South Esk – Great Lake
Water Management Review

Scientific Report on the Upper Lake River

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UPPER LAKE RIVER

1. ASSESSMENT OF ISSUES AND STATUS

Development History and Present Management

The upper Lake River comprises approximately 10 km of river channel between Arthurs Lake and Woods Lake. Over this distance the channel drops about 200 m, from an elevation of 940 m above sea level at Arthurs Dam to about 740 m above sea level at the inflow to Woods Lake.

The construction of Arthurs Dam in 1963 completely diverted the flow of the upper sections of the Lake River. Apart from sporadic releases in the early 1970s, and recent releases to 'top up' Woods Lake (December 1995, July 2000), all of the natural flow in the Lake River has been diverted into Great Lake to generate electricity at the Poatina Power Station. This diversion reduced the effective catchment area of the upper Lake River from more than 266 km^2 to about 21 km^2.

The major tributary stream is Jacks Creek, which drains Jacks Marsh, to the west of the river. This tributary is regulated to some extent by the Ripple Canal Diversion, which captures the headwaters of Jacks Creek and diverts them into the Lagoon of Islands. The flow in Ripple Canal may be re-diverted back into Jacks Creek, augmenting its natural pick up. Operationally, this occurs during the initial discharges of the winter, which allows sediments and nutrients that have built up in the dry channel of the canal over the summer to be diverted away from the Lagoon of Islands and into the Upper Lake River. It is thought that wetlands at the junction of Jacks Creek and the Upper Lake River settle most of these sediments out before this water then flows into Woods Lake.

Discharge in the upper Lake River, between Arthurs and Woods Lake, is now limited to local pick up in the Lake River and Jacks Creek catchments. Figure 1 shows the upper Lake River and Jacks Creek, and their relationship to Arthurs and Woods Lakes and the Lagoon of Islands.

Discharge data are available for the upper Lake River immediately downstream of the Arthurs Dam from 1944 to 1990. Figure 2 shows the daily discharge values, in cumecs, for this period. The figure illustrates both unregulated (pre-1963) and regulated flow in the river. This figure shows that, following closure of the dam in 1963, discharge released into the upper Lake River, under normal operating conditions, has effectively been zero.

The biological issues that have been identified for the upper Lake River during earlier stages of the South Esk – Great Lake Water Management Review were related to the natural dispersal and migration requirements of the threatened native fish species, the saddled galaxias (*Galaxias tanycephalus*) and the Arthurs paragalaxias (*Paragalaxias mesotes*). In the four decades since the riverine connection between Arthurs Lake and Woods Lake was broken, both these native fish species have persisted in Arthurs Lake, while *Paragalaxias mesotes* has apparently disappeared from Woods Lake.

