1987 Annual Report

FIRTA PROJECT 85/52

INVESTIGATION OF THE PRESENT STATUS AND POTENTIAL YIELD OF WHITEBAIT STOCKS IN TASMANIA

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ANNUAL REPORT FIRTA PROJECT 85/52

Investigation of the present status and potential yield of whitebait stocks in Tasmania.

The majority of field work has been completed on the above project and the findings are presently being evaluated by the Inland Fisheries Commission.

The attached report is submitted essentially as background information to an application to FIRTA for funding of a project on the aquaculture potential of whitebait species.

A complete report on the work associated with the present grant will be submitted in due course.

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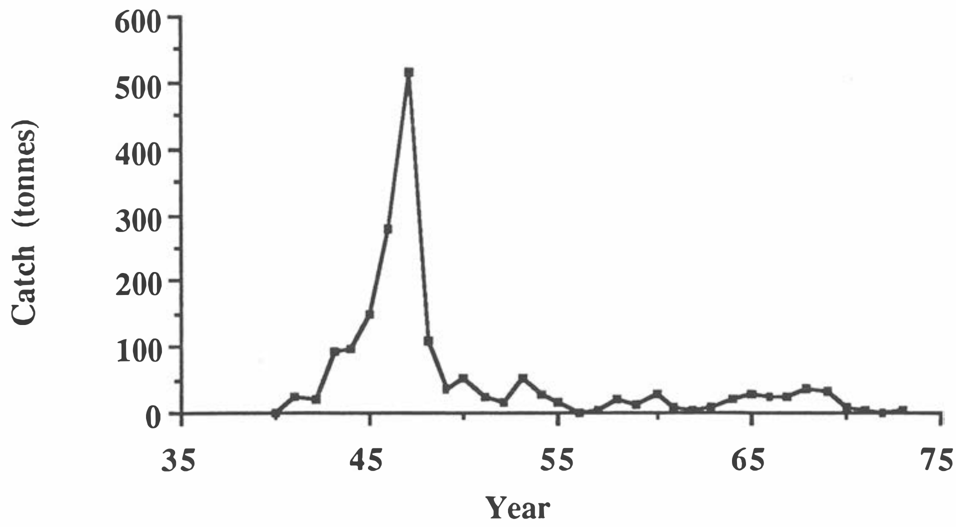
HISTORY OF THE FISHERY

The history of the fishery for whitebait dates back to at least the early 1930's. Significant commercial fisheries began in the south in 1941 and in the north in 1943, and licensing of the fishermen by the Tasmanian Fisheries Division was introduced in 1944. Production was always greater in the northern rivers, probably because these rivers have shorter, shallower tidal reaches that make access to the fish much easier.

From its start in the early 1940's the northern fishery rapidly reached a peak catch of 515 tonnes by 1947 (Fig. 1). However, the catch per scoop for this period, ie. the return to the individual fisherman, had already indicated a decline by 1947.

Fig. 1 Yearly whitebait catch



A study of the fishery by the C.S.I.R.O. was commenced in 1945. The findings of this work, reported by Dr. Blackburn in 1948, recommended the closure of the season in the north of the state in 1949 and future annual quotas were suggested. The season was again opened in 1950, but in this and subsequent years catches did not even approach the quotas set.

In 1957 further deregulation of the fishery occured, despite the fact that the catches for 1956 and 1957 were the lowest since the fishery began. The ban on weekend fishing was removed and an earlier opening to the season was allowed. The decline in production continued without any attempts to rectify the situation.

Control of the fishery was transferred to the Inland Fisheries Commission in 1965. Although some restrictions were imposed at this time the decline in stocks continued until closure of the fishery by regulation in 1974. This was to have been for a three year period only, but trials by commercial fishermen in 1976 resulted in poor catches and the season has since remained closed. No detailed study of the fishery has been attempted since the 1940's.

At its peak, whitebaiting provided direct, part, or full-time seasonal employment for about 230 persons. Numbers declined to about 65 by 1960 whilst only 21 fishermen participated in 1973, In value, illegal Tasmanian fishermen have been known to receive $15-20/kg during 1985-87. In New Zealand in 1985 the fishermen received $23-27/kg off the river whilst the fish retailed in Christchurch at $45.00/kg. This would value the average catch for all years of the Tasmanian fishery at approximately 2.5 million dollars.

In 1983-84 some encouraging runs were observed in certain rivers and requests were made to re-open the fishery. Before any further exploitation of the whitebait could be allowed it was considered necessary to evaluate the status of the stocks. Funding for this work was sought and a three year grant was obtained from the Commonwealth funded Fishing Industry Research Trust Account. This study began with the migrations of 1985.

1985-87 WHITEBAIT STUDY PROGRAM

OBJECTIVES

The project was undertaken with the following objectives in mind;

1. Determine whether the present whitebait populations in Tasmanian streams can support any level of recreational and/or commercial fishing.

2. If a sustainable yield is identified, establish procedures and guidelines for management of the fishery consistent with species and stock conservation and compatability with sea-run trout fishing interests.

3. If an open season cannot be supported, establish suitable measures to protect, and if possible assist recovery of the populations.

As mentioned above there has not been any biological study of the whitebait fishery since the 1940's. That study concentrated on the species most abundant at that time (*Lovettia sealii*). However, with the decline in the fishery being essentially due to a decrease in abundance of that species and a coincident expansion in areas fished, other species are presently being illegally exploited. Thus it was necessary to examine the biology of all species involved in the fishery in some detail.

APPROACH

As the Commission's research staff had no first-hand experience of the commercial fishery, two former commercial fishermen were hired on a seasonal basis to assist with the research. They were employed specifically to evaluate the whitebait populations of the Mersey and Rubicon rivers in northern Tasmania using commercial style fishing methods.

As well as a lack of experience with the former commercial fishery there was little biological information available on the species of fish involved other than *Lovettia sealii*

(Blackburn 1950). Consequently other staff were engaged in biological investigations of the species in the migrations around the state.

The project has therefore focused on a number of biological factors as follows;

1) Detailed examination of whitebait migrations in the Mersey and Rubicon rivers.
2) Examination of species composition of the runs.
   a) with time of year.
   b) between various rivers.
3) The life history of the major species.
4) The population status of adult galaxias.
5) The extent of isolation of populations of *L. sealii* and *G. maculatus*.

