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FRESHWATER FISH FAUNA OF TASMAN PENINSULA

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(with two tables and two text-figures)

Of the 25 native freshwater fish species found in Tasmania, nine occur on Tasman Peninsula along with one species of introduced fish, the brown trout *Salmo trutta*. The spotted galaxias *Galaxias truttaceus* and the common jollytail *G. maculatus* were the most widespread and abundant species found and fishes within the family Galaxiidae dominated the fauna. The life cycles of the fish species could be classified into three types largely based on the juvenile and adult habitats. Type 1 species, exemplified by the pouched lamprey *Geotria australis*, breed and the young undergo a period of development in freshwater and there is an extended period spent at sea. Type 2 species, such as the short-finned eel *Anguilla australis*, breed at sea and, after a marine juvenile stage, mature in freshwater. Type 3a species breed in estuaries, the young spend a period of development at sea and the fish mature in freshwater. The common jollytail is an example of this type. Type 3b species, such as the spotted galaxias, mature and breed in freshwater and, as with Type 3a, have a marine juvenile stage. Most fish were collected in habitats characteristically possessing abundant cover in the form of aquatic vegetation, logs or boulders. The only introduced species, brown trout, was not widespread on the peninsula and its effect on the native fish, although uncertain, appears minimal. Due to the necessity for all species of native freshwater fish found on the peninsula to migrate up and down streams at some stage of their life cycles, caution is expressed regarding any modifications to stream habitat which may prevent this.

Key Words: Tasman Peninsula, Tasmania, freshwater fish.

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INTRODUCTION

An examination of a topographical map of Tasman Peninsula reveals the absence of any large river or lake systems. The fresh waters of the peninsula are restricted to relatively few short coastal streams, an occasional elevated marsh and numerous farm dams.

The freshwater fish fauna of Australia is depauperate by world standards, with less than 200 species in total (Merrick & Schmida 1984). This low number reflects the continent's aridity and its long history of isolation. The freshwater fish fauna of Tasmania totals 25 species which is 12.5% of the total Australian fauna in just 4% of the total land area. Tasmania is the most well watered state of Australia and therefore its comparatively speciose freshwater fish fauna is not unexpected. Tasmania possesses 12 endemic species of freshwater fish, ten of these belonging to one family, the Galaxiidae (table 1). The remaining endemics belong to the Retroponnidae and Aplochitonidae, the latter species being the only representative of the genus *Lovettia*. The Galaxiidae represent 60% of the freshwater fish fauna of Tasmania and 15 of the 20 species of galaxiids found in Australia occur in Tasmania.

Many Tasmanian species have restricted distributions (table 1), some occurring in only a single lake system (e.g. golden galaxias *Galaxias auratus* and saddled galaxias *G. tanycephalus*) or river system (e.g. Swan galaxias *G. fontanus*), whilst other restricted species only occur in northerly-flowing streams (e.g. river blackfish *Gadopsis marmoratus* and pigmy perch *Nannoperca australis*). None of the restricted species is found on Tasman Peninsula. To date nine species of freshwater fish have been collected from the peninsula. It is possible that the remaining three species (short-headed lamprey *Mordacia mordax*, longfinned eel *Anguilla*

TABLE 1

Families of Tasmanian Native Freshwater Fishes

Families	Total*	Endemic**	Restricted§	Tasman Peninsula‡
Class Agnatha				
Family Geotriidae pouched lampreys	1	0	0	1
Family Mordaciidae short-headed lampreys	1	0	0	0
Class Pisces				
Order Anguilliformes				
Family Anguillidae freshwater eels	2	0	0	1
Order Salmoniformes				
Family Galaxiidae galaxiids	15	10	11	4
Family Retropinnidae Australasian smelt	1	1	0	1
Family Prototroctidae Australasian grayling	1	0	0	0
Family Aplochitonidae whitebait	1	1	0	1
Order Perciformes				
Family Kuhliidae pygmy perch	1	0	1	0
Family Gadopsidae river blackfish	1	0	1	0
Family Bovichthyidae sandy	1	0	0	1
Totals	25	12	13	9

* Number of species of each family reported from Tasmania.
** Number of species of each family only found in Tasmania.
§ Number of species with a limited geographic distribution in Tasmania (may also occur outside of Tasmania).
‡ Number of species reliably recorded from freshwater habitats on Tasman Peninsula.