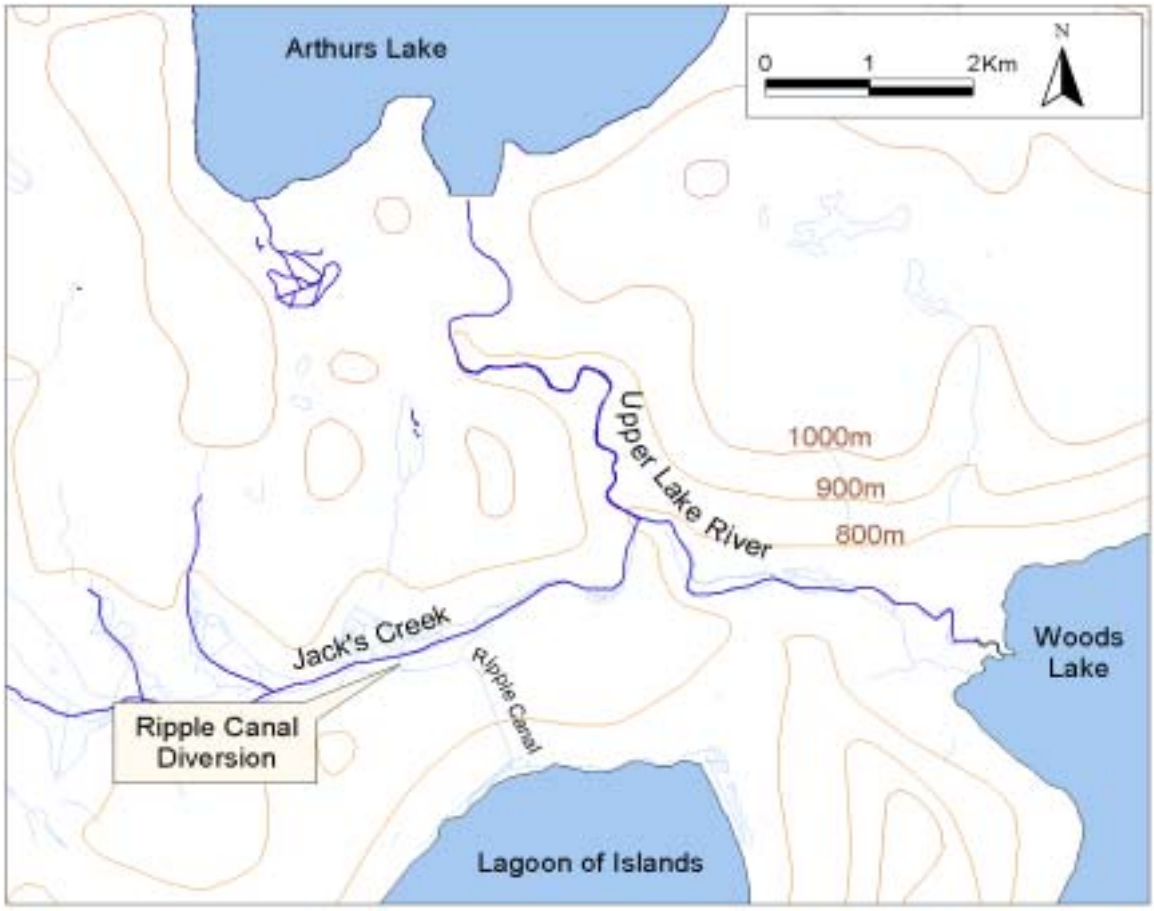

Figure 1: Map of the upper Lake River and surrounds

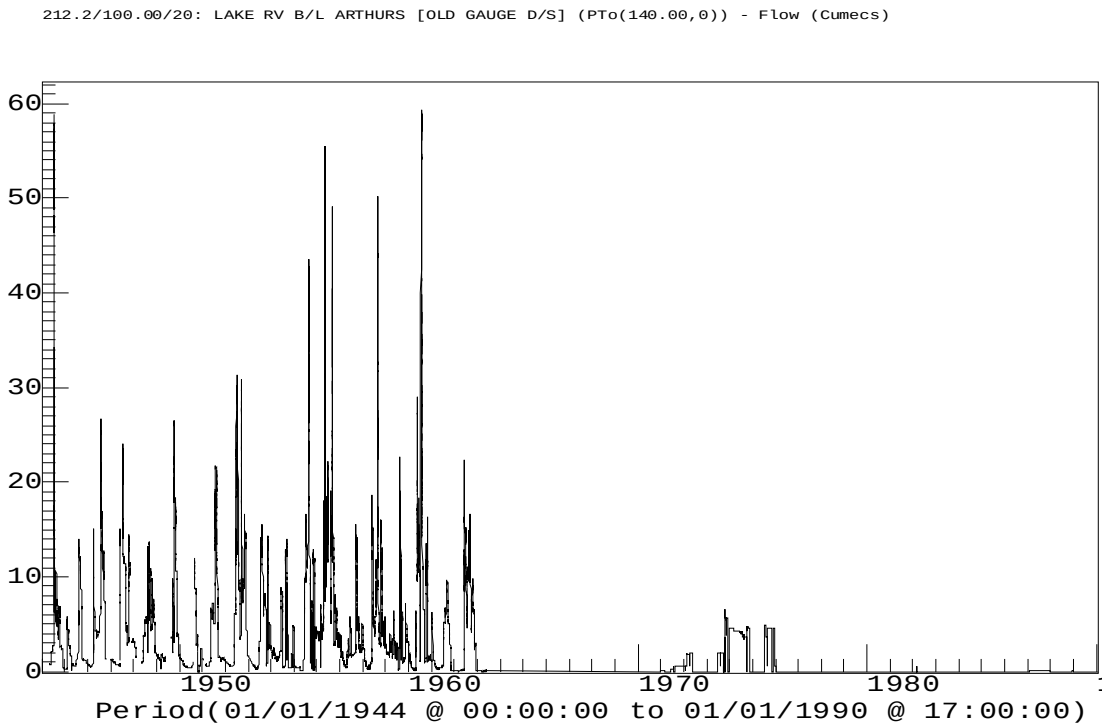

Figure 2: Daily discharge (cumecs) for the upper Lake River immediately downstream of Arthurs Dam for the period January 1944 to December 1989. The dam was closed in 1963

