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Galaxias gollumoides of the Nevis River

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Clutha Fisheries Trust
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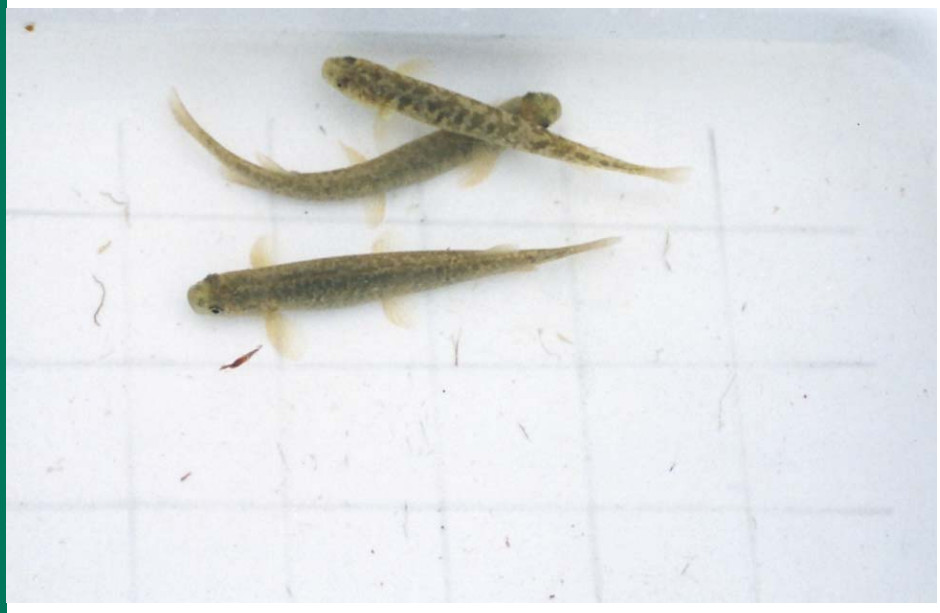

REPORT

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Table of Contents

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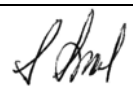
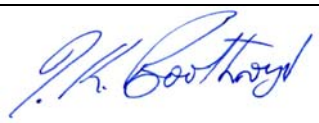
Approved Reviewer(s)	SCOTT SPEED	
Approved Signatory	IAN BOOTHROYD	

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Summary

Gollum galaxias *Galaxias gollumoides* is a non-migratory galaxiid found in Otago, Southland and Stewart Island. A population of galaxiids was discovered in the Nevis River and its tributaries in the mid-1990s. Subsequent genetic investigations both of the Nevis River populations and elsewhere determined that the Nevis population of fish was part of the Gollum galaxias species. However, the population is distinct from all other Gollum galaxias populations and the population is a basal offshoot that has inhabited the Nevis River since a river capture event some five hundred thousand to eight hundred thousand years ago. The genetic data, when compared with other non-migratory galaxiid species in the region, indicates that the species status of the Nevis River population warrants further investigation. To date biological and morphological studies have not investigated the relationship between the Nevis River population and other Gollum galaxias populations.

The Nevis River population of Gollum galaxias can currently be classified as a distinct Evolutionary Significant Unit within the species and is the only population in its unit. The population also classifies as a *key population* using criteria from the New Zealand non-migratory galaxiid recovery plan. The population is also one of the most northerly in the distribution of Gollum galaxias and it occupies an altitudinal range far higher than any other Gollum galaxias population. As a result of this distributional distinction, the population is likely to reside in a significantly different climatic zone to other Gollum galaxiid populations.

It is therefore concluded that the Nevis River population is a unique population within the Gollum galaxias species. The population is characterised by unique mtDNA haplotypes and a distinct geographic distribution when assessed against all other Gollum galaxiid populations. It is also one of the only five non-migratory galaxiid populations known in the Kawarau River catchment and is a large population of non-migratory galaxiids in an area where they are an uncommon faunal element.

The current Water Conservation Order that protects the Nevis River does afford the population some protection. However, the construction of a hydro-electric power scheme in the Nevis Valley, at this time, represents an uncertain level of detrimental impact on the Gollum galaxias population. Habitat and fish passage barrier loss will lead to detrimental effects in the vicinity of the reservoirs. A more significant threat is the possibility of the establishment of a landlocked population of koaro in the Nevis Valley that could have significant effects on Gollum galaxias well upstream of the reservoirs and above barriers to salmonid passage.

1.0 INTRODUCTION

1.1 Background

The Nevis River is a high altitude river tributary of the Kawarau River in the Clutha River catchment. The catchment is currently subject to a Water Conservation Order (WCO) application submitted by Fish & Game Otago. The Nevis River is currently protected by the 1997 Water Conservation Order (Kawarau River) (Appendix 1), but this WCO does allow hydro-electric development in the Nevis catchment. The river is highly valued in regard to fisheries, with a large number of back country trout anglers travelling into the Nevis Valley (Olsen & Hayes 2006). The river also has significant biodiversity value with the presence of a unique lineage of the native fish Gollum galaxias (*Galaxias gollumoides*), within the Nevis Valley (Waters et al 2001).

This report reviews the status and biodiversity value of the Gollum galaxias population in the Nevis River.

1.2 The Nevis River Catchment

The Nevis River is a tributary of the Kawarau River and flows into the Kawarau River near the upstream end of the Kawarau Gorge. The Nevis catchment is 689 km^2 and drains the Hector and Garvie Mountains and Remarkable Ranges. The lower section of the Nevis River descends to the Kawarau River confluence through a steep gorge. The upper 40 km is, in contrast, a relatively gentle gradient river with numerous tributaries that drain the adjacent mountain ranges.

The catchment landuse is generally low intensive summer sheep grazing and conservation estate with some pasture development in the lower Nevis Valley. The region lacks any forest vegetation, but shrubs and tussock are dominant on the valley floor and mountains. Exotic vegetation is limited to some willows along the Nevis River but rarely on the tributaries, shelter belts around homesteads, occasional wilding pines and pasture grasses amongst the tussocks. Localised areas of gold mining have occurred historically during the late 1800's during the Otago gold rush and continue up until the present at localised sites. Despite the mining activity, much of the river and it tributaries are unmodified (Allibone pers. obs.) and possibly the most significant feature of the mining activity are the water races that still remain on the hillside in the catchment.

Four fish species are recorded as being present in the Nevis River, Gollum galaxias, brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*) and brook char (*Salvelinus fontinalis*) (New Zealand Freshwater Fish Database, NZFFD). The latter three are introduced fish that have been shown to have significant negative impacts on native non-migratory galaxiids across the South Island (e.g., Townsend 1996; McIntosh 2000; McDowall 2006).

1.3 Water Conservation Order for the Kawarau River

The scenic and recreational values of the Nevis River are protected by the WCO (Kawarau River) but the WCO does allow hydroelectric development to take place within the Nevis Valley (Appendix 1). However, restrictions have been placed on the hydro-electric development. These include a provision for fish passage that would allow fish to migrate from the lower Nevis into the upper section of the river and that any impounded water must not extend beyond a specified map reference (NZMS 260 F42 943468), approximately six kilometres upstream of the Nevis Crossing.

The WCO has no provisions to protect the population of Gollum galaxias present within the catchment. At the time of the original WCO hearings neither the presence nor the status of the population of Gollum galaxias was known and as such this biodiversity value information was not available to the WCO Commissioners.

1.4 Scope of Report

This report reviews the conservation status and biodiversity value of Gollum galaxias in the Nevis River catchment. It compares the current knowledge of this population of Gollum galaxias with Gollum galaxias else where in Otago, Southland and Stewart Island and uses information on:

- Gollum galaxias distribution;
- Habitat use;
- Co-existence with other fish species; and
- Genetic information.

The conservation value of the Nevis River population is assessed against criteria from the New Zealand Non-migratory galaxiid Recovery Plan (Department of Conservation 2003). Threats to the population including the potential impacts of hydro-electric development in the catchment are briefly assessed to indicate the probably risk to the population if development occurs.

2.0 GALAXIAS GOLLUMOIDES

2.1 Recognition of *Galaxias gollumoides*

A series of descriptions and redescriptions of non-migratory galaxiids of Otago and Southland was undertaken in the 1990's. Allibone et al. (1996) first recognised that distinct new taxa existed in Otago and McDowall & Wallis (1996) described *Galaxias depressiceps* (flathead galaxias) for the first time and redescribed *Galaxias anomalus* (roundhead galaxias). Both species were reported to range over much of Otago and Southland. A second pair of new species were described by McDowall (1997), *Galaxias eldoni*, (Eldon's galaxias), and *Galaxias pullus*, (dusky galaxias), both from the Taieri River catchment. Continued investigations of galaxiids in Otago and Southland by the Department of Conservation coupled with genetic identification of fish collected found further galaxiids and hybrid populations (Esa et al. 1999). This subsequent work identified new galaxiids in the Clutha River catchment that were given the tag names of *Galaxias sp'D'* and *Galaxias teviot*. Additional collections from the Nevis River, Von River and from across Southland identified further mtDNA lineages that, while similar to existing lineages, were distinct enough to question the taxonomy of the species described at that time. All the non-migratory galaxiids collected fit into two distinct groups, flathead galaxiids (*Galaxias vulgaris*, the Canterbury galaxias, flathead galaxias, *G. spD* and *G. teviot*) with blunt heads and roundhead galaxiids (*G. anomalus*, *G. pullus*, and *G. eldoni*) with roundhead snouts. This general morphological difference was supported by the mtDNA lineages that also indicated two sister groups flatheads and roundheads.

