band along the lateroventral trunk (in preserved, larger adults). It closely resembles the other species of *Galaxiella* — *G. pusilla* and *G. nigrostriata* — from which it differs in characters discussed in the diagnoses of these two species (pp.555 and 562 respectively).

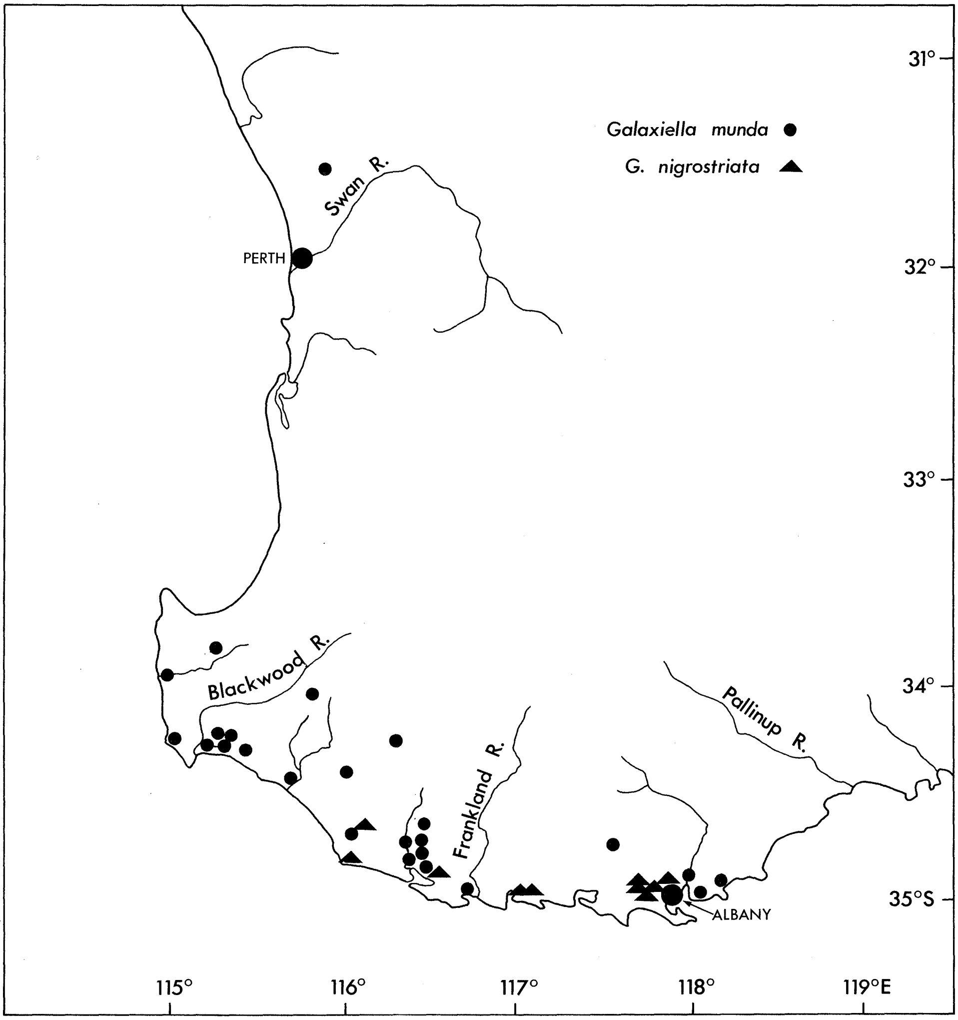

Fig. 36. Distribution of *Galaxiella nigrostriata* and *G. munda*.

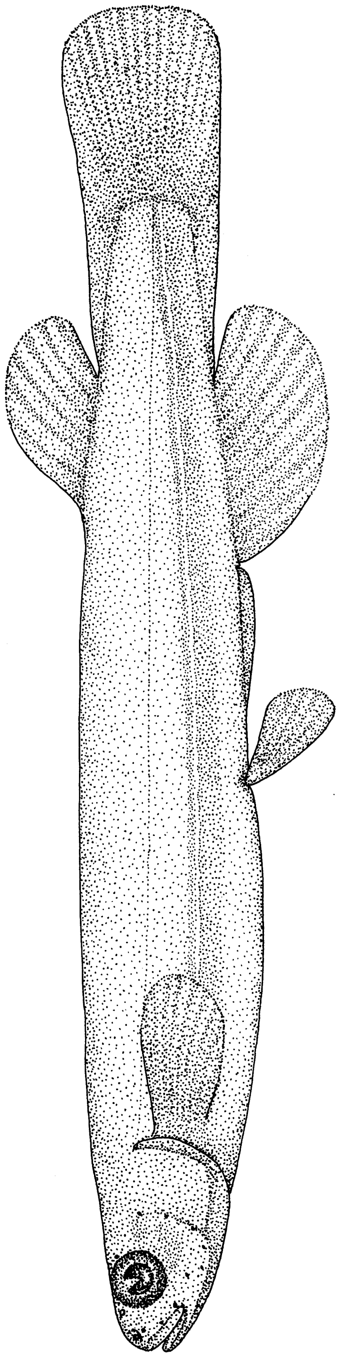

Fig. 37. *Galaxiella munda* McDowall; pool near Canebreak Yards, W.A., 45.5 mm T.L.

DESCRIPTION: A small, almost tubular species, compressed behind the vent, the dorsal and ventral body profiles almost parallel, or the belly deepened a little. Caudal peduncle long and deep, much longer than deep, head very short, of moderate depth, about as deep as broad. Snout short and bluntly rounded. Mouth small, oblique, reaching back to about front of eye, jaws about equal. Eye very large, upper margin at about head profile, interorbital broad and flat. Jaws without enlarged lateral canines; mesopterygoidal teeth few but strong; lingual teeth well developed. Gill rakers long and slender (Fig. 44); pyloric caeca lacking (Fig. 46). Laterosensory pores on head as in Fig. 47. No submandibular pores; nine pores in preopercular-supramaxillary series with a distinct "dog-leg" in row below eye (fourth to seventh pores); pores in anterior nostril depression distinctly posterior to nostril.

Fins small and membranous; dorsal fin short-based, anal much longer-based, but fins rounded and extending well back behind fin bases; posterior rays long; anal fin origin distinctly in front of dorsal origin. Pectoral fins narrow-based, small and rounded, insertion high laterally, fin lamina distinctly lateral. Pelvic-anal interval very short, pelvic fins very small, inserted at about midpoint of standard length. Caudal fin long and rounded to truncate, depth much less than length and less than body depth. Caudal peduncle flanges strongly developed and reaching forward to be more or less confluent with dorsal and anal fin bases; few procurrent caudal fin rays.

Variation: meristic: see Table 16.
morphometric: See Table 17.

COLOUR: Colour when alive variable, related to the colour of the water inhabited. In the frequently tannin-stained swampy waters of Western Australia, *G. munda* is a dark brown on the back and sides with a longitudinal crenulate, silvery stripe along the lower sides; the belly is silvery-white. Less densely coloured fish are greenish-olive on the back and upper sides with a longitudinal silvery stripe below which is a soft brownish-orange stripe and then a narrow, dark stripe. The belly is silvery.

Colour in preservative dusky grey-brown. In small fish up to about 25 mm T.L. there is general dorsal and lateral covering of melanophores, the belly unpigmented. With growth, a crenulate pale longitudinal stripe develops on the lower sides; when the fish reach about 40 mm a variously intense dark line forms above the pale stripe with a few scattered, large melanophores in the edge of the pale stripe. Below the pale line a broad, indistinct, reticulate dark band forms, below which the belly is unpigmented.

The peritoneum of the abdominal cavity is black.

SIZE: *G. munda* is by far the largest of the species of *Galaxiella* reaching a known maximum length of 52 mm T.L., not infrequently reaching 35 mm or more.

HABITAT: The habitat at the type locality was described by Mr W. H. Butler, who collected the specimens, as "A shallow, cool pool, arising out of laterite and densely covered with jarrah/marri low forest. The undergrowth tends to be *Hakea* and other sundry proteaceous bushes. The pool is quite small, approximately 2 metres long, 60 cm wide and perhaps 20 cm deep, heavily coloured with the tannin stain of *Eucalyptus* leaves". *G. munda* has been collected from the type locality of *Lepidogalaxias salamandroides* Mees (family Lepidogalaxiidae), which Mees (1961: 34) described as follows: "a very small creek in heavy forest of mixed Karri and Jarrah. The creek was on average about 30 cm wide and 5 cm deep; the creek bed was largely filled with *Eucalyptus* leaves, especially in those places where the creek was slightly wider and deeper... The creek is probably permanent, the water is cool, and fairly rapidly flowing".

Mr G. L. Liddelow of the Western Australian Forests Department collected specimens "in waterways formed by road formations" in an area described as "black peaty sands of flats subject to prolonged flooding or water-logging where there are extensive areas of sedgeland . . . with closed heath forming pockets in the wettest parts of the low, open woodland" (pers. comm.). From these accounts and from brief details on sample labels, it appears that *G. munda* occurs mostly in pools and quietly flowing streams, but that it also inhabits flowing waters.

LIFE HISTORY: Nothing is known of the life history of *G. munda;* it is most likely that its entire life cycle is spent in fresh water.

DISTRIBUTION: *G. munda* is known only from Western Australia where it is widespread in the far west and southwest, from north of Perth to the vicinity of Albany (Fig. 36). In the eastern fringes of its range it overlaps the range of *G. nigrostriata.*

Genus **Paragalaxias** Scott

Paragalaxias Scott 1935 (April): 41 (type species: *Galaxias shannonensis* Scott, 1934: 41, a junior synonym of *G. dissimilis* Regan, by original designation).

Querigalaxias Whitley, 1935 (July): plate III (type species: *Galaxias dissimilis* Regan, 1905: 383, by original designation, genus undiagnosed).

DIAGNOSIS: Small, stocky fishes (up to 99 mm L.C.F.), trunk cylindrical to slightly compressed; scales lacking; lateral line present; open pores present on head, rows of laterosensory papillae (pit organs) on head and across tail base. Dorsal fin origin above or very slightly behind pelvic fin insertion; pelvic fins with 5-6 rays; procurrent rays numerous. No adipose fin. Vertebrae 37-44; branchiostegals 6-8. Sexes similar, both gonads present in both sexes; no pyloric caeca.

Maxilla almost excluded from gape, toothless; jaw teeth conical, uniserial, without enlarged canines laterally; mesopterygoidal teeth few and of moderate size; lingual teeth few and large. Vomer shafted but toothless; no palatine teeth. Orbitosphenoid and basisphenoid absent; ethmoid lacks dermal ossification but there is a block of endochondral bone including an ethmomyodomal. Post-temporal simple; no mesocoracoid; postcleithrum present. Epineurals and epipleurals present. Five hypurals plus a parhypural on urostylar centrum; caudal neural and haemal spines compressed caudally.