Threatened Species

Historically, the saddled galaxias (*Galaxias tanycephalus*) and the Arthurs paragalaxias (*Paragalaxias mesotes*) have had distributions restricted to Woods and Arthurs Lakes. Populations of *G. tanycephalus* continue to exist in both lakes, however *P. mesotes* has not been recorded in Woods Lake in recent years. Prior to the construction of the Arthurs Dam, the upper Lake River formed a riverine connection between these two lake-based populations. *G. tanycephalus*' distribution appears to include the upper Lake River, although its riverine habitat requirements are not clear.

The self-sustaining nature of the lake-based populations suggests that regular dispersal between the lakes is not essential to their continued survival, however pre-dam downstream dispersal from Arthurs into Woods Lake may have provided a path for recruitment into Woods Lake.

Both species are listed as 'Endangered' under the Tasmanian *Threatened Species Protection Act* 1995, due to their restricted distribution, and the effects of predation from introduced trout in their habitat range. *G. tanycephalus* is also listed as 'Vulnerable' and *P. mesotes* has recently been nominated for listing as 'Endangered' under the Commonwealth's *Environment Protection and Biodiversity Conservation Act* 1999.

Introduced Recreational Fish

Woods Lake supports a self-sustaining population of the brown trout (*Salmo trutta*) and a smaller population of the rainbow trout (*Oncorhynchus mykiss*). Both introduced exotic species are predators of galaxiids and predation is considered to be a threatening process associated with the decline in native fish populations in this lake. Both salmonids utilise the upper Lake River for spawning when there is sufficient discharge to facilitate fish passage to suitable spawning areas during the spawning seasons for each species. The interactions between migrating trout and dispersal attempts by the endemic species are presently unknown.

2. Formulation of Study Objectives

The main environmental issue for the upper Lake River is the reduction in discharge caused by the diversion of its upper catchment. Local pickup in the river and its tributaries provides some seasonally variable discharge, but the volume has been greatly reduced and the incidence and duration of zero flows has been greatly increased, especially in the upper half of this stretch of the river.

The objective of this study was to investigate whether either threatened species uses, or attempts to use, the upper Lake River for dispersal, migration or other key life-cycle purposes. Information regarding this issue is seen as critical to determining whether a formal 'environmental flow' is required in this reach of the river. The following section details the sample methods, results and a general discussion of the studies findings.

3. DATA COLLECTION AND ANALYSIS

Native Fish Sampling

Methods

Fish distribution was assessed by netting at multiple sites along the upper Lake River, between the Arthurs Dam and Woods Lake. Fine-mesh single 5 m wing fyke nets were used, and these were fitted with platypus and trout exclusion panels in the mouth of the net. Trout were excluded to remove the threat of large trout predating upon captive galaxiids, while the exclusion nets prevent platypus from entering the nets and drowning. The nets were deployed overnight. Upon retrieval, captive fish were identified, counted, measured (fork length) and released.

Sites were sampled on two occasions; 26 - 27 July and 12 - 13 September 2001. Six sites were sampled during the first survey (UL 02-UL08), but this was cut back to 5 sites in September as site UL08 had been inundated by a rise in water level in Woods Lake.

Brown trout were collected from the Lake River for gut content analysis. Fish were collected using backpack elecrofishing equipment. The Inland Fisheries Service Biological Consultancy carried out analysis of trout gut contents.

Sites

A brief description of the sites sampled during the survey is provided below. Site nomenclature was derived from a preliminary technical study conducted in 2000/2001. Several of the original sites used in the preliminary study were removed, as they were unsuitable for the current study.

