7 INLAND HABITAT MANAGEMENT

7.1 The Inland Waters of New South Wales

There are four main catchments within New South Wales. These are the eastern drainage, the Murray Darling Basin, the Bulloo River Basin, and the Lake Eyre Basin. The latter two are located in the north-west of the State and consist entirely of seasonal creeks flowing into salt lakes and swamps, known as the western drainage.

The eastern drainage consists of high gradient, separate river valleys on the eastern side of the Great Dividing Range flowing through estuary systems to the Pacific Ocean. The main recreational and commercial native freshwater fish species are Australian bass, short and long finned eels, mullet, and the Australian grayling. All of these have some link to the sea during their lifecycle[1]. The rare eastern freshwater cod is found in sections of the Richmond and Clarence rivers, while translocated Murray cod, silver perch and eel-tailed catfish also occur in some eastern rivers. Introduced species, such as carp and trout, are also found in parts of the eastern drainage.

The Murray-Darling Basin consists of a vast system of connected, low gradient river valleys, with the largest having their headwaters on the western slopes of the Great Dividing Range. The entire drainage eventually flows out of the mouth of the Murray River in South Australia. The Basin covers 75 per cent of New South Wales, with this area equating to 56 per cent of the entire Basin[2]. There are 29 indigenous fish species within the Basin[3]. The main recreational and commercial native freshwater fish species of the western drainage are the Murray cod, silver and golden perch, and eel-tailed catfish. Other species include the trout cod, Macquarie perch and river blackfish. Many of these

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1 A Law (1980). "Fish and fisheries of New South Wales", *Fish and Fisheries*, State Fisheries NSW, Sydney, p 137

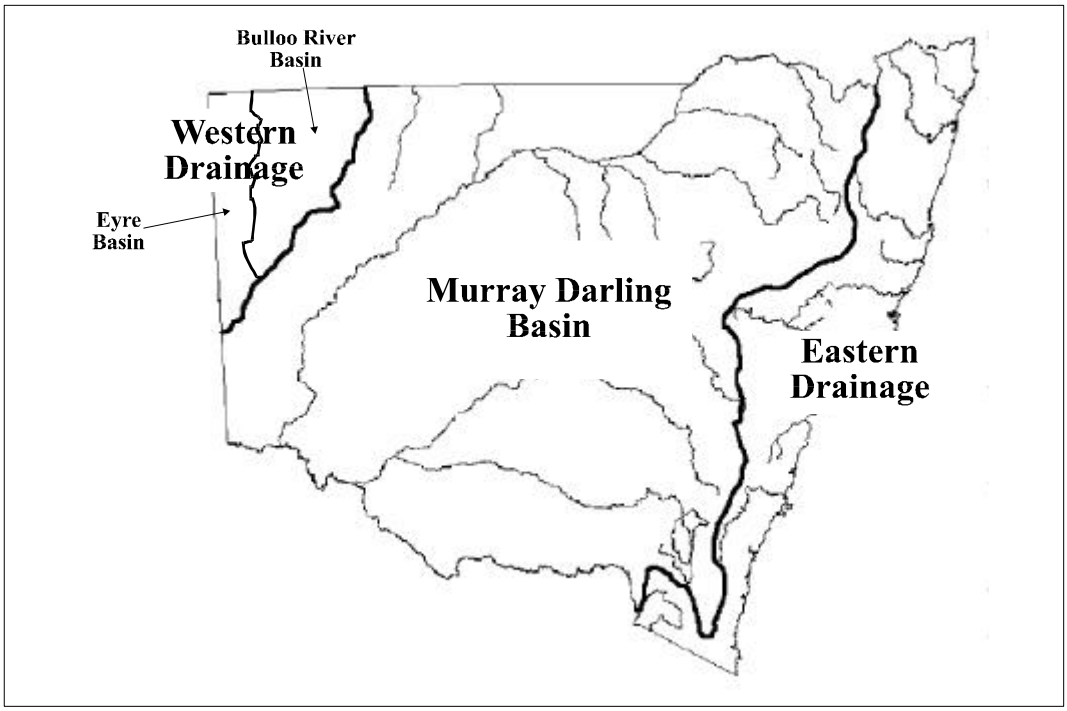
2 Murray-Darling Basin Commission (1993). *The Murray-Darling Basin*, promotional material, Murray-Darling Basin Commission

3 Australian Conservation Foundation (1996) *Fish Out of Water*, Special Habitat Supplement, Australian Conservation Foundation, p 2

species are highly migratory and require an increase in water level and or temperature to spawn. Introduced species include trout, carp, and redfin. [4]

Alpine and sub-alpine waters exist on both sides of the Great Dividing Range. River blackfish exist in some of the less regulated alpine waters. Introduced salmonids, most notably rainbow and brown trout, are widespread throughout the State's alpine and sub-alpine waters and are actively stocked by individuals, angling clubs, and NSW Fisheries. Trout cod and Macquarie perch are found in a number of major river systems in western sub-alpine areas and are the subject of conservation programs including restocking.

Figure 7.1 - NSW Catchments [5]



[4] Law (1980). "Fish and fisheries of New South Wales", *Fish and Fisheries*, p 137

[5] Adapted from Environment Protection Authority Internet Site http://www.epa.nsw.gov.au

The inland regions of the State face very different habitat management problems to the marine and estuarine issues described in the preceding chapter. During the course of the inquiry the Standing Committee heard much evidence from experts in the fields of native freshwater fish biology, water and land resource management, and freshwater recreational and commercial fishing.

Dr John Harris, Principal Fisheries Scientist with NSW Fisheries specialising in freshwater fish ecology, described the state of the inland fishery thus:

> There is strong evidence that many species are being extremely badly affected by a range of impacts. For example, silver perch used to be one of the most common species of our inland waterways and was found all over the lower, warmer parts of the inland drainage system. The institute has just completed the biggest-ever survey of freshwater fish throughout New South Wales, and Australia generally for that matter. The survey involved exceedingly extensive work on the part of all of my team for two years and in that time a total of nine individual silver perch were found. There were major problems in the 1950s and the Murray cod species was badly impacted by overfishing and environmental change. At the moment the commercial catch of Murray cod is at only 10 per cent of its level in the 1950s. Other data from the lower Murray shows that in a 50-year period there has been a 50 per cent decline in the abundance of golden perch and a 93 per cent decline in the abundance of silver perch. The [Fisheries Research] Institute has all sorts of evidence.[6]

Although commercial fishers have over-exploited the inland fishery in the past and there is now considerable recreational fishing pressure in some areas, the major factors contributing to the decline in native freshwater fish stocks appear to be directly related to their physical environment. This chapter outlines the evidence received in relation to four interrelated areas of concern: water flows and temperature; the riparian and riverine environment; discharges; and introduced species.

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[6] Evidence of Dr Harris, 2 April 1997, pp 20-21

7.2 Water Flow and Quality

The widespread storage and use of inland water resources for irrigation and electricity generation since the late 1940s, particularly within the Murray-Darling Basin, has greatly altered the natural flow regimes that operated over thousands of years. The inter-related problems of altered water flow volumes, decreased water temperature, and artificial waterway barriers have introduced new difficulties for native fish species and compounded those posed by riparian degradation.