Four species in the highlands of central Tasmania. (Identification of *Galaxias dissimilis* Regan with one of the species in Great Lake, Tasmania, suggests that the type locality for this species, 'New South Wales' is incorrect. Certainly no further specimens identifiable with *G. dissimilis* have been found in continental Australia).

Stokell's (1950) inclusion of the South African species *G. zebratus* (Castelnau) has been shown elsewhere to be erroneous (Scott 1966; McDowall 1973b).

KEY TO SPECIES OF *PARAGALAXIAS*

1. Gill rakers 9-10 (occasionally up to 12); caudal rays 14(13); vertebrae 37-39(40); no submandibular pores (Great Lake and Shannon Lagoon, Tasmania) .... *P. eleotroides* p.575.
   Gill rakers 12-18; caudal rays 15(14); vertebrae 40-42(44); submandibular pores present or absent. 2
2. Pelvic rays 5; gill rakers very short stubs, length about equal to basal width; anterior interorbital laterosensory pore well-separated from posterior nostril

(Julian Lakes, Ida and Tallinah Lagoons, and Lakes Dudley, and Ada, Tasmania). ....*P. julianus,* p.581.
Pelvic rays 6; gill rakers longer, length much greater than basal width; anterior interorbital laterosensory pore confluent with posterior nostril..........3

3. Dorsal rays 9-12; gill rakers 12-15; vertebrae 40-41; two pairs of submandibular pores, widely separate; supramaxillary pores very large (Great Lake, Shannon Lagoon and Penstock Lagoon, Tasmania) ....*P. dissimilis,* p.570.
Dorsal rays 13-14; gill rakers 16-18 (occasionally 15); vertebrae 42-43 (occasionally 41 or 44); submandibular pores rarely present, if present close together; supramaxillary pores small (Arthurs Lake and Woods Lake, Tasmania) ....*P. mesotes,* p.578.

Paragalaxias dissimilis (Regan)
Fig. 38

Galaxias dissimilis Regan, 1905: 383 (holotype: BMHN 1905.7.29:1, not seen; type locality: "New South Wales", probably erroneous); McCulloch, 1921: 28; 1922: 18; 1929: 49; Whitley, 1933: 61; Scott, 1935: 46; 1936: 110; Frankenberg, 1966b: 27; Scott, 1966: 248; 1971a: 8.

Paragalaxias shannonensis Scott, 1935: 41 (holotype: formerly QVML HT 939a, now lost — Andrews, 1976; paratypes: (1) QVML PT 939b, seen; (1) BMNH 1935.10.19:2, not seen; (1) AMS IA.6439, seen; (1) NMVM A.413, seen; (2) TMH D.996, D.1/180, seen; type locality: Shannon River, Tasmania); Whitley, 1935: 42; Scott, 1936: 110; 1941: 60; Stokell, 1945: 128; 1950: 2; 1953: 20; Whitley, 1956a: 34; Munro, 1957b: 15; Scott, 1966: 247; Frankenberg, 1966a: 162; 1966b: 28; 1966c: 22; Lynch, 1966: 14; 1967: 20; Dixon, 1972: 121; McDowall, 1973b: 94; Andrews, 1973: 105; Lake, 1971: 20; Lynch, 1974: 15; Green, 1974: 3; Frankenberg, 1974: 123; Lake, 1974: 449; Andrews, 1976: 331 *(partim).*

Querigalaxias dissimilis — Whitley, 1935: plate III.

Paragalaxias dissimilis — Stokell, 1950: 2; 1953: 50; Whitley, 1956a: 34; 1956b: 39; 1957a: 6; Munro, 1957b: 15; Whitley, 1964: 35; Lake, 1971: 20; McDowall, 1973b: 94; McDowall and Fulton, 1978a: 95; 1978b: 664; Lake, 1978: 26.

TAXONOMY: Stokell (1950) first proposed that *P. shannonensis* is a junior synonym of *P. dissimilis,* but Scott (1966) rejected this, suggesting, in particular, that the dorsal fin is in front of the pelvic fins in *P. dissimilis* but behind in *P. shannonensis*. Study of material identifiable with *P. shannonensis* from Great Lake, Tasmania, indicates that Stokell is probably correct, and we follow Stokell (1950) in regarding *P. shannonensis* as a junior synonym of *P. dissimilis* (see McDowall and Fulton, 1978a).

DIAGNOSIS: Characterised by large dorsal fin above pelvic fins, very large laterosensory pores on head, and long gill rakers. The large pores and long rakers distinguishing it from all other species of *Paragalaxias.*

Differs from *P. eleotroides* in having a somewhat shorter and more forked tail (S.L./T.L. ratio higher), a higher predorsal/preanal ratio, a shorter-based dorsal fin, a broader interorbital (Table 20), and in having 15 principal caudal rays, more and longer gill rakers, and more vertebrae (Table 19). There are two pores on each side below the lower jaw (submandibular) in *P. dissimilis,* none in *P. eleotroides* (Fig. 47).

Differs from *P. mesotes* in having a longer dorsal fin base, larger pectoral fins (Table 20), and in having more dorsal fin rays, gill rakers, and vertebrae (Table 19). *P. dissimilis* regularly has two, large, well-separated submandibular laterosensory pores,

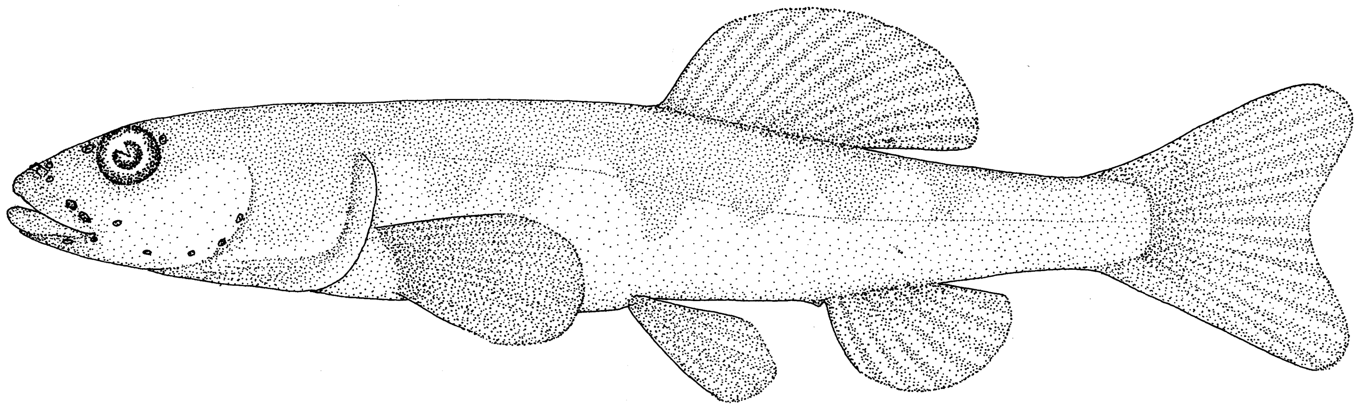

Fig. 38. *Paragalaxias dissimilis* (Regan); Great Lake, Tas. 57 mm L.C.F.

while *P. mesotes* usually lacks such pores — if present they are small and close together.

Differs from *P. julianus* in having a much longer dorsal fin base, much bigger pectoral and pelvic fins, a longer head (Table 20), and in having more dorsal fin rays, pelvic fin rays and gill rakers (Table 19). In *P. dissimilis* the opening of the anterior interorbital laterosensory pores is confluent with the posterior nostril but in *P. julianus* the two openings are well separated (Fig. 47).

DESCRIPTION: A small, stout, bullet-shaped species, the trunk rounded in section, the back and belly moderately and evenly arched; depressed anteriorly on head, and somewhat compressed behind vent. Caudal peduncle long and slender, much longer than deep. Head long, flattened, about as broad as deep. Snout long, broad and flattened. Mouth large, moderately oblique, extending back to or a little beyond anterior eye margin; jaws about equal in length. Eyes of moderate size with upper margin at about head profile, inter-orbital broad and flat. Jaws without enlarged canine teeth. Gill rakers long and slender (Fig. 44). Pyloric caeca lacking (Fig. 46).

Open pores on head very large, particularly those above upper jaw. Disposition of pores as shown in Fig. 47. Only four pores in preopercular series; opening of pore adjacent to posterior nostril with a visible partition between pore and nostril; two well-separated sub-mandibular pores.

Fins well developed. Some thickening at bases of dorsal and anal fins. Dorsal fin inserted at about pelvic fin origin, distinctly behind midpoint of standard length, fin high and quite long-based, and extending well back behind fin base; anal fin much smaller, short-based, origin below rear of dorsal fin. Pectoral fins large, inserted low lateroventrally. Pelvic fins also quite large, inserted distinctly behind midpoint of standard length. Caudal fin forked, fin lobes rounded, fin depth about equal to body depth; peduncle flanges well developed but not extending far forward on caudal peduncle.

Variation: meristic: see Table 19;
morphometric: see Table 20.

COLOUR: Colour in life highly variable and relating to substrate colour; often very dark green-grey to almost black, varying to olive-brownish. The sides are traversed by indistinct to quite bold grey-black blotches which are confluent with the darker colouration of back. There is olive-gold iridescence on the opercula and belly and the eyes are golden. The fins are olive coloured and unmarked.

In preservative a dull grey-black on the top and sides of the head and on the back, this darker colour extending down on to the sides as broad bands which alternate with the paler grey of the lower sides and belly, or often about six dark grey oval spots or blotches.

SIZE: *P. dissimilis* was described from a holotype 75 mm L.C.F. (65 mm S.L.); no further examples this large are known; the largest seen in this study was 72 mm L.C.F. (62 mm S.L.); the species commonly exceeds 50 mm L.C.F.

NATURAL HISTORY: *P. dissimilis* is a lacustrine species, and is not known in streams flowing into lakes except for some taken at the edge of a short section of stream connecting Great Lake and Shannon Lagoon (Scott, 1935). It is usually found amongst rocks around the margins of lakes, often in only a few centimetres of water; however, it may be taken from amongst both dead and living vegetation and beneath planks, sheets of iron and from inside cans. Small examples have been taken in dredge samples at

Table 19. Meristic variation in *Paragalaxias* species.

