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FINAL RECOMMENDATION

AQUATIC ECOLOGICAL COMMUNITY IN THE NATURAL DRAINAGE SYSTEM OF THE LOWLAND CATCHMENT OF THE LACHLAN RIVER

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a final recommendation to list the Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River 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 Lowland Catchment of the Lachlan River is part of the Murray-Darling Basin. The area covered by this recommendation includes all natural rivers, creeks, streams and associated lagoons, billabongs, lakes, wetlands, paleochannels, floodrunners, effluent streams (those that flow away from the river) and the floodplains of the Lachlan River within the State of New South Wales, and including Lake Brewster, Lake Cargelligo and Lake Cowal. This area includes:

- The main channels and tributaries of the Lachlan River from Wyangala Dam (33°58'S; 148°57'E) to the convergence with the Murrumbidgee River (34°20'S; 143°54'E).
- The Boorowa River, the Belubula River downstream of Carcoar Dam (33°36'S; 149°11'E), Mandagery Creek, Goobang Creek and Crowie Creek.
- Lake Cowal (33°36'S; 147°25'E), Bland Creek and its tributaries.
- Lake Brewster (33°27'S; 145°58'E) and Lake Cargelligo (33°16'S; 146°24'E).
- The effluent waters of Willandra Creek, Moolbang Creek and Merrowie Creek.
- The Great Cumbung Swamp.

Excluded from this recommendation are the man-made canals, off-stream reservoirs, water distribution and drainage works, and farm dams. Specifically, Mirrool Creek including Barren Box Swamp, and its catchment west of the township of Mirrool (34°18'S; 147°04'E) is excluded because under the current regulated system, the majority of water entering Barren Box Swamp is from the Murrumbidgee Irrigation Area. Other watercourses above an altitude of 500m not specifically named in this recommendation are excluded.

The Fisheries Scientific Committee has found that:

1. The aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River is characterised by the following assemblage of native animal species:

CRUSTACEANS	
Lepidurus viridis (shield shrimp)	*Macrobrachium australiense* (freshwater prawn)
Apus australiensis (shield shrimp)	*Paratya australiensis* (shrimp)
Amarinus lacustris (freshwater crab)	*Cherax destructor* (yabby)
Branchinella australiensis (fairy shrimp)	*Austrothelphusa transversa* (freshwater crab)
Limnadopsis parvispinus (clam shrimp)	*Daphnia lumholtzi* (water flea)
FINFISHES (OSTEICHTHYES)	
Galaxias olidus (mountain galaxias)	*Craterocephalus stercusmuscarum fulvus* (flyspecked hardyhead)
Nematalosa erebi (bony bream)	**Ambassis agassizi* (olive perchlet/Agassizs glassfish)
Tandanus tandanus (freshwater catfish)	**Bidyanus bidyanus* (silver perch)
Melanotaenia fluviatilis (crimson-spotted rainbowfish)	*Hypseleotris klunzingeri* (western carp gudgeon)
Gadopsis marmoratus (river blackfish)	*Hypseleotris* spp. (Midgley's carp gudgeon, Lake's carp gudgeon, Murray-Darling carp gudgeon)
Maccullochella peelii peelii (Murray cod)	*Philypnodon grandiceps* (flathead gudgeon)
Macquaria ambigua (golden perch)	**Nannoperca australis* (southern pygmy perch)
Leiopotherapon unicolor (spangled perch)	**Mogurnda adspersa* (purple-spotted gudgeon)
Retropinna semoni (Australian smelt)	
INSECTS (COLEOPTERA)	
Aulonogyrus strigosus (whirligig beetle)	
INSECTS (DIPTERA)	
Anopheles (Cellia) annulipes (mosquito)	*Tanytarsus richardsi* (chironomid fly)
Dicrotendipes pelochloris (chironomid fly)	*Tanytarsus fuscithorax* (chironomid fly)
Dicrotendipes conjunctus (chironomid fly)	*Cardiocladius australiensis* (chironomid fly)
Kiefferulus martini (chironomid fly)	
INSECTS (HEMIPTERA)	
Microvelia peramoena (water bug)	*Tenagogerris euphrosyne* (water strider)
Limnogonus(Limnogonus) luctuosus (water strider)	
INSECTS (ODONATA)	
Aeshna (Adversaeschna) brevistyla (dragonfly)	*Austrolestes annulosus*(damselfly)
Spinaeschna tripunctata (dragonfly)	*Austrolestes cingulatus* (damselfly)
Hemigomphus gouldii (dragonfly)	*Austroargiolestes icteromelas* (damselfly)
Pseudagrion aureofrons(damselfly)	*Synlestes weyersii tillyardi* (damselfly)
Ischnura heterosticta (damselfly)	*Isosticta simplex* (damselfly)
	Nososticta solida (damselfly)
INSECTA (TRICHOPTERA) all caddisflies	
Hellyethira malleoforma	*Triplectides varius*
Hellyethira simplex	*Triplectides similis*
Hydroptila obscura	*Triplectides australicus*
Hydroptilia scamandra	*Triplectides volda*
Orthotrichia bishopi	*Notalina spira*
Ecnomus myallensis	*Apsilochorema gisbum*
Econmus pansus	*Koetonga clivicola*
Ecnomus tillyardi	*Ulmerochorema lentum*
Ecnomus turgidus	*Taschorema kimminsi*
Triplectides australis	*Ethochorema nesydrion*
INSECTA (EPHEMEROPTERA)	
Tasmanocoenis tillyardi (mayfly)	