A re-examination of historical samples collected from across the southern South Island and Stewart Island noted some unusual specimens including a roundhead type from Stewart Island, collected from the Robertson River at the southern end of Stewart Island (McDowall pers. com.).

Two return trips to the Robertson River were made in 1998-99 to re-collect this fish for morphological and genetic analysis (Allibone & Chadderton unpub data). Further surveys were made across Stewart Island to determine if this fish could be located elsewhere and a second population was located in wetlands in the Freshwater River catchment (McDowall & Chadderton 1999). Genetic and morphological analysis determined that the Stewart Island fish were distinct from all other roundhead galaxiid types. Subsequently McDowall & Chadderton (1999) described a new roundhead species *Galaxias gollumoides*, the Gollum galaxias.

Continuing work on this species determined that it was widespread across Southland and that the population of roundhead galaxiids in the Nevis River were most closely related to Southland Gollum galaxias rather than other Clutha River galaxiids such as the roundhead galaxias (Waters et al 2001; Burridge et al. 2007; Anderson 2007).

2.2 Life History of Gollum galaxias

The biology of Gollum galaxias is not well understood, as little research has been conducted on this fish species. However, studies of other closely related species and anecdotal observations of Gollum galaxias can be used to provide some understanding of this species.

Galaxias gollumoides is a non-diadromous species, spending its entire lifecycle in fresh water. Spawning occurs in spring (McDowall & Chadderton 1999, Dunn 2007), with the fish species spawning in a variety of habitats that reflect the available habitat. Larval fish are in the order of 6 - 8 mm long on hatching from the approximately 2 mm diameter eggs. The longevity and maximum size of Gollum galaxias are unknown. There is considerable variation in the size range of fish collected at different sites. McDowall & Chadderton (1999) noted that the two populations on Stewart Island from a river and wetland habitat were small, generally less than 80 mm long. Similar populations of small fish occur in the Catlins region and tributaries of the lower Clutha River (Allibone pers. obs.). Chadderton (unpub. data) also noted the presence of a large elongate body form of Gollum galaxias (up to 150 mm) in the small hill tributaries in the upper Mataura River catchment. Gollum galaxias in the Nevis River catchment have been noted to grow up to 130 mm (Allibone pers. obs.) and could be expected to be similar to the upper Mataura River fish.

Habitat use by Gollum galaxias is highly variable. The type locality is a shallow wetland. The fish is also found in small (< 1 m wide) bedrock dominated forest streams (Catlins area) to the sandy bed Robertson River of Stewart Island that is over 10 m wide. The fish is common in small streams in the Southland tussock areas in the upper reaches of the Oreti, and occurs in tributaries of the Waiau and Mataura Rivers. There are populations from heavily modified streams in the agricultural landscape of the lower Mataura River catchment and the Waimea Plains (Dungey 2004). In the upper Mataura River catchment the fish is also found in wetlands formed in the terminal moraine deposits left since the last glacial period. From survey results it is apparent the fish is capable of occupying relatively steep streams (Chadderton unpub. data), something its close relative *G. anomalus* is not capable of doing (Allibone & Townsend 1997).

2.3 Distribution

2.3.1 Distributional Range

Galaxias gollumoides is endemic to the southern South Island and Stewart Island (New Zealand Freshwater Fish Database, NZFFD, McDowall & Chadderton 1999, Figure 1). It has been

recorded at only two sites on Stewart Island, Chocolate Swamp and the Robertson River. In Southland it occurs in tributaries of the Mataura, Oreti, Aparima and Waiau Rivers. The stream habitat utilised by Gollum galaxias over much of its range are in areas developed for agricultural use and the channels are often straightened and maintained for drainage purposes. Riparian margins are developed and unshaded and stock access to the stream is common (Dungey 2004, NZFFD, Allibone pers.obs.). Within the Catlins forest area and Stewart Island, the habitat is substantially less modified and stream channels are generally natural with good shading and indigenous riparian vegetation (Figure 2).

The distribution of Gollum galaxias in Southland includes two conspicuous areas of absence; one in the Waikaia River, a major Mataura River tributary and the second across the Southland Plains. The Waikaia River system extends northwards from the Mataura River draining the Garvie, Old Woman and Old Man Ranges of northern Southland and central Otago. Freshwater fish surveys in the last decade have found much of this area to be devoid of native fish (Figure 3). The potential exists for migratory native fish such as longfin eel (*Anguilla dieffenbachii*) (E. Edwards, DoC pers. com.) and lamprey (*Geotria australis*; Jellyman et al. 2002) to be present in the upper catchment at densities below that generally detected in fish surveys. However, it is unlikely that non-migratory galaxiid populations would remain undetected at the survey sites due to the higher densities likely to be present for viable populations to exist.

In Otago the fish is common in streams in the Catlins areas of South Otago. However the distribution of Gollum galaxias north of the Catlins and Southland is limited. It is generally absent from the Clutha River system, with the exceptions being the Nevis River (Waters et al. 2001), Von River (Burridge et al. 2007), Puerua River and Waiwera River (Anderson, unpub. data., NZFFD) populations, all southern tributaries of the Clutha river system (Figure 1). The fish is absent from the main southern tributary in the mid Clutha catchment, the Pomahaka River, where no roundhead types have been found (Figure 2, NZFFD) and does not occur in any parts of the upper Clutha River catchment upstream of the Kawarau and Clutha River confluence (now Lake Dunstan), nor does it occur in the Manuherikia catchment.

The fragmented distribution of Gollum galaxias is possibly contributed to in the short term by trout interactions and farming development (Department of Conservation 2004). The wide scale distribution across Southland, Otago and Stewart Island is the result of geological activity over longer time periods and fish movement during glacial periods with low sea level. Waters et al. (2001) demonstrated that it was most likely that Gollum galaxias colonised the Nevis River when uplift along the Nevis-Cardrona Fault system lead to the upper reaches of the Nokomai River being cut-off from the river and being captured by the Kawarau River as a new tributary, the Nevis River. In a similar way, Burridge et al. (2007) showed that the Von River populations of non-migratory galaxiids have also arrived in the upper Kawarau headwaters via river capture events.

It is also important to note that non-migratory galaxiids in the Kawarau River catchment are rare. The majority of waterways in the Kawarau Catchment either have no galaxiids or upstream of Lake Wakatipu are occupied by koaro (*Galaxias brevipinnis*). Populations of Gollum galaxias and southern flatheads exist in the Von River (Burridge et al. 2007). A small population of alpine galaxias (*Galaxias paucispondylus*) is present in the Lochy River (NZFFD). A population of *Galaxias* sp'D' is present in Bannock Burn Creek, now a tributary of Lake Dunstan. These four populations together with the Nevis River Gollum galaxias population are the only populations of non-migratory galaxiids in the catchment and as such all could be considered rare faunal elements of the Kawarau catchment.