		P. dissimilis	*P. eleotroides*	*P. mesotes*	*P. julianus*
Dorsal rays	9			1	3
— segmented	10			6	15
	11			10	2
	12		1	6	
	13	17	12		
	14	9	7		
total	10			1	4
	11			5	14
	12			11	2
	13		1	6	
	14	11	11		
	15	9	7		
	16		1		
Anal rays	6		3		
— segmented	7	1	16	3	12
	8	13	1	18	8
	9	7		2	
total	7		3		1
	8	1	16	3	13
	9	12	1	18	6
	10	7		2	
Caudal rays	13		1		
— principal	14	1	19		1
	15	20		23	19
Pectoral rays	11				1
	12	1			4
	13	15	11	4	10
	14	5	9	15	5
	15			5	
Pelvic rays	5		1		20
	6	21	19	23	
Vertebrae	37		3		
	38		19		
	39		2		
	40		1	9	2
	41	3		14	15
	42	34			12
	43	10			3
	44	1			
Gill rakers	9		10		
	10		9		
	11		0		
	12		1	3	6
	13			7	9
	14			10	4
	15	1		3	1
	16	9			
	17	12			
	18	3			

Table 20. Morphometric variation in *Paragalaxias* species. Figures are given as percentages of denominator in ratios.

	P. dissimilis				*P. mesotes*				*P. eleotroides*				*P. julianus*			
	Min.	Mean	Max.	S.D.	Min.	Mean	Max.	S.D.	Min.	Mean	Max.	S.D.	Min.	Mean	Max.	S.D.
Standard length/Total length	85.6	87.25	89.7	1.16	87.1	88.64	90.9	1.24	82.1	84.63	86.8	1.13	87.2	88.52	90.5	1.07
Body length at vent/Standard length	12.8	13.89	15.2	0.58	12.5	13.62	14.8	0.63	11.9	13.25	14.4	0.66	11.6	12.81	13.9	0.66
Length of caudal peduncle/Standard length	18.4	19.62	21.4	0.78	17.2	18.72	20.7	1.00	18.5	20.67	23.1	1.12	19.2	20.93	22.2	0.89
Depth of caudal peduncle/Length of peduncle	43.7	48.41	54.1	2.81	38.2	48.31	55.0	3.61	39.4	45.24	52.2	3.42	40.0	44.90	50.0	2.62
Predorsal length/Standard length	55.7	57.56	59.5	1.04	58.0	59.60	61.6	0.91	53.5	55.07	57.0	1.04	57.5	58.74	60.9	0.89
Predorsal length/Pre anal length	78.2	80.32	83.9	1.47	79.7	81.84	84.6	1.41	75.5	77.58	81.7	1.94	78.9	80.85	83.3	1.10
Length of dorsal fin base/ Standard length	18.0	19.37	20.7	0.82	12.9	14.84	17.8	1.12	19.6	23.10	25.4	1.46	12.3	14.48	16.4	1.17
Maximum length of dorsal fin/ Basal length	135.3	143.82	153.3	4.79	132.1	151.01	170.0	9.83	122.2	134.87	158.6	7.84	131.0	136.69	147.8	7.26
Length of anal fin base/ Standard length	7.9	9.98	11.7	0.96	8.6	9.67	10.7	0.65	8.2	9.57	12.0	1.06	8.4	9.42	10.7	0.76
Maximum length of anal/ Basal length	161.1	180.87	201.1	14.02	150.0	165.42	185.7	7.71	153.3	187.3	218.2	19.36	138.9	154.64	171.4	10.21
Pectoral fin length/ Pectoral-pelvic length	77.4	72.93	100.0	6.53	56.4	64.90	76.7	6.75	60.9	77.26	92.1	7.25	48.4	57.00	66.7	5.19
Pelvic fin length/Pelvic-anal length	60.9	88.00	91.8	5.64	63.8	75.35	88.5	7.40	67.7	81.13	88.9	6.35	57.1	67.05	82.8	7.57
Pre pelvic length/Standard length	54.2	56.77	59.0	1.24	54.9	56.49	58.7	1.07	52.3	53.95	56.2	1.24	53.6	55.97	57.6	1.05
Pectoral-pelvic length/ Standard length	25.6	27.61	30.5	1.40	25.0	28.11	30.2	1.39	25.7	28.06	31.6	1.47	28.0	29.65	32.5	1.22
Pelvic-anal length/Standard length	14.6	16.68	18.5	0.94	15.6	18.02	19.8	1.13	17.8	19.06	20.3	8.68	16.3	18.21	19.4	0.86
Head length/Standard length	29.5	30.57	32.0	0.72	28.2	29.96	31.8	0.88	25.3	27.93	30.0	1.27	27.2	28.67	29.8	0.77
Head width/Head length	50.0	52.84	59.3	2.92	53.1	56.41	62.3	2.33	52.9	58.79	68.8	3.94	55.7	59.92	63.2	2.55
Head depth/Head length	48.0	52.31	57.4	2.74	46.6	52.31	56.1	2.64	52.9	57.95	65.0	3.09	50.0	53.97	58.8	2.43
Snout length/Head length	30.6	33.48	37.1	1.70	28.6	31.90	34.7	1.42	31.4	33.76	37.5	1.56	31.6	34.57	37.5	1.47
Post orbital head length/Head length	48.3	52.08	57.4	2.64	50.0	53.79	60.0	2.69	50.0	55.26	60.00	3.11	50.0	53.04	58.0	2.21
Inter orbital width/Head length	28.0	31.10	35.2	1.91	28.8	31.86	36.4	1.98	23.5	27.52	31.6	2.97	30.1	33.81	36.6	2.03
Eye diameter/Head length	19.0	21.61	24.1	1.50	17.6	21.46	25.5	1.77	20.0	22.93	25.6	1.51	16.7	19.51	22.0	1.87
Length of upper jaw/Head length	35.9	38.01	41.1	1.63	33.3	36.67	39.7	1.68	28.2	34.88	39.6	2.60	34.4	37.10	40.0	1.67
Length of lower jaw/Head length	31.5	34.97	38.8	1.89	31.3	34.70	38.2	1.74	28.2	33.23	39.6	2.85	33.0	35.78	39.4	1.76
Width of gape/Head length	28.0	32.34	37.0	2.63	28.6	32.75	34.8	1.76	28.2	32.39	38.1	3.63	32.9	36.13	39.1	2.08
Number of fish measured		20				23				20				20		

depths of up to 10 m. Although it is a common species it is secretive during the day and is therefore seldom seen. When placed in an aquarium it is an active, mid-water swimming species and does not rest on the bottom as does *P. eleotroides*. It seems likely that it is most active during the night.

DISTRIBUTION: *P. dissimilis* is confined to the Central Plateau region of Tasmania, having been collected from Great Lake, Shannon Lagoon, the Shannon River connecting these two bodies of water, and Penstock Lagoon. The two lagoons are artificial impoundments downstream from Great Lake (Fig. 39).

Paragalaxias eleotroides McDowall and Fulton

Fig. 40

Paragalaxias shannonensis — Stokell, 1950: 3; Scott 1966: 247; Andrews, 1976: 332 (*partim* — non *Paragalaxias shannonensis* Scott, 1935: 41, a junior synonym of *P. dissimilis* (Regan, 1905: 383)).

Paragalaxias eleotroides — McDowall and Fulton, 1978a: 101 (holotype: TMH D.1259, seen; paratypes: (2) TMH D. 1261-2, seen; (2) QVML 1976.5.166 (type 213), seen; (6) AMS I. 19152-001, seen; (2) BMNH 1976.8.13:6-7, seen; type locality: shallow water along the shore of Swan Bay, Great Lake, Tasmania); 1978b: 664; Lake, 1978: 27.

TAXONOMY: The wide range of vertebral counts published by Stokell (1950) — viz. 37-44 — indicates that his samples contained both *P. dissimilis* and *P. eleotroides*. Andrews (1976) appears to have described only *P. dissimilis*, but figured *P. eleotroides*.

DIAGNOSIS: Characterised by dorsal fin above pelvic fins, stocky build, blunt head and steep snout profile, and truncate caudal fin.

Differs from *P. dissimilis* in characters discussed in the diagnosis of that species (p.570).

Differs from *P. mesotes* in having a longer and less forked tail (S.L./T.L. ratio higher), lower predorsal/S.L. and predorsal/preanal ratios, a much longer-based dorsal fin, somewhat larger pectoral and pelvic fins, a narrower interorbital (Table 20), and also in having only 14 principal caudal fin rays, fewer anal rays, gill rakers and vertebrae (Table 19); the gill rakers are much shorter in *P. eleotroides*.

Differs from *P. julianus* in having a much longer dorsal fin base, much larger pectoral and pelvic fins, a narrower interorbital and smaller eye (Table 20); also in having fewer dorsal fin rays, caudal fin rays and vertebrae, and more pelvic fin rays and gill rakers (Table 19). Whereas *P. eleotroides* has no submandibular laterosensory pores and has the anterior interorbital pore confluent with the posterior nostril, in *P. julianus* there are two pairs of submandibular pores, and the anterior interorbital pore is well separated from the posterior nostril.

DESCRIPTION: A small, stout-bodied species, the trunk rounded in section, the belly rather flattened and the back more arched; depressed anteriorly on head and somewhat compressed behind vent. Caudal peduncle long and slender, much longer then deep. Head of moderate length, somewhat flattened ventrally, profile of snout moderately steep, snout blunt, cheeks broadening a little below eyes. Mouth scarcely oblique, of moderate size, extending back to about front of eyes, jaws about equal. Eyes moderate, upper margin at head profile, interorbital of moderate width, flat. Jaws without enlarged canines; gill rakers very short and stout (Fig. 44). Pyloric caeca lacking (Fig. 46). Open pores on head small; disposition as shown in Fig. 47. Five pores in