Other factors that were examined included;

6) The effects of stream barriers on certain species.
7) The effects of certain pollutants on some species .
8) The commercial catch potential of certain rivers.

The program of commercial style fishing was essentially concentrated on the north-west coast in the initial stage as this area had been the centre of the fishery. Later in the program the commercial potential of some of the west coast rivers and of the Derwent River in the south was examined in some detail.

A general limitation of the research program was the inability to be in more than one place at any time as the peak of the runs was often coincident or short-lived in a number of streams and could not always be checked or observed.

RESULTS

The following is a brief summary of the major findings of the study. Some of the points listed are not original but are nevertheless important in a management context. By way of explanation the whitebait catch may contain a number of different species of fish and the term 'whitebait' is therefore used only in a broad descriptive sense.

1. MERSEY AND RUBICON RIVERS

Historically the Mersey River was the centre of the commercial whitebait fishery. Consequently this river, along with the Rubicon River nearby, were monitored intensively throughout the three years of the study. This work has provided information on the present quantities of whitebait and also forms the basis for a future monitoring program that must be undertaken. It essentially was concerned with the species *Lovettia sealii* although considerable information on other species was also collected in the course of this program.

The catch recorded over the three years from both rivers is shown in Figure 2 below.

Fig. 2 : Catch records from experimental fishing in the Mersey and Rubicon rivers during the 1985-87 seasons.

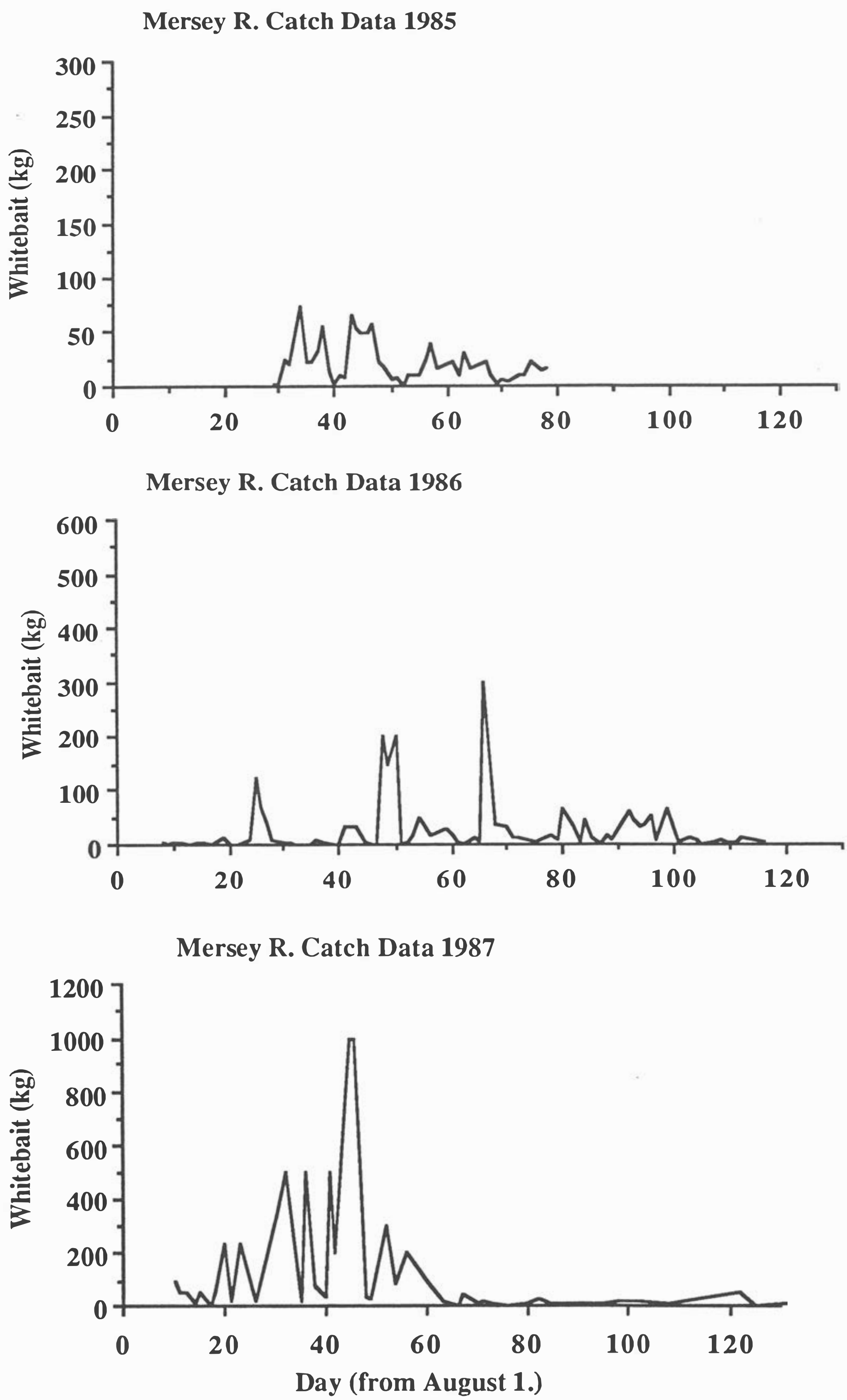
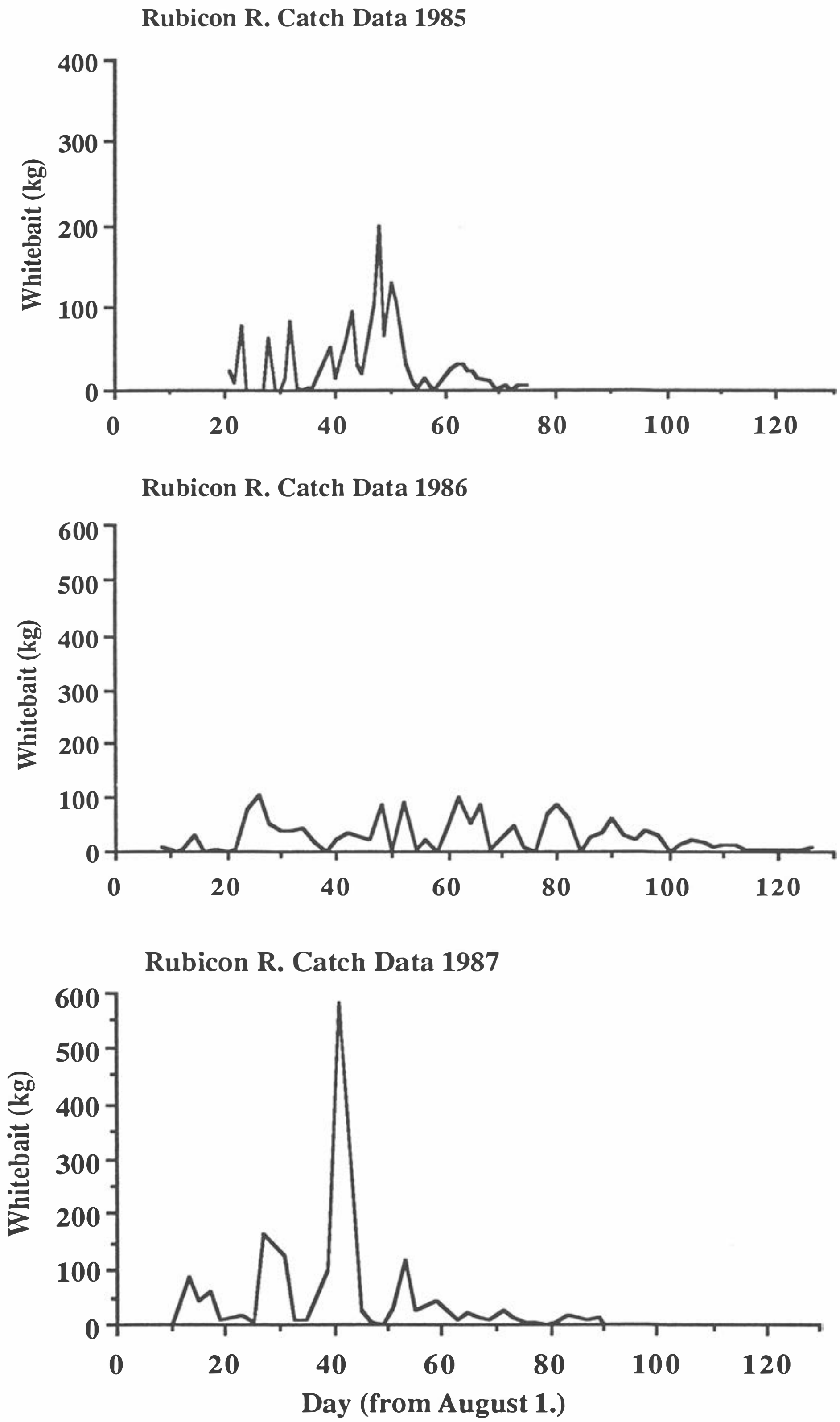


