



Fisheries Management Paper

Assessment of the ecological
sustainability of the Victorian Eel Fishery
for exemption from export controls
under the *Environment Protection and
Biodiversity Conservation Act 1999*

A draft submission to Environment Australia

**Fisheries Victoria
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Table of Contents

TABLE OF CONTENTS	1
INTRODUCTION	3
Eel Biology	3
The Victorian Eel Fishery	4
CONSISTENCY WITH ENVIRONMENT AUSTRALIA'S ASSESSMENT CRITERIA	7
CONSISTENCY OF MANAGEMENT OF THE VICTORIAN EEL FISHERY WITH ENVIRONMENT AUSTRALIA'S ESD PRINCIPLES	5
PRINCIPLE 1.	5
Objective 1.	5
Objective 2.	14
PRINCIPLE 2.	16
Objective 1.	16
Objective 2.	20
Objective 3.	22
ACKNOWLEDGEMENTS	3
REFERENCES	3

Introduction

Eel Biology

The genus *Anguilla* comprises 15 recognised species worldwide, four of which occur in Australian freshwaters. Of these, the shortfinned eel (*Anguilla australis*) and longfinned eel (*A. reinhardtii*) make up the fishery in Victoria. All species of Anguillid eels are catadromous, spending the majority of their life cycle in fresh water or estuaries, and are semelparous, reproducing once only in the ocean before dying. *A. australis* and *A. reinhardtii* eels are long-lived, reaching maturity at between 10-20 years (Beumer 1996). Spawning of both species is thought to occur in the vicinity of the Coral Sea, but no precise spawning location for either species has been identified. Eggs are thought to be pelagic and hatch after about 2 days. The newly hatched larvae, or leptocephali, survive on the resources of their yolk sac for about 5 days before commencing exogenous feeding. As the leptocephali feed and grow, they are transported toward the eastern Australian coastline by the South Equatorial Current, and then along the coast by the East Australian Current. Metamorphosis to the glass eel is thought to occur along the continental shelf, and tidal currents transport the glass eels, which are also actively swimming, toward and into embayments and estuaries at random. Glass eels are between 50-60mm in length and weigh between 0.1-0.2g each. *A. australis* glass eels migrate mainly in the winter and spring, while *A. reinhardtii* glass eels migrate mainly during summer, although glass eels of each species may continue to arrive at some estuaries throughout the year (McKinnon *et al.* 2002).

In Australia, *A. reinhardtii* generally inhabits tropical and subtropical regions ranging from Cape York in northern Queensland, to eastern Victoria and Tasmania, while *A. australis* is considered to be a more temperate species, common from south-east Queensland to south-east South Australia, and throughout Tasmania. Both species are found outside Australia in the South Pacific and *A. australis* comprises a significant fishery in New Zealand. *A. reinhardtii* is also found in the South Pacific region, however this species has only been recently recorded in New Zealand (Jellyman *et al.* 1996). In Victoria *A. australis* is common throughout all coastal Drainage divisions while *A. reinhardtii* is restricted to the eastern basins (Figure 1).

Despite such a broad distribution for each species, it is generally accepted that both the shortfinned and longfinned eel species belong to single genetic stocks respectively. Thus fishing mortality in any one catchment is not expected to affect the long-term viability of the eel population within that catchment, or over the species' respective ranges. Such panmixia combined with random recruitment suggests that eel stocks may exhibit considerable resilience to fishing pressure, provided a precautionary approach to the escapement of spawning stock is adopted.