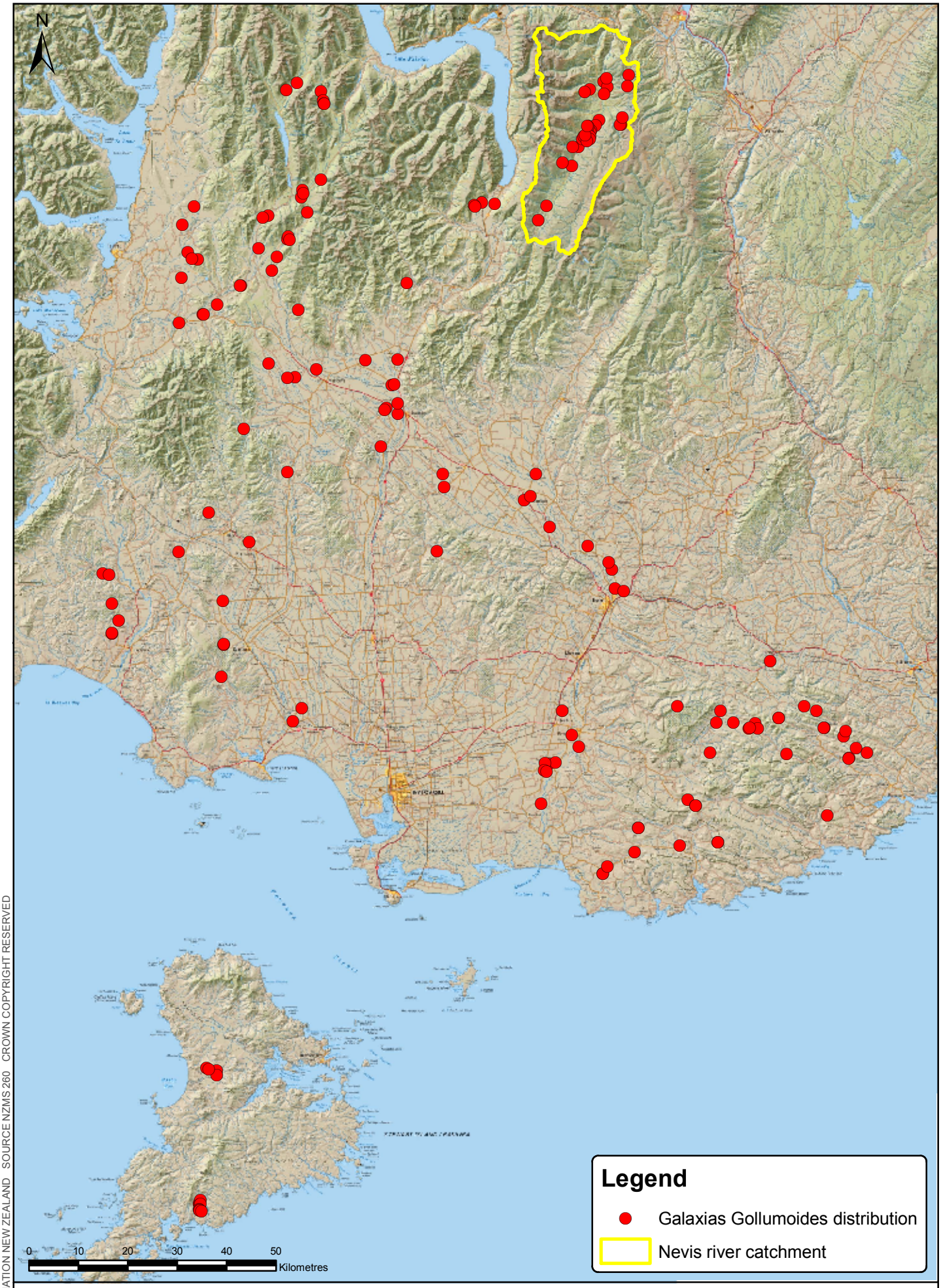

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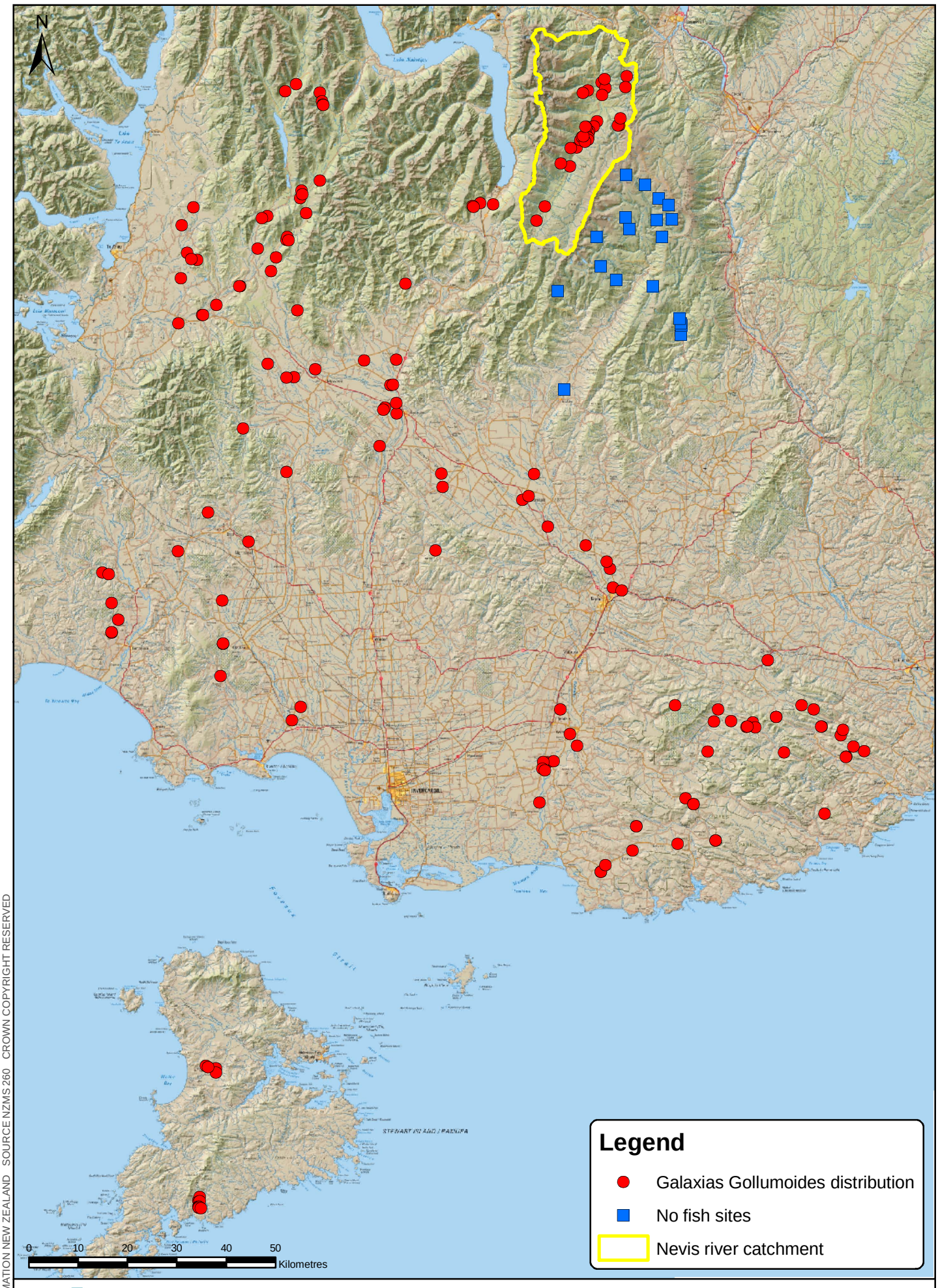
Figure 2: **Gollum galaxias habitat Robertson River, Stewart Island (top left); Mataura River tributary (right); Nevis Burn, Nevis Valley (bottom left).**



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2.3.2 Altitudinal Range

The altitudinal range of Gollum galaxias is considerable with sites at near sea level (8 m) to sites at 1230 m (Figure 4). Many of the sites are at low altitude with 30% of the sites below 100 m. The high altitude sites (above 750 m) are dominated by the Nevis Valley sites and the only other sites to occur above 750 m are in the Von River. An analysis of the distribution of site altitudes found that altitudinal range of the Nevis valley sites are significantly different to the altitudinal range of all other Gollum galaxias sites (ANOVA, *F*-stat 57.43, P< 0.001). This reflects the high elevation of the Nevis Valley, i.e. the Nevis Valley floor upstream of the Nevis Gorge is 900 m high. Many other areas occupied by Gollum galaxias do not have maximum elevations of this height. For instance on Stewart Island the highest mountain (Mt Anglem) is 980 m and most of the island and stream habitat is well below this elevation.

The Nevis River population of Gollum galaxias therefore does occupy a unique altitudinal range for Gollum galaxias. This has several implications for the life history of the fish in the Nevis catchment. The valley and its tributaries will present the Gollum galaxias with an environment that is more extreme than that present in other areas. Winter temperatures are likely to be exceedingly low compared to the low elevation sites and during mid-summer, the temperatures in Central Otago can be high.

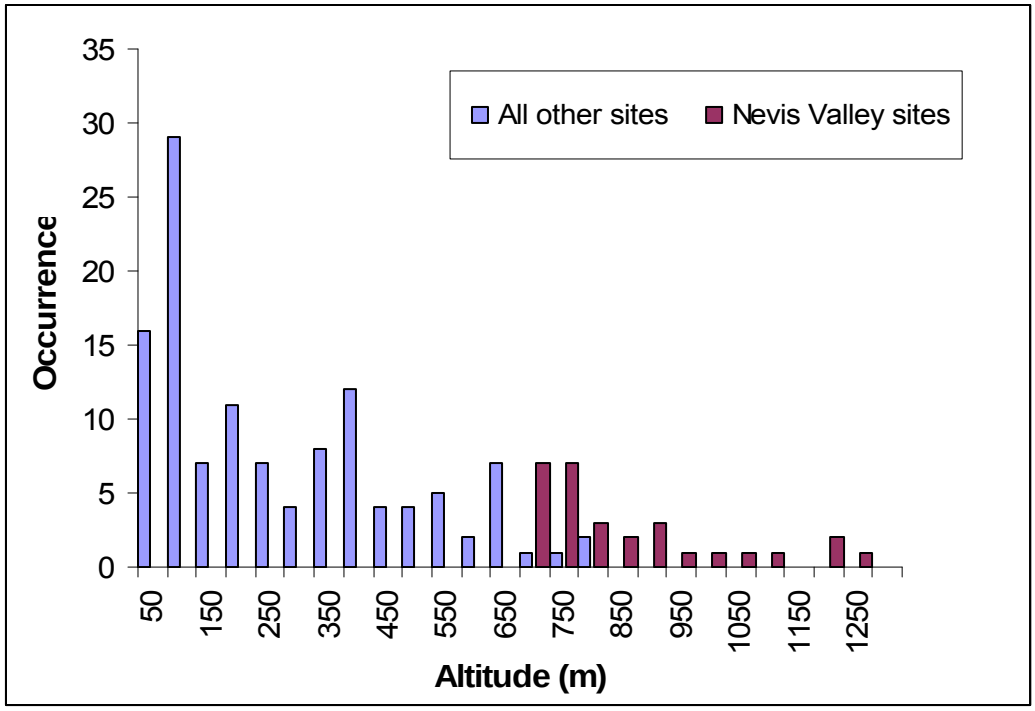


Figure 4: The altitudinal range of Gollum galaxias sites (data source NZFFD).