Fig. 2 : Cont.


Rubicon R. Catch Data 1985
Whitebait (kg)
400
300
200
100
0
0
20
40
60
80
100
120
Rubicon R. Catch Data 1986
Whitebait (kg)
600
500
400
300
200
100
0
0
20
40
60
80
100
120
Rubicon R. Catch Data 1987
Whitebait (kg)
600
500
400
300
200
100
0
0
20
40
60
80
100
120
Day (from August 1.)

These catch quantities do not necessarily indicate the amount of fish that could be caught and removed by a commercial fisherman as *L. sealii* tends to move back and forth with the tides and certain schools may have been caught more than once on successive days. However the methods used were constant and the amounts provide a means of comparing each years runs as well as giving information on the timing etc. of the peak migration periods.

Summary

- The total quantity of *L. sealii* in these rivers has increased over the three year study period.
- Considerable variation in migrations may occur from one day to the next throughout a season, consequently assessment of quantities of whitebait cannot be made without extensive observations.
- The peak migration time in these rivers occurs in late August through September with occasional good runs in October as well. This is supported by historical catch records but is known to differ in, for instance southern Tasmanian rivers.
- Flooding will, as expected, physically prevent migrations but tends to concentrate the fish until water levels recede.
- Migrations on a daily basis are strongly linked to the tidal sequence.

2. SPECIES COMPOSITION

In the whitebait runs, six species of fish are commonly found.

Tasmanian whitebait	*Lovettia sealii* Johnston
Jollytail	*Galaxias maculatus* (Jenyns)
Spotted galaxias	*Galaxias truttaceus* Valenciennes
Climbing galaxias	*Galaxias brevipinnis* Gunther
Tasmanian mudfish	*Galaxias cleaveri* Scott
Smelt	*Retropinna tasmanica* McCulloch

The four galaxias also occur outside Tasmania with the jollytail being the predominant fish in the New Zealand whitebait fishery. The Tasmanian whitebait and the smelt are only found in this State. The Tasmanian mudfish is a new addition to the list of common species in the runs as a result of this study. The presence of adults of this species in estuarine areas had previously been known but the life history of the fish had not been studied. A number of other migratory species also occur to a lesser degree in the catches. Perhaps the most notable of these is the Australian Grayling, *Prototroctes maraena* Gunther. This species is nowadays uncommon but juveniles were regularly recorded from a number of rivers in various parts of the state and some adult fish were collected from west coast rivers in particular.

In the study carried out during the late 1940's the catches consisted of about 95% *Lovettia*. Although some changes to the species composition of whitebait runs have been suggested since, our experience from monitoring the recent migrations suggests that no small scale sampling program could possibly give a true indication of the overall species composition as this varied on a daily basis as well as over the whole season. Marked variations were also apparent from one site in a river to another and also from one river to another. However, the commercial fishing was sited and timed principally for the one species, namely *Lovettia*, and there is no doubt that catches of that species similar to those of the 1940's could not be obtained today.

The variation in species composition associated with sites within a river is essentially related to the life history of the species concerned as some species migrate further upstream than others. This pattern is generally consistent from one river to another all round the state although the various limits for each species in each river must be determined. The other sources of variation require further examination.

a) Spatial variation

Within each river the site fished in regard to distance from the sea may determine the species caught. This is essentially a function of the life history of the particular species concerned and is discussed further below.

The composition of the catch also varies considerably from one river to another. This is partly due to site selection in that the choice of fishing site is influenced by access as well as river morphology and hydrology. However, there is also considerable variation in abundance of various species in different rivers. In Table 1 the variation in the galaxiid component of the catch in different rivers around the state is shown.

Table 1 : Variation in galaxiid species composition (numbers) from various rivers.

