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**PROPOSED DETERMINATION**

AQUATIC ECOLOGICAL COMMUNITY
IN THE NATURAL DRAINAGE SYSTEM OF THE CATCHMENT OF
THE SNOWY RIVER IN NSW

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a proposed determination to list the Aquatic Ecological Community in the Natural Drainage System of the Catchment of the Snowy River in NSW as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 4 of the Act.

Under Part 7A of the Act (Division 1, Section 220B), an ecological community means an assemblage of species of fish or marine vegetation (or both) occupying a particular area. Listing of Endangered Ecological Communities is provided for by Part 7A, Division 2 of the Act.

The area covered by this recommendation includes all natural rivers, creeks, streams of the Snowy River within the State of New South Wales, and including the Eucumbene River, Thredbo River, Gungarlin River, Mowamba River, Maclaughlin River, Delegate River, Lake Eucumbene, Lake Jindabyne and the water bodies upstream of the dams.

The Fisheries Scientific Committee has found that:

## Background

1. The aquatic ecological community in the natural drainage system of the Snowy is characterised by the following assemblage of species:

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|---|---|
| **Finfishes (Osteichthyes)** | |
| *Galaxias olidus* (mountain galaxias) | *Mordacia* spp. (lamprey spp.) |
| *Retropinna semoni* (Australian smelt) | *Psuedaphritis urvillii* (congoli) |
| **Gadopsis marmoratus* (river blackfish) | *Macquaria novemaculaeata* (Australian bass) |
| **Nannoperca australis* (southern pygmy perch) | *Gobiomorphus coxii* (Cox's gudgeon) |
| *Anguilla australis* (short finned eel) | *Philypnodon grandiceps* (flat headed gudgeon) |
| *Anguilla reinhardtii* (long finned eel) | *Prototroctes mareana* (Australian grayling) |
| *Galaxias maculatus* (common galaxias) | *Galaxias brevipinnis* (climbing galaxis) |
| *Gobiomorphus australis* (striped gudgeon) | |
| | |
| **Worms (Annelida)** | |
| *Philaemon pungens* (leech) | *Antipodrilus davidis* (tubifex worm) |
| *Phreodriloides notabilis* (worm) | *Rhyacodrilis bifidus* (tubifex worm) |
| *Rhyacodrilis coccineus* (tubifex worm) | |
| | |
| **Crustaceans** | |
| *Alona davidi* (water flea) | *Psammaspides* sp. (isopod) |
| *Alona elliptica* (water flea) | *Australatya striolata* (riffle shrimp) |
| *Dunhevedia crassa* (water flea) | *Paratya australiensis* (shrimp) |