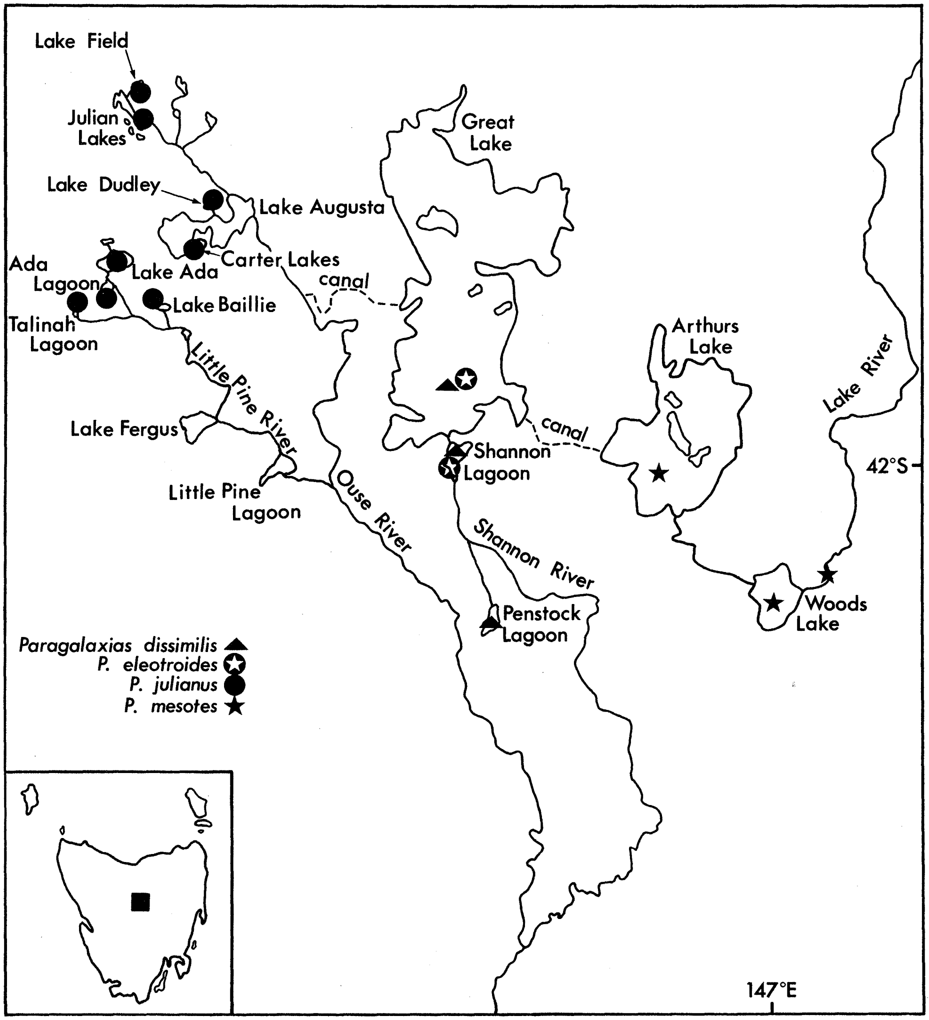

Fig. 39. Distribution of *Paragalaxias* species.

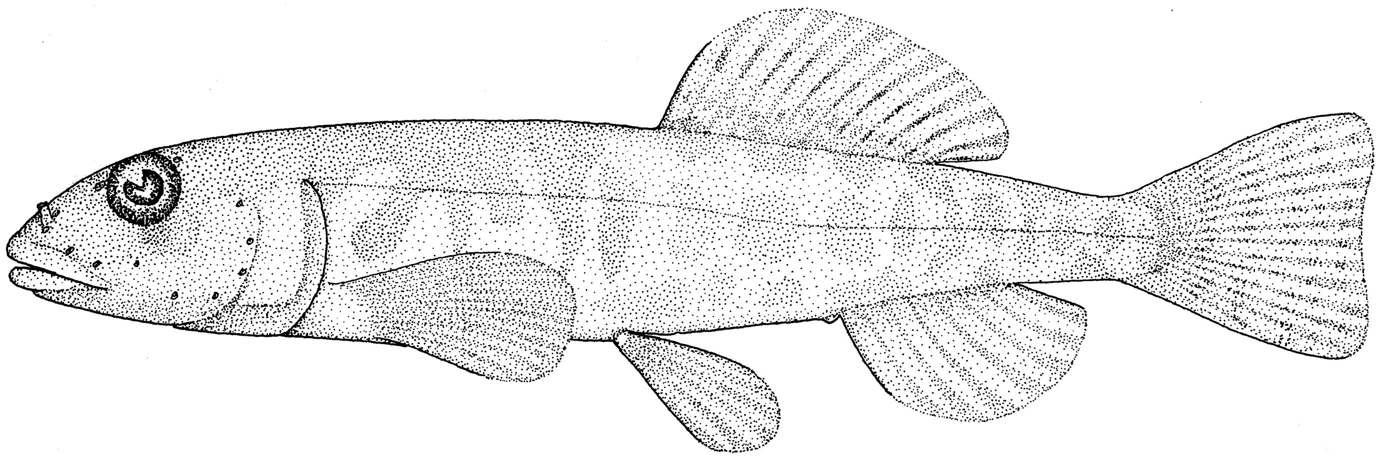

Fig. 40. *Paragalaxias eleotroides* McDowall and Fulton; Great Lake, Tas. 50 mm L.C.F.

preopercular series; opening of pore adjacent to posterior nostril without a visible partition between pore and nostril; no submandibular pores.

Fins well developed, little basal thickening. Dorsal fin inserted at about pelvic fin bases, distinctly behind mid-point of standard length, fin long-based, moderately high and rounded, and extending somewhat back beyond fin base; anal fin much smaller than dorsal, origin below rear of dorsal. Pectoral fins large, inserted low lateroventrally; pelvic fins also quite large, inserted distinctly behind mid-point of standard length. Caudal fin truncate to emarginate, fin tips rounded, fin depth less than body depth; peduncle flanges weak.

Variation: meristic: see Table 19.
morphometric: see Table 20.

COLOUR: Colour in life light brown-gold with no obvious bands, but irregular and diffuse blotching and speckling on sides and over back. Eye golden. Fins amber to olive with quite distinct black blotches along fin rays.

In preservative the fish are contrasting dark grey and pale grey-white, the back with dark patches, these spreading on to the sides as smaller and more fragmented patches, with a tendency for there to be a mid-lateral series of dark patches. The belly is greyish-white.

SIZE: *P. eleotroides* is a small species reaching only 59 mm T.L. (51 mm S.L.); it commonly reaches 40 mm T.L.

NATURAL HISTORY: *P. eleotroides* was collected from shallow water at the rocky margins of Great Lake, which seems to be its favoured habitat; it was also taken from amongst marginal aquatic vegetation and dead terrestrial scrub inundated by a rise in lake level, beneath planks, sheets of iron and from inside cans, as well as in dredge samples from depths of up to 10 m. It is secretive in habit and is seldom seen. As the name of the species implies there are similarities to eleotrids, both in general appearance, the darting, benthic habits, and also the habit of remaining at rest on the bottom with the anterior part of the body slightly elevated and supported by the pectoral fins (c.f. pelvic fins in eleotrids). When placed in an aquarium it remains on or close to the bottom at nearly all times.

DISTRIBUTION: *P. eleotroides* has restricted distribution in the Central Plateau of Tasmania, at present being known only from Great Lake and Shannon Lagoon (Fig. 39).

Paragalaxias mesotes McDowall and Fulton
Fig. 41

Paragalaxias shannonensis — Scott, 1966: 247; Andrews, 1976: 332 (*partim* — non *Paragalaxias shannonensis* Scott, 1935: 41, a junior sysnonym of *P. dissimilis* (Regan, 1905: 383)).

Paragalaxias mesotes McDowall and Fulton, 1978a: 103 (holotype: TMH D.1260, seen; paratypes: (3) TMH D.1263-5, seen; (3) QVML 1976/5/167 (type 214), seen; (6) AMS I.19151-001; seen; (2) BMNH 1976.8.13:4-5, seen; type locality: amongst rocks around the shore near pumping station at Arthurs Lake, Tasmania); 1978b: 664; Lake, 1978: 28.

DIAGNOSIS: Characterised by bullet-shaped form, smallish dorsal fin above pelvic fins, and bold coloration.

Differs from *P. dissimilis* and *P. eleotroides* in features discussed in diagnoses of these two species (pp.570 and 575 respectively).

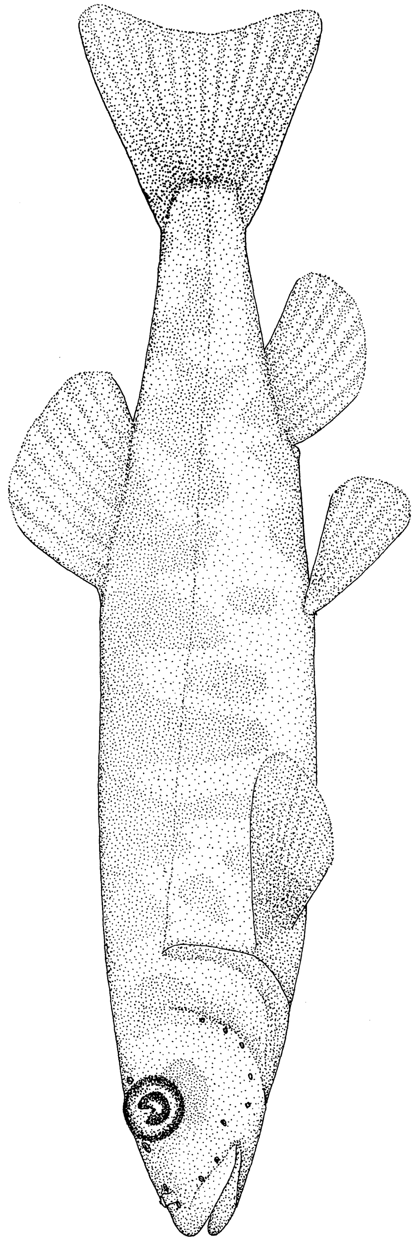

Fig. 41. *Paragalaxias mesotes* McDowall and Fulton; Arthurs Lake, Tas. 66.5 mm L.C.F.

Differs from *P. julianus* in having much longer gill rakers, in usually lacking submandibular laterosensory pores, and in having the opening of the anterior interorbital pores confluent with the posterior nostril (pore and nostril well separated in *P. julianus*).

DESCRIPTION: A small, stout species, the trunk rounded in section, somewhat flattened ventrally, the back more arched; depressed anteriorly on head, compressed behind vent. Caudal peduncle long and slender, length much greater than depth. Head long, ventrally flattened, dorsal profile sloping to a blunt point. Snout long. Mouth large, slightly oblique, extending back to or a little beyond anterior eye margin, jaws about equal in length. Eyes of moderate size, upper margins at head profile or projecting slightly above, interorbital flat to slightly concave. Jaws without enlarged canine teeth. Gill rakers moderately long, slender (Fig. 44); pyloric caeca lacking (Fig. 46).

Open pores on head small; disposition as shown in Fig. 47, somewhat variable, particularly the series above and below jaws. Five pores in preopercular series; opening of pore adjacent to posterior nostril with a visible partition between pore and nostril; usually no submandibular pores, but irregularly on one side or both there may be one pore, or two closely adjacent pores.

Fins well developed. Dorsal fin inserted somewhat behind pelvic fin bases and distinctly behind mid-point of standard length; fin rounded and short-based, and extending back well beyond fin base; anal fin much smaller, originating below rear of dorsal fin. Pectoral fins of moderate size, insertion low lateroventrally. Pelvic fins also of moderate size, inserted distinctly behind mid-point of standard length. Caudal fin slightly forked to emarginate, fin tips rounded, fin depth somewhat less than body depth; peduncle flanges well developed but not extending far forwards on caudal peduncle.