2.4 Conservation Status

2.4.1 Overview

Galaxias gollumoides was initially classified by the Department of Conservation as not threatened with an additional note that it was data poor (Hitchmough 2002). The threat classification process requires some knowledge of trends in population decline or increase (Molloy et al. 2002). For the newly described species in 2002 this information was lacking and the widespread range of the species in Southland led the classification committee to conclude it was not threatened (Allibone pers. obs.). Subsequently in 2005 (Department of Conservation 2007) Gollum galaxias was classified as a threatened species with a ranking of gradual decline. The change in status was due to the recognition that populations across the Southland and Waimea Plains in the Mataura, Oreti, Aparima and Waiau River catchments were being threatened by increased land development as sheep farms were converted to diary farms. A loss of riparian vegetation and increases in nutrient inputs were expected to create additional pressures on populations and lead to declines in the more modified areas. Many of the populations known from the lower Mataura River and the Waimea Plains area were also found in areas of poor water and habitat quality (Dungey 2004) leading to some concern about the long term viability of these populations.

2.4.2 Co-existence with other fish

Records from the NZFFD indicate Gollum galaxias is found with a range of other native and introduced fish species (Figure 5). However co-existence is rare with most other fish species and generally one or more of the fish species at co-occurrence sites is rare. Gollum galaxias most frequently occurs with two other non-migratory native fish, the upland bully (*Gobiomorphus breviceps*) and the southern flathead (*Galaxias* "southern flathead") although still not frequently. Two large predatory fish, longfin eel (*Anguilla dieffenbachii*) and brown trout (*Salmo trutta*), are also relatively common at Gollum galaxias sites. However, there is a distinct inverse relationship in the density of Gollum galaxias in the presence of either of these predatory fishes, indicating that these predators may suppress Gollum galaxias populations (NZFFD, R. Allibone pers. obs.).

Galaxiids are known to be predated upon by introduced trout species, with brown trout causing the greatest effect (in part due to its wide distribution), but also brook char and rainbow trout (*Oncorhynchus mykiss*) (e.g., Allibone & McDowall 1997, Allibone & McIntosh 1999, McDowall 2006). Galaxiid species in the South Island, including Gollum galaxias, have become increasingly restricted in their range and populations have become fragmented due to the salmonid introductions (McDowall 2006). There are examples of trout having a negative impact on galaxiid densities (Allibone & McIntosh 1999), with the presence of large trout distinctly reducing galaxiid density, whereas small trout do not have this affect (McIntosh 2000).

One native fish has also been implicated in the decline of non-migratory galaxiids in Otago and Southland. McDowall & Allibone (1994) and Allibone (1999) found that koaro and brown trout had displaced the smaller non-migratory galaxiids, Eldon's galaxias (*Galaxias eldoni*) and dusky galaxias (*Galaxias pullus*) in the Waipori River catchment upstream of the hydro-electric storage impoundment, Lake Mahinerangi. Survey datum to date (NZFFD) indicates that koaro very rarely co-exist with Gollum galaxias although whether this is related to predation by koaro is not apparent. Koaro has not been recorded in the Nevis Valley to date, although the creation of Lake Dunstan has now provided possible new larval rearing habitat and thereby increasing the probability that koaro could establish in the Nevis River and its tributaries.

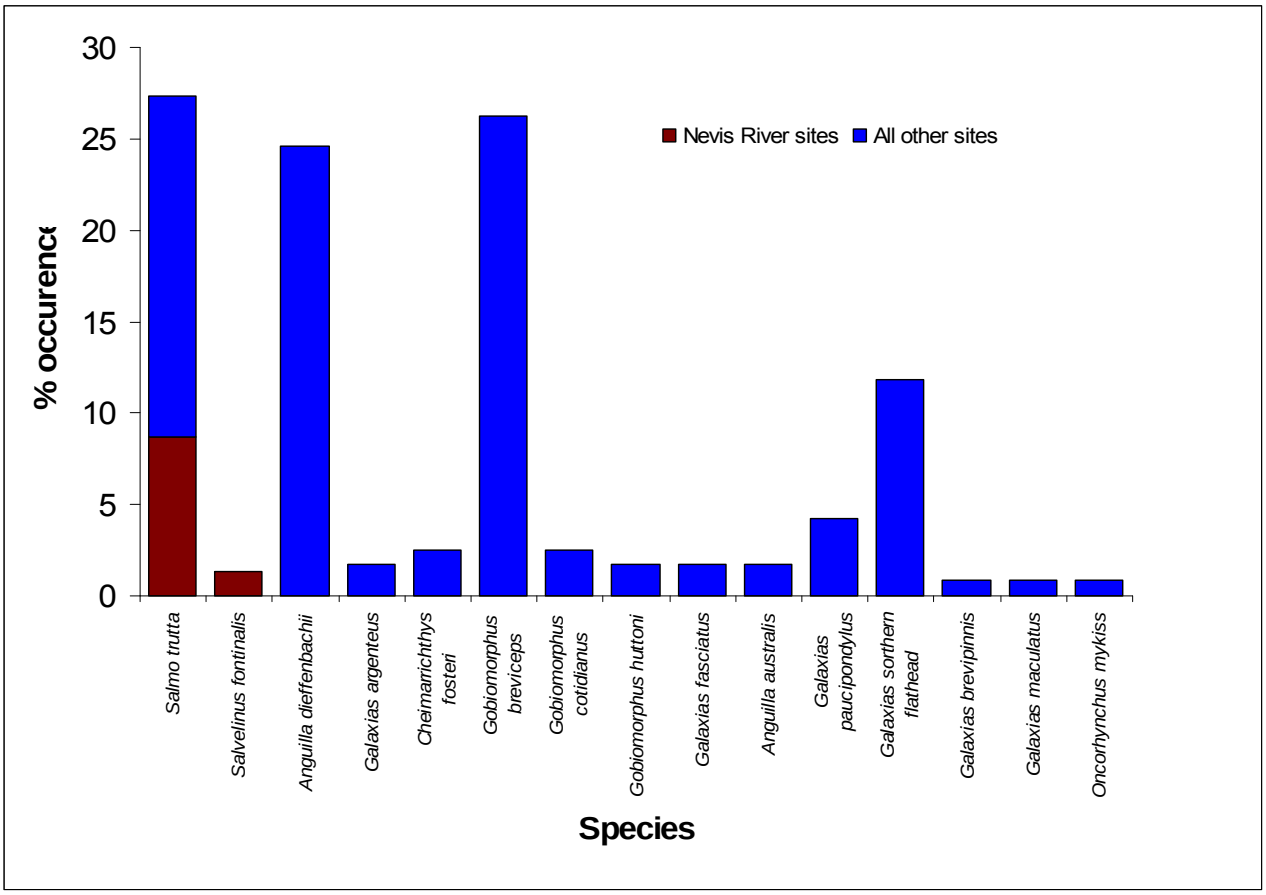


Figure 5: Fish species co-occurring with Gollum galaxias in the Nevis River catchment and elsewhere (data source NZFFD).

2.4.3 Role of fish passage barriers

The majority of galaxiid populations occur in areas inaccessible to salmonids (Townsend & Crowl 1991, Department of Conservation 2004). Barriers such as waterfalls prevent upstream migration of salmonids, thereby protecting galaxiid fish populations (Townsend & Crowl, 1991). However, if these barriers are breached, a decline in galaxiid abundance is likely to occur. Studies of galaxiids in the Taieri River indicate the presence of barrier waterfalls, which block upstream migration of trout, were the best predictor of galaxiid presence. In other areas of Otago, streams that flow through wetlands with no clear flow path also present barriers to upstream movement by salmonids (Allibone pers. obs.) and this type of barrier has been reported in the Nevis Valley (Neilson pers. com.).

Barriers that prevent the upstream migration of koaro are generally man-made, as the migratory juvenile of this fish can climb waterfalls and other steep surfaces. As such, koaro can penetrate inland/upstream past significant waterfalls. The potential increase in koaro in the upper Clutha and Kawarau River catchments, as a result of the creation of Lake Dunstan, has increased the likelihood that koaro could enter the Nevis Valley. The lower Nevis River gorge will not form a

barrier to koaro migration and the upper valley should not be considered isolated from any population of koaro that eventuates in Lake Dunstan.

3.0 NEVIS RIVER POPULATION

3.1 Distribution within the Nevis Valley

Galaxias gollumoides are spread throughout the Nevis Valley, in the mainstream and in tributaries. The predation pressure from brown trout and brook char has most likely influenced the current distribution of Gollum galaxias with large populations generally upstream of barriers that preclude trout migration (Figure 3). The Gollum galaxias population extends from Potters Creek, a tributary in the Nevis Gorge, upstream to the headwaters and in many of the tributaries of the Nevis River. The fish is found at a range of altitudes, reaching as high as 1200m above sea level (Coal Creek, NZFFD), where no other fish species are present. Many of the tributary systems in the Nevis catchment have not been fully investigated; rather fish surveys have concentrated along the Nevis Valley Road at tributary crossing points.

Population density information is not available for Gollum galaxias at most of the survey sites, although some database records note whether the fish is rare, occasional, common or abundant. For the majority of sites (NZFFD) the available records indicate the fish is either common or abundant. When brown trout and/or brook char are present there is a tendency for the densities of Gollum galaxias to be lower but this is not a consistent effect.

3.2 Co-existence with Other Fish in the Nevis Valley

There is a lack of diversity in fish species within the Nevis Valley, with brown trout, rainbow trout, brook char, and Gollum galaxias the only recorded fish present. In the upper valley above the gorge only Gollum galaxias, brown trout and brook char have been recorded in the NZFFD.