Site	Percentage composition			
	G. maculatus	*G. truttaceus*	*G. brevipinnis*	*G. cleaveri*
Pieman 85	1.6	25.9	24.0	48.5
Duck 85	90.3	8.2	0.1	1.4
Forth 85	76.9	17.7	3.4	2.0
Mersey 85	92.4	7.1	0.2	0.3
Rubicon 85	72.3	26.1	0.2	1.4
Derwent 85	92.4	3.3	-	4.3
Lune 85	29.5	7.6	1.0	61.9
Huon 85	35.7	7.0	6.3	50.4
Pieman 86	-	95.2	4.4	0.4
Duck 86	94.2	2.0	0.1	3.7
Mersey 86	88.5	10.0	0.3	1.2
Rubicon 86	62.7	35.1	0.2	2.1
Pieman 87	11.7	40.7	22.6	25.1
Mersey 87	90.5	8.6	0.3	0.5
Rubicon 87	51.8	34.6	0.4	13.3
Derwent 87	73.9	11.2	0.5	14.4

In general the darker coloured rivers of the west coast and south of the State contain more *G. truttaceus* and *G. cleaveri* than the clear rivers of the north coast in which *G. maculatus* is generally more abundant. The abundance of *G. cleaveri* is frequently underestimated visually because of the small size of this species.

b) Seasonal variation

Whitebait runs generally occur from August to December with some annual and local variation in the timing of the peak. The major run has usually finished by November, although jollytails in particular may still be locally abundant through summer. The composition of the run varies through the season with *Lovettia* tending to arrive earlier than the galaxias. The jollytail runs extend through December whilst the other galaxias have only a short migratory period in comparison.

The seasonal timing of the *Lovettia* migrations is essentially as shown in Figure 2. The timing of the migrations of the other species is shown in Figure 3 below. The actual numbers of fish caught are not of importance but the time of capture is indicated as are relative abundances.

Fig.3 : Variations throughout a season in the composition of the 1985-86 whitebait catches from the Mersey River.

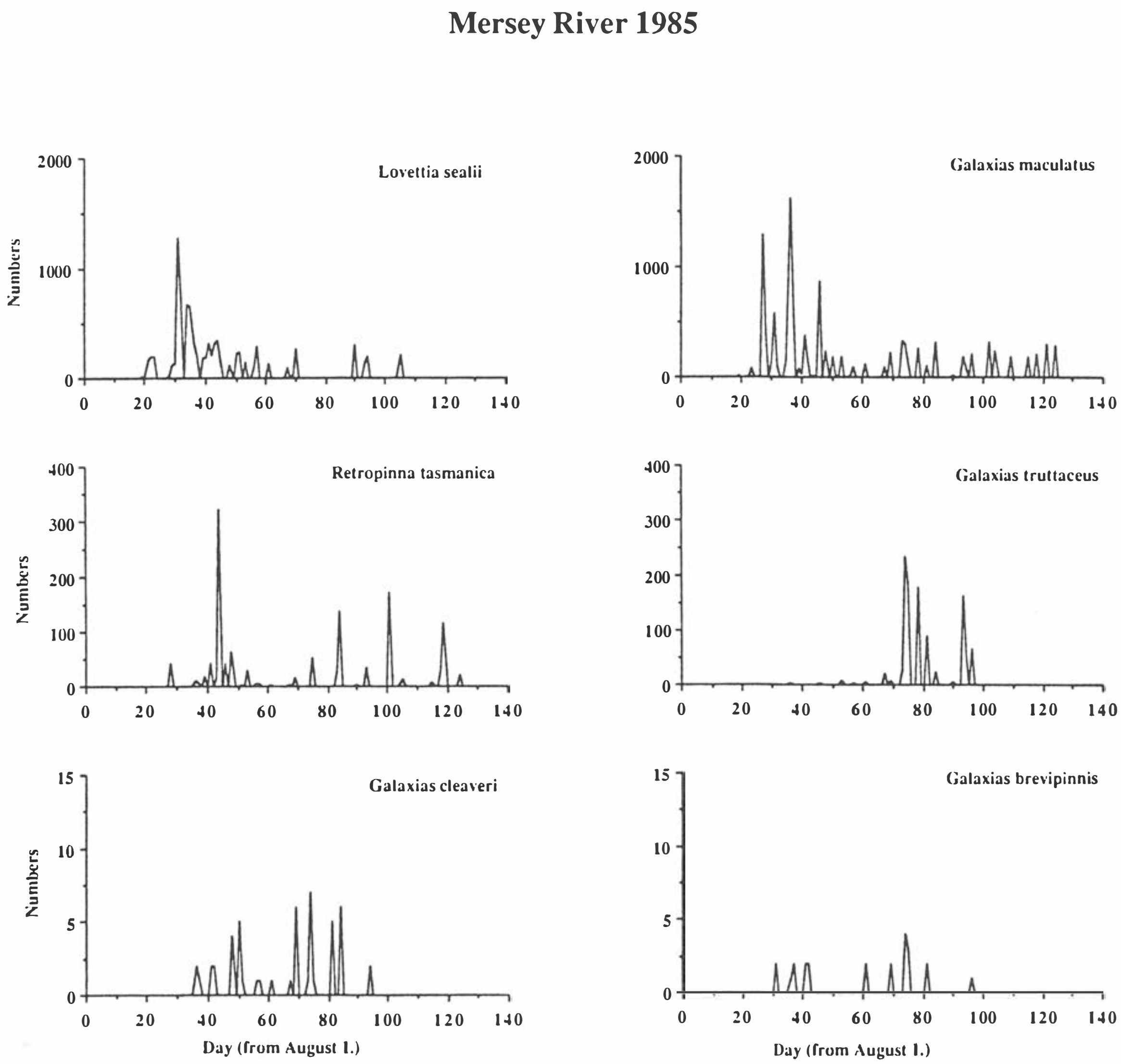
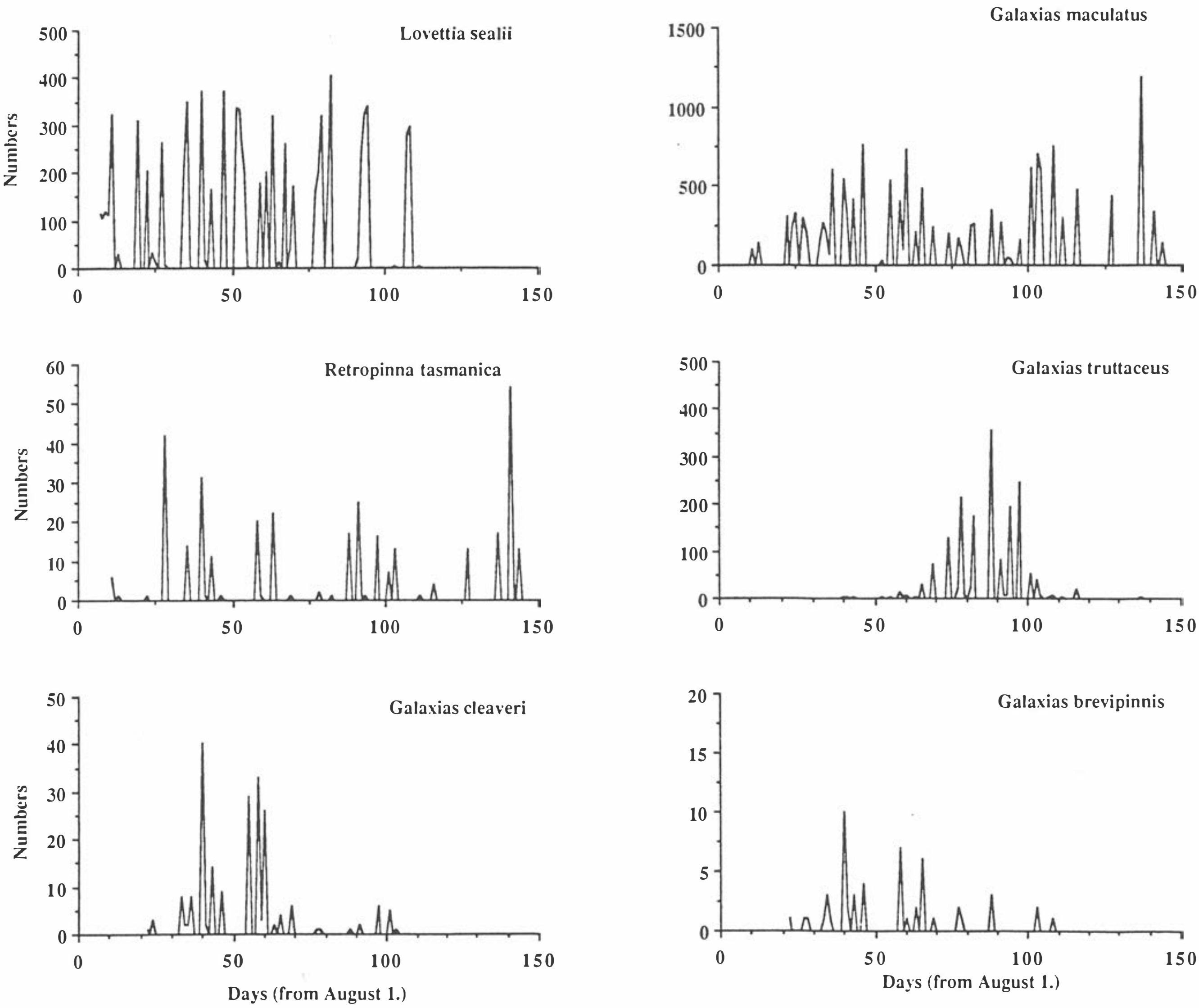