INSECTA (PLECTOPTERA) all stoneflies	
Leptoperla neboissi	*Illiesoperla (Illiesoperla) brevicauda*
Leptoperla bifida	*Illiesoperla (Illiesoperla) mayi*
Leptoperla primitiva	*Riekoperla rugosa*
Illiesoperla (Illiesoperla) australis	*Neboissoperla alpina*
MOLLUSCA	*Austropeplea tomentosa* (snail)
**Notopala sublineata hanleyi* (snail)	*Alathyria jacksoni* (bivalve)
Lymnaea lessoni (snail)	*Alathyria condola* (bivalve)
Thiara balonnensis (snail)	*Corbicula australis* (bivalve)
Glyptophysa gibbosa (snail)	
PORIFERA	
Heterorotula contraversa (sponge)	*Heterorotula multidentata* (sponge)

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

2. The total species list of the Lachlan River is larger than that given above. The above list is based on a combination of Australian Museum records, NSW Fisheries and Department of Infrastructure, Planning and Natural Resources (DIPNR, formerly Department of Land and Water Conservation) reports and records, and historical and scientific literature. This list, however, is considered to be data deficient for many species and areas of the Lachlan River. For example, although two threatened species, trout cod (*Maccullochella macquariensis*) and Macquarie perch (*Macquaria australasica*), have not been recorded in the lowland catchment of the Lachlan River, both species were or are found in the upper reaches of the Lachlan River and the Macquarie River to the north, and in the lowland areas of the Murrumbidgee and Murray rivers to the south. The taxonomy of *Hypseleotris* has not been resolved, hence the number of species of gudgeons in the Lachlan River catchment is uncertain. Suter (2001, unpublished report) lists 265 taxa as occurring in the catchment, but a large portion of these taxa are not identified to a described species. The Zoological Catalogue of Australia lists 144 species (Annelida: Hirudinea; Insecta: Heteroptera, Coleptera, Neuroptera, Plecoptera, Trichoptera) from the Murray-Darling Basin, many of which could have distributions extending into the Lachlan River catchment. At any particular site, not all species listed above may be present. The species composition of a site will be influenced by the time of the 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. In its natural state, many of the water-bodies in this catchment are characterised by variable and unpredictable patterns of high and low flows and water levels. The natural morphology of the river system includes deep channels, deep pool areas, sandy-muddy banks, terraces formed by floods, suspended load depositional 'benches', higher floodplain 'benches', paleochannels, floodrunners, anabranches, wetlands, and a terminal wetland complex. Although small flows are contributed to the Murrumbidgee River, the Lachlan River is considered to culminate in a large, expansive swamp known as the Great Cumbung Swamp. The floodplain is also an integral part of this river system. Many fish species rely on the seasonal flow pattern and inundation of the floodplain for successful reproduction. The complex river

morphology provides a multitude of habitats that play a critical role in the life cycles of the species making up this ecological community.