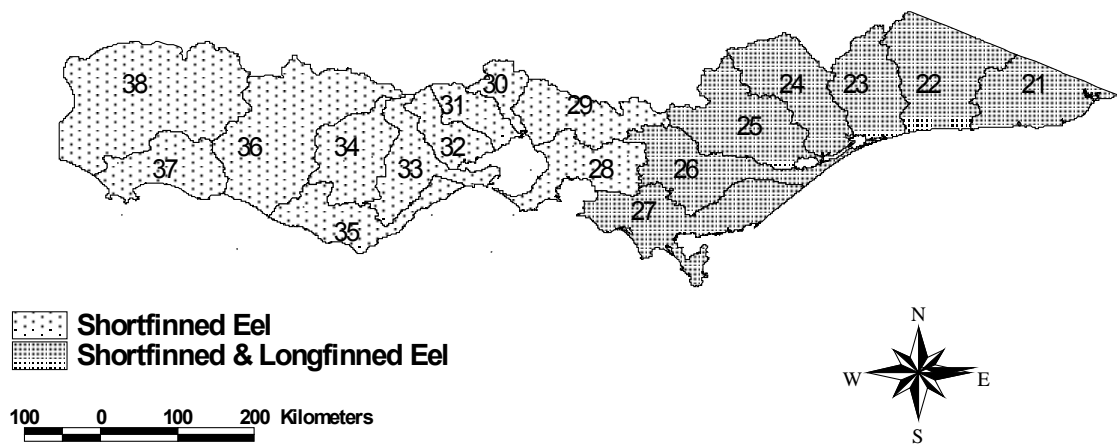


Figure 1. Distribution of *A. australis* and *A. reinhardtii* in Victoria by major River Basin.

The Victorian Eel Fishery

The Victorian commercial Eel Fishery comprises two species, the shortfinned eel (*Anguilla australis*) and longfinned eel (*A. reinhardtii*), producing 125-450 tonnes, worth approximately \$1.4-4.7M annually. Overall, the shortfinned eel makes up approximately 95% of total eel production, however longfinned eel may comprise up to 20% of the total catch (Figure 2). The eel fishery has been relatively stable, in terms of production, over the last 2 decades, however the fishery is strongly affected by seasonal factors, and recent drought conditions have resulted in relatively low production of shortfinned eel in successive years (Figure 2). A large component of eel production is from stock enhancement, whereby elvers and undersized eels are stocked under specified licence conditions into selected lakes for extensive on-growing under natural conditions. In most years the commercial catch is roughly comprised of up to 40% stock-enhanced cultured shortfinned eel product, however protracted drought conditions since 1994 have resulted in a significant decrease in both stock-enhanced, and wild shortfinned eel production (Figure 2). By contrast, longfinned eel production has been maintained at between 10 and 50 tonnes annually (Figure 2). The longfinned eel fishery in Victoria is restricted to the east of the State, by virtue of the species' distribution, and prevailing drought conditions appear to have impacted this component of the fishery to a lesser degree than that of the shortfinned and stock enhanced fishery components of the fishery.

An apparent recovery in the wild shortfinned eel sector in 2001 suggests that the effects of drought may have been mitigated in riverine habitats in coastal Victoria, while the stock

enhanced shortfinned eel sector, although comparatively low, appears to have stabilised at between 40-50 tonnes under continuing drought conditions in western Victoria (Figure 2). In addition, ongoing drought conditions have not adversely affected longfinned eel production (Figure 2). The wild shortfinned and longfinned eel components of the fishery are comprised largely of migrating adult eels. The reliance of the existing commercial eel fishery in Victoria on this component of the fishery is consequently very great, particularly during periods of drought when productivity from stock-enhanced waters is low.

There are 18 licences in the commercial Victorian Eel Fishery, and each licence entitles the holder to fish in specified Crown waters allocated to that licence, and in certain unspecified Crown waters, and in private waters. Crown waters in which stock enhancement occurs are fished by Eel Fishery Access Licence (EFAL) holders under an Aquaculture Licence.

The commercial fishery is input managed, with limited entry, gear restrictions and water allocation the main input restrictions. A minimum legal length for both species of eel currently exists and is set at 30cm. There is no Total Allowable Catch (TAC) set. Fyke nets are the only gear permitted for use by EFAL holders and only holders of an EFAL may use or possess fyke nets. Fyke nets are described as a framed hoop net, with 1-3 wings leading into a drum section where a series of non-return funnels guides fish into a bag end (Beumer *et al.* 1981) (Figure 3). A small quantity of eel is also taken commercially in bay and inlet fisheries by haul seine operators. Restrictions on the use of fyke nets include: mesh size of not less than 15mm and not greater than 39mm, and a maximum of three wings, each of 46m maximum length, 67cm maximum drop and meshes of no more than 32mm. Currently, each licence holder may use up to 50 fyke nets and nets must be cleared at least once every 48 hours. A fyke net when set must not occupy more than half of the width of a watercourse, and may not be within 5m of another net. Some EFAL holders are permitted to use oversize fyke nets specifically for targeting migrating sea run eels. At present three permits for modified (oversize) gear are issued and include 5 nets for Tarwin River, 10 for Gippsland Lakes and 20 for Curdies Inlet. These are included in the 50 net cap for each EFAL they pertain to. Modified gear is required to be cleared every 24 hours and permits are valid for one year. Specifications for modified gear include:

- (a) a double wing fyke net with each of the wings not exceeding sixteen metres [approx 50 feet] in length nor one and a half metres [approx 5 feet] in height. The height at the first 'D' shall not exceed eleven hundred millimetres; or
- (b) a triple wing fyke net with each of the wings not exceeding six metres [approx 20 feet] in length nor one and half metres [approx 5 feet] in height. The height at the first 'D' shall not exceed eleven hundred millimetres [approx 3.5 feet].

There is limited information on the level of recreational eel fishing in Victoria, however anecdotal evidence suggests that the recreational take of both species of eel is significant. The recently completed National Recreational Fisheries Survey (NRFS) has provided an interim estimate of the recreational eel take in Victoria. The analyses were not complete at the time of writing, and potential outliers exist in the raw data. Consequently the estimated recreational eel take in Victoria is, at best, expected to be inconclusive. Management of the recreational eel fishery includes a bag limit of 10 eels per fisher per day, and all other rules under the General Angling Licence apply. A minimum legal length of 30cm TL for eel currently applies to the recreational eel fishing sector, as it does to the commercial eel fishing sector. Recreational eel fishing is permitted in all Crown waters which are open to recreational angling, including waters which are stock enhanced by the commercial sector.

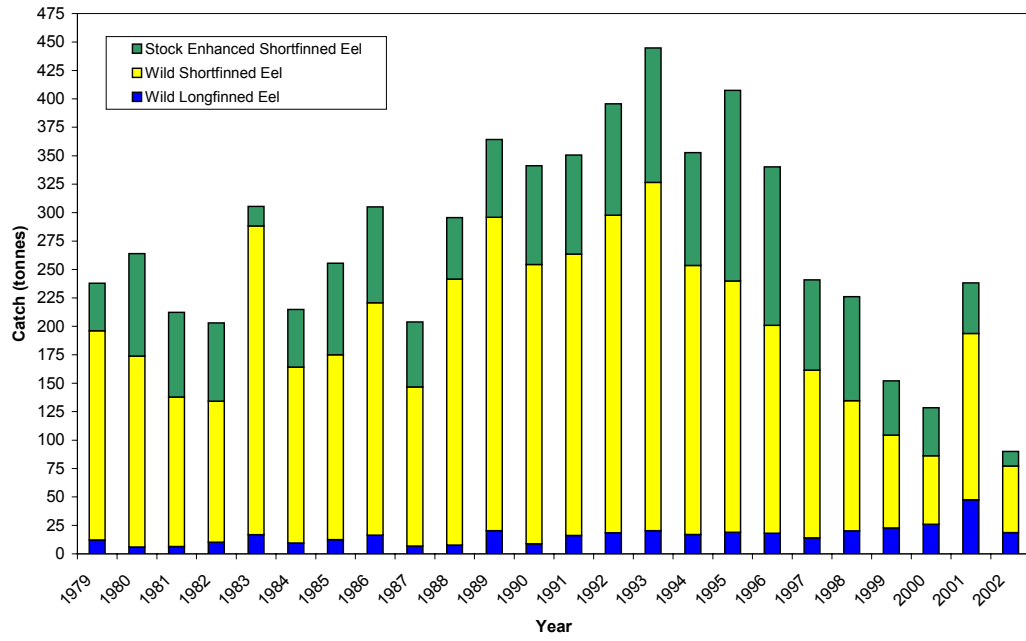


Figure 2. Total Commercial Victorian Eel Catch, 1979-2002. Catch returns to 30 June 2002 only.



Figure 3. Example of a single-winged fyke net as used in the Victorian eel fishery.