Fig. 3 : Cont.

Mersey River 1986



From these graphs it is apparent that it would be possible to target a fishery predominantly on individual species simply by regulation of the timing of any open season. However this could only be achieved on an individual river basis as there is also some variation in the timing of the peak migration times of each species from one river to another.

Summary

- Whitebait of some species may be caught over at least 5 months of the year.
- Catch composition may vary depending on ;
    - site in river (life history)
    - time of year
    - time of day

3. LIFE HISTORY

As mentioned above, consideration of the life history of the key whitebait species will be important in any future management program.

Lovettia sealii : The life history of this species has been studied in some detail in Tasmania by Blackburn (1950). Our findings do not conflict with that work in any major detail.

Briefly, this species is migrating into the upper estuaries as a mature adult. It is about 12 months old at this stage with a very small percentage (<1) of two year old fish. Spawning takes place in the upper estuaries below the upper limit of tidal influence. At any particular time the spawning site will be determined to some extent by river discharge. The adult fish appear to spawn over an extended period on successive days. They do not die immediately after spawning but progressively deteriorate in condition. Each female may carry up to about 350 eggs, depending on her size. These are adhesive and are attached to submerged logs, stones and branches etc. below low water level and in an area with strong current flow and thus good aeration.

Hatching takes about 14 days but this can be delayed considerably by low temperatures and probably also low water conductivity. The larvae are then thought to go to sea. The distance that *Lovettia* moves out of the estuaries is uncertain and may well depend on the hydrology of the particular estuary. There is some evidence to suggest that in those estuaries with limited tidal movement (ie. non Bass Strait rivers) the larvae may not move far out of the estuary if at all. Further work on this aspect of the life history, as well as on the early post-larval behaviour, would be of interest.

Problems: - The low fecundity and single age class structure of *L. sealii* means that this species is slow to recover from any depletion of its numbers resulting from any cause be it pollution, floods, overfishing etc.

- The estuarine spawning site of this species is also subject to considerable development and inputs from a number of sources and is therefore at risk.

Galaxias maculatus : The biology of this species has been studied in some detail in New Zealand (McDowall 1968) and Victoria (Pollard 1971, 1972, 1973).

In contrast to *Lovettia*, the jollytails are juvenile fish of about 4-5 months of age on migration into the estuaries. They take up residence in the lower reaches of streams (including the upper estuaries) where they grow to adult fish.

The jollytails may migrate at any time throughout the season although never in the same quantities as Lovettia. Schools tend to be small but frequent, and less dependent on state of the tide. The juvenile fish develop pigmentation soon after entering the streams, consequently the best quality fish are those caught close to the sea or those that move upstream quickly.

Jollytails may mature at 12 months of age, ie. the following autumn. They then migrate back downstream to spawn in tidal marshes in the estuaries. Eggs are deposited in these marsh areas on the high water mark of the peak tides and are left there out of water, but moist, until the following peak tide 14 or 28 days later when hatching takes place.

After hatching, the young are washed to sea to return the following spring.

Problems: - The adult habitat of this species ie. lowland streams, is frequently subject to pollution from agricultural areas.

- Stream barriers, particularly low level flow gauging weirs are a particular problem for this species as it is not a strong climber.