7.2.1 Environmental Flows

The inland waterways of New South Wales, and particularly the western drainages, are naturally ephemeral, with generally modest flows interspersed over time with periods of low flow due to drought and short term flooding. The Murray Darling system is also influenced by seasonal rainfall patterns, with reliable winter rains in the south-east of the Basin and summer monsoon rainfall in the north[7]. The predominantly dry nature of Australia's inland waterways has resulted in the evolution of unique freshwater fish fauna, many of which rely on seasonal fluctuations in water flows as a trigger for spawning. In addition, the volume of water flowing through inland waterways at any one time also determines the relative level of nutrients and pollutants within the system, thereby influencing water quality.

Despite receiving only 25 per cent of the State's total rainfall, inland areas use 80 per cent of all water used in New South Wales. 90 per cent of the water used in inland areas is for irrigation[8]. There are presently 21 major water storages in New South Wales or on its borders (see Figure 7.2). Many of these are located in areas with naturally high winter flows and low summer flows. As a result of agricultural demands, these flows have been made more constant

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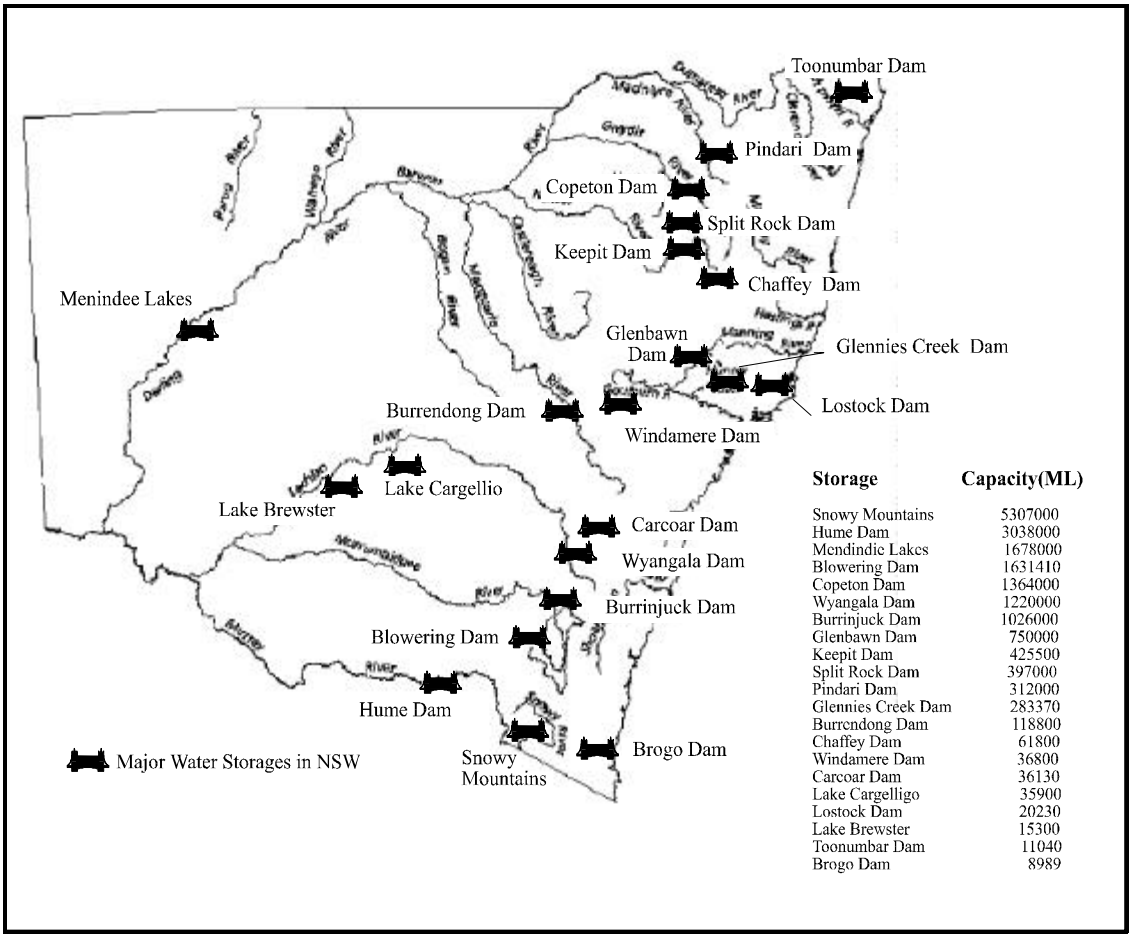
[7] Source: Murray-Darling Basin Commission (1993). *The Murray-Darling Basin*, promotional material

[8] NSW Department of Land and Water Conservation (January 1997). *Water Reform - the Need for Change: A Guide for Water* Users, NSW Department of Land and Water Conservation, Sydney, p 2

or reversed so that high flows now occur in summer, thereby upsetting the natural migratory and breeding cycles of many native fish species.[9]

Figure 7.2 - Major Water Storages in NSW [10]



9 Kailola et al (1993). *Australian Fisheries Resources*, Commonwealth of Australia, Canberra, pp 39-40

10 Adapted from *Storage Resources Weekly Report*, Department of Land and Water Conservation State Water Management,Week ending 22/9/97, p 9. "Snowy Mountains" includes the dams comprising the Snowy Mountains Hydroelectric Scheme.

Many witnesses claimed that water extraction was too great in many areas to sustain healthy fish populations and called for greater environmental flows.

For example, Mr Maloney said:

> Our members have a great many concerns with habitat protection and river management. We feel that not enough is being done to manage our rivers in an environmentally friendly way. To us it appears that most of the water is being allocated for irrigation purposes and perhaps not for the environment.[11]

Mr Jonassen was critical of government agencies charged with finding a balance between agriculture and the environment, stating:

> I believe there is too much water extraction. So often the streams are pumped almost dry. ...
>
> I believe that ... [the Department of] Conservation and Land Management have little interest in other than extracting the water for commercial purposes. They appear to have no interest in having a minimal flow to sustain fish life. The water drops to the stage where fish cannot possibly survive. I believe there is just so much to be done. [12]

Members of both the inland commercial and recreational fishing sectors emphasised the importance of environmental flows, claiming a correlation between good flows and catch levels. For example, Mr Davison stated:

> On some of the early records, and there is one that South Australia put out, you can see that when the catches are high that coincides with the flow of water. We have got a lot of problems with too many dams and cold water, and we need more fish ladders. But those problems are slowly getting addressed.[13]

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[11] Evidence of Mr Maloney, 2 April 1997, p 82

[12] Evidence of Mr Jonassen, 24 March 1997, p 6

[13] Evidence of Mr Davison, 25 March 1997, p 8

Mr Maloney stated:

> I think it is extremely important that flows at periods of the year are maintained to whatever levels are required. We are hearing not just about fish but about red gums in the Barmah Forest dying because they are not getting regular flooding. Some of my friends at Fisheries monitor fish numbers. After the floods that came through the north east of Victoria three years ago there has been a marked increase in small Murray cod below Lake Mulwala, which coincides with that flooding. We are now waiting anxiously to see what results from the floods that devastated a lot of farmers between Albury and Corowa a few months ago. It will be very interesting to see what affect that has in the next two or three years on native fish numbers in that area.[14]
>
> ... The fish are probably only a barometer of how healthy the river is. When you get fish numbers declining, one must start to look at the reasons. ... I think stream flows and water quality are probably two of the major factors for the decline in native fish in the last few years.[15]

The Snowy River is the State's most dramatically regulated river system in terms of its flow regime, with 99 per cent of its original flow being diverted to the Murrumbidgee River for irrigation use via Jindabyne dam and the hydroelectric scheme[16]. The specific issue of increased environmental flows for the Snowy river received some attention during the inquiry. Mr Hood described the present condition of the Snowy River thus:

> Out of Jindabyne we get only 1 per cent of the original flow of the Snowy. To all intents and purposes, the Snowy River begins

[14] Evidence of Mr Maloney, 2 April 1997, p 84

[15] Evidence of Mr Maloney, 2 April 1997, pp 85-86

[16] Snowy Genoa Catchment Management Committee (February 1996). *Expert Panel Environmental Flow Assessment of the Snowy River Below Jindabyne Dam*, Jindabyne, p 1

> at Jindabyne. There is some good fishing above Jindabyne in the Thredbo and up above Eucumbene. The river between Eucumbene and Jindabyne, which used to be quite good, is now degraded to such an extent that it is no longer fishable.[17]

Referring to historical photographs of the River, Mr Leete added:

> You will see that the Snowy River was a very wide and powerful river. That is why it has been written up in literature and so on. As was pointed out earlier, now it is just a weed-choked, overgrown river bed, and in places you can actually straddle it. I mean, there should not be any argument about that. If you take 99.25 per cent of the water out of a river it is fairly obvious that the habitat or the resource for that habitat is completely depleted.[18]

Mr Leete claimed that the method used for setting the present allocation of water to the Snowy River was based solely on the domestic and agricultural requirements of the communities downstream, with no allowance made for the ecological needs of the River. He also pointed out that a single pipe built into the Jindabyne dam wall with a diameter of 50cm was now the source of the River[19], adding:

> Part of the deal under the existing Act for the Snowy Mountains hydro-electric scheme is that they measure certain target points along the river and, if those target points drop, they have to open up the valve of that 50-centimetre siphon pipe and let more out. So, even the 50-centimetre pipe is not opened to full flow. That is a regulated pipe. They only have the requirement to get 25 megalitres to Dalgety, which is roughly 25 to 30 kilometres downstream. So about half the capacity of that pipe is all they need to get downstream.[20]

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17 Evidence of Mr Hood, 24 March 1997, p 38

18 Evidence of Mr Leete, 24 March 1997, p 21

19 Evidence of Mr Leete, 24 March 1997, p 21

20 Evidence of Mr Leete, 24 March 1997, p 26

Mr Hood expressed concern about the proposed corporatisation of the Snowy Mountains Authority before water additional water was allocated to the Snowy, seeing this as the last opportunity to increase the allocation for several decades. Mr Hood also described the practical difficulties faced by his committee due to uncertainty regarding the Snowy's final allocation:

> ... we as a committee are finding it very difficult to set any plan for the river, to draw up any strategic plan for the restoration of the river, because we do not know what amount of water we are going to be dealing with. That is holding up the whole process. There is work that we can go on with in the meantime, but getting the whole plan up and running is very difficult unless you know what you are dealing with.[21]

Mr Leete expressed concern that the New South Wales and Federal governments were intent on corporatising the Snowy Scheme before deciding on environmental flows for the Snowy River, stating:

> Victoria's position is to address flows for the Snowy River prior to corporatisation. ... However, New South Wales and the Federal Government are sticking with their line that they want to corporatise, and once they have corporatised they want to do a water inquiry, and it is from that water inquiry that they will make recommendations, if any, on the provision of water for the Snowy River.[22]

Unnatural flow regimes have also had an adverse impact on the physical aspects of riverine environments. Persistent low flows or changes to relative water velocities at the junction of streams can cause the undercutting of river banks and result in increased sedimentation.

The Department of Land and Water Conservation supported further research into the effects of river flow on both the geomorphology and ecology of riverine environments. Mr Wright stated:

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[21] Evidence of Mr Hood, 24 March 1997, p 39

[22] Evidence of Mr Leete, 24 March 1997, pp 26-27

> I think that one of the key areas area that we need to address is research into ... the relationship between river flows and the flow regime in rivers, which ... has been greatly changed since we have been building dams around the State and regulating rivers and now there is talk about what we call river flow objectives, that is, making some component of that flow available to restore some of the natural variability of the flow in order to restore natural habitats and ecosystems within those.
>
> ... we need to know what is the best way to change the operations of our rivers to meet those sorts of objectives and at the moment there is some research which our department is doing, a small amount of research, but I do not think that is nearly enough.[23]

7.2.2 Barriers to Fish Migration

Many Australian native freshwater fish instinctively migrate upstream to spawn. For example, golden and silver perch have been found to travel up to 1,000 and 500 kilometres respectively during spring and summer[24]. This maximises the geographical spread of fertilised eggs and fry, some of which are carried downstream great distances, and to ensure that juveniles are not swept out to sea.[25]

There are around 1,850 significant artificial barriers to fish passage on New South Wales waterways[26]. The nature of these barriers range from small weirs less than a metre in height, which can restrict upstream fish movement to periods of high water flow, to large dam walls over 20 metres high, which can completely stop fish passage in both directions.

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[23] Evidence of Mr Wright, 5 May 1997, p 57

[24] Mallen-Cooper (16 April 1994). "How High Can A Fish Jump?", *New Scientist*, p 34

[25] Kailola et al (1993). *Australian Fisheries Resources*, p 264

[26] NSW Fisheries (December 1992). *Policy on Fish Passage,* NSW Fisheries, Sydney, Section 1

Over 50 fishways have been constructed in New South Wales[27]. Unfortunately, most of these structures are based on North American and European designs suitable for the salmonid family of fishes, such as trout and Atlantic salmon, which are generally larger and stronger swimmers than the native migratory species. As a result, native species have been unable to effectively use most of the existing fishways[28].

The Standing Committee heard evidence to the effect that declining fish numbers and shrinking species ranges can be partly attributed to the existence of barriers to fish migration. For example, Mr Maloney stated:

> The problems with our native fish started about 50 years ago or whenever dams like that at Lake Hume were constructed. There was no provision whatsoever for the travel of native fish. ... Some of the more successful releases of trout cod are in the upper reaches of the Murray and the Murrumbidgee above Burrinjuck and Lake Hume. They were there; they just cannot get there any more. That is where breeding and releasing of our native fish could re-establish those native populations. It is important to allow our native fish to travel up and down those river systems.[29]

NSW Fisheries has undertaken considerable research in relation to barriers to fish migration and possible remediation works. Dr Harris stated:

> Fish passage issues, the question of getting migratory fish through the river system that is filled with barriers, is an area in which our research effort is now being declined because we have been successful in developing work to a stage at which it is being used on a practical, day-to-day basis. The institute is still dealing with some areas of the fish passage issue that go to the question of reducing cost and the matter of high-level

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27 NSW Fisheries (December 1992). *Policy on Fish Passage*, Section 3.