Gollum galaxias tend to be found in areas without salmonids; however within the Nevis Valley there are regular recorded instances of this species alongside brown trout (42% of all Gollum galaxias records in the Nevis Valley) and two recorded cases of a co-existence with brook char (NZFFD). Given that brown trout have significant impacts on non-migratory galaxiids, the level of coexistence is high.

3.3 Status of the Nevis River Gollum galaxias

3.3.1 Overview

A key factor for determining the value of the Nevis River population of Gollum galaxias is to determine how the population contributes to the overall biodiversity in Gollum galaxias. Life history data on Gollum galaxias is lacking due to a lack of investigation both in the Nevis Valley and for other Gollum galaxias sites. However extensive genetic investigations have been conducted and provide significant information on the values and status of the Nevis River population.

3.3.2 Genetic investigations of the Nevis River population

Waters et al. (2001) and Waters & Wallis (2001) report the results of an intensive mtDNA investigation of the Nevis River population of Gollum galaxias and the relationship of this population to other Gollum galaxias populations and other galaxiids. The results show that the Nevis River population of galaxiids is most closely related to the Gollum galaxias of Southland and Stewart Island (Figure 6). However, the Nevis River population is distinct and the divergence from other Gollum galaxias populations is much greater than that amongst all other Gollum galaxias populations. Compared with genetic differences amongst other non-migratory galaxiids in Otago and Southland the level of divergence among haplotypes between the Nevis River Gollum galaxias and other Gollum galaxias is 3.4% ±0.3% (range 3.0 – 4.2%, Waters et al 2001). This haplotype divergence was greater than that found for other within taxon comparisons for other non-galaxiids in the area (e.g., *G. sp D* 2.2%, *G. anomalus / pullus* clade 1.8%; Waters et al. 2001).

To date while morphological analysis has been undertaken for Gollum galaxias (McDowall & Chadderton 1999), this compared Gollum galaxias from Stewart Island populations with data from other established galaxiid species. McDowall (2006) conducted a review of morphological characters and taxonomic status for non-migratory galaxiids in Otago and Southland. However McDowall (2006) did not investigate the Gollum galaxias data set to determine if the Nevis River samples differed from other Gollum galaxias populations. It was noted that Gollum galaxias on Stewart Island had different pelvic fin ray counts to Southland populations, so some morphological diversity is currently recognised within the species at present.

While species status of the Gollum galaxias population in the Nevis River has not been assessed there is strong mtDNA data to indicate that this warrants further investigation. Currently while extensive morphological data has been collected and analysed no specific examination has investigated the hypothesis that the Nevis River Gollum galaxias is distinct from Southland Gollum galaxias. Morphological differences have been noted (e.g., pelvic fin ray counts) and visually the appearance of Gollum galaxias varies (Figure 7).

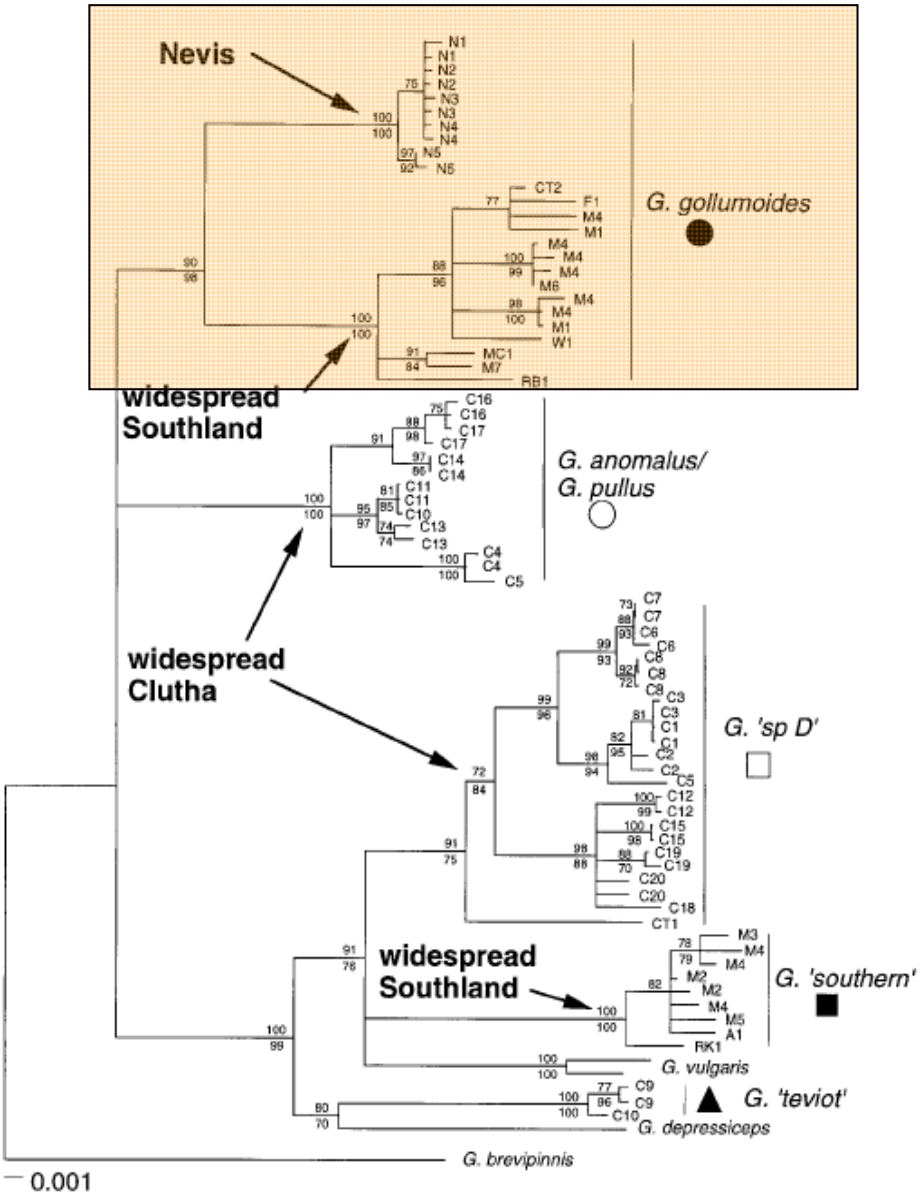


Figure 6: **Phylogram from Waters et al (2001) displaying relationships among galaxiid taxa. Gollum galaxias clade highlighted.**

Figure 7: Gollum galaxias from the Nevis Valley (large body morph) (left) and from the Tarwood Stream, Catlins area (small body morph) (right).

3.3.3 Evolutionary Significant Unit assessment

For species with highly divergent populations it has been proposed to define Evolutionary Significant Units (ESU); (e.g., Waples 1991). The ESU concept centres on determining the diversity (genetic, morphological and life history) within a species and managing the species to protect the full range of diversity. The definition of an ESU has been debated and Waples (1991) proposed two relatively simple criteria to define ESU's within a species:

- is substantially reproductively isolated from other conspecific populations units; and
- represents an important component in the evolutionary legacy of the species.

The Nevis population of Gollum galaxias is genetically distinct from all other populations of Gollum galaxias and is considered to be a unique lineage isolated by geological events from Southland populations of Gollum galaxias (Waters et al. 2001). The level of divergence of the Nevis River population from all other populations of Gollum galaxias is high and this population is a distinct outlier. The Nevis population of Gollum galaxias reflects the mid-Pleistocene river capture event that created the Nevis River from the upper part of the Nokomai River. Under Waples' (1991), definition part (1) is achieved for Gollum galaxias, as the population in the Nevis River is reproductively isolated from all other Gollum galaxias populations.

Waters et al. (2001) showed that the Nevis River Gollum galaxias is a distinct coherent genetic group with Gollum galaxias. The analysis of the genetic data by Waters et al. (2001) found that the Nevis samples were monophyletic and were the most basal (and therefore most likely the oldest) off shoot from the wider Gollum galaxias population. An analysis of time since divergence (molecular clock analysis) for the Nevis River Gollum galaxias by Waters et al. (2001) indicated that the Nevis River populations has been isolated for at least 800,000 years, although geological data would suggest a time of 300,000 to 500,000 years. Either time is substantial and significantly greater than, for instance, the isolation of the Stewart Island populations by rising sea levels after the last glacial period 14,000 years ago. Furthermore, distributional and altitudinal information indicates that the Nevis River population resides in a distinctly different environment to the populations in the lowland plains and low altitude forest environments. This combination of factors would meet the second criteria of Waples' (1991), that the population represents a significant evolutionary legacy of the species. It is therefore concluded that the Nevis River

population represents a distinct ESU within Gollum galaxias and only populations within the Nevis Valley are part of this distinct unit.

3.3.4 Key Population Status of the Nevis River Gollum galaxias

The Non-Migratory Galaxiid Recovery Plan (Department of Conservation 2004) has a series of recovery objectives for non-migratory galaxiids. This includes the identification and targeted protection of 30 populations of each non-migratory galaxiid species. The 30 populations are called *key populations* and are to be determined using a prioritisation process (Appendix 2). To be designated a *key population*, the population has to fit at least one of seven criteria. *Key populations* are to be designated for all the threatened non-migratory galaxiid species, including Gollum galaxias and six of the seven criteria can be assessed for the Nevis River Gollum galaxias. Populations that meet any of the first six criteria are not assessed against the seventh criteria and this seventh criteria requires the judgement of local Department of Conservation managers and is only invoked when less than 30 *key populations* for a species have been determined via the first six criteria.