- The spawning sites in the estuaries are also being reduced in many areas by land reclamation projects.

Galaxias truttaceus : The IFC supported a recent study on the life history of this species. Brief details are given by Humphries (1987) and further papers are in preparation.

The spotted galaxias is also a juvenile of about 4-5 months of age when migrating into freshwater in spring. It is somewhat larger than the jollytail and the duration of its migration period is more restricted. It is a very strong swimmer and is less influenced by spates or tidal conditions than Lovettia.

The adult habitat of the spotted galaxias overlaps that of G. maculatus in the lower reaches but extends further upstream. Adults tend to prefer deeper stream sections, often in association with log debris.

This species can have both riverine and landlocked populations with only the riverine populations of significance to the whitebait fishery. These populations spawn in autumn in the streams with the larvae being washed to sea on hatching. Adults mature at two years of age and may live for 5-6 years. Fecundity is quite high for a salmonid fish.

Problems: - Gauging weirs and HEC dams, are a problem for *G. truttaceus* as this species moves further inland than *G. maculatus*.

- Pollution from agricultural areas is also a potential problem for this species.

- As the migration period of *G. truttaceus* is of short duration it would be more at risk from natural or other disasters.

Galaxias brevipinnis : The life history of this species has not been studied and only brief details are available.

It also has both riverine and lacustrine populations. Adult fish inhabit the upper reaches of streams generally above the range of any other species. It can gain access to these areas because of the remarkable climbing ability of the juvenile fish.

Stream dwelling fish probably spawn somewhere near their adult habitat. Very early stage larvae have been collected drifting downstream in May, indicating an autumn spawning period and thus suggesting that the larvae are about five months of age on return.

This species is not as common in most rivers as the preceeding three species although it does occur in significant numbers in the west coast whitebait.

Problems: - As it inhabits the upper reaches of streams the main problem facing this species is large stream barriers in the form of HEC dams.

***Galaxias cleaveri*:** : Again, the life history of this species has not been studied and prior to the present work it was not known to have a whitebait stage in its life cycle.

The whitebait of the mudfish is much smaller than the other whitebait species and its abundance is ofter underestimated. It is only 2-3 months old at this stage, suggesting a mid-winter spawning period.

The adult mudfish inhabit swamp areas in the upper estuaries and lower river reaches. They are able to survive dry conditions by aestivating in the absence of surface water.

Again, it is quite widely distributed around the State but is most abundant in the less disturbed river systems.

Problems: - The estuarine habitat of this species would suffer the same problems as outlined for *L. sealii* .

- The lowland swamps that are the main habitat of this species are also the subject of much land reclamation.

***Retropinna tasmanica*:** : The smelt is not sought after in the whitebait catches but occurs throughout the season, occasionally is significant numbers. Its life history has not been studied in detail.

It can be caught at a range of sizes from about 30-80 mm in length. Several year classes are involved and the larger fish are mature and ready to spawn when taken in the whitebait fishery.

The degree to which the smelt is dependent on either fresh or saltwater is unknown. They are not common any great distance from the sea. Consequently, the effects of any harvesting in whitebait catches are not known.

Problems: - Because of the absence of life history information on this species no specific problems can be identified. It is not favoured as a whitebait species because of the cucumber odour and this may afford some protection.

4. POPULATION STATUS OF ADULT GALAXIAS

During stream survey work around Tasmania over the past few years, populations of *Galaxias maculatus* and *G. truttaceus* have been surveyed. The habitat variables associated with the home range of these species have also been examined.

Some of these stream sections will be surveyed again in 1988 whilst other sections around the State will be surveyed with a view to establishing sites for future monitoring. It is likely that the status of the adult galaxiid populations will be the best future indicator of the stocks of these species.

5. ISOLATION OF POPULATIONS OF *L.sealii* AND *G. maculatus*

Lovettia sealii

To date electrophoretic investigation of approximately 2400 fish has revealed significant genetic variation between samples of *Lovettia sealii* in Tasmania. It was the aim of our study to investigate the population structure of this species by using allozymes as genetic markers. Allele frequencies at several polymorphic loci were compared for samples collected:

1. within river systems over a single tidal cycle
2. within rivers over the duration of the spawning season
3. between rivers

North coast

As reported to FIRTA in 1986 there appears to be a distinct genetic stock based on the northern coast of Tasmania. Samples from the Mersey River, the previous centre of commercial fishing activity, were collected over 3 successive seasons. Results show no significant variation in allele frequencies between 1985 and 1987. Several samples have also been collected from a range of locations across the north coast (Inglis River, Leven River, Duck River) (Fig.4) and results indicate a high level of genetic uniformity.

West coast

In 1987 the first sample of this species was collected from the west coast of Tasmania at the Pieman River. Allele frequency data, particularly results at the Pep-A locus, indicate the existence of a unique stock on the west coast. Attempts to collect this species from Macquarie Harbour, also on the west coast, have had limited success, with only two fish captured that would be suitable for electrophoretic examination.

South-east coast

Derwent River

The Derwent River is characterised by a large and well developed estuary. Information from allozyme screening indicates that this system supports a genetically distinct stock. This is supported by striking differences in allele frequencies observed between samples collected in the Derwent River and those of the nearby rivers which contain Southern stock (see below) representatives. Samples collected in the Derwent River in 1987 were not found to be significantly different from individuals collected in this river in 1986. An investigation to determine the amount of genetic variation which can be expected over the duration of the spawning migration was conducted in 1986. Results indicate no significant genetic variation within this season.