Site UL02

Located about 9.25 km upstream of Woods Lake (2.25 km downstream of the dam), this site was flowing moderately at the time of sampling, and consisted of areas of bedrock interspersed with moderately deep pools. Tea-tree formed dense marginal stands on both sides of the stream and within the channel, wherever appropriate habitat was available.

Aquatic macrophytes comprised relatively dense stands of a grass-like macrophyte, with some filamentous algae attached. Small individual *Triglochin procera* and scattered *Potamogeton* spp. were also common.

Site UL04

Site UL04 was located approximately 3.85 km upstream from Woods Lake. The channel was steeply incised, with fast flowing water and numerous cascades and riffles. The immediate riparian (within the incised margins) vegetation was comprised of thick tea-tree. No macrophytes were observed.

Site UL05

This site was located in the upper region of Pattersons Flats, about 1.8 km upstream from Woods Lake. The site was relatively wide and slow flowing with considerable canopy cover. The riparian tea-tree community was well developed, with thick, vigorous growth on the stream margins and taller, more-senescent

stands away from the stream. Many of the taller stands had suffered tree fall, probably due to the effects of high winds. The understorey vegetation consisted mostly of ferns.

No aquatic macrophytes were observed, although occasional ferns occurred in littoral areas.

The lesser slope of this reach of the river meant that there were shallow marginal areas with very low water velocities. These areas were characterised by deposits of small woody debris.

Site UL06

Site UL 06 was located approximately 1 km upstream of Woods Lake. The site was open and relatively shallow, with backwaters fringed with woody debris.

Site UL07

This downstream site was located in the lower reaches of the upper Lake River, approximately 200 m upstream of Woods Lake. The site was basically the flooded river channel, characterised by short grass and macrophytes but with no overhanging riparian vegetation. Despite the width of the river channel, flow was noticeable at the site.

Site UL08

Site UL 08 was the most downstream site assessed during the survey, located within Woods Lake adjacent to the flooded river channel levee.

Results and Discussion

Figure 3 shows the catch per unit effort (fish per net hour) for all sites using pooled data from both sample occasions. A total of 383 saddled galaxias were captured in July compared to 72 in September, however it should be noted that the majority of fish caught in the July sample (n = 294) originated from site UL08, which was subsequently removed from the September survey for the reasons outlined above. The histogram shows that saddled galaxias occur in the Lake River, and were found as far upriver as site UL05 (~1.8 km upstream of Woods Lake). Arthurs paragalaxias were not captured during the surveys. Figure 3 shows that although numbers of saddled galaxias are significant at the river mouth; they rapidly decrease with distance upstream of Woods Lake.

Less than one percent of the fish captured during the July survey were ripe (i.e. containing developed eggs), while no ripe fish were observed in the September survey.