TABLE 2

Species of Native Freshwater Fishes Recorded from Tasman Peninsula

Species	Distribution*	Life cycle type**
Class Agnatha		
Family Geotriidae		
Geotria australis (Richardson) pouched lamprey	Tas, Aust, NZ, SAm	1
Class Pisces		
Order Anguilliformes, Family Anguillidae		
Anguilla australia Richardson short-finned eel	Tas, Aust, NZ	2
Order Salmoniformes, Family Galaxiidae		
Galaxias maculatus (Jenyns) common jollytail	Tas, Aust, NZ, SAm	3a
Galaxias brevipinnis (Günther) climbing galaxiid	Tas, Aust, NZ	3b
Galaxias truttaceus (Valenciennes) spotted galaxiid	Tas, Aust	3b
Galaxias cleaveri Scott Tasmanian mudfish	Tas, Aust	3b
Order Salmoniformes, Family Retropinnidae		
Retropinna tasmanica McCulloch Tasmanian smelt	Tas	3b?
Order Salmoniformes, Family Aplochitonidae		
Lovettia sealii (Johnston) Tasmanian whitebait	Tas	1
Order Perciformes, Family Bovichthyidae		
Pseudaphritis urvillii (Cuvier & Valenciennes) sandy	Tas, Aust	3a

* Tas = Tasmania, Aust = Australia, NZ = New Zealand, SAm = South America.
** See text and figure 3 for explanation of life cycle types.

reinhardtii and Australian grayling *Prototroctes maraena*), which are found in Tasmania but have not been recorded from the peninsula, may occur there sporadically.

DISTRIBUTIONS OF FRESHWATER FISH

Of the nine species found on Tasman Peninsula (table 2), seven are also found in mainland Australia, four occur in New Zealand and two have an even wider distribution encompassing South America. Only two of the peninsula's freshwater fish species are endemic to Tasmania.

Distributions of freshwater fish within Tasman Peninsula (fig. 1) have been taken from records held by the Tasmanian Inland Fisheries Commission, the Tasmanian Museum and Art Gallery, the Queen Victoria Museum, from Lake & Fulton (1981) and from an electrofishing survey conducted by the senior author in July and August 1986. Statewide distributions are given in Fulton (in press). It is clear that the spotted galaxias *Galaxias truttaceus* and the common jollytail *G. maculatus* have the widest distributions within the state as well as within the peninsula. The shortfinned eel *Anguilla australis*, the sandy *Pseudaphritis urvillii*, pouched lamprey *Geotria australis* and climbing galaxias *Galaxias brevipinnis* were all found in several streams on the peninsula and were locally abundant (fig. 1). However, the Tasmanian whitebait *Lovettia sealii*, Tasmanian smelt *Retropinna tasmanica*, Tasmanian mudfish *G. cleaveri* and introduced brown trout *Salmo trutta* were all restricted to one or two streams on the peninsula and were generally found in small numbers.

LIFE CYCLES

All of the native fish which occur on the peninsula are to a greater or lesser extent dependent on the sea for part of their life cycle and therefore cannot be classed as totally freshwater. The possession of a marine phase may enable fish species to withstand local eliminations due to the scarcity of water during times of drought. Many of the peninsula's streams become extremely marginal during summer and it is at this time that juveniles of the galaxiid species, at least, spend their time at sea. Thus it is probable that continuous recruitment can occur via the sea and may explain the absence of species that rely on freshwater for their entire life cycle.

Despite their common dependence on the sea, Tasman Peninsula freshwater fish essentially exhibit three types of life cycles, although Type 3 has been divided due to slight differences (table 2, fig. 2).