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

- In-stream structures, such as dams and weirs, regulate natural flows thereby affecting the normal reproductive and other biological cues of species in the community. The 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.

  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.

  Large in-stream structures, particularly Wyangala Dam and Carcoar Dam, cause thermal pollution. The release of cold water from the base of these dams has altered the natural temperature regime downstream, at least as far as Forbes, with adverse effects on fish reproduction, migration and distribution. Most fish native to the lowland reaches of the Lachlan River require species-specific water temperatures between 18° to 24°C to induce spawning, and so significantly reduced water temperatures below dams prevent or decrease the incidence of spawning. Migration is an important part of the biology of some 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.

  Reduced floodplain and wetland inundation caused by the in-stream structures and levee banks has seriously affected the ecosystem. The morphological complexity of the system involving the main channel, floodplain and wetlands is critical for ecosystem health. The floodplains and wetlands play a vital role in the accumulation and processing of organic matter, which provides a key source of nutrients, energy and food for the micro and macro-invertebrates at the lower levels of the food chain. Zooplankton and aquatic insects are important food items of larval and juvenile fish and their production is linked to inundation of the floodplain. Isolation of the river channel and alienation of the floodplain and wetlands, have reduced the complexity and productivity of the ecosystem.

  Water extraction for irrigation, industrial and domestic purposes has decreased flows to levels that may be detrimental to ecosystem functioning, particularly the lower reaches of the Lachlan River and the Great Cumbung Swamp and other wetlands. 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 members of the ecological community and degrade that which remains. In addition, the reduced flows and high nutrient input from some agricultural sources are major factors contributing to the increased incidence of blue-green algal blooms in parts of the Lachlan River and lakes. The installation and operation of in-stream structures and other mechanisms that alter natural flow regimes of rivers and streams have been 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.*

- Deterioration of water quality is a threat to the ecological community because good water quality is essential for the health of aquatic ecosystems. Although scientific studies of water quality in the Lachlan River catchment found no major trends through the 1990's, some studies and all the historical and anecdotal information strongly suggest that water quality has significantly deteriorated in since the 1950's. Key aspects of this deterioration are: thermal pollution; increased salinity in some tributaries; increased nutrients; increased incidence of blue-green algal blooms; and increased turbidity (particularly in Lake Brewster and the lower reaches of the system). Through-out most of the 1900's, the water of the Lachlan River was characteristically clear, except during floods and large freshes. Since the 1970's, the turbidity of waters in the lowland catchment has been consistently high, suggesting a major change and deterioration of water quality in this aquatic ecosystem.

- The loss of aquatic plants from the Lachlan River, creeks and wetlands has contributed to the degradation and destabilisation of the ecosystem, and to an overall reduction in biodiversity. In the 1970's, there was a marked and synchronous decline of the predominant aquatic plants of the Lachlan River; ribbon weed (*Vallisneria* spp.), floating pondweed (*Potamogeton tricarinatus*), duckweed (*Azolla* spp.) and cumbungi (*Typha* spp.). The common reed (*Phragmites australis*) and lignum (*Muehlenbeckia florulenta*) were widespread and common in the wetter areas of wetlands, and have also undergone significant reductions in distribution and abundance. The aquatic flora of the Lachlan River catchment remains seriously depleted. Aquatic macrophytes play an essential role in ecosystems through primary production, stability of the substrate, and by providing shelter, habitat, spawning sites, nursery areas, and food for fish, crustaceans and other organisms.