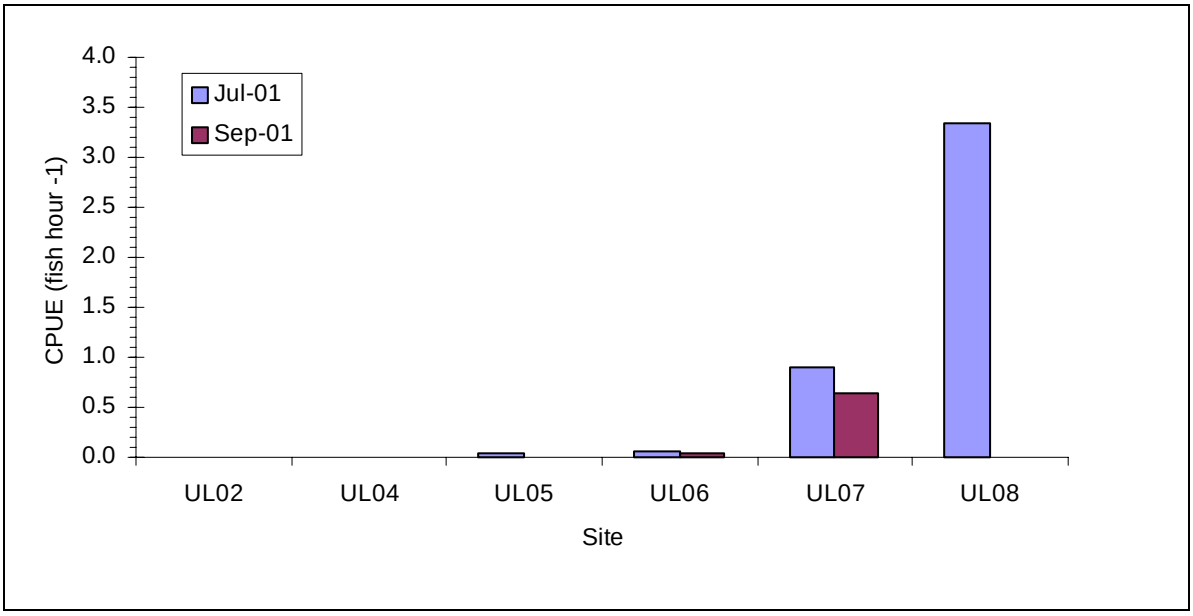

Figure 3: Catch rate of saddled galaxias captured by fyke netting in the Lake River during July 2001 and September 2001

Figure 4, Figure 5 and Figure 6 show the length frequency distribution of saddled galaxias captured in the Lake River. Figure 4 shows data from all sites sampled in July, while Figure 5 also shows July data, but excludes data from site ULR08 as it was considered a lake site. Figure 6 shows data from all sites sampled in September. These histograms show that the majority of fish ranged in size between 50 mm and 65 mm. The July data displayed a larger size range in comparison to the September sample, but this was principally due to small numbers of outlying (larger) individuals. Modes were similar between the histograms. Generally, there was little difference in population structure between surveys.

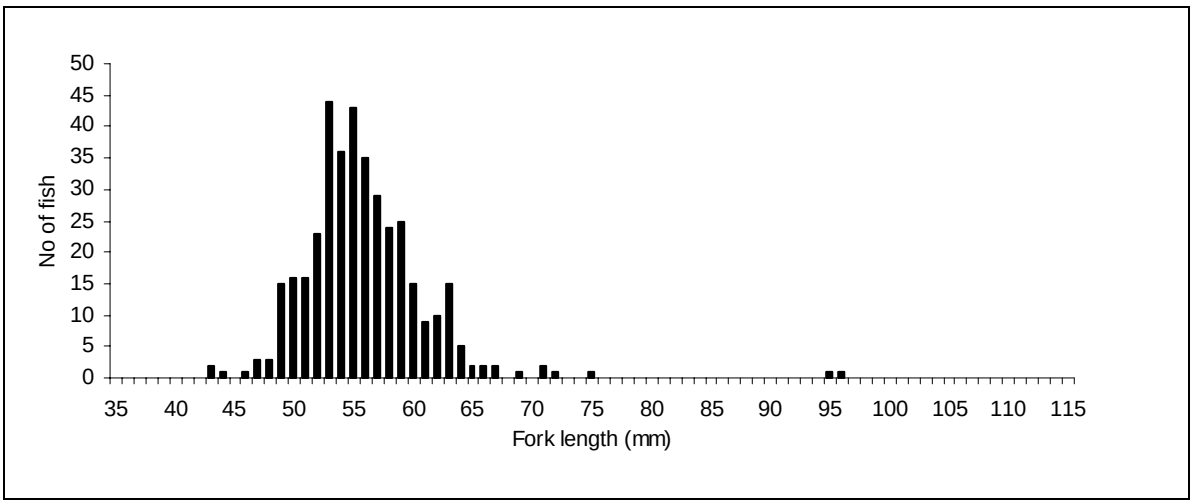

Figure 4: Length frequency histograms from saddled galaxias collected by fyke netting in the Lake River during July 2001. n = 383