Variation: meristic: see Table 19.
morphometric: see Table 20.

COLOUR: Colour in life very bold dark greenish-grey on the back, this colour spreading down sides as irregular bands that become fragmented into isolated patches; paler trunk colour grey to olive-gold, belly silvery-grey; head olive-grey and eyes golden; fins amber with some darker colouration along the fin rays.

In preservative very boldly contrasting grey and creamish white; smaller specimens have more irregular and fragmented markings closely resembling *P. eleotroides*.

SIZE: *P. mesotes* reaches a known length of 73 mm L.C.F. (65 mm S.L.) and not uncommonly exceeds 60 mm L.C.F.

NATURAL HISTORY: *P. mesotes* in Arthurs Lake is much less common than the species of *Paragalaxias* in Great Lake. It has been collected mostly from the cover of man-made rock piles at construction sites; it was taken rarely from amongst aquatic weeds which bordered the rocky areas, although it seems likely that it would move into these areas to feed, perhaps at night. It was not collected from streams entering the lakes, although two small specimens were taken from the upper part of Lake River at a time when the river was not flowing.

DISTRIBUTION: *P. mesotes* is known only from the eastern part of the Central Plateau of Tasmania, from Arthurs Lake, Woods Lake and the Lake River below the Woods Lake dam (Fig. 39).

Paragalaxias julianus McDowall and Fulton
Fig. 42

Paragalaxias julianus McDowall and Fulton 1978b: 660 (holotype: TMH D.1327, seen; paratypes: (4) TMH D.1328-1331, seen; (3) QVML 1978.5.76-78, (types 255-257) seen; (4) AMS I.20276-001-20278-001, seen; (2) BMNH 1978.6.1:2-3 seen; (5) FRD unregistered, seen; type locality: from amongst rocks around the shores of Lake Field, Julian Lakes, Tasmania).

DIAGNOSIS: Characterised by bullet-shaped form, dorsal fin high on back above pelvic fins, very short gill rakers, and two submandibular laterosensory pores. Differs from all other *Paragalaxias* in having the anterior interorbital pore well separated from the posterior nostril; from *P. dissimilis*, *P. eleotroides* and *P. mesotes* also in features listed in the diagnoses of these three species (pp. 570, 575, and 578 respectively).

DESCRIPTION: A small, stout species, the trunk rounded in section, somewhat flattened below but the back a little more arched; depressed anteriorly on head, compressed from above vent. Body deepest at about mid-way between pectoral and pelvic fins and tapering to the caudal peduncle which is long and slender, its length much greater than its depth. Head long, flattened below, snout long, bluntly pointed. Mouth large, only slightly oblique, reaching back to about anterior margin of eye, the jaws about equal in length, lips thick and fleshy. Eyes of moderate size, upper margins often projecting above upper head profile; interorbital broad, flat to slightly concave. Jaws without enlarged canine teeth laterally. Gill rakers very short, little more than stubs (Fig. 44). No pyloric caeca (Fig. 46).

Open pores on head small; disposition as shown in Fig. 47. Five pores in preopercular series; opening of anterior interorbital pore well separated from posterior nostril; two submandibular pores on each side.

Fins well developed. Dorsal fin inserted a little behind pelvic fin insertion and well behind mid-point of standard length; dorsal fin short-based and rounded, extending back well beyond fin base; anal fin much smaller, origin below or a little behind rear of dorsal fin. Pectoral fins small, fan-shaped, inserted low lateroventrally. Pelvic fins also small, inserted distinctly behind mid-point of standard length. Caudal fin slightly to moderately forked, fin tips rounded, fin depth somewhat less than greatest depth; peduncle flanges moderately developed.

Variation: meristic: see Table 19.
morphometric: see Table 20.

COLOUR: In life brownish to black-olive, markings varying from broken irregular patches to distinct and bold bars or reticulations, the background colour a yellowish-olive; belly a silvery-olive. Intensity and hue of colouration varies with colour of substrate. In preservative boldly contrasting dark grey and greyish-white.

SIZE: *P. julianus* is known to reach at least 99 mm L.C.F. (88.5 mm S.L.) and commonly exceeds 60 mm L.C.F.

NATURAL HISTORY: *P. julianus* was abundant amongst and beneath rocks on the beds of the lakes, particularly where the rocks were lying spaced apart on a gravelly substrate; less common amongst piles of rocks, where *Galaxias truttaceus* (Valenciennes) and *G. brevipinnis* Günther were much more abundant.

DISTRIBUTION: *P. julianus* is known from Lake Field, one of the uppermost lakes in the Julian Lakes system, from the main series of lakes in the system, which flow via the

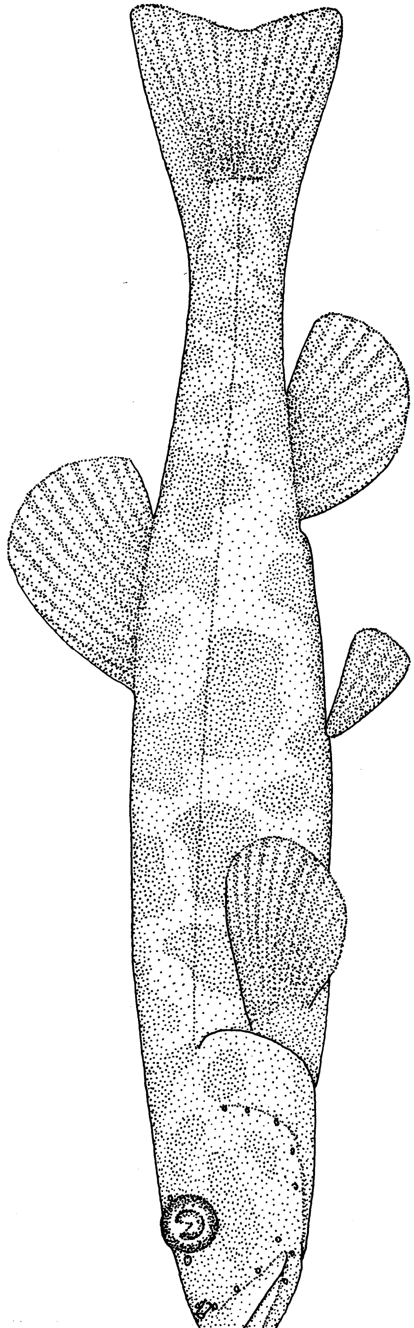

Fig. 42. *Paragalaxias julianus* McDowall and Fulton; Lake Field, Tas. 70.5 mm L.C.F.

Ouse River into Lake Augusta, from Carters Lake, from Lake Dudley which drains directly into Lake Augusta and from Ida and Talinah Lagoons and Lake Ada in the upper reaches of Little Pine River (Fig. 39). No attempt was made to sample Lake Augusta itself. This lake drains naturally via the Ouse River to ultimately join the Shannon River. (The Shannon RIver drains Great Lake, and finally joins the Derwent River). However, Lake Augusta water has been diverted, via the Liaweenee Canal, into Great Lake, where *P. dissimilis* and *P. eleotroides* are present. *P. julianus* does not yet seem to have made its way down the canal into Great Lake.

SUMMARY

The family Galaxiidae includes 20 species in the Australian region, in three genera (*Galaxias* Cuvier, *Galaxiella* McDowall, and *Paragalaxias* Scott).

1. *Galaxias brevipinnis* Günther: (synonyms in general, recent usage include *G. coxii* Macleay, *G. weedoni* Johnston, *G. parkeri* Scott); known in coastal flowing rivers from central New South Wales (just north of Sydney), to eastern South Australia (near Adelaide), and widely in Tasmania; also present in New Zealand, Chatham, Auckland and Campbell Islands; a diadromous species with numerous landlocked populations, particularly in Tasmania.

2. *Galaxias olidus* Günther: (syn *G. schomburgkii* Peters, *G. ornatus* Castelnau, *G. bongbong* Macleay, *G. findlayi* Macleay, *G. kayi* Ramsay and Ogilby, *G. oconnori* Ogilby, *G. fuscus* Mack); known widely in moderate to high elevation rivers in the mountains of eastern New South Wales, Victoria and southeastern South Australia; confined to fresh water.

3. *Galaxias johnstoni* Scott: known only from Clarence Lagoon in the highlands of Tasmania; confined to fresh water.

4. *Galaxias pedderensis* Frankenberg: known from the Lake Pedder region, southwestern Tasmania; confined to fresh water.

5. *Galaxias fontanus* Fulton; newly described from the Swan River, eastern Tasmania; confined to fresh water.

6. *Galaxias truttaceus* Valenciennes: (syn. *G. occellatus* McCoy, *G. scopus* Scott, *G. truttaceus hesperius* Whitley); known from southern coasts of eastern and western Australia and widely in Tasmania; a diadromous species with landlocked populations in Tasmania.

7. *Galaxias auratus* Johnston: known from Lakes Sorell and Crescent in the highlands of Tasmania; confined to fresh water.

8. *Galaxias tanycephalus:* known only from Arthurs Lake in the highlands of Tasmania; confined to fresh water.

9. *Galaxias cleaveri* Scott: (syn. *Saxilaga anguilliformis* Scott, *G. upcheri* Scott); known from low elevation localities in northern, western and southeastern Tasmania; confined to fresh water.

10. *Galaxias parvus* Frankenberg: known from Lake Pedder and tributaries, and the upper Huon River, Tasmania; confined to fresh water.