- The presence of at least seven introduced species: (carp [*Cyprinus carpio*], redfin perch [*Perca fluviatilis*], goldfish [*Carassius auratus*], rainbow trout [*Oncorhynchus mykiss*], brown trout [*Salmo trutta*], mosquitofish [*Gambusia holbrooki*] and the snail [*Physa acuta*]) is an additional threat to the aquatic community. Introduced species can act as predators, competitors, habitat modifiers and disease carriers. In particular, carp and redfin perch have been identified as having deleterious effects on native species in the Lachlan River catchment. Redfin were common in the Lachlan River from the late 1940's to the 1960's. They are prolific, aggressive carnivores that compete with and prey on native

fishes, and have been implicated in the decline of Murray cod in the 1950's. Carp first appeared in the Lachlan in the late 1960's, and their populations increased rapidly during the 1970's, with numbers remaining high through the 1980's and 1990's. Although few scientific studies have been completed, carp are thought to cause significant environmental damage. Historical and anecdotal information suggests that carp had a rapid and dramatic affect on the Lachlan River and it tributaries commencing in the 1970's. Carp uproot, damage and kill aquatic plants, and may have been a factor in the large-scale loss of aquatic plants from the Lachlan River catchment. Besides affecting plants, the carp's feeding behaviour also increases the turbidity of water, and may have contributed to changes in bank stability, channel structure and siltation. Carp may compete with native fauna for food, prey on eggs of some native fish, prey on yabbies and other crustaceans, and are known to act as a disease vector by carrying parasites such as anchor worm (*Lernaea* sp.). Yabbies were once common, but now are extremely rare in most parts of the Lachlan River. 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*.

- The clearing of riparian vegetation 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. Murray cod [*Maccullochella peelii peelii*] and river blackfish [*Gadopsis marmoratus*] are thought to use fallen, submerged river redgums [*Eucalyptus camaldulensis*] as spawning sites). 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.*

- Some types of agriculture can produce threatening processes to native aquatic animals. The reduction of river flow by water extraction for irrigation, and pollution through insecticide and fertilizer runoff, are detrimental to aquatic life. These processes are especially pertinent during periods of low river flow when demand for irrigation and stock water is highest, and pollutants are concentrated in waterways.

- Overfishing has reduced populations of native fish species including Murray cod *(Maccullochella peelii peelii)* and golden perch (*Macquaria ambigua*) in parts of the Murray-Darling River System. For species listed as endangered or vulnerable, such as olive perchlet (*Ambassis agassizii*), purple-spotted gudgeon (*Mogurnda adspersa*) and silver perch (*Bidyanus bidyanus*), targeted or incidental collection and recreational catch must be considered as a threatening process.

- Although de-snagging has not been extensively practised in the Lachlan, it is a threat to the ecological community. The removal of snags reduces the amount of aquatic habitat and sites available for reproduction of fishes and invertebrates. Many native fishes are dependant on habitats with dense accumulations of woody debris. These areas also provide vital substrate for many invertebrates. Murray cod, river blackfish and various species of gudgeons spawn adhesive eggs onto and in submerged logs. The removal of large woody debris has been listed as a Key Threatening Process in Schedule 6 of the *Fisheries Management Act 1994*.

5. Four of the native finfish species (*Ambassis agassizi* [Olive perchlet/Agassizs glassfish], *Bidyanus bidyanus* [silver perch], *Nannoperca australis* [southern pygmy perch], and *Mogurnda adspersa* [purple-spotted gudgeon]) in this community are listed in the Threatened Species Schedules for New South Wales. One species of freshwater snail within the community, *Notopala sublineata*, is endangered. Serious declines of at least two other species of fish native to the Lachlan River catchment (*Tandanus tandanus* [eeltail catfish] and *Gadopsis marmoratus* [river blackfish]) have been documented.

6. The Lachlan, like other inland river systems in New South Wales, is subject to a natural drought-flood cycle. The present drought conditions have exacerbated the problems associated with the aquatic ecological community of the lowland catchment of the Lachlan River. However, the decline of species and degradation of the aquatic habitat have occurred over the last 50-100 years, and drought (including the current drought) is not a major causative factor.