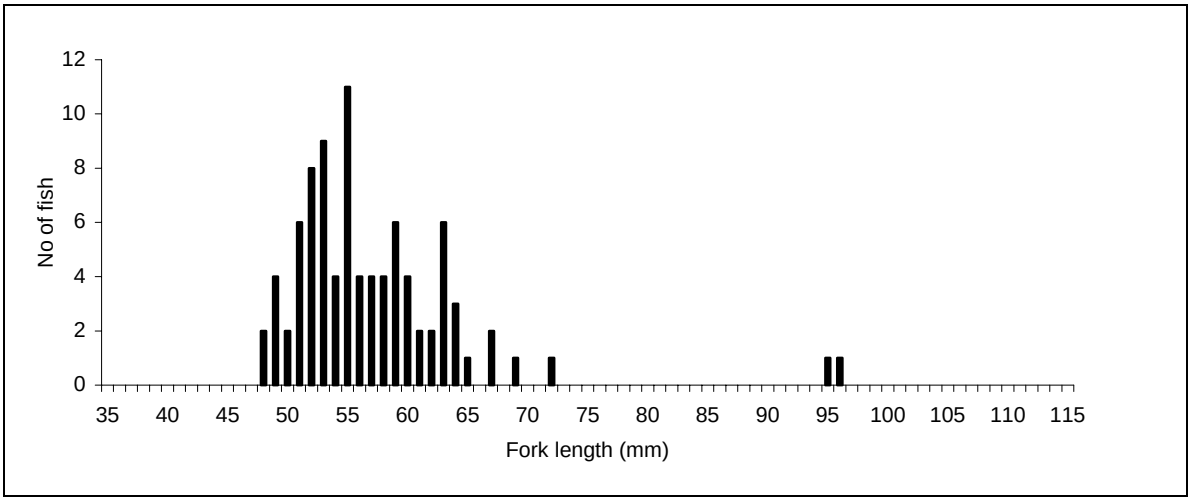

Figure 5: Length frequency histograms from saddled galaxias collected by fyke netting in the Lake River during July 2001, excluding data from site ULR08. n = 89

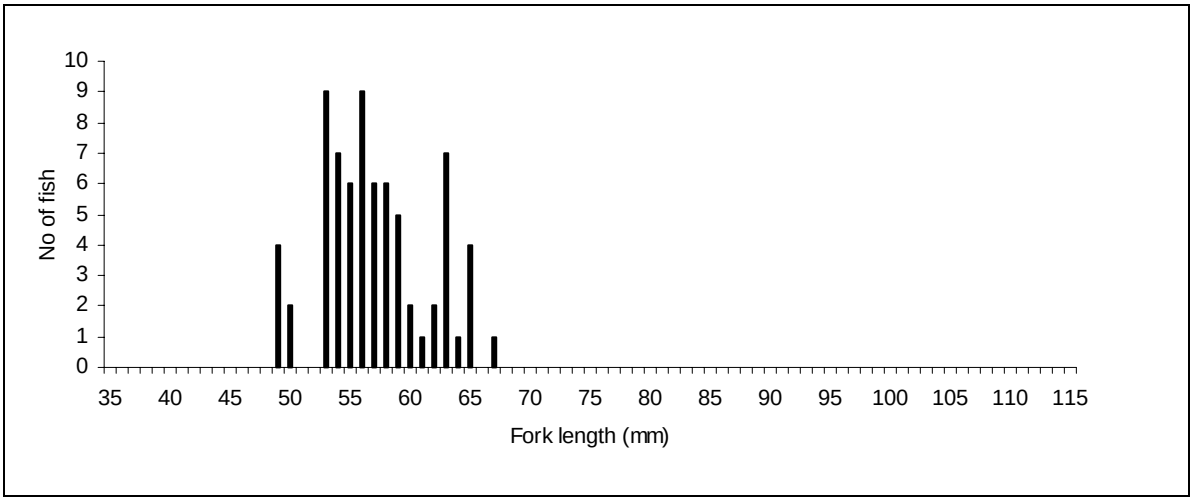

Figure 6: Length frequency histograms from saddled galaxias collected by fyke netting in the Lake River during September 2001. *Site UL08 was not sampled. n = 72

Six brown trout were collected at site UL05 by electrofishing for approximately 20 minutes. The digestive tracts of these fish were removed and preserved, but were later found to be empty. The trout were aggregated prior to capture, and a significant proportion were in ripe condition indicating that the fish were preparing to spawn. This probably accounts for their lack of stomach contents at this time.

The results of this survey indicate that, although small numbers of saddled galaxias occur short distances upstream, the Lake River does not appear to offer spawning or significant habitat for *G. tanycephalus*. Saddled galaxias appear to move into the river opportunistically, probably as an artefact of their general dispersal behaviour.