28 Mallen-Cooper (16 April 1994). "How High Can A Fish Jump?", *New Scientist*, pp 32-33.

29 Evidence of Mr Maloney, 2 April 1997, pp 83-84

> barriers. Work is continuing in those areas and good progress is being made.[30]

The New South Wales Weirs Policy, under the administration of the Department of Land and Water Conservation, was released in August 1997 as part of the State Rivers and Estuaries Policy. The goal of the policy is to "halt and, where possible, reduce and remediate the environmental impact of weirs".[31] The policy has three components. The first is based on the following statement:

> A proposal to build a new weir or enlarge an existing weir should not be approved unless it can be demonstrated that the primary component of the proposal is necessary to maintaining the essential social and economic needs of the affected community.[32]

Secondly, a weir review programme is to be conducted, starting with the identification of all weirs in the State, followed by a review of weirs which:

- come up for licence renewal;
- are considered for modification under the Algal Management Program;
- are considered for the inclusion of a fishway;
- have been identified as having a serious environmental impact;
- are considered to be redundant; or
- are DLWC operational structures.[33]

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30 Evidence of Dr Harris, 2 April 1997, p 22

31 Department of Land and Water Conservation (August 1997). *NSW Weirs Policy,* Department of Land and Water Conservation, Sydney, p 3

32 Department of Land and Water Conservation (August 1997). *NSW Weirs Policy*, p 4

33 Department of Land and Water Conservation (August 1997). *NSW Weirs Policy*, p 6

Each review will identify likely options including no action, operational change, structural change, or removal.

Thirdly, weirs considered to have a significant impact on the movement of fish shall be formally considered for inclusion of a fishway under the Fishways Program, jointly coordinated by DLWC and NSW Fisheries. [34]

The Standing Committee was briefed by NSW Fisheries on fish barrier issues while at Narrandera including the three fishway types preferred by the Department: rock-ramp, for small barriers to one metre in height[35]; vertical slot fishway, for intermediate barriers between one and six metres in height; and fish elevators for higher barriers. The Standing Committee also inspected a number of barriers in the Dubbo / Wellington area, including a weir with a prototype rock ramp on the Bell River near Wellington and Burrendong Dam.

The Standing Committee considers the existence of such a large number of barriers to fish migration to be a major problem throughout the inland fishery, a serious threat to the survival of a number of species such as the trout cod and Macquarie perch and, in many cases, unnecessary. It recommends:

Recommendation 21

That the Government ensure that the Fishways Program is adequately funded to enable the removal of unnecessary barriers to fish migration and the installation of suitable fishways where necessary. The programme should set targets for the removal of barriers within one year of the tabling date, and report to Parliament within five years.

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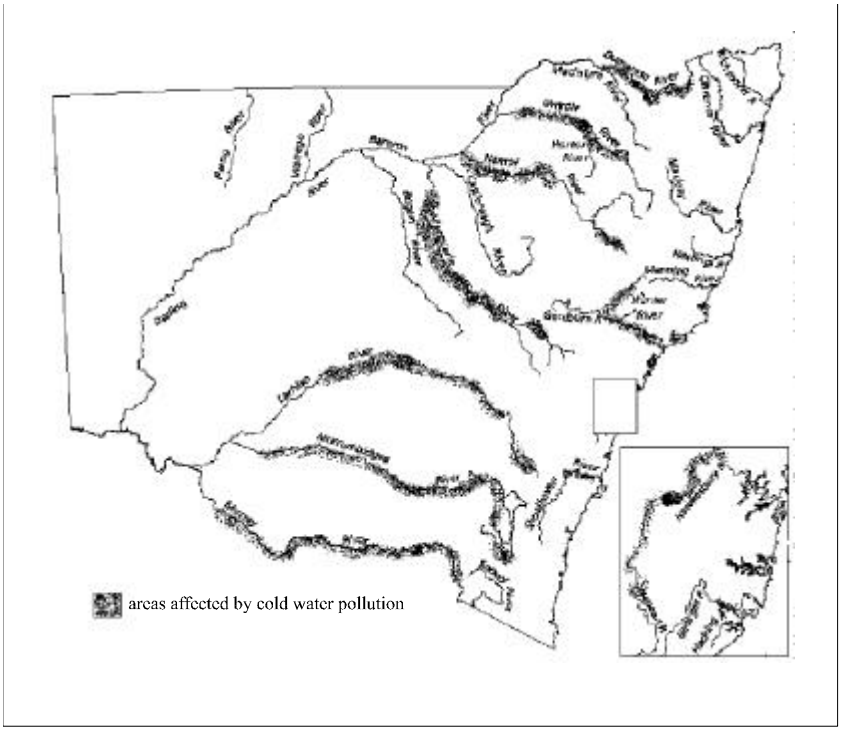
[34] Department of Land and Water Conservation (August 1997). *NSW Weirs Policy*, p 7

[35] G A Thorncraft and J H Harris (May 1996). *Assessment of Rock-ramp Fishways,* NSW Fisheries Research Institute and the Cooperative Research Centre for Freshwater Ecology, NSW Fisheries, p 36

7.2.3 Cold Water Pollution

The construction of large impoundments on the major inland rivers of New South Wales for irrigation and electricity generation has resulted in significant changes to the thermal regimes of these waterways. At the time that most of these impoundments were built, no consideration was given to their effect on downstream water temperature. As a result, most release their water from the bottom of the dam wall where there is less dissolved oxygen and where the water temperature may be 10 degrees Celsius colder than would naturally be the case for that river. The resulting downstream water temperature can be significantly lower for two to three hundred kilometres[36]. Figure 7.3 illustrates the likely extent of cold water pollution in New South Wales.

Figure 7.3 - Areas Affected by Cold Water Pollution [37]



[36] J H Harris and W D Erskine (1996). "Thermal Pollution: River-chilling Releases Below Large Dams", *The New South Wales Fisherman*, Vol 2 No 6, January-February 1996, Commercial Fishing Advisory Committee, p 28

[37] Adapted from the *NSW Fisherman*, January - February 1996, p 29

As a number of native fish such as golden perch and Murray cod require rising water temperatures to spawn[38], cold water pollution may seriously reduce the ability of these fish to reproduce. The health of aquatic plants and invertebrates, the major food sources for many native fish, also depend on water temperature[39]. The combined effect of these consequences of cold water pollution are therefore likely to have significantly contributed to the decline in freshwater native fish populations throughout New South wales and the relative increase in species introduced from colder climates, such as carp.