7. The Committee recognises the initiatives undertaken by the Murray-Darling Basin Commission, State, Commonwealth and Local Governments, community groups and private interest stakeholders (e.g. the Lachlan Community Monitoring Program) to address concerns about the decline in the health of this aquatic community. Improvements have been, or are being made in numerous areas, including water sharing allocations, riparian vegetation management, irrigation runoff, catchment 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. Despite these positive efforts, the ecological community remains threatened.

8. In light of the above, the Fisheries Scientific Committee has determined that the Aquatic Ecological Community in the Natural Drainage System of the Lachlan River is likely to become extinct in nature, unless the circumstances and factors threatening its survival cease to operate. Therefore, the community qualifies for inclusion in Part 3 of Schedule 4, as an ENDANGERED ECOLOGICAL COMMUNITY.

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Fisheries Scientific Committee

REFERENCES

Allen, G.R., Midgley, S.H. and Allen, M. (2002). Field Guide to the Freshwater Fishes of Australia. (Western Australian Museum: Perth).

Anon. (1998). Lachlan Catchment State of the River Report – 1997. (NSW Government: NSW Department of Land and Water Conservation).

Anon. (2003a). Rivers Program – Managing Catchments. (Murray-Darling Basin Commission: Canberra).

Anon. (2003b). Rivers Program – Managing Fish. (Murray-Darling Basin Commission: Canberra).

Anon. (2003c). Rivers Program – Managing Rivers. (Murray-Darling Basin Commission: Canberra).

Anon. (2003d). Rivers Program – Managing Wetlands. (Murray-Darling Basin Commission: Canberra).

Anon. (2003e). Rivers Program – Understanding the Basin. (Murray-Darling Basin Commission: Canberra).

Anon. (2003f). Rivers Program – Project Summaries 1990 – 2000. (Murray-Darling Basin Commission: Canberra).

Australian and New Zealand Environment and Conservation Council (1992). Australian Water Quality Guidelines for Fresh and Marine Waters.

Bennison, G., Hillman, T.J. and Suter, P.J. (1989). Macroinvertebrates of the River Murray (Survey and Monitoring: 1980-1985). Water Quality Report No. 3 (Murray Darling Basin Commission: Canberra).

Clunie, P. and Koehn, J. (2001a). Silver perch: a recovery plan. Vol. 1 Final Report for Natural Resource Management Strategy Project R7002. (Murray-Darling Basin Commission: Canberra).

Clunie, P. and Koehn, J. (2001b). Silver perch: a resource document. Vol. 2 Final Report for Natural Resource Management Strategy Project R7002. (Murray-Darling Basin Commission: Canberra).

Clunie, P. and Koehn, J. (2001c). Freshwater catfish: a recovery plan. Vol. 1 Final Report for Natural Resource Management Strategy Project R7002. (Murray-Darling Basin Commission: Canberra).

Clunie, P. and Koehn, J. (2001d). Freshwater catfish: a resource document. Vol 2. Final Report for Natural Resource Management Strategy Project R7002. (Murray-Darling Basin Commission: Canberra).

Crook, D.A. and Robertson, A.I. (1999). Relationships between riverine fish and woody debris: implications for lowland rivers. *Marine and Freshwater Research* 50: 941-953.

Crook, D. and Pogonoski, J. (2003). Threatened fishes committee report December 2002. *Australian Society for Fish Biology Newsletter* 32: 45-52.

Douglas, J.W., Gooley, G.J. and Ingram, B.A. (1994). Trout cod, *Maccullochella macquariensis* (Cuvier) (Pisces: Percichthyidae), resource handbook and research and recovery plan. (Department of Conservation and Natural Resources: Melbourne).