P. mesotes was not captured during the survey, and given that current evidence indicates that they are probably locally extinct in Woods Lake, the study provided no insight into their potential utilisation of the Lake River.

Management Implications

The management implications of the Lake River, particularly those relating to the conservation of *P. mesotes* and *G. tanycephalus*, are closely linked to those of Woods Lake and Arthurs Lake by virtue of the natural distribution of the species and the potential role the river may have in linking these lakes. While the Lake River does not appear to be important habitat for saddled galaxias, and the potential use of the river by *P. mesotes* remains unclear, the river would originally have provided a downstream dispersal pathway for galaxiids to recruit to Woods Lake. Apart from the occasional operation of the siphon on Arthurs Dam, this linkage is broken for the majority of the year, with unknown implications for the threatened galaxiid populations in Woods Lake.

Environmental Management Options for the Upper Lake River

The dominant environmental issue for the upper Lake River is the reduction in discharge caused by the diversion of its upper catchment. Local pickup in the river and its tributaries provides some natural seasonality in discharge pattern, but the volume has been greatly reduced and the incidence and duration of zero flows has increased.

The principal management issue arising from these changes is whether there is a need to provide an additional discharge from Arthurs Lake to supplement the local pickup and to re-establish the riverine connection between Woods and Arthurs Lakes.

The existing management objective for threatened galaxiids in the upper Lake River, Arthurs Lake and Woods Lake are linked, and focus on the conservation of *P. mesotes* and *G. tanycephalus* populations in the catchment.

4. OPTIONS

Management options for the lake river fall into two categories; flow management and threatened species management. Management options for the Lake River are also linked, by virtue of its geographical position, to those of Woods Lake and Arthurs Lake.

Environmental Flows

Flow management options identified for the upper Lake River are as follows;

1. Permanent environmental releases;
2. Seasonal downstream dispersal flows for threatened galaxiids; or
3. No change to current management.

Existing management does not appear to have created significant environmental problems in the upper Lake River, although vegetative encroachment by tea-tree (*Leptospermum* spp.) of the original streambed is well established down the length of the river. The existing conditions facilitate spawning for the exotic trout thus enhancing the recreational fishery of Woods Lake. From this perspective, no change in management is considered necessary. A permanent, year-round environmental flow release from Arthurs Dam would be costly and of uncertain benefit to the conservation of galaxiids in Woods Lake, as there is no evidence that

native fish rely on flows in the river for any part of their life-history. No permanent environmental flow release is therefore recommended. Similarly, seasonal downstream dispersal releases, while less costly, will not guarantee the re-establishment of *P. mesotes* in Woods Lake. Strategies for threatened species management are discussed below.

Threatened Species Management

Due to its tenuous position in Woods Lake, threatened species management options for the upper Lake River focus on *P. mesotes* and are as follows;

1. direct translocation of *P. mesotes* from Arthurs Lake to Woods Lake;
2. direct translocation of *P. mesotes* from Arthurs Lake to the upper Lake River;
3. flow releases from Arthurs Lake to facilitate the downstream dispersal of *P. mesotes* to replenish stocks in Woods Lake; or
4. no active management of *P. mesotes.*

Under the existing conditions, native fish are able to utilise the riverine habitats, although their requirements for this appear opportunistic and of limited ecological importance. Occasional water release from Arthurs Lake to supplement the yield of Woods Lake may be beneficial to the threatened galaxiids in the lake. Although not directly beneficial in terms of maximising critical habitat, releases may provide Arthurs paragalaxias seed stock to Woods Lake, and possibly increase the genetic diversity of the Woods Lake saddled galaxias population.

Given its conservation status, threatened species in the catchment require management. The preferred option for management of *P. mesotes* in Woods Lake is by direct translocation from Arthurs Lake, as known quantities and size ranges of fish may be released when and where appropriate. Direct translocation also has the benefit of being relatively inexpensive in comparison to water releases. Translocations into the upper Lake River would presumably require releases to facilitate downstream passage if conducted during summer, and have no advantage over direct translocation to Woods Lake. However, while direct translocation is the preferred option to re-establish *P. mesotes* in Woods Lake, it is important that the factors behind the species presumed local extinction are understood and rectified to assist in their re-establishment following translocation.