Speaking in relation to the Snowy River, Mr Miners described a possible solution to the adverse thermal effects of large dams:

> Normally you get around that by having a multi-level offtake, which is just an offtake tower in the dam. You measure the water quality parameters and actually take from a number of levels, so that you get a cocktail and the right temperature and the right level of dissolved oxygen, and probably turbidity as well.[40]

Outlining the efforts of NSW Fisheries in this area, Dr Harris stated:

> ... cold water pollution below large dams... is a crucial area in which investigation has only just begun. The institution [Fisheries Research Institute] is, I believe, about to receive extensive funding through the water management fund for experimental work at Burrendong dam. The institute will examine the matter in association with other departments which will undertake different components of work in the matter of cold water pollution. The issue is certainly manageable.

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38 Kailola et al (1993). *Australian Fisheries Resources*, pp 263, 266

39 J H Harris and W D Erskine (1996). "Thermal Pollution: River-chilling Releases Below Large Dams", *The New South Wales Fisherman*, Vol 2 No 6, p 28

40 Evidence of Mr Miners, 24 March 1997, p 50

> Technical solutions to the problem are available right now, but they are quite expensive.[41]

The Standing Committee considers cold water pollution to be a major contributor to the decline of native freshwater fish in New South Wales, but recognises the considerable expense involved in converting large dams to utilise multi-level water offtakes. Accordingly, it recommends:

Recommendation 22

That the Government make available the funds necessary to expedite the work of NSW Fisheries and the Department of Land and Water Conservation into methods of ameliorating the thermal effects of large impoundments. The aim of this work should be the prioritisation of the capital works necessary to alleviate the cold water pollution throughout the State with a view to implementing a staged conversion program.

7.2.4 Discharges

The Murray-Darling Basin contains 10 major urban centres with more than 30,000 inhabitants, including Canberra with a population of over 300,000[42]. A similar number of centres are located on the freshwater reaches of the eastern drainage. All of these centres can potentially contribute to nutrient and pollutant discharge into these drainages through their sewerage or stormwater systems and manufacturing industries.

The State's innumerable agricultural enterprises are also a major source of effluent through agricultural runoff and septic systems. Agricultural runoff discharges herbicides, pesticides and fertiliser into waterways. The discharge of nutrients from agricultural and urban areas can promote algal blooms, particularly in times of low flow, which seriously affects water quality and can lead to fish kills.

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41 Evidence of Dr Harris, 2 April 1997, p 22

42 Source: Murray-Darling Basin Commission (1993). *The Murray-Darling Basin*, promotional material

Mr Maloney stressed the importance of some control over urban and rural development:

> Water quality is probably being affected mostly because of the fact that some of the towns on our major rivers are getting so much bigger; we are getting effluent and excess water from sewerage plants still being released into some rivers; and we are getting the stormwater wash from the roads. ... I think probably chemicals and fertiliser from irrigation farmlands would have to be a factor. I think that is probably evidenced by the blue-green algae outbreaks on the Darling River, which seem to be fairly close to the cotton and have increased as the cotton growing in that area has increased.[43]

Mr Hood emphasised the discharges emanating from both urban and rural areas in the Snowy River area:

> As to sewerage, there are the Jindabyne and Berridale and Bombala sewerage works and the Nimmitabel sewerage works in our area. We are trying to get them all upgraded to tertiary stage, and we are trying to keep the phosphorus out of the rivers. Agricultural practices are the source of other contaminants. Nobody knows quite how much this degrades the river, but the more we can stop the knocking down of banks and getting trees along the river banks, the more we can stop the manure and so forth washing into the river and upsetting the balance.[44]

Mr Miners also described widespread problems with septic systems associated with scattered rural residential development in the Snowy River area, claiming:

> ... In particular, with some of the studies done in the alpine areas, because of the harsh conditions, they were getting 80 per

[43] Evidence of Mr Maloney, 2 April 1997, p 86

[44] Evidence of Mr Hood, 24 March 1997, pp 39-40

> cent failure of septic systems on a fairly regular basis. So there is a fair danger.
>
> The Snowy River Shire Council is acting on that at the moment. It has put a development freeze on rural residential developments in the whole of the Snowy River Shire area, I think for two years, and has set the Shire a two-year limit to develop a rural residential development plan.[45]

7.3 The Riparian and Riverine Environment

7.3.1 Sedimentation Caused by Bank Erosion and Collapse

The de-vegetation of the riparian environment, interference with a river's natural flow regime, and allowing stock access to the water's edge can all contribute to bank erosion and collapse, sedimentation, and increased water turbidity. Sedimentation can reduce useable fish habitat by filling in pools and reducing river-bed variation. It can also affect fish reproduction by filling in the spaces between rocks and the like on the river-bed, which are used as rearing and habitat areas for juvenile fish, and smothering the adhesive eggs of species that use the river-bed for attachment, such as Murray cod[46]. In extreme cases bank collapse and sedimentation can alter a water course.

A number of witnesses expressed concern at the widespread and serious nature of riparian degradation and the slow progress of remedial measures. For example, Mr Jonassen stated:

> I believe that a lot of the decay of the river, particularly in the western streams, is due to the lowering and raising of the water level and to exposure of the banks so that the banks are

[45] Evidence of Mr Miners, 24 March 1997, p 47

[46] Kailola et al (1993). *Australian Fisheries Resources*, p 40

> collapsing. I could go on and on regarding the abysmal state that our river systems in New South Wales are in.[47]

Mr Hood noted:

> Erosion and sedimentation are the second problem we have. The Snowy catchment was the only one mentioned in the Soil Conservation Act by name as a highly degraded catchment area. There was the Duncan report of 1989. Duncan, a soil conservationist in the area, did a very detailed report on the source of sediment and erosion in the area. Following on that, we have started works in the Corrowong area, and hopefully we can get into the Dalgety, Matong and Paupong area next, to try to alleviate some of those problems.[48]

The Standing Committee inspected a number of degraded inland river systems and witnessed the physical consequences of altering flow regimes. The junction of the Bell and Macquarie rivers was perhaps the most graphic example, with the unregulated Bell River entering the Macquarie at high velocity during naturally high-flow periods while the regulated Macquarie is maintained at a relatively low level resulting in serious bank erosion.

The Standing Committee also inspected riparian crown land, under the management of the Department of Land and Water Conservation, which was leased to private individuals for grazing. When asked what the Department is doing to minimise this type of usage, both of private and crown land, in the future, Mr Wright replied:

> ... we are looking at an approach to management whereby we are trying to put in place buffer strips along the banks not to just to keep the cattle out but also to provide vegetative buffers where the phosphorous and other nutrients will not flow directly into the rivers and therefore further degrade water quality.