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|---|---|
| *Caenestheriella* sp. (water flea) | *Biffarius arenosus* (ghost shrimp) |
| *Daphnia alpina* (water flea) | *Macrobrachium intermedium* (prawn) |
| *Daphnia carinata* (water flea) | *Palaemon affinis (*shrimp*)* |
| *Daphnia magniceps* (water flea) | *Engaeus cymus* (crayfish) |
| *Daphnia nivalis* (water flea) | *Engaeus orientalis* (crayfish) |
| *Daphnia thomsoni* (water flea) | *Euastacus bidawalus* (crayfish) |
| *Limnadia* sp. (water flea) | *Euastacus brachythorax* (crayfish) |
| *Limnadopsis birchii* (water flea) | *Euastacus claytoni* (crayfish) |
| *Limnadopsis parvispinus* (water flea) | *Euastacus crassus* (crayfish) |
| *Lynceus* sp. (water flea) | *Euastacus diversus* (crayfish) |
| *Macrothrix spinosa* (water flea) | *Euastacus rieki* (crayfish) |
| *Branchinella compacta* (water flea) | *Euastacus yanga* (crayfish) |
| *Macrocyclops albidus* (water flea) | *Crenoicus* sp. (isopod) |
| *Taneroa* sp. (water flea) | *Metaphreatoicus australis* (isopod) |
| *Cypretta hirsuta* (ostracod) | *Metaphreatoicus lacustris* (isopod) |
| *Neoniphargus fulton* (amphipod) | |
| | |
| **Nemertean** | |
| *Argonemertes australiensis* (nemertean worm) | |
| | |
| **Flatworms (Platyhelminthes)** | |
| *Temnocephala comes* (flatworm) | *Geoplana lucasi* (flatworm) |
| *Temnosewellia belone* (flatworm) | *Geoplana sanguinea* (flatworm) |
| *Geoplana coxii* (flatworm) | *Geoplana spenceri* (flatworm) |
| *Geoplana howitti* (flatworm) | *Heterorotula contraversa* (flatworm) |
| | |
| **Sponges** | |
| *Spongilla* sp. (sponge) | |
| | |
| **Molluscs** | |
| *Ferrissia petterdi* (freshwater limpet) | *Gyraulus gilberti* (snail) |
| *Ferrissia tasmanica* (freshwater limpet) | *Gyraulus scottianus* (snail) |
| *Glacidorbis hedleyi* (snail) | *Helicorbis australiensis* (snail) |
| *Austropyrgus buchanensis* (snail) | *Isidorella brazieri* (snail) |
| *Austropyrgus cooma* (snail) | *Isidorella montana* (snail) |
| *Austropyrgus monaroensis* (snail) | *Isidorella newcombi* (snail) |
| *Austropyrgus ora* (snail) | *Corbicula australis* (freshwater clam) |
| *Austropyrgus synoria* (snail) | *Hyridella australis* (freshwater mussel) |
| *Austropyrgus tathraensis* (snail) | *Hyridella depressa* (freshwater mussel) |
| *Austropyrgus viridarium* (snail) | *Hyridella drapeta* (freshwater mussel) |
| *Austropyrgus buchanensis* (snail) | *Velesunio ambiguus* (freshwater mussel) |
| *Potamopyrgus antipodarum* (snail) | *Musculium quirindi* (freshwater mussel) |
| *Austropeplea lessoni* (snail) | *Musculium tasmanicum* (freshwater mussel) |
| *Austropeplea tomentosa* (snail) | *Pisidium carum* (freshwater clam) |
| *Austropeplea brazieri* (snail) | *Pisidium casertanum* (freshwater clam) |
| *Sphaerium* sp. (freshwater clam) | *Pisidium etheridgei* (freshwater clam) |
| *Physa acuta* (snail) | *Pisidium hallae* (freshwater clam) |
| *Glyptophysa aliciae* (snail) | *Pisidium kosciusko* (freshwater clam) |
| *Glyptophysa placata* (snail) | *Pisidium tasmanicum* (freshwater clam) |
| | |
| **Algae (Charaophytes)**** | |
| *Nitella arthroglochin* | *Chara vulgaris* |


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|---|---|
| *Nitella subtilissima* | *Chara australis* |
| *Nitella cristata* var. | *Chara fibrosa* |
| *Nitella* sp. aff. *Mucosa* | *Chara gelatinosa* var. |
| *Chara australis* | *Chara muelleri* |

***** Denotes a listed threatened species in the Act.

** Freshwater algae listed above are an important component of the community but are not covered under the *Fisheries Management Act 1994* and are covered under the *Threatened Species Conservation Act 1995*.

2. The total species list of the community is much larger than that given above. The list is based on a combination of Australian Museum and literature records and is data deficient for any areas of the Snowy River drainage. At any particular site, not all of the species listed above may be present. The species composition of the site will be influenced by the time of year, the size and ecological characteristics of the area and the level of threatening processes present. The species listed in the above table are considered aquatic species under the definition of the *Fisheries Management Act 1994*.

3. The Snowy River rises in the mounts of the Great Dividing Range in southeastern NSW and flows generally southward into Victoria to discharge into Bass Strait at Marlo. Four large dams – Guthega, Island Bend Pondage, Eucumbene and Jindabyne – and the Mowamba River aqueduct have been constructed on its headwater tributaries as part of the Snowy Mountains Hydro-Electric Scheme. The Snowy Mountains Scheme was constructed between 1955 and 1967 for hydro electric power generation and provision of a water resource for irrigators in the Murray and Murrumbidgee valleys (Snowy Hydro 2003). The river passes through a variety of landscapes along its length with a high proportion of 'gorge' country. Snowy Falls in the Burnt Hut Gorge reach forms a natural barrier that has been exacerbated by reduced flows (Lugg *et al.* 2006, Gilligan and Williams 2008).

**Criteria – reduction in ecological function, geographic distribution or genetic diversity (Regulation clause 340L)**

1. Two of the 15 native finfish species *Nannoperca australis* (southern pygmy perch), and *Gadopsis marmoratus* (river blackfish) in this community are listed in the Threatened Species Schedules for New South Wales. *Prototroctes mareana* (Australian grayling) is listed as Vulnerable under the *Commonwealth Environment Protection and Biodiversity and Conservation Act 1999* and listed as a protected species under the *Fisheries Management Act 1994*.