Driver, P.D., Harris, J.H., Norris, R.H. and Closs, G.P. (1997). The role of the natural environment and human impacts in determining biomass densities of common carp in News South Wales rivers. In: "Fish and Rivers in Stress: The NSW Rivers Survey." (Eds Harris, J.H. and Gehrke, P.C.) pp. 225-250. (NSW Fisheries Office of Conservation and the Cooperative Research Centre for Freshwater Ecology: Cronulla).

Faragher, R.A. and Lintermans, M. (1997). Alien fish species from the New South Wales Rivers survey. In: "Fish and Rivers in Stress: The NSW Rivers Survey." (Eds Harris, J.H. and Gehrke, P.C.) pp. 201-223. (NSW Fisheries Office of Conservation and the Cooperative Research Centre for Freshwater Ecology: Cronulla).

Gehrke, P.C., Brown, P., Schiller, C.B., Moffatt, D.B. and Bruce, A.M. (1995). River regulation and fish communities in the Murray-Darling river system, Australia. *Regulated Rivers: Research and Management* 11: 363-375.

Gilligan, D. and Schiller, C. (2003). Downstream transport of larval and juvenile fish in the Murray River. NSW Fisheries Final Report Series No. 50 (NSW Fisheries: Sydney).

Growns, I. (2001). An assessment of the status of native fish and fish habitats in the Lachlan River. (NSW Fisheries: Sydney).

Growns, I., Gehrke, P. and Bruce, A. (2001). Integrated monitoring of environmental flows, 4th progress report. (NSW Fisheries: Sydney).

Harris, J.H. and Gehrke, P.C. (Editors) (1997). Fish and Rivers in Stress: the NSW Rivers Survey. (NSW Fisheries Office of Conservation and the Cooperative Research Centre for Freshwater Ecology: Cronulla).

Harris, J.H. and Rowland, S.J. (1996). Family Percichthyidae Australian Freshwater Cods and Basses. In "Freshwater Fishes of South-eastern Australia" (Ed. R. McDowall) (Reed: Sydney).

Hawking, J.H., and Smith, F.J. (1997): Colour guide to invertebrates of Australian inland waters. (Identification Guide, No. 8.) Identification Guide No. 24. (Co-operative Research Centre for Freshwater Ecology: Albury).

Hawking, J.H. (2000): Key to keys: a guide to keys and zoological information to identify invertebrates from Australian inland waters. 2nd ed. (Cooperative Research Centre For Freshwater Ecology: Albury).

Humphries, P., King, A.J. and Koehn, J.D. (1999). Fish, flows and floodplains: links between freshwater fishes and their environment in the Murray-Darling River system, Australia. *Environmental Biology of Fishes* 56: 129-151.

Ingram, B.A., Barlow, G.G., Burchmore, J.J., Gooley, G.J., Rowland, S.J. and Sanger, A.C. (1990). Threatened native freshwater fishes in Australia – some case histories. *Journal of Fish Biology*. 37 (supplement A): 175-182.

Kearney, R.E. and Kildea, M.A. (2001). The Status of Murray Cod in the Murray-Darling Basin. (University of Canberra: Canberra).

Keenan, C.P., Watts, R.J. and Serafini, L.G. (1995). Population genetics of golden perch (*Macquaria ambigua*), silver perch (*Bidyanus bidyanus*) and eel-tailed catfish (*Tandanus tandanus*) within the Murray-Darling Basin. Final Report – Murray-Darling Basin Commission Project M262. (Murray-Darling Basin Commission: Canberra).

Koehn, J., Brumley, A.R. and Gehrke, P.C. (in press). Managing the Impacts of Carp. (Bureau of Rural Science: Canberra).

Koehn, J. and O'Connor, W. (1990). Threats to Victorian native freshwater fish. *Victorian Naturalist* 107: 5-12.

Lake, J.S. (1967). Freshwater Fish of the Murray-Darling River System. New South Wales State Fisheries Research Bulletin No. 7.

Lake, J.S. (1971). Freshwater Fishes and Rivers of Australia. (Nelson: Sydney).

Llewellyn, L.C. (1983). The Distribution of Fish in New South Wales. Australian Society for Limnology Special Publication No. 7.