Type 1

Breeding takes place in freshwater and, after some early development, the young fish moves down to the sea where it grows and, as a maturing adult, subsequently returns to streams to breed.

Geotria australis is an example of a species with such a life cycle. The eggs of this lamprey are deposited by a female in a depression in gravel or sand, which is thought to have been excavated by a male. The larva (ammocoete) emerges from the egg and lives half-buried in the substrate, pumping water in through its mouth and out through its gills, filtering out fine organic particles which are trapped in a mucus net inside the pharynx. The larva is sedentary and its sense organs are poorly developed. By about the fourth year of life, when the lamprey is approximately 100 mm in length, the larva metamorphoses into a juvenile (macrophthalmia). The colour changes from brown to steel blue, the sense organs develop and a complete sucker forms around the mouth. The juvenile lamprey swims downstream and adopts an ectoparasitic lifestyle, attaching itself to the sides of fish and ingesting the abraded muscle tissue and blood of its host.

When fully grown, at about 400–500 mm, the lamprey returns to freshwater as a velasia and does not feed again as the gonads develop. The sucker of the male becomes enlarged and a large ventral swelling, known as the pouch, forms beneath the head. This pouch is filled with loose connective tissue and recent studies suggest that it may have some role in the establishment of a breeding territory through an endocrine or olfactory function (I.C. Potter, pers. comm.). The lamprey breeds after about 15 months of gonadal development and probably dies after breeding.

Type 2

In contrast to fishes with a Type 1 life cycle, those with a Type 2 life cycle breed in the sea but spend the greater proportion of their growth in freshwater. *Anguilla australis* has a Type 2 life cycle and is thought to breed in the Pacific Ocean, probably near the Solomon Islands. The larval eel (leptocephalus) is carried passively in the plankton of the East Australian Drift Current to our coasts. The eel metamorphoses into a glass eel when it reaches coastal waters and takes up a benthic existence. It becomes pigmented as it enters freshwater and swims upstream