2. Surveys have been undertaken of the fish and aquatic macroinvertebrate communities' pre and post environmental flow releases (Brooks *et al.* 2007, Gilligan and Williams 2008). Fish communities were different in the upper catchment (above Snowy Falls) and in the lower catchment (below Snowy Falls). The fish communities did not become more similar to reference sites following environmental flows releases and this was considered to be due to the extended drought and the low levels of flow release (Gilligan and Williams 2008). The macroinveretebrate fauna of the upper Snowy River, reference sites and control sites remained distinct following environmental flows releases. In addition, the


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**Phone: (02)4982-1232 Fax: (02)4982-1107 Email:fsc@industry.nsw.gov.au**

macroinvertebrate assemblages within riffle and pool edge habitats of the midland and lowland reaches of the Snowy River did not exhibit any response that could be related to the environmental flow releases (Brooks *et al.* 2007).

3. In light of the above, the Fisheries Scientific Committee has found that the aquatic ecological community in the natural drainage system of the catchment of the Snowy River has undergone a very large reduction in ecological function and genetic diversity within a time frame appropriate to the life cycle and habitat characteristics of the component species; this meets the criteria of an Endangered Ecological Community.

**Criteria – threatening processes (Regulation clause 340M)**

1. The Fisheries Scientific Committee has identified the following threats to the continued survival of the Aquatic Ecological Community in the catchment of the Snowy River:

    - Since construction of the Snowy Mountains Scheme (SMS) in 1967, flows in the Snowy River have been diverted into the Murray and Murrumbidgee Rivers, with only 1% and 4% of Mean Annual Natural Flows being recorded in the Snowy River at Jindabyne or Dalgety, respectively. Construction of the SMS has affected all components of the flow regime in the Snowy River below Jindabyne Dam, with reduced baseflows, flow variability, spring snowmelts and floods (Pendlebury *et al.* 1996, Rose and Bevitt 2003, Bevitt and Jones 2008, Lugg *et al.* 2006, Gilligan and Williams 2008). Natural in-stream structures, such as falls or cascades and sand-slug accumulations, as well as constructed features, such as dams and weirs, have regulated natural flows thereby affecting the normal reproductive and other biological cues of species in the community. The flow regulation has altered the seasonal flow regime from natural winter-spring floods and low flows in summer, to high flows in summer. River regulation has also significantly reduced the frequency, extent and duration of flooding. The reproduction of many native fishes is closely linked to high flows and flooding in spring, and regulation has reduced the incidence of spawning and the conditions suitable for the high survival of larvae and juveniles (Humphries and Lake 2000, Lugg *et al.* 2006, Gilligan and Williams 2008).

      In-stream structures have reduced upriver fish migrations, particularly of the more mobile species, because few barriers allow fish passage. This has fragmented populations and reduced the habitat available to many species. There are major differences in the fish assemblages, especially of diadromous migratory fish, above and below Snowy Falls (Lugg *et al.* 2006, Gilligan and Williams 2008).

      Water extraction and river regulation contribute to decreased bank stability, increased erosion during high flow and flood events, and the formation of sand shoals in some parts of the river and its tributaries. The vigour of vegetation is also closely linked to the volume of flow into wetlands. These changes decrease the available habitat for the ecological community and degrade that which remains. The installation and operation of in-stream structures and other mechanisms that alter natural flow regimes of rivers and streams have been


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listed as a Key Threatening Process in Schedule 6 of the *Fisheries Management Act 1994*. The alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands has been listed as a Key Threatening Process in Schedule 3 of the *Threatened Species Conservation Act 1995*.

Large in-stream structures, particularly Jindabyne Dam and Eucumbene Dam, cause thermal pollution. The release of cold water from the base of these dams has altered the natural temperature regime downstream, with adverse effects on fish reproduction, migration and distribution. Migration is an important part of the biology of most native fishes, and usually occurs at temperatures around or over 20°C between spring and mid-autumn. Thermal pollution inhibits migration, subsequently restricting distribution to areas well below dams; this also results in a loss of habitat for some fish species (Astles *et al.* 2003).