McDowell, R.M. (Editor) (1996). Freshwater Fishes of South-eastern Australia. (Reed: Chatswood).

Merrick, J.R. and Schmida, G.E. (1984). Australian Freshwater Fishes Biology and Management. (J.R. Merrick; North Ryde).

Morris, S.A., Pollard, D.A., Gehrke, P.C. and Pogonoski, J.J. (2001). Threatened and Potentially Threatened Freshwater Fishes of Coastal New South Wales and the Murray-Darling Basin. (NSW Fisheries: Sydney).

Pollard, D.A., Llewellyn, L.C. and Tilzey, R.D.J. (1980). Management of freshwater fish and fisheries. In: "An Ecological Basis for Water Resource Management." (Ed. Williams, W.D.) pp. 227 – 269. (ANU Press: Canberra).

Roberts, J. and Sainty, G. (1966). Listening to the Lachlan. (Sainty & Associates: Sydney).

Roberts, J. and Sainty, G. (1997). Oral history as a tool in historical ecology: Lachlan River as a case. CSIRO Land & Water Consultancy Report 97 – 20.

Roberts, J. and Sainty, G. (2000). Oral history, ecological knowledge, and river management. In "Environmental History and Policy Still Settling Australia." (Ed. Dovers, S.) pp. 118 – 143. (Oxford University Press: Sydney).

Rowland, S.J. (1983). Spawning of the Australian freshwater fish Murray cod, *Maccullochella peeli* (Mitchell), in earthen ponds. *Journal of Fish Biology* 23:525-534.

Rowland, S.J. (1989). Aspects of the history and fishery of the Murray cod, *Maccullochella peeli* (Mitchell) (Percichthyidae). *Proceedings of the Linnean Society of New South Wales* 111: 201-213.

Rowland, S.J. and Ingram, B.A. (1991). Diseases of Australian native freshwater fishes with particular emphasis on the ectoparasitic and fungal diseases of Murray cod (*Maccullochella peeli*), golden perch (*Macquaria ambigua*) and silver perch (*Bidyanus bidyanus*). Fisheries Bulletin 4. (NSW Fisheries: Sydney).

Schiller, C.B., Bruce, A.M. and Gehrke, P.C. (1997). Distribution and abundance of native fish in New South Wales rivers. In: "Fish and Rivers in Stress: The NSW Rivers Survey." (Eds Harris, J.H. and Gehrke, P.C.) pp. 71-102. (NSW Fisheries Office of Conservation and the Cooperative Research Centre for Freshwater Ecology: Cronulla).

Sheldon, F. and Walker, K.F. (1998). Spatial distribution of littoral invertebrates in the lower Murray-Darling river system. *Marine and Freshwater Research* 49: 171-182.

Walker, D. (2001). Lachlan Community Monitoring Annual Report 2000/2001. (Lachlan Community Monitoring Program: Forbes).

Walker, D. (2003). Lachlan Community Monitoring Annual Report 2001/2002 and 2002/2003. (Lachlan Community Monitoring Program: Forbes).

Weatherburn, A. K. (1972). The discovery and exploration of the Lachlan River. *Proceedings of the Hay Historical Society* No. 2: 18 – 26.

Williams, W.D. (1980). Australian Freshwater Life - The Invertebrates of Australian Inland Waters. (MacMillan: South Melbourne).

PERSONAL COMMUNICATIONS

Hartley, S. (2003). Discussion of the fish fauna of the Lachlan River.

Parker, L. (2004). Discussion of the Lachlan River aquatic flora and fauna.

Wettin, P. (2004). Discussion of the Lachlan River catchment at FSC meeting No. 65.

Wooden, I. (2004). Discussion of the fish fauna of the Lachlan River.

UNPUBLISHED REPORT

Suter, P. (2001). Invertebrates of the Lachlan River. Unpublished report for Conservation and Land Management.

Parker, L. (2004). Notes and observations on the fishes and other aquatic fauna of the Hillston area (2000-2004).