11. *Galaxias maculatus* (Jenyns): (syn. *G. attenuatus* (Jenyns), *G. obtusus* Klunzinger, *G. parrishi* Stokell, *G. maculatus ignotus* Stokell); known in coastal flowing streams from southern Queensland to eastern South Australia, in southwards flowing

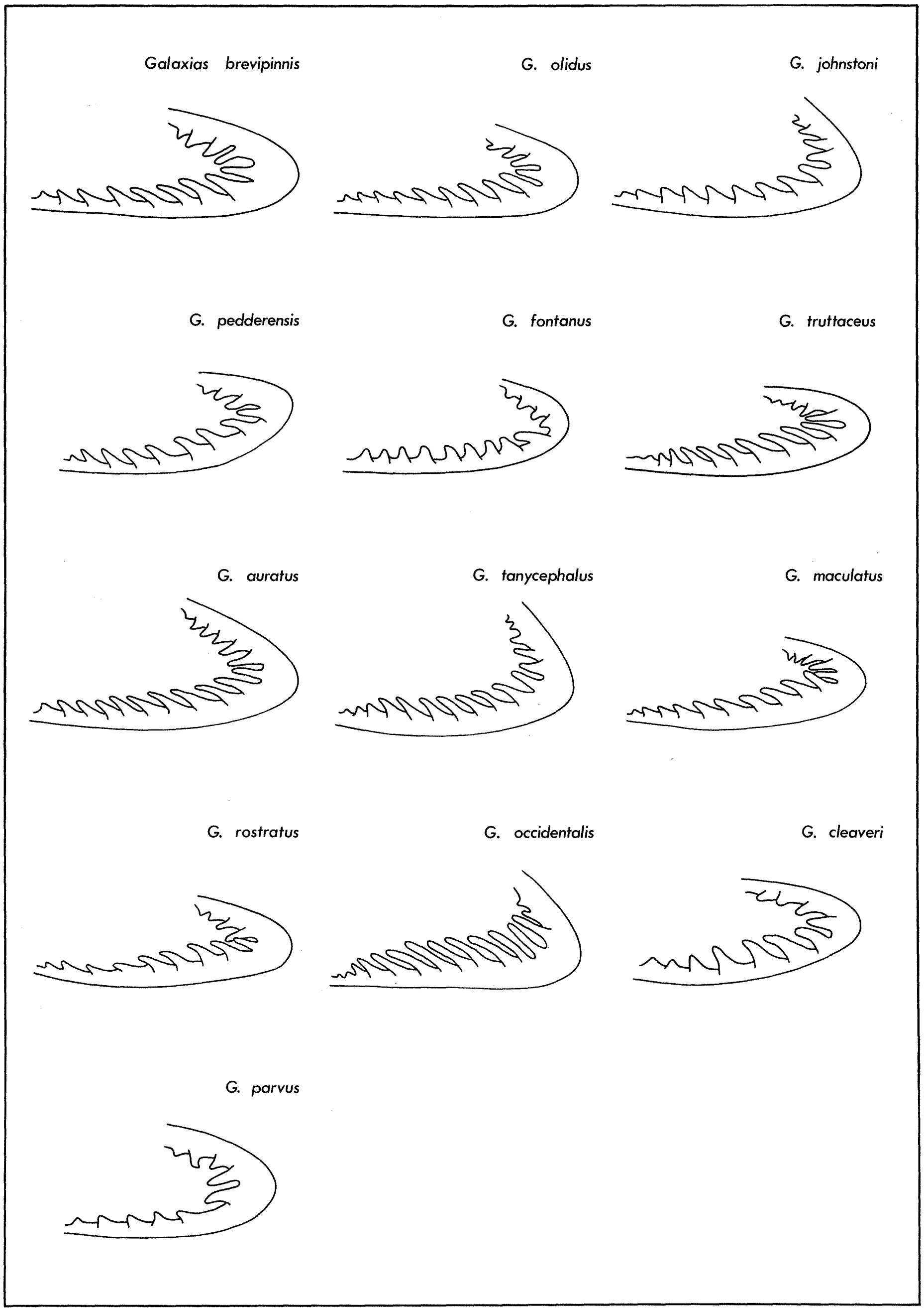

Fig. 43. Length of gill rakers in Australian *Galaxias* species.

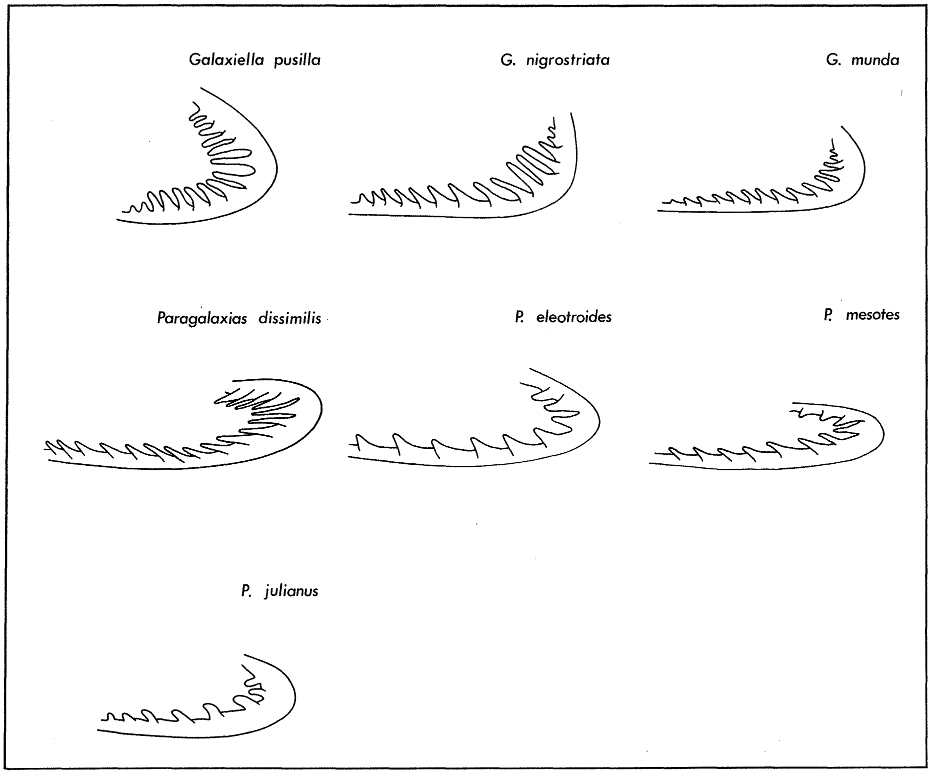

Fig. 44. Length of gill rakers in *Galaxiella* and *Paragalaxias*.

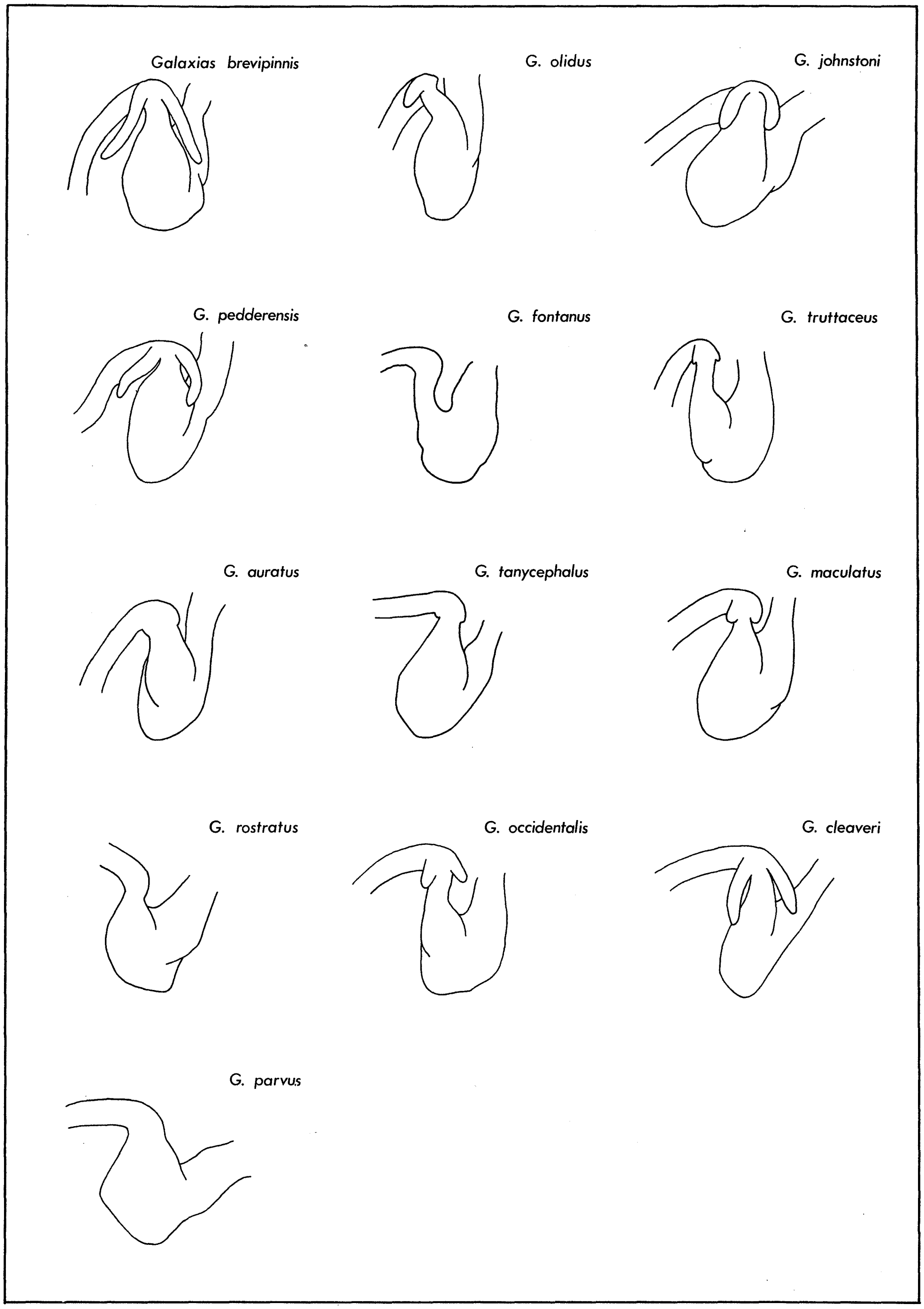

Fig. 45. Length of pyloric caeca in Australian *Galaxias* species.

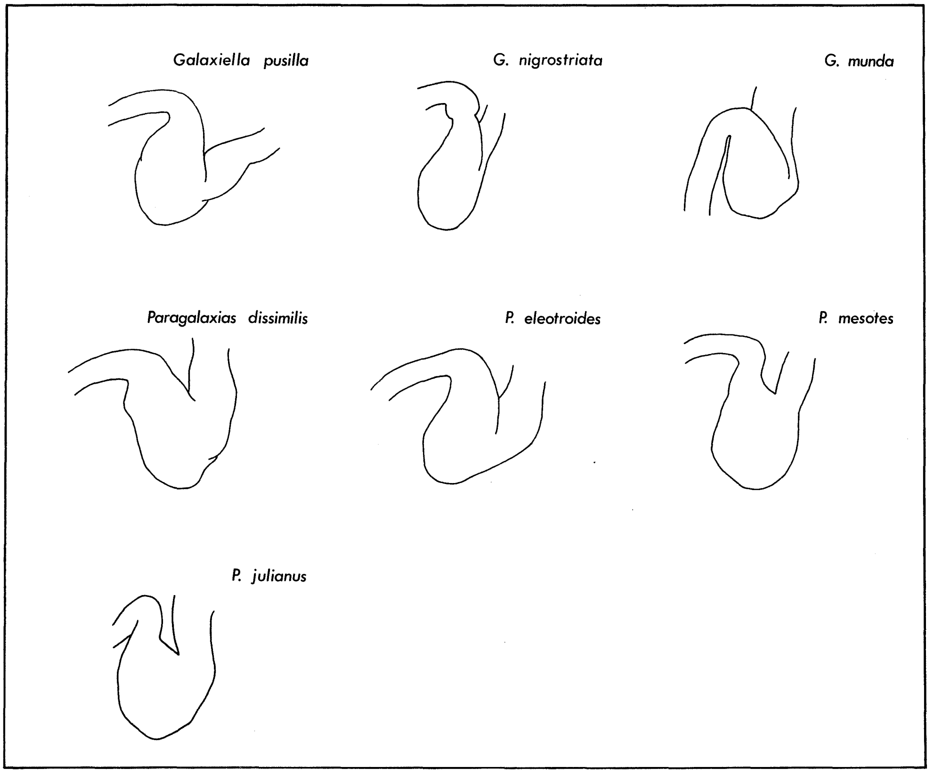

Fig. 46. Length of pyloric caeca in *Galaxiella* and *Paragalaxias*.