The first possible criterion for a key population is that the population is one of the three largest within an ESU. Currently the Nevis River population may consist of more than one population as the tributary populations may be isolated from one another due to trout in the main stem of the river. However this isolation is recent and the population should be considered to be a single entity. As such, the Nevis is the largest and only population in its ESU.

The second criterion for a *key population* is that the population is the type locality for the species. Chocolate Swamp is the type locality for Gollum galaxias and does not apply to the Nevis River population.

The third criterion designates geographic outliers as *key populations.* The Nevis River population is a clear outlier being the most northerly population of this fish and also one of only two populations identified in the upper Clutha Catchment.

The fourth criterion recognises populations that occur in unusual habitats. The Nevis River and its tributaries are not unique habitats, however when compared against other streams inhabited by Gollum galaxias, there are key unique aspects. The population exists at an altitude much higher than other Gollum galaxias and are exposed to quite different climatic conditions to the populations in the low lands. The riparian areas are relatively unmodified and increasingly so in areas now returned to the crown during the tenure review of pastoral leases and the vegetation is tussock and sub-alpine scrub rather than pasture or lowland forest. The population is also secure from the landuse change and habitat modification threats that are presently causing the species' decline in Southland and therefore the riparian and riverine characteristics are not threatened.

The Nevis River does not form part of a long term research area (criteria 5) nor is it within an area of active management (criteria 6) and as such the Nevis population does not fit the final two criteria that can be assessed here.

It is concluded that the Nevis River Gollum galaxias is a *key population* for Gollum galaxias and it meets three of the criteria for that designation.

4.0 POTENTIAL EFFECTS OF DAM CONSTRCUTION

4.1 Potential Effects

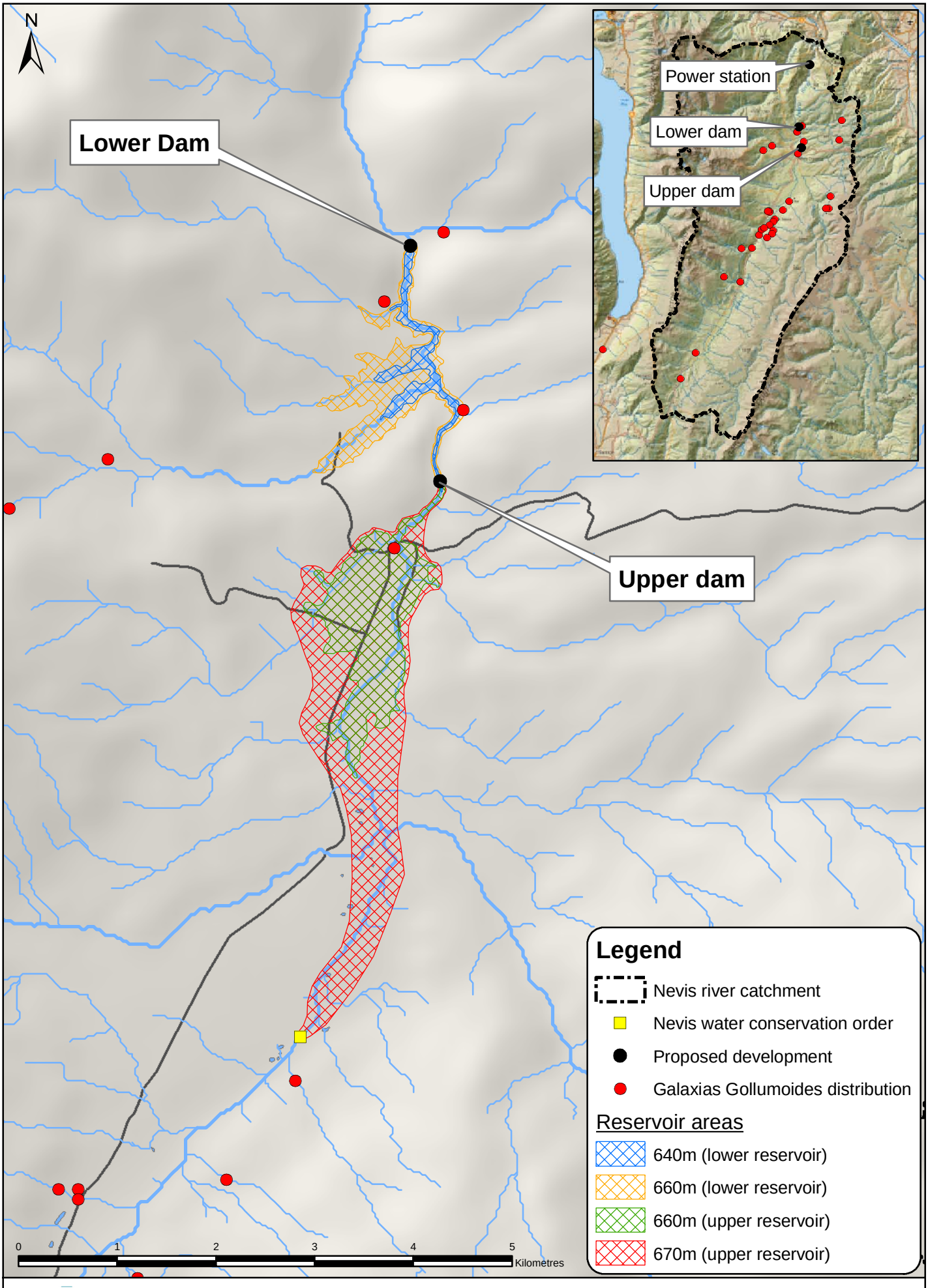
There are a series of potential effects on Gollum galaxias if a hydro-electric dam or dams are constructed in the Nevis Valley and Gorge (Figure 8). These are not fully assessed below (in sections 4.2-4.5) but are briefly discussed to indicate the possible impacts of hydro-electric development in the Nevis Valley. The possible effects are:

- Loss of fish passage between streams containing Gollum galaxias;
- Loss of habitat;
- Loss of key fish passage barriers that prevent salmonids gaining access to tributaries; and
- Potential establishment of other predatory fish species.

4.2 Fish Passage Effects

The extent to which Gollum galaxias individuals move about the catchment is unknown. Studies of galaxiids elsewhere including migratory (Allibone et al. 2003) and non-migratory species (Allibone 1997) have shown that adult individuals are relatively sedentary and no spawning migrations similar to those under taken by salmonids occur. It is possible a small percentage of fish are more mobile and due to this mobility are not noted in tagging and movement studies (Rodŕiguez 2002). Any movement of Gollum galaxias individuals between streams does prevent isolation occurring and the construction of dams and reservoirs will hinder movement.

The construction of dams in the Nevis Gorge to create storage reservoirs that flood back to the upper limit allowed under the WCO will create a significant barrier to Gollum galaxias fish passage. Gollum galaxias currently occurs in tributaries of the Nevis River upstream of the reservoir areas, in streams that would become tributaries of the reservoir(s) and are likely to be in streams downstream of the reservoir in Potters Creek. The WCO requires that fish passage is protected if hydro-electric development occurs. It is likely that when this condition was imposed, the presence of Gollum galaxias was not considered. Gollum galaxias is unlikely to be able to negotiate a fish ladder that is appropriate for salmonids. However, a lower gradient pass may be appropriate. The storage reservoir also presents an additional fish passage problem. Reservoirs, while not a physical barrier, may present a behavioural to fish passage barrier (e.g., the reservoir lacks water velocity cues to direct fish movements) and may also be habitat for large predatory fish. It is uncertain what the full effects of the reservoir would be, yet it is likely that a reservoir would hinder Gollum galaxias fish passage.



Golder Associates

TITLE | NEVIS RIVER SUBMISSION
- LIKELY EXTENT OF RESERVOIRS

DECEMBER 2007

PROJECT | FISGODUD001

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In summary the need for fish passage of large numbers of Gollum galaxias is unlikely, but without careful consideration and the construction of appropriate facilities, any hydro-electric scheme could further isolate the tributary stream populations below Nevis Crossing.

4.3 Loss of Habitat

The construction of a dam or dams in the Nevis Valley would lead to some loss of habitat for Gollum galaxias in the lower Nevis Valley and gorge area. The streams upstream of the upper dam reservoir limit would be unaffected. Given the size of the Nevis Valley and the distribution of Gollum galaxias throughout the valley the effect of habitat loss would be relatively small.

4.4 Key Fish Passage Barriers

The Nevis, Burn and Potter Creek populations of Gollum galaxias join the Nevis River at confluences that are likely to be flooded when reservoirs are filled. These streams are not known to contain any salmonids and it is highly likely that barriers to upstream passage for salmonids exist in the lower reaches of these streams. The type and nature of these barriers is unknown, although wetland or waterfall barriers would both be lost when the areas are flooded. This would allow salmonids access to these two key streams in the lower Nevis area.

Salmonid impacts on non-migratory galaxiids are generally significant (e.g., Townsend & Crowl 1991, McIntosh 2000). However in the Nevis co-existence of salmonids and Gollum galaxias does occur at a number of survey sites, although fish density may be low at these sites. Therefore while the creation of reservoirs would allow salmonids to colonise additional areas of the Nevis Valley it is uncertain if this would lead to local extirpation of Gollum galaxias.