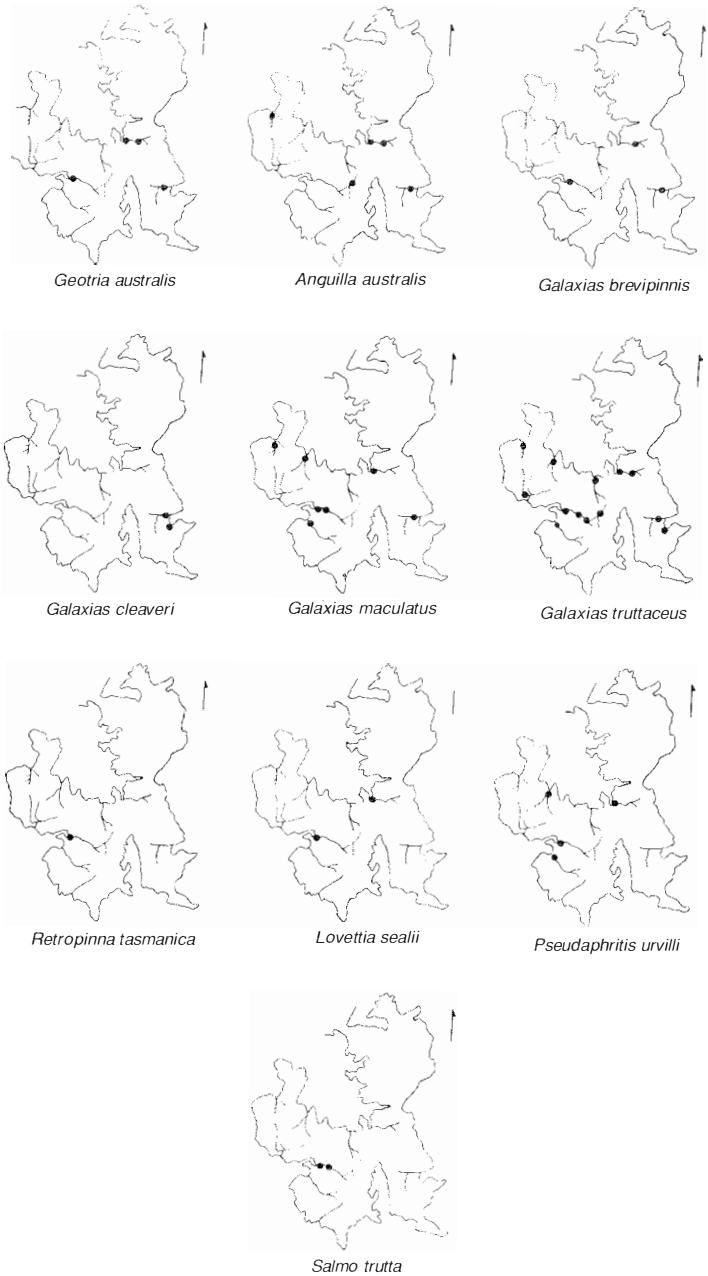

FIG. I—– The distributions of freshwater fishes on Tasman Peninsula (from Fulton, in press, and authors' surveys).

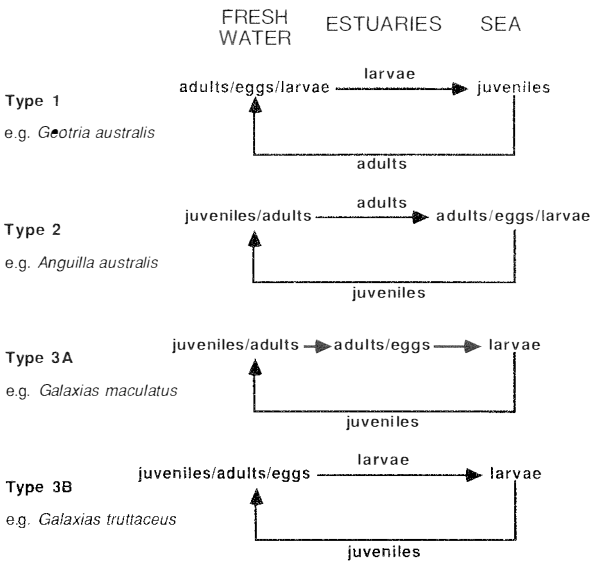

FIG. 2—A schematic representation of the three major life cycle patterns of freshwater fishes found on Tasman Peninsula (see text for explanation).

as an elver. Growth is slow and it may take up to 15 or 20 years to mature, at which time the eel is between 500 and 700 mm in length. At this stage the maturing eel swims down to the sea and returns to the breeding site where it is thought to die after having spawned.

Type 3a

In this type of life cycle the adults breed in estuaries, the larval phase is spent at sea and maturation occurs in freshwater. *Galaxias maculatus*, unlike the previous two examples has a relatively short life, maturing in its first year. A large proportion of individuals die after spawning. The adults move downstream in autumn and spawn amongst aquatic vegetation that has been inundated by spring tides. The tide recedes and the eggs undergo a period of extra-aquatic development until the next spring tide submerges the eggs and they hatch. The larva is carried out to sea where it is thought to feed and grow in the plankton. In late spring or early summer the transparent jollytail returns to an estuary and enters freshwater as what is known as whitebait. The jollytail, along with other species, formed a large proportion of the commercial catch during the former whitebait fishery (Blackburn 1950). Variation of the life cycle detailed above has been described for a landlocked population of *G. maculatus* in Lake Modewarre, Victoria (Pollard 1971).

Type 3b

In this type of life cycle the larval phase is also spent at sea; however, the adults breed in freshwater, above the tidal limits. *Galaxias truttaceus* has a Type 3b life cycle. It has been the subject of a study from early 1984 to late 1986 in Allens Creek, near Taranna and Fortescue Lagoon Creek which opens into Fortescue Bay (Humphries 1986, 1987). Both creeks are short (<5 km) in length, rarely exceed 1 m in depth, except at times of peak flow, and are shaded for the most part by a dense riparian canopy of *Eucalyptus, Banksia* and *Acacia*.