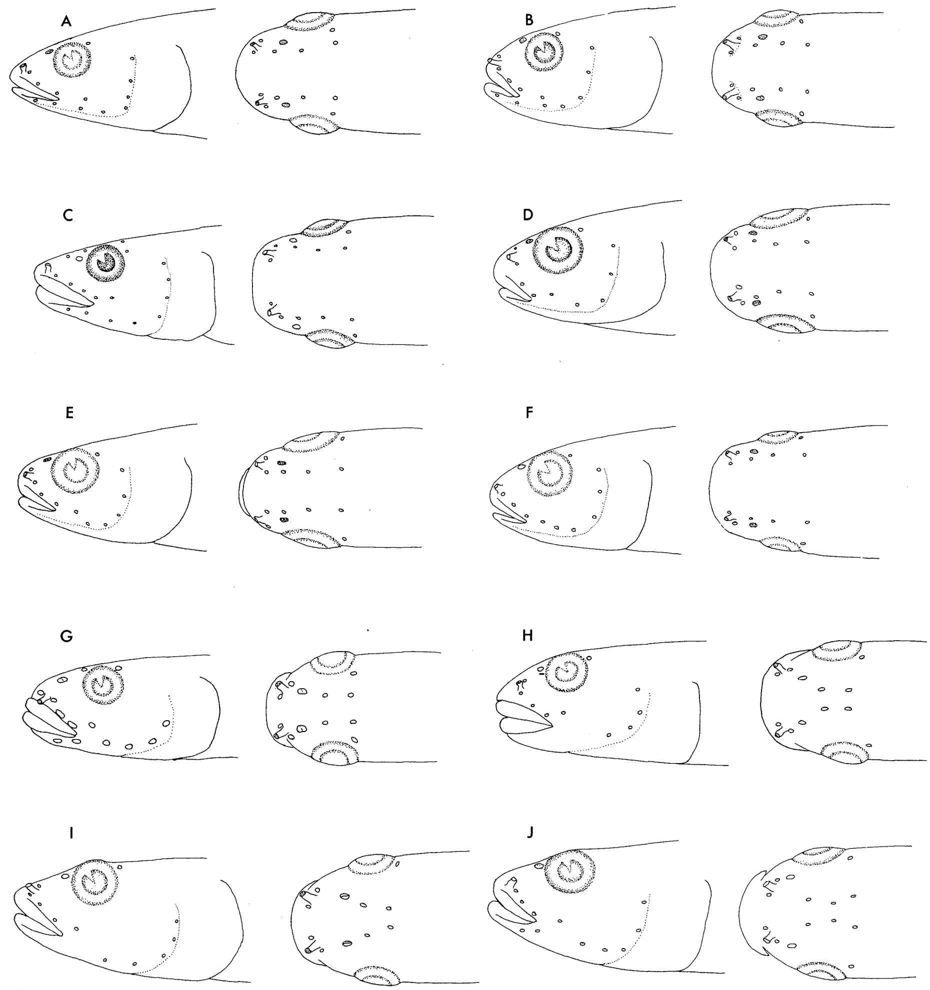

Fig. 47. Disposition of laterosensory pores in Australian galaxiid species. **a** most *Galaxias* spp (*Galaxias auratus* illustrated); **b.** *G. parvus;* **c.** *G. fontanus;* **d.** *Galaxiella pusilla;* **e.** *G. munda;* **f.** *G. nigrostriata;* **g.** *Paragalaxias dissimilis;* **h.** *P. eleotroides;* **i.** *P. mesotes;* **j.** *P. julianus.*

streams in Western Australia and widely in Tasmania; also occurs in Lord Howe Island, New Zealand, the Chathams, southern South America and the Falkland Islands; a diadromous species with numerous landlocked populations.

12. *Galaxias occidentalis* Ogilby: known in Western Australia from north of Perth, south and east towards Albany; confined to fresh water.

13. *Galaxias rostratus* Klunzinger: (syn. *G. planiceps* Macleay); known only in the Murray-Darling River system; confined to fresh water.

14. *Galaxiella pusilla* (Mack): (syn. *Brachygalaxias pusillus* (Mack), *B. pusillus pusillus* (Mack), *B. pusillus tasmaniensis* Scott, *B. pusillus flindersiensis* Scott); known in southeastern Australia from Gippsland west into eastern South Australia and in northern Tasmania; confined to fresh water.

15. *Galaxiella nigrostriata* (Shipway): (syn. *Brachygalaxias nigrostriatus* Shipway, known in Western Australia on the south coast between about Albany and Esperance; confined to fresh water.

16. *Galaxiella munda* McDowall: recently described from Western Australia where it is present in the far southwest (north of Perth to about Albany); confined to fresh water.

17. *Paragalaxias dissimilis* (Regan): (syn. *P. shannonensis* Scott); known from Great Lake, Shannon Lagoon and Penstock Lagoon in the highlands of Tasmania; confined to fresh water.

18. *Paragalaxias eleotroides* McDowall and Fulton: recently described from Great Lake and Shannon Lagoon in the highlands of Tasmania; confined to fresh water.

19. *Paragalaxias mesotes* McDowall and Fulton: recently described from Arthurs Lake and Woods Lake in the highlands of Tasmania; confined to fresh water.

20. *Pargalaxias julianus* McDowall and Fulton: newly described from the Julian Lakes and Lake Dudley in the highlands of Tasmania; confined to fresh water.

Although this revision is concerned primarily with the systematics of the Australian Galaxiidae, knowledge of the natural history of these fishes is briefly reviewed.

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APPENDIX 1
Material examined

Samples of galaxiid fishes listed below include samples from which morphometric and/or meristic data were taken, the data being presented in tables 1-20. The amount of data and the number of characters examined varies widely, from just a pelvic fin ray count to measurements and counts of all characters considered in the evaluation and distinguishing of species. When available, registration numbers for the samples are given, together with locality, repository of samples, and the number and length-range of specimens examined (all lengths, length to caudal fork in mm).

A detailed list of all material examined to ascertain distribution patterns of Australian galaxiids is available from the authors. A copy of this list has also been deposited in the Fish Department of the Australian Museum.

Galaxias brevipinnis Günther: New South Wales — Ourimbah Creek, (7 specimens 62.5-182 mm L.C.F.) AMS IB.747-8; Linden, Blue Mountains, (1, 163) AMS I.10429; Rivulet of Colo River, Mount Wilson, Blue Mountains, (12, 129.5-174) AMS I.8062-

8094; Gerringong Creek, Kangaroo Valley near Mossvale, (20, 111-152), AMS I.16930, AMS I.19035-001; South Australia — Tappanappa and Rocky River, Kangaroo Island, (7, 92-134) SAM F.2646, F.2672; Morialta Gorge, (5, 107.5-129) SAM F.1116; Yattalunga River, Cape Jervis, (1, 178) NMVM-; Victoria — Scrubby Creek cave 0.5 km from mouth, Buchan River (2) NMVM-; cave near Nowa Nowa, (1), NMVM-; Refuge Cove Creek, Wilsons Promontory, (2), FWDV-; Good Hope Creek, northeast Gippsland, (1) FWDV; Turtons Creek, (1) FWDV-; Lang Lang River, Heath Hill, (2) FWDV-; Henderson Creek, George River, (8, 79.5-152) NMVM-; Erskine River, Otway Range, (7, 113.5-170) NMVM 414-423; below Eucumbene Dam, Snowy River, (1, 200 mm) AMS I.17331; Lake Tarli Karng, Vic. (4) NMVM A.408-11; Tasmania — Samphire Creek about 1.5 km southeast of Strzelecki Peaks and Rhodes Creek, 11 km from Whitemark on road to Locotta, Flinders Island (7, 108.5-156.5) NMVM-; Dove River, Cradle Valley, (11) QVML-; Lake King William, (9) collection of E.O.G. Scott; Pine Creek, (17) TIFC-; Great Lake, (10, 63-106) FRD-.

Galaxias olidus Günther: Queensland — Condamine River, Warwick District, AMS IB.3777-8; Accommodation Creek, Severn River, Wallangara, (10, 62-83.5) AMS I.12440-8; New South Wales — Tenterfield, (10, 55.5-69.5) AMS I.17925; Anne River (10, 55.5-63) AMS I. 18913-001; Condobolin, Lachlan River (7, 49.5-95.4) AMS IB.2892; Lake Canobolas, Lachlan River, (10, 63-80.5) NSWSF-; Katoomba, (10, 47-62) AMS IB.3589, IB.5235; Towneys Creek, Anembo, Queanbeyan River (12), NMVM-; Burra Creek, Old London Bridge, Queanbeyan River, (15), NMVM-; creek 30 km from Brindabella Post Office on Rules Point Road, Goodradigbee River, (25) NMVM-; Happy Jacks Creek, Tumut River, N.S.W. (10, 70.5-87) AMS I.18874-001; Cockatoo Creek, 1.5 km north of Dundurrabin, Clarence River, N.S.W (4) NMVM-; Cordeaux Creek 3 km north of Berrima, Wollondilly River, (18) NMVM-; creek 5 km from Majors Creek on road to Tallaganda, Shoalhaven River, (7) NMVM-; Bells Creek 17.5 km south of Braidwood, Moruya River, (8) NMVM-; 1.5 km east of Delegate, Delegate River, (8) NMVM-; headwaters of Racecourse Creek, left branch above falls, Kiandra, Eucumbene River, (25) NMVM-; Australian Central Territory — Lake George, (11), NMVM-; Victoria — Cobungra River 1.5 km southeast of Mount Loch., Mitta Mitta River, (9) NMVM-; Middle Creek near Langfords Gap, Bogong High Plains, Mitta Mitta River, (11) NMVM-; tributaries of Pretty Valley Creek, Bogong High Plains, Kiewa River, (17) NMVM-; west branch of Kiewa River, (8) NMVM-; 1.5 km southwest of Tatra Inn, Mount Buffalo, Buckland River, (25) NMVM-; creek on Ovens Highway 27 km southeast of Wangaratta, Ovens River, (14) NMVM-; Scrubby Creek, near Alexandra, Goulburn River, (25) NMVM-; Strath Creek falls, 8 km southsouthwest of Strath Creek, Goulburn River, (25) NMVM-; tributary of McIvor Creek, 9.5 km from Tooboorac on road to Heatcote, Campaspe River, (13) NMVM-; Blackjack and Barker Creeks, Loddon River, (9) NMVM-; Smiggin Holes, Snowy River, (17) NMVM-; Mount Kosciusko, Snowy River, (25) NMVM-; Little Dargo River, Dargo High Plains, Mitchell River, (25) NMVM-; Shaws Creek, McAlister River, Benison High Plains, (13); Jerralong Creek, Latrobe River, Traralgon, (6) NMVM-; Clearwater Creek, Lerderderg Gorge, Werribee River, (12) NMVM-; Parker River above falls about 1.5 km from mouth, (7) NMVM-; Chapple and Charlies Creeks, near Lavers Hills, Gellibrand River, (15) NMVM-; Scotts Creek on Harraps Track, Glenelg River, Grampians, (9) NMVM-; Seymour Creek, Gellibrand River, Otways, (10, 78-107.5 mm) NMVM-; South Australia — First Creek, Waterfall Gully above falls, Torrens River, (25) SAM-; Myponga River above reservoir, (5) SAM; Fifth Creek, (6, 72-80 mm AMS I.5-7.