4.5 Additional Predators

Koaro occur naturally throughout much of the Clutha River catchment and have been recorded upstream and downstream from the Nevis Valley. To date none have been recorded in the Nevis Valley but there is an increasing risk of koaro entering this system from koaro that may rear in Lake Dunstan. Distributional data across New Zealand (NZFFD) and investigations in the Waipori system (Allibone 1999) have indicated that koaro appear to displace the smaller non-migratory galaxiids. The restriction on koaro is its migratory life history that requires the larval fish to rear at sea or in lakes.

In the Clutha River catchment the creation of Lake Dunstan has provided an additional large lake for rearing koaro larvae. Currently the effect of the creation of this lake on koaro numbers in the upper Clutha is unknown. However it is highly likely that koaro numbers are increasing in tributaries of Lake Dunstan and will continue to do so for some twenty years (the projected life span of koaro; Allibone unpub. data.) following the creation of Lake Dunstan.

Juvenile koaro that migrate up the Kawarau River from Lake Dunstan encounter few tributaries before the Nevis River. It is likely that the Roaring Meg and the Nevis River are the two rivers with the most suitable habitat for koaro as the fish penetrate upstream from Lake Dunstan. However, koaro upstream penetration and abundance declines with distance from the larval fish habitat (Lake Dunstan) and at this time it is uncertain whether koaro are entering the Nevis catchment.

The creation of reservoirs in the Nevis Valley would provide new larval rearing habitat in the Nevis Valley and remove the restriction of migration distance from Lake Dunstan to the Nevis Valley. If koaro adults occur in the areas to be flooded or in areas upstream of the reservoirs, then it is very likely that a self-recruiting population of koaro would establish in the Nevis Valley. Once established, it is likely that koaro numbers would increase in the Nevis Valley and have significant negative effects on Gollum galaxias, especially in areas relatively close to the reservoirs. The very upstream areas occupied by Gollum galaxias may not be affected if koaro fail to penetrate to the Nevis River headwaters.

5.0 CONCLUSIONS

The Gollum galaxias in the Nevis Valley are a significant population and potentially a distinct species. Significant attributes of the population are:

- That it is a distinct Evolutionary Significant Unit;
- It meets three of the criteria to be considered a *key population* for the New Zealand Non-Migratory Galaxiid Recovery Plan;
- The populations occupies a distinct altitudinal range;
- The population occurs in a catchment that has limited land-use effects on water quality and habitat quality; and
- The population is geographically isolated and represents a distinct northern element of the species distribution.

The current WCO will protect some of these values and the population is also well protected from the landuse change and habitat modification that is impacting on lowland populations in Southland. However, the creation of the reservoirs for hydro-electric generation will present new threats to Gollum galaxias that at this time cannot be fully assessed and may put this significant population in the Nevis River valley at risk.

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March 2008

APPENDIX

Water Conservation Order (Kawarau River)

APPENDIX 1

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WATER CONSERVATION (KAWARAU) ORDER 1997

MICHAEL HARDIE BOYS, Governor-General

ORDER IN COUNCIL
At Wellington this 17th day of March 1997
Present:
His Excellency the Governor-General in Council

PURSUANT to sections 214 of the Resource Management Act 1991, His Excellency the Governor-General, acting by and with the advice and consent of the Executive Council, makes the following order.

ORDER

1. Title and commencement---(1) This order may be cited as the Water Conservation (Kawarau) Order 1997.

(2) This order comes into force on the 28th day after the date of its notification in the Gazette.

2. Interpretation---In this order, unless the context otherwise requires,---
``Act'' means the Resource Management Act 1991:
``Preserved waters'' means the waters set out in Schedule 1 of this order:
``Protected waters'' means the waters set out in Schedule 2 of this order.

3. Preservation in natural state---(1) It is declared that the waters described in Schedule 1 contain one or more of the following outstanding amenity and intrinsic values which are afforded by waters in their natural state:
(a) Natural and physical qualities and characteristics that contribute to---
(i) People's appreciation of pleasantness of waters:
(ii) Aesthetic coherence:
(iii) Cultural and recreational attributes:
(b) Biological and genetic diversity of ecosystems:
(c) Essential characteristics that determine the ecosystem's integrity, form, functioning, and resilience.

(2) Because of the outstanding amenity and intrinsic values recognised in subclause (1), these outstanding values shall be sustained.

(3) Because of the outstanding amenity and intrinsic values recognised in subclause (1), it is declared that the water bodies set out in Schedule 1 are outstanding in their natural state.

(4) Because the water bodies set out in Schedule 1 are recognised to be outstanding in their natural state, they must be preserved as far as possible in their natural state.

(5) Except as provided in clauses 5 and 6 of this order, the exercise by a regional council of its functions and powers under section 30 (1) (e) and (f) of the Act (as they relate to water) are restricted or prohibited so as to retain the preserved waters as far as possible in their natural state.

4. Protection of characteristics---(1) It is declared that the waters set out in Schedule 2 which are no longer in their natural state contain one or more amenity and intrinsic values which warrant protection because they are considered outstanding.

(2) Because of the outstanding amenity and intrinsic values recognised in subclause (1), these outstanding values shall be sustained.

(3) Because of the outstanding amenity and intrinsic values recognised in subclause (1), it is declared that the water bodies described in Schedule 2 contain one or more of the following outstanding characteristics, as set out in Schedule 2:
(a) As a habitat for terrestrial and aquatic organisms:
(b) As a fishery:
(c) For its wild, scenic, and other natural characteristics:
(d) For scientific values:
(e) For recreational, or historical purposes:
(f) For significance in accordance with tikanga Maori.

(4) Because of the outstanding characteristics specified in subclause (3), the characteristics of the waters, as set out in Schedule 2, are protected.

(5) Except as provided in this order the exercise by a regional council of its functions and powers under section 30 (1) (e) and (f) of the Act (as they relate to water) are restricted or prohibited as set out in Schedule 2.

5. Exemptions---The restrictions and prohibitions in clauses 3 (5) and 4 (5) and Schedule 2 do not limit the regional council's functions or powers to grant a resource consent or to make a rule for any part of the preserved waters or protected waters for all or any of the following purposes:

(a) Maintenance or protection of any network utility operation (as defined in section 166 of the Act) or any public or private road or any bridge:
(b) Maintenance of soil conservation and river protection works:
(c) Research into, protection of, enhancement of, or restoration of, values and characteristics for which the water bodies are being preserved or protected, as the case may be:
(d) On the same or similar conditions for any lawful use of water being undertaken immediately before the date on which this order came into force.

6. Further exemptions---(1) This clause applies to---
(a) The Dart River mainstem from Lake Wakatipu to its confluence with the Beans Burn; and
(b) The Rees River mainstem from Lake Wakatipu to its confluence with Hunter Stream.

(2) The restrictions and prohibitions in clause 4 (5) and Schedule 2 do not limit the regional council's functions and powers to grant a resource consent or to make a rule for the waters referred to in subclause (1) for all or any of the following purposes:
(a) The construction, maintenance, and protection of roads and bridges:
(b) Any exercise of the powers of a Catchment Board under the Soil Conservation and Rivers Control Act 1941:
(c) Any exercise of the powers of a River Board or local authority under the River Boards Act 1908:
(d) Any exercise of the powers of a Land Drainage Board or local authority under the Land Drainage Act 1908.

(3) The purposes in subclause (2) include---
(a) The undertaking of work necessary to prevent or control soil erosion and flooding affecting properties adjacent to the above water bodies including work in the riverbed such as (but not by way of limitation) the diversion of water and damming of water to construct river training works, groynes, and other flood protection works:
(b) The maintenance of existing flood protection and erosion control works both in and adjacent to the above water bodies:
(c) Action taken in accordance with section 330 of the Resource Management Act 1991 to carry out any of the works referred to in paragraphs (a) and (b).

7. Provisions for Nevis River---The regional council may grant a resource consent or make a rule in a plan for hydro-electric development in respect of the Nevis River if that resource consent or rule complies with the restrictions and prohibitions set out in Schedule 2.

8. Existing permits may be replaced---The restrictions and prohibitions in clauses 3 (5) and 4 (5) and Schedule 2 do not limit the regional council's functions in respect of any part of the preserved or protected waters to replace any existing resource consent or grant any resource consent in substitution for an expiring resource consent if the new resource consent is granted on substantially the same terms and conditions as the existing or expiring resource consent.

9. Lake Dunstan not affected---Nothing in this order affects the levels of Lake Dunstan or the operation of the Clyde power station.

10. Scope---Nothing in this order limits the effect of sections 14 (3) (b) and 14 (3) (e) of the Act relating to the use of water for an individual's reasonable domestic needs, the reasonable needs of an individual's animals for drinking water, and for fire-fighting purposes.