The spotted galaxias moves downstream at the end of autumn and deposits its adhesive eggs in freshwater, presumably amongst submerged vegetation or on dead twigs and leaves. Depending on the temperature, the eggs hatch after about four weeks and the larvae can be collected as they are carried downstream by the current. The larvae spend between three and four months at sea and return to freshwater as whitebait in late spring. The juvenile spotted galaxias matures in freshwater, living under logs and boulders and feeding on a variety of aquatic and terrestrial invertebrates, mainly larval insects. The species takes two years to mature, at which time the fish are between 70 and 80 mm in length. The largest fish collected during the study were over 180 mm and these fish were considered to be about eight years old. As for the jollytail, the spotted galaxias shows

considerable variation in its life cycle. In a comparison of lotic and lentic populations, variation was found in spawning time, egg size, fecundity and reproductive investment (Humphries 1987).

HABITAT

Geotria australis

The pouched lamprey was collected during the present survey only rarely and always in the ammocoete form. This species was found buried in the substrate and appeared to prefer sand and gravel rather than a finer sediment. This is consistent with the observations of Lake & Fulton (1981) for this species in Parsons Bay Creek.

Anguilla australis

The short-finned eel occurred in high numbers in slow-flowing, clear streams and in a number of dams which were adjacent to these streams. Large individuals were caught in shallow water, although they were most commonly associated with aquatic vegetation. Lake & Fulton (1981) found that this species dominated at most sites in their study of Parsons Bay Creek, except for the extreme lower reaches of the creek.

Galaxias maculatus

The common jollytail was the second most abundant species caught on the peninsula and was found in both slow and fast flowing streams as well as in clear and turbid water. Fish were found sheltering amonst dense aquatic vegetation or under fallen logs and boulders. Where there was dense riparian vegetation, fish could sometimes be observed swimming in the water column and were presumed to be feeding. Jollytails were found along the entire length of some streams and adults were collected from the estuary entering Fortescue Bay. As this was not at the documented spawning time of this species, it is presumed that this species can survive for considerable periods of time in brackish water.

Galaxias brevipinnis

Although the climbing galaxias is locally abundant in northern streams and alpine lakes in Tasmania, this species was rarely collected in Tasman Peninsula streams. Lake & Fulton (1981) only found the climbing galaxias at two sites in Parsons Bay Creek, and in the two-year study mentioned above the species was present in Fortescue Lagoon Creek rarely and in Allens Creek only one individual was ever caught, although this particular fish occurred in several consecutive monthly samples. The species appears to prefer streams with abundant cover in the form of aquatic vegetation and boulders, although fish were most often collected from beneath the latter.

Galaxias truttaceus

As mentioned previously, the spotted galaxias was the most abundant and widespread species on the peninsula. It occurred in both slow and fast flowing streams and, although numbers of individuals were greatest in clear water, it was also found associated with extremely turbid water such as that of Saltwater River. Fish were most often caught sheltering beneath logs and boulders or amongst submerged aquatic vegetation. Very large numbers could be collected at spawning times and it appears that fish congregated at the lower stretches of pools when their access was blocked due to low flows. It was not until sufficient rain increased flows that fish were able to continue their downstream migration to spawn in the lower reaches of streams.

Galaxias cleaveri

The Tasmanian mudfish is one of the least abundant of the galaxiid species in Tasmania and was caught at only two localities on the peninsula. Until recently it was thought to lead a totally freshwater existence, but recent evidence of the species occurring in the whitebait run has suggested a Type 3b life cycle (W. Fulton, pers. comm.). There is strong evidence that the mudfish can aestivate during times of desiccation of its habitat. During the survey and the two-year study of the spotted galaxias, the mudfish was only collected during high flows, when normally dry habitat was inundated. At this time the fish were found in the water column despite a considerable velocity of water.