Galaxias johnstoni Scott: Tasmania — Clarence Lagoon, (2, 51-59.5) TMH D.1116, (3, 46-68) QVML 70, 71 (7, 50.5-86.5) AMS I.19593-001; (10, 48-98) FRD-.

Galaxias pedderensis Frankenberg: Tasmania — Stillwater Rivulet, Serpentine River, (5, 69.5-98) TMH D.1118; Swampy Creek, Upper Serpentine River, (4, 84-110.5) TMH D.1123; Hermit Creek, Hermit Valley, Upper Serpentine River, (10, 58.5-83.5) TMH D.1122; Serpentine River, (6, 57.5-102.5) TMH D.1121; Lake Pedder, near the mouth of the inflowing stream from Lake Maria (1) TMH D.941.

Galaxias truttaceus Valenciennes: Victoria — stream at Shelley Beach, (10, 85.5-168.5) AMS I.16985-003, I.16896-001; Growlers Creek on P.M.G. track to lighthouse, Wilsons Promontory, (9) NMVM-; Tasmania — Camp Creek, Currie Harbour, King Island (10, 87.5-145.0) NMVM-; Rhodes Creek, 11 km from Whitemark on road to Locotta (10, 86.5-119.5) NMVM-; Upper Scamandar and Wynyard, (25) NMVM-; Dover, Tas. (15) NMVM-; stream at Cox's Bight, (10, 91.0-145.0) NMVM-; Great Lake, (22, 67.0-133.5) FRD-; NMVM-; Western Australia — creek 4.5 km from Nanarup turn-off on road to Two Peoples Bay, Goodja River (7, 48.0-119.0), NMVM-; near Albany, (2, 64-67) AMS IB.280; Kalgan River above upper road bridge, (1, 119), AMS IB.1739; Creek flowing into Taylor Inlet, Nanarup (1) WAM P.2580.

Galaxias auratus Johnson: Tasmania — Lake Crescent, (20, 115.5-143.0) TMH D.1110.

Galaxias tanycephalus Fulton: Tasmania — Arthurs Lake, (20, 60-110.5) FRD-; TIFC-, AMS, I.19592-001, AMS I.19334-001, QVML 76/5/183, TMH D.1266, D.1267-9.

Galaxias cleaveri Scott: Tasmania — Punchbowl Creek, Tamar River, (3, 46.5-60.5) QVML 1975.5.558; Pieman River, (3, 60.5-80.0) QVML 1975.5.77; Queenstown, (8, 69.0-102.0) AMS IA.3488; Melaleuca, Port Davey, (6, 90.5-119.5) TMH D.1150; Esperance River, Dover, (1, 65) CSIRO B.229, (5, 63.0-101.5) TMH D.1149, (2, 47.0-73.5) TMH D.1148.

Galaxias parvus Frankenberg: Tasmania — Anabranch of Huon River 5 km south-southeast of HEC Hut, (12, 42.0-55.5) NMVM-; River below Trappes Hill, Lake Pedder, (9, 59.0-78.5) TMH

Galaxias maculatus (Jenyns): Diadromous Populations: New South Wales — St. Albans Common, Hawkesbury River, (9, 63.5-142.0) AMS I.18857-001; Gulpa Creek, Tuross River, (10, 95.5-150.0) AMS I.15857-001; Victoria — drain about 5 km along Denham Road from Rossiter Road, Kooweerup, (10, 82.0-119.0) NMVM-; streams on Wilson's Promontory, (10) NMVM-; Toomuc and Cardinia Creeks, (25) NMVM-; Browns Creek, 400 m upstream, Otway Range, (10, 63.5-122.0) FWD-; South Australia, — Port Lincoln, (10), SAM F.96; Port Macleay Jetty, (18) SAM F. 1102; Breakneck River, Flinders Chase, Kangaroo Island, (25) NMVM-; Tasmania — streams on Flinders Island (10) NMVM-; creeks northwest of Gladstone, (10, 72.5-98.0) AMS I.17579-002; Nelson River, (10, 83.5-100) AMS I.17587-002; Derwent River, Hobart, (1, 92), FRD-; Orielton Lagoon, (9, 71.0-114.5) FRD-; Huon River, (7, 78.5-113.0) FRD-; Lacustrine populations: New South Wales — Lake Windimere, Jervis Bay, (10, 60.0-89.0) AMS I.17444-002; Victoria — Lake Corangamite, (10, 67.5-102.0) AMS I.16989-009; Lake Modewarre, (10, 86.0-130.0) FRD-; Lake Bullen Merri, (10, 68.0-101.0) FRD-; Lake Colac, (10, 65.0-84.5) FRD-; Lake Purrumbete, (25) NMVM-; Wurdiboluc Reservior, (6) NMVM-; Lake Bongbong, (20) NMVM-; near Lake Wangery, (10) NMVM-; Western Australia — Pallinup River south of Formby, (12) WAM P.8042; Gairdner Lake, (10, 73.5-97.5) AMNH 33612; Fitzgerald River, (10, 68.5-125.5) AMNH 36616; Hammersly River 53 km from Ravensthorpe on road to Ongerup (25) NMVM-; Dalyup River 36.5 km from Esperance on road to Ravensthorpe, (15, 48.5-77.5) NMVM-; Shark Lake, near Esperance, (8) WAM P.8043-50; Dandy Creek, (17) NMVM.

Galaxias rostratus Macleay: New South Wales — Rankins Lagoon at Bathurst, (4, 104.0-116.0) MS I.16261-001; Victoria — Colbinabbin, (15, 83.0-110.0) NMVM —; Third Reedy Lake, near Kerang, (7) NMVM —.

Galaxias occidentalis Ogilby: Western Australia — Twin Swamps Reserve, Bickley, about 40 km northnortheast of Perth, (7) NMVM —; pool in upper Swan River 1.5 km north of Walanga, (10, 60.0-76.0) AMNH 31474; Blackwood River, 100 m down from Sues Road Bridge, (10, 69.0-109.5) AMNH 31477; pool 13.5 km south of Northcliffe on Windy Harbour Road, (10, 65.5-115.0) AMNH 31476; Shannon River at Shannon River Mill, (5) NMVM —; Waychinnicup Creek 11 km west of Cheyne Beach, (7) NMVM —; pool under bridge near Elleker turnoff at Marbellup (1) NMVM —.

Paragalaxias dissimilis (Regan): Tasmania — Great Lake, (20, 43.5-63.0), FRD —.

Paragalaxias eleotroides McDowall and Fulton: Tasmania — Great Lake, (20, 37.0-51.5) FRD —; AMS I.19152-001; QVML 1976.5.166; TMH D.1259, D.1261-2; BMHN 1976. 8.13:6-7.

Paragalaxias mesotes McDowall and Fulton: Tasmania — Arthurs Lake, (20, 41.0-69.0) FRD —; AMS I.19151-001; TMH D.1260, D.1263-5; QVML 1976.5.167; BMNH 1976.8.13:4-5.

Paragalaxias julianus McDowall and Fulton: Tasmania — Lake Field, (6, 41-62.5) TMH D.1327, TMH D.1328, AMS I.20276-001, QVML 1978/5/76, BMNH 1978.6.1:3, Julian Lakes, (6, 51-83.5), TMH D.1329-30, AMS I.20277-001, QVML 1978/5/77, BMNH 1978.6.1:2, FRD —, Lake Dudley, (18, 43.5-74), TMH D.1331, AMS I.20278-001, QVML 1978/5/77, FRD —.

Galaxiella pusilla (Mack): Victoria — drain flowing into Narracan Creek, La Trobe River system, (20, 24.0-34.0) FRD —; (7, 24.75-33.75), Cardinia Creek, (1, 25.75, 2 unmeasured), AMS IB 1999/3199; Eumeralla R, 5 km west of Yambuk, (1, 24.25) NMVM —; Tasmania — AMS I.17251; Blackman's Lagoon, (4, 24-25.75) FRD —.

Galaxiella nigrostriata (Shipway): Western Australia — small swamp 100 m E of Gledhow South Road on road to Elleker (1, 29.5) NMVM —; drain 100 m north of Elleker-Albany Road on Marbellup Road, (5, 24.5-34.75) NMVM —; Marbellup Creek, Elleker, (2, 26.5, 21.5) AMS IB.3197-8; drain entering Marbellup Creek at Elleker, 16 km west of Albany, (8, 24.5-28.75) NMVM —.

Galaxiella munda McDowall: Western Australia — pool in jarrah forest about 8 km north of Scott River, south of Canebreak Yards, between Nanup and Augusta, (10, 29.25-39.0), WAM P.25736-001, WAM P.5225, AMS I.19522-001; creek 10 km eastnortheast of Shannon River (type locality of *Lepidogalaxias salamandroides* Mees), (9, 28.5-41.0) WAM P.8067; creek 4.6 km from Nanarup turnoff on road to Two People's Bay (4, 25-36), NMVM —; Carey Brook, Donnelly River, a small, clear jungle stream, near Jasper Road and Boat Landing, south of Nanup, 37 km west of Pemberton, (2, 35.5), WAM P. —; creeks and waterholes at Walpole, (2, 36.5, 38.0) WAM P. —.

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