- The clearing of riparian vegetation and its replacement with introduced species such as willows and continued access of stock to the riparian zone increases erosion and subsequent siltation in the waterways, and removes potential habitat and reproductive sites for some fish species (e.g. river blackfish [*Gadopsis marmoratus*] are thought to use fallen, submerged trees as spawning sites) (Jackson *et al.* 1996). Clearing of the floodplain vegetation for agriculture also reduces carbon inputs which are a basis of the food resources for in-stream invertebrates and the food chains in general. Degradation of native riparian vegetation along NSW waterways has been listed as a Key Threatening Process in Schedule 6 of the *Fisheries Management Act 1994*. The clearing of native vegetation has been listed as a Key Threatening Process in Schedule 3 of the *Threatened Species Conservation Act 1995*.
- The aquatic macroinvertebrate assemblages of the upper Snowy River were different from the assemblages occurring in reference (nearby unregulated rivers) and control (rivers with highly altered flow regimes and not receiving environmental flows). The main factors contributing to the differences between sites were primarily variations in riparian cover and composition and landuse (Brooks *et al.* 2007).
- The loss of aquatic plants from the Snowy River has contributed to the degradation and destabilisation of the ecosystem, and to an overall reduction in biodiversity. Aquatic macrophytes play an essential role in ecosystems through primary production, stability of the substratum, and by providing shelter, habitat, spawning sites, nursery areas, and food for fish, crustaceans and other organisms.
- The removal of snags reduces the amount of aquatic habitat and sites available for reproduction of fishes and invertebrates. Native species, particularly Bass and River Blackfish are strongly associated with underwater structures such as snags and depend on habitats with dense accumulations of woody debris. These areas also provide vital substrata for many invertebrates. River blackfish and various species of gudgeons spawn adhesive eggs onto and in submerged logs (Jackson *et al.* 1996, Larson and Hoese 1996). Thousand of snags have been removed from the Orbost and Sandy Point reaches to enhance navigability (Haupt 2000). In addition, the loss of riparian vegetation means that there is no longer a ready source of new snags in some areas. The removal of large woody


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**Phone: (02)4982-1232 Fax: (02)4982-1107 Email:fsc@industry.nsw.gov.au**

debris has been listed as a Key Threatening Process in Schedule 6 of the *Fisheries Management Act 1994*.

- Deterioration of water quality is a threat to the ecological community because good water quality is essential for the health of aquatic ecosystems. Scientific studies of water quality in the Snowy River catchment have not been conducted in sufficient detail to determine if they have contributed to the decline in Snowy River fish populations. Reduced flows have probably affected water quality attributes such as dissolved oxygen concentration and temperature in the reach immediately downstream of Jindabyne.
- The rate of sedimentation into the Snowy River has greatly accelerated since European settlement due to mining, land clearing, grazing, cropping, stream and gully erosion. This has resulted in elimination of deep holes and smothering of gravel beds and aquatic plants which has caused loss of refuge and breeding habitat with a direct impact upon fish and their food chain.
- There are at least eight introduced species: *Carassius auratus* (goldfish), *Gambusia holbrooki* (eastern gambusia), *Salmo trutta* (brown trout), *Perca fluviatilis* (redfin perch), *Salmo salar* (Atlantic salmon), *Salvelinus fontinalis* (brook trout), *Onchorhynchus mykiss* (rainbow trout) and *Misgurnis anguillicaudatus* (oriental weatherloach) in the Snowy River system (Lugg *et al.* 2006, Gilligan and Williams 2008). Introduced species can act as predators, competitors, habitat modifiers and disease carriers. In particular, redfin perch and trout prey on small native species such as galaxiids and juveniles of larger species and gambusia are known to 'fin-nip' other species. The introduction of fish to fresh waters within a river catchment outside their natural range has been listed as a Key Threatening Process in Schedule 6 of the *Fisheries Management Act 1994*.

2. The Committee recognises the initiatives undertaken by the Snowy Hydro Limited, State, Commonwealth and local governments, Southern River Catchment Management Authority, community groups and private interest stakeholders to address concerns about the decline in the health of this aquatic community. Improvements have been, or are being made in numerous areas, including environmental flows, thermal discharges, riparian vegetation management, and fish passage at smaller weirs. The Committee also recognises that changes to commercial and recreational fishing regulations have been made in the interests of protection of threatened species and stock conservation for exploited species. At this stage, the Committee does not consider that the benefits of these programs have reversed the decline of the aquatic community in the Snowy River.

3. In light of the above, the Fisheries Scientific Committee is of the opinion that there are current threatening processes affecting the aquatic ecological community in the natural drainage system of the Snowy River.

**Conclusion pursuant to section 220FB(2) of the Act**

In the opinion of the Fisheries Scientific Committee:


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a. The Aquatic Ecological Community in the Natural Drainage System of the Snowy River is facing a very high risk of extinction in New South Wales in the near future, as determined in accordance with the criteria prescribed by the Regulation as discussed above; and
b. That it is not eligible to be listed as a critically endangered ecological community.

The Aquatic Ecological Community in the Natural Drainage System of the Snowy River is eligible to be listed as an ENDANGERED ECOLOGICAL COMMUNITY.

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Assoc Prof Ron West
Chairperson
Fisheries Scientific Committee



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**Phone: (02)4982-1232 Fax: (02)4982-1107 Email:fsc@industry.nsw.gov.au**