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47 Evidence of Mr Jonassen, 24 March 1997, p 6

48 Evidence of Mr Hood, 24 March 1997, p 39

> Once again, it would seem to me this applies equally to land which we might lease as Crown land or to privately owned land. I do not think there is any distinction made. ...
>
> What has happened so far, we have done some trial works around New South Wales over about the last five years or so to actually look at the effectiveness of these. By restricting access or providing these buffer strips, you are asking land holders to remove some of their land from production for these. Prior to any wide scale use of these, we would really want to know how effective they are. We have put in demonstration works in various parts of New South Wales and they are being monitored to look at the effectiveness of them.[49]

With respect to the leasing of land under the Department's management, Mr Wright stated:

> It gives them, I guess, the same rights as a private land holder to manage their property. In some cases, presumably there are some environmental or some restrictions on what they can do. I am not qualified to comment on that. As far as I know, the same sorts of proposals with regard to buffer strips and the riverland corridor are in place for both private and Crown lands.[50]

7.3.2 Desnagging

Semi-submerged rocky outcrops or dead trees that have fallen into a waterway, known as snags, are an important source of shelter, breeding sites, and protection from high water velocities for some native freshwater fish species, such as the Murray cod and river blackfish[51]. Redgum snags can provide fish habitat for several hundred years.

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[49] Evidence of Mr Wright, 5 May 1997, pp 52-33

[50] Evidence of Mr Wright, 5 May 1997, p 53

[51] Kailola et al (1993). *Australian Fisheries Resources*, p 41

Over a period of many decades, government agencies and individuals have removed hundreds of thousands of snags from large stretches of our inland rivers to improve water supplies, for navigation, and aesthetics[52]. The importance of snags to native fish has only recently been realised and government agencies are now running education campaigns on the issue, such as the Murray-Darling Basin Commission's 'Cod Love Snags' campaign.

A number of witnesses described the importance of public education in relation to the retention of snags for fish habitat, including Mr Davison who pointed out:

> I am a [NSW Fisheries] habitat monitor, too, for the inland. That is another little job that somebody has got to have. I am dead against desnagging because you have got to have snags and logs to allow the fish to breed.[53]

7.4 Introduced Species

7.4.1 Carp

Carp, a species native to Asia, were introduced into Victoria in the late 1950s as an ornamental fish and, through both accidental and deliberate releases, found their way into the Murray-Darling system in 1968/69[54]. They have since become established throughout the Murray-Darling Basin and in some rivers of the eastern drainage.

Carp have a number of attributes that have assisted their spread throughout south-eastern Australia. They prefer warm, slow flowing waters but have a wider spawning temperature range than native species, are highly fecund, with a single female producing up to 1 million eggs, and are tolerant of high salinities and low oxygen concentrations[55].

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52 Australian Conservation Foundation (1996). *Fish Out of Water*, p 7

53 Evidence of Mr Davison, 25 March 1997, p 8

54 Law (1980). "Fish and fisheries of New South Wales", *Fish and Fisheries*, p 138

55 Kailola et al (1993). *Australian Fisheries Resources*, pp 214-215

While carp have been declared a noxious fish in most states including NSW, with prohibitions on returning them to the water, there is little scientific evidence of either negative or positive interactions with native fish species. It has been suggested that carp increase water turbidity through their practice of straining food material from the mud, and that they may reduce aquatic plant concentrations. It has also been suggested that carp utilise a food resource (benthic detritus) relatively unexploited by native fish and that juvenile carp are a significant forage species for predatory native species such as golden perch and Murray cod.[56]

Regardless of this scientific ambiguity, fisheries managers throughout Australia have concentrated on the control of carp numbers and limiting their spread. The Standing Committee received evidence suggesting that carp populations have declined in recent years. For example, Mr Davison claimed that, while commercial fishers are still catching substantial numbers of carp:

> The carp in our 5 per cent [of the State open to commercial fishing] have dropped off a lot to what they were. We were getting between 400 and 500 tonne a year. I have not done the figures lately for that, but our carp catch has gone down a lot now because they are not there. They are in pockets, but not everywhere like they were.[57]

Mr Davison added:

> They are a problem, but where we are fishing at the moment it is just a nuisance. The carp are still there. You can't keep taking out the amount of carp we have taken out of those sections of the river and not break their numbers down a little bit. High water and flood waters, every time it comes along, in the last couple of years, when we have been yabbying, the traps have been full of small carp, but they don't seem to be increasing. I could not get enough carp during the summer months to keep my yabby traps. I was getting the heads off fish

[56] See Kailola et al, pp. 214-216, and Law op cit, p 138

[57] Evidence of Mr Davison, 25 March 1997, p 5

> and the backbones from one of the wholesalers at the border at Moama to keep up the bait because I could not catch enough.[58]

When made aware of these comments, Dr Harris replied:

> We commonly hear such comments. They tend to arise from areas in which commercial fishermen operate intensively. They also reflect cyclical changes that happen to a very high degree in freshwater fish populations, as they do in all fish populations, but cyclical fluctuation in freshwater fish is very marked, especially in Australia. There is certainly no problem with the supply of carp generally. We recently finished some experimental work in the Bogan River near Bourke. We estimated the total fish population in the reach of the river and came up with the very concerning result that on average, for the total surface area of the lower Bogan River, there is one carp for every square metre of river. Such figures reflect an immense problem with the development of the population of carp throughout our rivers.[59]

Other comments made by Mr Davison supported the view that the degree of carp infestation is highly variable due to seasonal fluctuations:

> Going back 14 or 15 years ago, our native fish catch went down when the carp got real bad, but now that the carp have dropped back our native fish are coming up. I am probably getting 10 to 20 native fish to a carp at the moment in the area that I am fishing. But that can turn around with different water temperatures and at different water levels.[60]

Considerable state and Federal resources have been devoted to the study and control of carp. Dr Jane Roberts, Senior Research Scientist with CSIRO and Project Leader of the River and Wetlands Programme, stated:

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[58] Evidence of Mr Davison, 25 March 1997, p 9

[59] Evidence of Dr Harris, 2 April 1997, pp 15-16

[60] Evidence of Mr Davison, 25 March 1997, p 14

> In terms of controlling the fish, we certainly need to have an integrated strategy. I do not think we can rely on one kind of tactic that is going to work. In terms of what people can do at the moment to control the fish - for example, commercial harvesting or use of chemicals - I think these control mechanisms are wishful thinking, will not achieve anything, and will put us backwards.[61]

Dr Roberts also said that she did not support the large scale stocking of predatory native fish, such as Murray cod, as a control measure except as part of an integrated control strategy[62], adding:

> ... An integrated strategy, to me, means including managing the rivers better and in a way that is more suitable for native fish. We may have to, as it were, give a kick-start to the whole process. My ideal would be that, after having given the whole system a kick start, it would be managed in such a way that it would maintain itself in a better condition than that in which it is maintaining itself now.
>
> ... A kick-start could be some kind of futuristic method of control. Now, the various futuristic methods that have been suggested have been pathogenic, immuno-contraception, genetic manipulation.
>
> ... There is a single virus that is a potential candidate. I would expect it not to be acceptable as a candidate, for various reasons, in its natural state.[63]

Dr Glaister agreed with this assessment:

> I do not believe that you can physically control carp with fishing and techniques like that. There have been suggestions of a fish equivalent of a calicivirus, but my feeling is that the virus that