SCHEDULES

SCHEDULE 1

Cl. 2

Waters to be Preserved

All map references NZMS 1

Waters	Outstanding amenity and intrinsic values
Dart River mainstem above the Beans Burn confluence to source (S113:226162 to S114:465360):	a, b, c, e, f
All tributaries of the Dart River within the boundaries of the Mount Aspiring National Park, excluding Route Burn, but including the sections of the Rock Burn and Beans Burn within the boundary of the Mount Aspiring National Park:	a, b, c, e, f
Parts of tributaries of the Dart River not within the Mount Aspiring National Park; Rock Burn (S113:237131 to S113:234129); Beans Burn (S113:226162 to S113:221170):	a, b, c, e, f
Route Burn from confluence with Dart River to source, and all its tributaries, including Left Branch and North Branch (S122:245058 to S122:125093 and S113:135145):	a, b, c, d, e, f
Rees River mainstem about Hunter Stream confluence to source (S114:363204 to S114:451273):	a, b
All tributaries of the Rees River within the boundaries of the Mount Aspiring National Park:	a, b

Waters	Outstanding amenity and intrinsic values
Greenstone River mainstem from Lake Wakatipu to source, including Lake McKellar and its tributaries S122:292812 to S122:112927 and S122:084929):	a, d, f
Caples River mainstem from Greenstone River confluence to source (S122:260812 to S122:128960 and S122:135901):	a, d, f
Lochnagar and Lake Creek (at or about S114:490230; and S114:526193 to S114:503230):	f
Nevis wetland (all water bodies upstream of S143:768240 on a tributary of Roaring Lion Creek).	f

Key:

Amenity values:

(a) Natural and physical qualities and characteristics that contribute to people's appreciation of pleasantness of waters:

(b) Natural and physical qualities and characteristics that contribute to aesthetic coherence:

(c) Natural and physical qualities and characteristics that contribute to cultural attributes:

(d) Natural and physical qualities and characteristics that contribute to recreational attributes.

Intrinsic values:

(e) Biological and genetic diversity of ecosystems:

(f) Essential characteristics that determine the ecosystem's integrity, form, functioning, and resilience.

SCHEDULE 2

Cl. 2

Waters to be Protected

All map references NZMS 1

Waters	Outstanding Characteristics	Restrictions and Prohibitions
Kawarau River mainstem from Scrubby Stream to Lake Wakatipu control gates (S133:940715 to S132:615707)	(c) wild and scenic characteristics; (c) natural characteristics, in particular the return flow in the upper section when the Shotover River is in high flood; (d) scientific values, in particular the return flow in the upper section when the Shotover River is in high flood; (e) recreational purposes, in particular rafting, jetboating, and kayaking.	(i) no damming allowed; (ii) water quality to be managed to Class CR standard.
Nevis River mainstem gorge from Nevis Crossing to Kawarau River confluence (S133:877677 to S133:847538)	(c) wild characteristics; (e) recreational purposes, in particular fishing and kayaking.	(i) no damming allowed unless a rule in a plan or condition in any water permit granted makes provision for river flows to be provided at sufficient levels to enable kayaking to be undertaken in the gorge at times stated in the plan or permit, and the extent

Waters	Outstanding Characteristics	Restrictions and Prohibitions
		of any impounded water is not beyond S143:836485; (ii) fish passage to be maintained; (iii) water quality to be managed to Class CR, Class F, and Class FS standards.
Nevis River mainstem above Nevis Crossing to source (S133:847538 to S142:673213)	(c) scenic characteristics; (e) recreational purposes, in particular fishing.	(i) no damming allowed unless a rule in a plan or condition in any water permit granted makes provision for river flows to be provided at sufficient levels to enable kayaking to be undertaken in the gorge at times stated in the plan or permit, and the extent of any impounded water is not beyond S143:836485; (ii) fish passage to be maintained; (iii) water quality to be managed to Class F and Class FS standards.
Shotover River mainstem (at or about S132:645720 to S114:542262)	(c) wild and scenic characteristics; (c) natural characteristics, in particular the high natural	(i) no damming allowed; (ii) water quality to be managed to Class CR standard.

Waters	Outstanding Characteristics	Restrictions and Prohibitions
	sediment load and active delta at confluence with Kawarau River; (d) scientific value, in particular the high natural sediment load and active delta at confluence with Kawarau River; (e) recreational purposes, in particular rafting, kayaking, and jetboating; (f) historical purposes, in particular goldmining.	
Dart River mainstem from Lake Wakatipu to confluence with Beans Burn (at or about S122:291916 to S113:226162)	(a) habitat for wildlife; (c) scenic characteristics; (c) natural characteristics, in particular natural turbidity; (d) scientific value, in particular natural turbidity; (g) significance in accordance with tikanga Maori, in particular sites at the mouth of the river.	(i) no damming allowed; (ii) braiding of water to be maintained.
Rees River mainstem from Lake Wakatipu to confluence with Hunter (at or about S123:301915 to S114:363204)	(a) habitat for wildlife; (c) scenic characteristics; (g) significance in accordance with tikanga Maori, in particular sites at the mouth of the river.	(i) no damming allowed; (ii) braiding of water to be maintained.
Diamond Lake, Diamond Creek, and Reid Lake (at or about	(a) habitat for wildlife and quinnat salmon;	(i) no damming allowed; (ii) fish passage to be

Waters	Outstanding Characteristics	Restrictions and Prohibitions
S122:290050; S122:299036 to S123:305987)	(b) fishery.	maintained; (iii) water quality to be managed to Class F and Class FS standards.
Lake Wakatipu (from outlet at control gates (S132:615707) to confluences of Dart River (at or about S122:291916) and Rees River (at or about S123:301915) and including whole lake)	(b) fishery; (c) scenic characteristics; (d) scientific value, in particular water clarity, and bryophyte community; (e) recreational purposes, in particular boating; (g) significance in accordance with tikanga Maori, in particular sites at the head of the lake, and the legend of the lake itself.	(i) fish passage to be maintained; (ii) water quality to be managed to Class F and Class FS standards.
Lochy River mainstem (S132:592511 to S142:328409 and S142:307380)	(b) fishery; (e) recreational purposes, in particular fishing;	(i) fish passage to be maintained; (ii) water quality to be managed to Class F and Class FS standards.
Von River mainstem (S132:353629 to S141:288380 and S131:216620)	(b) fishery; (e) recreational purposes, in particular fishing;	(i) fish passage to be maintained; (ii) water quality to be managed to Class F and Class FS standards.

Key: Outstanding characteristics (S199 (2) (b) and (c) of Act):

(a) as habitat for terrestrial or aquatic organisms:

(b) as a fishery:

(c) for its wild, scenic or other natural characteristics:

(d) for scientific and ecological values:

(e) for recreational purposes:

(f) for historical purposes:

(g) for significance in accordance with tikanga Maori.

Restrictions and Prohibitions:

References to Classes are Water Quality Classes as in the Third Schedule of the Act.

MARIE SHROFF,

Clerk of the Executive Council.

EXPLANATORY NOTE

This note is not part of the order, but is intended to indicate its general effect.

This order, which comes into force on the 28th day after the date of its notification in the Gazette, declares---

(a) The waters described in Schedule 1 (the waters in the upper reaches of the Dart River and some of its tributaries, parts of the Route Burn, the upper reaches of the Rees River and some of its tributaries, the upper reaches of the Greenstone and Caples Rivers, Lochnagar and Lake Creek, and the Nevis wetland) are to be preserved as far as possible in their natural state because of the outstanding amenity and intrinsic values of the waters:

(b) The characteristics of the waters described in Schedule 2 (the waters in parts of the Kawarau River, Nevis River, Shotover River, lower reaches of the Dart River and Rees River, Diamond Lake, Diamond Creek, Reid Lake, Lake Wakatipu, and parts of the Lochy and Von Rivers) are to be protected because of the outstanding intrinsic and amenity values specified in that Schedule.

The order specifies how the waters are to be preserved or protected. The order also specifies the limitations of the protection or preservation.

Issued under the authority of the Acts and Regulations Publication Act 1989.
Date of notification in Gazette: 20 March 1997.
This order is administered in the Ministry for the Environment.

March 2008

APPENDIX 2

Defining key populations of non-migratory galaxiids

APPENDIX

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1.0 NEW ZEALAND NON-MIGRATORY GALAXIID RECOVERY PLAN CRITERIA FOR KEY POPULATIONS

Defining key populations for non-migratory galaxiids

By the end of its 10-year period, this recovery plan seeks to have all non-migratory galaxiid species classified as either Not Threatened or in Gradual Decline. The criteria for Gradual Decline are either 5000 mature individuals or 15 populations; this recovery plan is aiming for the latter. Up to 30 key populations need to be identified for each species in order to achieve this aim with some confidence in the long-term. More than 30 key sites should be designated if the sites fit within criteria 1.5 below.

The definitions of key populations are based on DOC's draft Natural Heritage Concepts and Principles (Department of Conservation 2001, see reference list, main text). The key populations are to be selected to preserve large populations or habitats, key scientific sites and to maintain the geographic range of species and the genetic and biological diversity within each non-migratory galaxiid species.

Criteria for key populations

- The three largest populations of any non-migratory galaxiid within any evolutionary significant unit (ESU). Population size will be determined from the area of habitat available and density estimates from monitoring sites for the species. When two or more sites are equivalent in terms of population size, the key populations can be determined using other conservation values including: the presence of other rare species, the degree of modification and the degree of control DOC has over outside influences on the habitat.
- The type locality of each species (or the nearest present-day population that is thought to be in the same ESU).
- Populations that are geographic outliers and are remnants of the historic range of the species, and populations that maintain the geographic range of ESUs.
- Populations at long-term research sites.
- Populations in unusual habitats for the species.
- Protected sites being actively managed under an integrated management programme.
- Further sites to be classified on habitat size and ease of protection and management if fewer than 30 have been designated for a species. Consultation between DOC Area Managers and the Non-migratory Galaxiid Recovery Group is recommended when designating these populations.

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