Retropinna tasmanica

Although the Tasmanian smelt was not collected during the July/August 1986 survey nor during the two-year study of the spotted galaxias, Lake & Fulton (1981) recorded its presence at one site in May at the

mouth of Parsons Bay Creek. It does not appear to enter far into freshwater and is normally associated with brackish water, while probably spending the major part of its life at sea (McDowall 1980).

Lovettia sealii

The Tasmanian whitebait is essentially a marine species which comes into freshwater or estuaries, sometimes in huge numbers, to breed in spring and then dies (life cycle Type 1). It produces a small number of relatively large eggs, which are deposited on logs and boulders, and the larvae are washed out to sea after hatching (Blackburn 1950). Little is known of the species' habits at sea.

Pseudaphritis urvillii

The sandy was collected from both turbid and clear water; however, it appeared to prefer the latter. It was found most commonly in moderate flows where extensive cover enabled the fish to take shelter. Lake & Fulton (1981) reported its occurrence in "areas with a coarse gravel and stone bottom especially around logs and aquatic macrophytes" and agreed with an earlier study of this species by Hortle (1978). As was found during the present survey, Hortle (1978) and Lake & Fulton (1981) showed that densities of the sandy were greatest in the lower reaches of streams, although fish did penetrate considerable distances upstream.

Salmo trutta

Brown trout was not recorded in samples during the present survey and was not found in Fortescue Lagoon Creek or in Allens Creek. Nevertheless, it was a component of the fish community in Parsons Bay Creek (Lake & Fulton 1981), generally in low densities. Lake & Fulton (1981) suggested that colonisation of this creek by migrating trout may have occurred from the sea and that it is unlikely that they have been artificially introduced. They also suggested that the habitat is probably not conducive to successful spawning of this species, as areas of clean gravel are rare in Parsons Bay Creek.

EFFECTS OF EUROPEANS

Europeans have played two distinct roles as far as the freshwater fish fauna of Tasman Peninsula is concerned: introducing alien species and modifying habitats. The majority of the native freshwater fishes found in Tasmania are small and are of little interest as sport or food fish. Many Tasmanian river and lake systems are ideal habitats for supporting large populations of introduced salmonids, and therefore it is not surprising that the early European settlers made efforts to introduce salmon and trout in Tasmania. In 1864 brown trout eggs were successfully hatched at Salmon Ponds on the Plenty River and since then both brown trout and rainbow trout *Salmo gairdneri* have been introduced to hundreds of streams and lakes throughout the state.

Although it has been shown that both brown and rainbow trout have detrimental influences on native fish populations (e.g. Tilzey 1976, Fletcher 1979), the effect of brown trout on the fish populations of Parsons Bay Creek cannot be readily assessed. The unsuitable habitat within this creek may prevent good recruitment of trout and so reduce both the competition for space between native and introduced fish and the predation pressure of the latter on the former.

Fish habitats can be modified in several ways and there is no general response of fish species to these different modifications. Impoundments can be placed in streams which may allow fish to migrate downstream but prevent subsequent upstream migration. Streams can be channelled or de-snagged to prevent a buildup of water which may flood adjacent agricultural land at peak flows. Channelling of a section of a small stream has recently been shown to reduce fish numbers and species diversity compared with an unchannelled section (Hortle & Lake 1983). Other modifications, such as reversal of flows (i.e. high flows in summer and low flows in winter) for irrigation purposes, chemical or thermal pollution of waters as by-products of industrial processes and siltation or salination of streams caused by forestry and road construction practices, all contribute to the degradation of native fish habitat.

Fortunately there is a conspicuous lack of high-level modification of streams on Tasman Peninsula, apart from widespread clearance of the catchments of several creeks. During the present survey, some siltation of streams below roads was noted and it was a common practice for dams to be constructed along the lengths of streams. An awareness of the requirements of native fish, especially the necessity to migrate upstream or downstream to breed, may go

far in ensuring the continued existence of these species and populations on the peninsula.

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