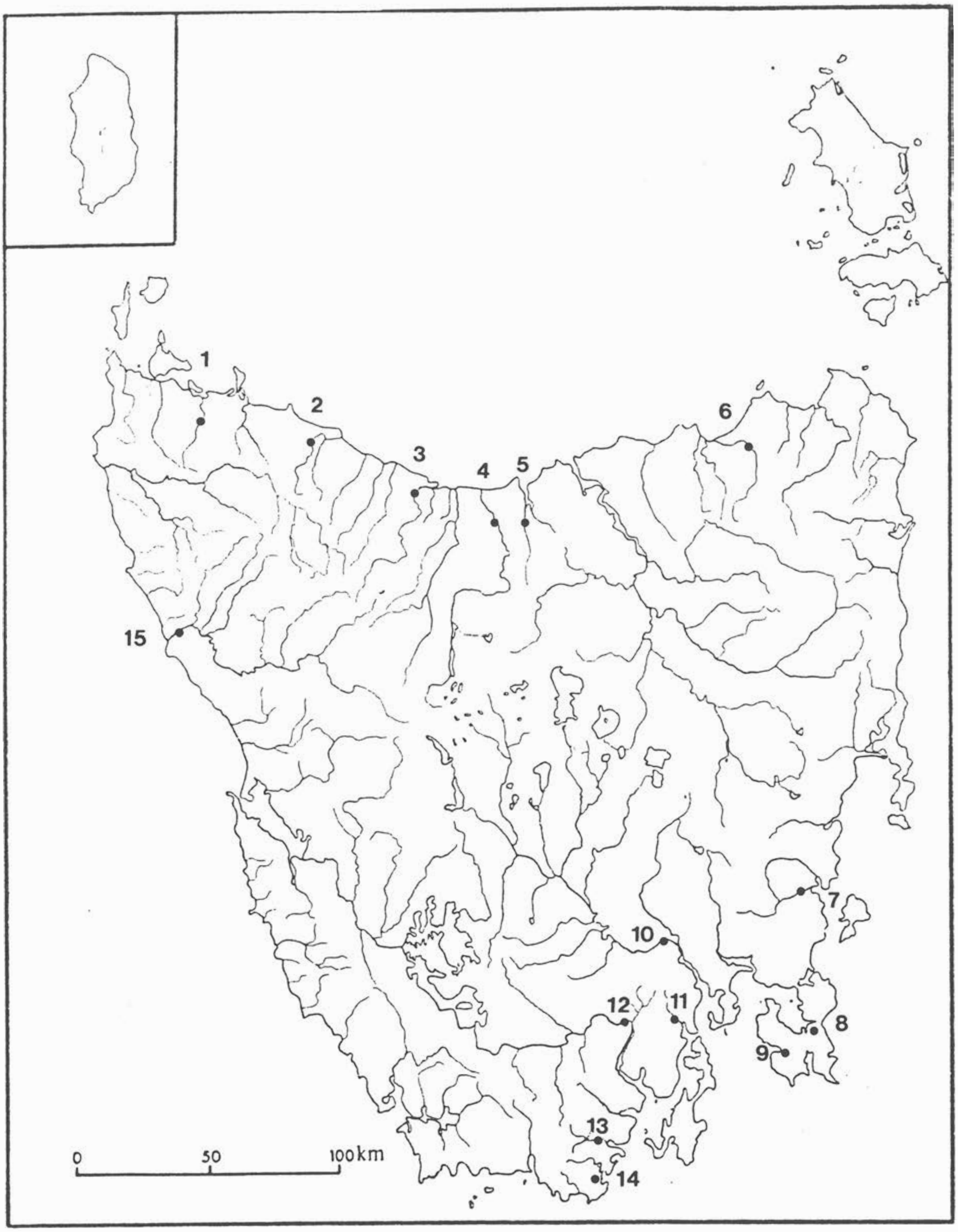
Allele frequencies in the Derwent River in 1986 and 1987 were similar to those observed on the Tasman Peninsula however, they were significantly different from both the Southern and Tasman Peninsula stocks in 1985. The reason for this is thought to be a combination of the larval biology and the hydrology in the area.

Huon and other nearby rivers

A distinct stock of *L. sealii* initially represented by individuals collected from the Huon

River (FIRTA report 1986) has now been extended to include fish from other southern rivers including the Catamaran and Lune (Fig.4). Samples from the Huon River collected in 1985, 1986

Figure 4 : Location of samples collected for electrophoretic analysis.



1. Duck R.	6. Great Forester R.	11. North West Bay R.
2. Inglis R.	7. Prosser R.	12. Huon R.
3. Leven R.	8. Allens Ck.	13. Lune R.
4. Mersey R.	9. Parsons Bay Ck.	14. Catamaran R
5. Rubicon R.	10. Derwent R.	15. Pieman R.

and 1987 display consistency of allele frequencies over successive whitebait seasons.

Due to the differences in the allele frequencies observed in the Huon and Derwent rivers a sample was collected at an intermediate location (NorthWest Bay River) in order to determine the relationship of this area to the surrounding stocks. The results of electrophoretic analysis indicate that fish within this small river belong to the Southern stock of *Lovettia sealii*.

Tasman Peninsula

Samples from the Tasman Peninsula (Allen's Creek and Parsons Bay Creek) (Fig.4) display consistent allele frequencies at all loci over successive seasons. Results of electrophoretic analysis indicate that these fish are not part of the Derwent or Southern stock and will need to be managed as a separate unit.

Summary

There is some evidence from our surveys that larval *L. sealii* do not leave the estuary directly upon hatching. This is supported by the small samples of larval fish that have been recovered close to the adult spawning area at about two months of age. It is possible that some members of this species do not go out to sea but remain isolated within the estuary thus leading to the formation of genetically distinct populations.

Some of the variation observed between seasons in the Derwent is attributed to the complex water circulation patterns in south-eastern Tasmania. In some years the predominant movement of water up the D'Entrecasteaux Channel from the Huon and North West Bay rivers would allow the mixing of Southern stock larvae and Derwent isolates as the water mass enters the Derwent River. The proportion of non-residents which enter the Derwent may account for the fluctuation in allele frequencies observed between successive seasons.

In summary there are at least five stocks of *Lovettia* in Tasmania:

1. Northern
2. West coast
3. Derwent
4. Southern
5. Tasman Peninsula

Galaxias maculatus

Initial analyses of approximately 850 fish collected from four locations in Tasmania, two in New Zealand and one in Western Australia and Victoria revealed the existence of several genetic stocks.

Western Australia

One stock is represented by the Western Australian sample. Electrophoretic analysis of this sample revealed a striking difference in allele frequencies particularly the predominance of the slow allele at the ADA locus in comparison to all other population samples. The low number of alleles per locus which were observed is characteristic of a genetically isolated population.

Victoria

A second genetic stock is represented by the fish collected in the Barwon River, Victoria.

Although this sample shared the most common alleles at all loci it lacked a high proportion of rare alleles observed in the Tasmanian and New Zealand samples.Statistical analysis using G-statistic estimates (log likelihood) revealed that this population is significantly different from all others at the 5% level.The fact that Victorian fish share all common alleles with Tasmania suggests that a small number of migrants may periodically enter the Victorian population in order to maintain some of the rarer alleles.