[61] Evidence of Dr Roberts, 25 March 1997, p 30

[62] Evidence of Dr Roberts, 25 March 1997, p 30

[63] Evidence of Dr Roberts, 25 March 1997, pp 30-31

> could do the job, the so-called spring viraemia virus, would have unknown impacts on native fish. So, on a decision to introduce something like that, I do not think we get agreement with all the States. ... The risk is too great.[64]

When asked about the use of electro-fishing for carp control, Dr Glaister said:

> Electro fishing is a useful research tool for sampling some waters. The down side is that the sub-lethal effects of electro fishing can adversely impact native species. In juvenile fish, for example, it causes a condition known as lordosis, which is a twisting of the spinal column, and that is at quite low doses. So willy-nilly use of electro fishing is not something I would support. [65]

With respect to other control measures, Dr Glaister stated:

> I think there has been some thought of biological control through breeding infertile carp and so on, but I think that we are going to be playing catch-up all the time. The best we can hope to do, I believe, is to improve the quality of the water of our inland rivers. I think that would do more to stop carp than any other technique.[66]

Dr Glaister later added to these comments, reiterating the importance of habitat improvement as a way of controlling carp:

> ... the issue with carp is really about maintenance of water quality as much as anything. The carp seem to flourish in waters that are adversely impacted.
>
> The Standing Committee on Fisheries, which is the peak body in Australia represented by each of the directors of fisheries in each of the States, has set up a carp coordinating group to look

64 Evidence of Dr Glaister, 26 May 1997, p 67

65 Evidence of Dr Glaister, 26 May 1997, p 95

66 Evidence of Dr Glaister, 26 May 1997, p 67

> at ways of tackling it, because it is multi-State; it goes across State borders. The consensus so far seems to be that limited physical harvest, combined with improving water quality, seems to be the likely way of tackling it. The use of gee-whiz things like viruses I do not think anyone will support. There may be some scope for bio manipulation of sterile animals, but, really, I think it is going to come down to long-term water quality issues.[67]

Referring to the commercial harvesting of carp, Mr Davison stressed that recent low prices made it uneconomical, stating:

> You can get rid of it if you want to give it away for 30 or 40 cents. I will put it into the market when the price is round the dollar. If it is under 80 cents, I feed it to the pelicans because it would not pay the freight, by the time you pay $10 a box for new ice, refrigeration and so on. I have got to take it out of the nets, so I feed it to the birds, or use the lot for yabby bait.[68]

Mr Davison was optimistic about the future demand for carp meat but warned that variable supply may pose problems in developing the market:

> Our counterparts in South Australia are now doing a lot of work on this. At the trout summit at Renmark a couple of years ago everyone ate carp for a couple of days and did not know what they had eaten, because they had gone to a lot of trouble and made little fish patties and little rolls and all sorts of stuff out of it, and no-one was any the wiser. They are doing a lot of work on it down at Lake Alexander. One of the professionals has a restaurant there too. They are selling mainly carp. But they are experiencing the same problem; they are having trouble getting enough carp now. When they rang me before Christmas and wanted another 300 tonne of carp, I said, "We can't fill the orders.[69]

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67 Evidence of Dr Glaister, 26 May 1997, p 95

68 Evidence of Mr Davison, 25 March 1997, p 9

69 Evidence of Mr Davison, 25 March 1997, pp 19-20

Other opportunities for the commercial exploitation of carp have been explored. Dr Glaister described some of these and their likely prospects:

> I have spoken with Richard Saul, who is an entrepreneur in Tasmania, but formerly in New South Wales, who harvests shark and uses shark livers to extract oils. He is very involved in that line of business. I asked him to run a sample of carp to see if there was anything comparable in the carp. He said not, that they are a very low oil fish.

The Standing Committee understands that carp populations in some unregulated rivers constitute a considerably lower proportion of the fish population than in regulated rivers. The relatively natural conditions in such rivers allow native fish populations to control carp numbers. The Standing Committee considers that improving the overall habitat quality of our river systems will in itself play an important part in the management of introduced fish populations.

7.4.2 Trout

Salmonids were introduced into the alpine and sub-alpine waters of New South Wales late last century. Since then, they have been regularly restocked by both private organisations and NSW Fisheries due to high demand from anglers and their inability to reproduce in some locations. The salmonid species found in New South Wales are brown, rainbow, and brook trout and Atlantic salmon. The latter cannot reproduce naturally in New South Wales and is stocked only in Lake Jindabyne.

The State's major trout stocking program is conducted by NSW Fisheries. Approximately 1.3 million brown trout and 1 million rainbow trout are hatched from captured wild stock by the Gaden Trout Hatchery, near Jindabyne, which distributes the fry and fingerlings to the State's four acclimatisation societies and the Dutton Trout Hatchery, near Armidale, for release[70].

[70] Source: Gaden Trout Hatchery, *Brief to State Development Committee*, March 1997

Although the various species of trout in the alpine areas of the State are generally seen as a valuable angling resource and are actively stocked into these waters, it has been argued that their predatory nature may have had an adverse affect on native species. A major survey of scientific work into the effects of salmonids on Australian native fauna conducted by P L Cadwallader concluded that trout, through predation and/or competition for food and habitat, have had an adverse impact on the number and distribution of stream-dwelling galaxiids and are implicated in the demise of trout cod, Macquarie perch, Australian grayling and two species of pygmy perch[71].

Speaking in relation to the possible displacement of native species by trout, Dr Harris stated:

> That has certainly been an area of discussion for a long time, and I think the information has not always been good. Alpine areas over about 700 metres of altitude in nature had very few species native to them—commonly, there were eels and two or three small specifies of non-targeted fish. That is the environment in which the trout become most successful. They have certainly displaced the native species from much of that environment. The impact occurred up to 100 years ago, so it is pretty much an established situation. The impoundments are totally artificial environments... In those areas there is no longer an issue about biodiversity, it seems to me. Where an issue still remains is in the interchange where the alpine zone merges with the slope zone. There are threatened native species there, such as trout cod and Macquarie perch, specifically in the upper Murray and the upper Murrumbidgee rivers. Trout stocking in those rivers is an issue that needs to be carefully monitored, in my view.[72]

Mr Miners, describing the fish species of the Snowy River prior to the release of trout last century, agreed that there was an absence of large predatory fish in the upper reaches, but claimed:

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[71] P L Cadwallader (1996). *Overview of the Impacts of Introduced Salmonids on Australian Native Fauna*, Australian Nature Conservation Agency, Sydney, pp 51-52

[72] Evidence of Dr Harris, 2 April 1997, p 21

> There were certainly remnants of blackfish populations. There are still blackfish populations in some of the other non-regulated rivers. The Delegate and Bombala systems have still got quite good populations of blackfish. They obviously co-existed with the trout since the early part of this century.[73]

When questioned in relation to the continued stocking of trout, Dr Glaister stated that such stocking only occurs in waters that have previously been stocked with trout, including those in national parks. Referring to the scarcity of galaxids in waters stocked with trout, Dr Glaister said:

> With the benefit of hindsight, stocking of exotics anywhere probably would not be a wise practice, but the fact that it was done 50 years ago or whenever it was to me indicates that there were interactions with native species that happened long ago and that [cessation of trout stocking] is not going to bring the galaxids back.[74]

Other witnesses questioned the amount of public resources used in stocking trout. Mr Maloney said:

> I agree entirely that a huge amount of money is being spent on trout, and for what reason I do not really know. Coming from a warm water area, perhaps our passion is with the native fish. A lot of our native species are under threat—fairly serious threat. We have seen the trout cod come back from almost extinction in the last few years. They are still not by any chance out of the woods but we are starting to see some of them in our waterways again after releases. I would very much like to see much more concentration on native species. The introduced species have been detrimental to our native species. Trout are very predatory fish.[75]

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[73] Evidence of Mr Miners, 24 March 1997, pp 54-55

[74] Evidence of Dr Glaister, 26 May 1997, p 86

[75] Evidence of Mr Maloney, 2 April 1997, p 83

Trout angling representatives argued that any displacement affects occurred many years ago and that many alpine habitats are now unsuitable for native species due to extensive regulation of these waterways, particularly in the Snowy Mountains area. Consequently, the stocking of trout in these areas should be continued so that local economies can benefit from tourism opportunities based on recreational trout angling. For example, Mr Hole stated:

> There is no doubt that trout are here to stay. If you were to take them out, suddenly you would remove this huge pile of dollars from the recreational tourist industry, because in this part of the world and in the Armidale district of New South Wales trout are the main attraction. I mean, if you took trout out of New Zealand half of its economy would collapse.
>
> Do they impact on native fauna? Yes. I mean, most fish are cannibals. Just because they are imported does not mean they eat harder or stronger. In fact, I would say that they have given huge enjoyment to mankind wherever they have been put in, and they have done less damage than any other species. ...
>
> ... I think I will finish by saying that, of course, the imported species that has done more damage than anyone else is the white Anglo-Saxon homo sapien.[76]

7.4.3 Willows

Willows, introduced from England, have become a major problem through a large proportion of the inland drainages. Willows choke waterways, form a dense canopy preventing the formation of an understorey of shrubs, grasses and reeds, and, because they are deciduous, release their leaves (that is, organic input) into the water at once, rather than steadily throughout the year as do native tree species[77].

Mr Geary explained the reason for the initial introduction of willows as follows:

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[76] Evidence of Mr Hole, 24 March 1997, p 32

[77] Kailola et al (1993). *Australian Fisheries Resources*, p 41

> When willows were initially introduced, they were introduced to stabilise essentially the outside of river bends. The theory at the time was that we had only one sex in Australia and they would not breed.[78]

Mr Hood described the spread of willows in the Snowy River area:

> Until recently, all willows were spread by vegetative means. Now, through the introduction of willows from overseas, there are female willows as well as male willows, and they are now seeding. You get willow seeds coming down the stream, and that leads to a lot quicker spread of willows. [79]

Mr Miners explained some of the difficulties experienced with the eradication of willows:

> ... one of the theories says that you start at the top of the catchment and you work all the way down, so that the areas you have treated lower down are not being re-infested from the top.
>
> The difficulty with the Snowy is that it is such a big river, and its problems are now so large, that the idea adopted was to treat seeding willows first. It is a little bit like precautionary management. We are hoping that the Snowy River environmental flows issue will be resolved fairly shortly, but if it is not it would not be worth allowing those seeding willows to stay in the river for the next five to 10 years because of their ability to rapidly colonise. You could get a couple of hundred thousand willow seedlings coming up in a season, having devastating impacts on your river.
>
> ... Then you have got to go back ... and take out the problem willows. There I refer to the willows that are within the channel and diverting flows onto any of the banks, or that are causing

[78] Evidence of Mr Geary, 5 May 1997, pp 53-54

[79] Evidence of Mr Hood, 24 March 1997, p 40

> major flow obstructions which compel the river to behave erratically under flow conditions, or increases the probably that the river will stop flowing in a dry time because of the willows drawing up a lot of water and forming small pondages, so that further downstream the river will be dry because the water is held back.[80]

Mr Geary outlined what the Department of Land and Water Conservation was doing to eradicate willows:

> ... we are now looking at firstly monitoring campaigns to find the extent of the spread of willows and at eradication campaigns. That sort of stuff is being researched at the moment. The manuals and things that are produced for vegetative stabilisation of rivers now still mention willows but as an avenue of last resort where we cannot find a replacement native species to do the same thing and we are now researching native species to try and replace them.[81]

The Standing Committee considers that willows are major contributor to the degradation of the riparian environment. The eradication of willows would benefit a number of groups dependent on healthy river systems including landholders, recreational fishers, rural and regional communities. The Standing Committee believes that there is scope for these groups to contribute towards willow eradication and recommends:

Recommendation 23

That the Department of Land and Water Conservation expedite its river bank willow eradication programme with the financial and non-financial support of the programme's beneficiaries, including funds raised through a recreational licence fee.

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[80] Evidence of Mr Miners, 24 March 1997, p 48

[81] Evidence of Mr Geary, 5 May 1997, pp 53-54

7.5 Conclusion and Recommendations

The Standing Committee considers that there are a number of major factors contributing to the existing poor state of our inland fisheries including flow regulation, barriers to fish passage, and thermal pollution. The solutions to these problems are invariably expensive and the lack of scientific research into these factors makes it difficult to prioritise their relative impacts. Nevertheless, the Standing Committee considers that progress in this area is urgently required to maintain and restore the State's inland fisheries.

The Standing Committee considers that a pilot scheme conducted on a catchment-wide basis would allow a scientific evaluation of the most effective methods for improving inland fish stocks and the general environment. The Standing Committee believes that the Macquarie Valley would be the most suitable catchment for such a study because:

1. It is a heavily regulated river system with high rates of water extraction and is therefore representative of many of the State's inland rivers;

2. It contains relatively few barriers to fish migration, allowing the effects of water temperature and flow improvements to be measured while providing some opportunity for fishway experiments;

3. It has significant populations of introduced fish species against which the effects of water quality and habitat improvements could be measured;

4. NSW Fisheries is about to undertake a major feasibility study of installing a multi-level offtake at Burrendong Dam (the principal water storage in the valley) to reduce downstream cold water pollution;

5. The 1996 Macquarie Marshes Water Management Plan is in effect and aims to provide variable environmental flows to the marshes.

Accordingly, the Standing Committee recommends:

Recommendation 24

That NSW Fisheries, in cooperation with DLWC and the Murray Darling Basin Commission, develop and commence a pilot study in the Macquarie Valley with the specific goals of estimating the combined effects on native and introduced fish species of:

- **the partial restoration of the river's natural flow regime in accordance with the Macquarie Marshes Water Management Plan;**
- **the elimination of cold water pollution downstream of Burrendong Dam; and**
- **the removal of barriers to fish migration and the installation of fishways (in conjunction with the Fishways Program).**

The results of this pilot study should be used to determine the most effective methods of restoring inland fish habitats across New South Wales.