Tasmania

Samples collected from the extremes of the north coast of Tasmania (Duck and Great Forester Rivers) are not statistically different from each other nor do they differ from the Derwent River in the State's south-east. However, significant variation (at the 5% level) was observed between these rivers and the Prosser River on the east coast. This can generally be attributed to the presence of a number of rare alleles observed in the Prosser sample.Statistical analysis reveals that at the 10% level there is no significant difference between the east coast and north-east coast samples. Thus there is limited exhange of genetic material between the two locations. Therefore the fish of the north and east coasts of Tasmania should be treated as a single genetic stock.

Interestingly the *Galaxias maculatus* samples collected from the east and west coasts of New Zealand's south island are not significantly different from each other nor do they differ significantly from the Tasmanian east coast sample (Prosser River). The exchange of genetic information between Tasmania and New Zealand may be explained by the presence of a marine dispersal phase during the larval stage of this species. McDowall (1968) has previously documented the capture of larval fish of this species 700 km at sea off the coast of New Zealand.

Summary

For management purposes it appears that Tasmanian populations of *G. maculatus* may be regarded as one unit. This work is the subject of an M.Sc. thesis (Pavuk 1988).

6. STREAM BARRIERS

As the adult habitat of some of the whitebait species is above the tidal limits of streams they must negotiate natural river barriers. The climbing ability of the three species concerned is variable with *G. brevipinnis* being very adept climbers whilst *G. maculatus* is not so good.

On most streams there are also artifical barriers with the low level flow gauging weirs being particularly significant for *G. maculatus* and *G. truttaceus*. Crude fish passes have been installed on a number of these weirs but these are negotiable only during certain river flow conditions.

The Don River is one river that does not have a fish pass. The fish populations above and below this weir have been investigated on several occasions, and as shown by the table below, the weir constitutes a significant barrier to migratory fishes.

Electrofishing of this area on subsequent ocassions produced very similar results with the occurrence of large numbers of small migratory whitebait being caught below the weir but with the exception of a single adult *Galaxias truttaceus* none were found above the weir. On one ocassion a single large grayling was caught above the weir. The results clearly indicate that the weir is a very effective barrier to the small migratory stage of whitebait.

It has not been possible to get a fish ladder installed on this weir at this stage but this will be evaluated in future. It is also not possible to evaluate the effectiveness of many other fish passes as the gauging weirs are often situated immediately above tidal areas, therefore fish populations above and below cannot be validly compared.

Further work on the effectiveness of fish passes on the low level weirs will be a priority in the future.

Table 2 : Fish catch above and below the Don River weir (15 nov. 1985)

	Below weir	**Above weir**
Brown trout	5	17
Short-finned eel	1	2
Pouched lamprey	6	-
Short-headed lamprey	5	-
Sandy	19	-
Spotted galaxias	93	1
Jollytail	277	-

In addition to these low level weirs most of the states major rivers have been dammed for hydro-electric power generating purposes. Depending on the siting of these dams they may effect migrations of several galaxiid (and other) species. Usually the migrant (*G. brevipinnis*) is the main species affected although large numbers of *G. truttaceus* and *G. cleaveri* collect below the Pieman dam each year. Fish passes are not provided on these dams and a large area of former habitat is therefore unavailable.

The physical barrier to migration is not the only problem arising from the large dams. There is also a subsequent change in river flow regimes both physical and chemical with consequent influences on the habitat of adult and migratory stage fishes, as well as on the actual migration stimuli themselves.

7. POLLUTION

The effects of certain pollutants on some of the whitebait species have been investigated in association with other research projects.

Adult *G. maculatus* have been used in investigations of sub-lethal effects of the commonly used pesticides acephate, MCPA and Fenitrothion. These pesticides are extensively used in the agricultural areas around the major habitat areas of *G. maculatus*, especially on the north west coast of Tasmania. The results of this study are not yet available.

The toxicity of paper mill effluent, in particular the resin acid component, has also been examined. This is particularly relevant to the Derwent River. The species investigated in this case were *L. sealii* (adults, eggs and larvae), *G. maculatus* (adults and whitebait) and whitebait stages of *G. cleaveri* and *G. truttaceus*.

Apart from establishing the relevant LC50 values for the resin acid mixtures which have been referred to the company concerned, other findings of the work were:

- all fish species tested showed similar responses to the resin acids.
- the resin acids have one principle mode of toxic action.
- when exposure ceases, significant mortality does not continue.

However, although *L. sealii* should not be significantly affected by a short passage through an effluent plume it appears that the hatching of eggs of this species exposed to moderate levels of effluent may be inhibited.

8. COMMERCIAL CATCH POTENTIAL

Apart from the Mersey and Rubicon rivers the possible catch from several other rivers has been estimated. This was done in 1985-86 using scoop and D nets as used in the former commercial fishery, whilst in 1987 large box traps similar to those used in New Zealand were used in certain rivers. The catches from this work are shown in Table 3 but with the exception of the Mersey, Rubicon and Pieman 87 catches the figures are by no means exhaustive.

Table 3. : Catch returns from experimental commercial style fishing.

River	Min. catch /day	Max. catch /day (kg)	Aver. catch /day fished(kg)	Est.catch /season (kg)
Pieman 87*	0	65	9.2	650
Arthur 87*	7 g	7.8	2.7	-
Derwent 87*	100 g	12.5	1.4	100
Duck 86	4 kg	75	22.3	2000
Duck 87	0	4.5	0.8	-
Inglis 86	0	41.8	11.3	800
Inglis 87	0	9	2.4	-
Mersey 85	0	72	22.5	1300
Mersey 86	0	124	15	1000
Mersey 87	2.8 kg	1000	127	7500
Rubicon 85	0	198.5	31	1800
Rubicon 86	0	105.5	28	2000
Rubicon 87	100 g	584	54	4000

*Large box traps used - insufficient data to estimate

The catches for the Mersey and Rubicon rivers are essentially *L. sealii* whilst those for the other rivers are mostly various galaxias. The Derwent was not fished during the short migration of *Lovettia* in 1987.

The last column of this table estimates the possible catch for one fisherman from these rivers. These are very much an estimate but they do indicate potential. It is highly likely that closer attention to fishing methods and sites on each river would enhance the catch. Inability to continually monitor each area was a considerable drawback with this research as was the need to maintain consistent fishing methods necessary for comparative purposes.

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