Consistency with Environment Australia's Assessment criteria

To satisfy the Commonwealth Government requirements for a demonstrably ecologically sustainable fishery, the eel fishery must operate under a management regime that meets Principles 1 and 2 of Environment Australia's guidelines for ecologically sustainable fisheries management under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999. The management regime must take into account arrangements in other jurisdictions, and adhere to arrangements established under Australian laws and international agreements. The Australia and New Zealand Eel Reference Group (ANZERG) was established in 1997 under the then Standing Committee on Fisheries and Aquaculture (SCFA). The original Terms of Reference for ANZERG were:

- Develop a coordinated approach to eel management
- Develop strategies for:
 - Stock allocation
 - Management & administration of the glass eel fishing sector
 - Eel industry development (collaboration with aquaculture committee)
 - Compliance (collaboration with compliance committee)
- Promote cooperative research on eels between States
- Advise on management policies to assist the promotion and enhancement of the eel aquaculture industry
- Facilitate communication between eel fisheries management, aquaculture management and research staff

Membership includes all Australian States plus New Zealand, consisting of one eel aquaculture representative (government) and one eel fisheries representative (government) person per State. Previous reporting responsibility to Management Committee of SCFA.

Presently ANZERG meets infrequently, however a number of key recommendations from the most recent meeting (12th July 2002) was to re- establish ANZERG with the Australian Fisheries Management Forum (AFMF). This action was supported at the recent meeting of the Southern Australian Fisheries Managers in Melbourne.

The key role of ANZERG is to develop a coordinated approach to eel management throughout the region, and to provide direction for all relevant jurisdictions for consistency in the management of eel stocks and the ecologically sustainable development of eel fishing and aquaculture industries. ANZERG is also the appropriate body to ensure the conservation and management of eels as "straddling stocks" in the South Pacific region. Such an arrangement is in accordance with The United Nations Agreement for the "Implementation of the Provisions of the United Nations Convention on the Law of the Sea of December 10, 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks" to which Australia is signatory. The objective of this Agreement is to ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks beyond areas under national jurisdiction through effective implementation of the relevant provisions of the Convention.

The Victorian Eel Fishery Management Plan (EFMP) (McKinnon 2002) describes the management regime for the fishery, as detailed below.

The management regime should:

- be documented, publicly available and transparent;

The EFMP is the policy document of Fisheries Victoria by which the eel fishery will be managed in conjunction with the Fisheries Act (1995) and the Fisheries Regulations (1998). In accordance with Victorian Government Legislation, the purpose of the Management Plan is to specify policies and strategies for the management of the eel fishery on an ecologically sustainable basis, having regard to relevant commercial, recreational, traditional and non-consumptive uses (Fisheries Act 1995 s.29(1)). The Management Plan was completed in 2002 following an extensive public consultative process, and is publicly available in hard copy or from the Departmental website: <http://www.nre.vic.gov.au/>.

- be developed through a consultative process providing opportunity for input by all interested and affected parties, including the general public;

The EFMP has been developed through a formal consultative process, overseen by the Victorian Fisheries Comanagement Council, including guidance for the planning process provided by an established Steering Committee which comprises members from both the commercial fishing and aquaculture industry sectors, the recreational fishing sector, conservation sector and government.

In accordance with Section 32 of the Fisheries Act 1995, the Minister published a notice of intention to declare the EFMP in major newspapers circulating generally in Victoria for at least 60 days prior to the declaration of the EFMP. Eleven submissions were received, each of which was considered by the Steering Committee appointed by the Secretary. The recommendations of the Steering Committee with respect to the submissions received were reported to the Minister through the Fisheries Comanagement Council.

- ensure that a range of expertise and community interests are involved in individual fishery management committees and during the stock assessment process;

Fisheries management in Victoria is the responsibility of Fisheries Victoria in conjunction with the Fisheries Comanagement Council (FCC). The FCC is comprised of representatives with knowledge and experience in commercial fishing, fish processing, fish marketing, recreational fishing, traditional fishing uses, aquaculture, conservation and fisheries science. The role of the FCC includes the promotion of comanagement of fisheries, overseeing the preparation of management plans, and to advise the Minister generally on all matters relating to Victorian fisheries. The FCC has a number of expert-based committees to provide it with advice and assistance, including the Inland Fishery Committee, which provides advice and assistance on the management of the eel fishery in Victoria. The Inland Fishery Committee membership comprises representatives from the general community, Seafood Industry Victoria (commercial fishing industry Peak Body), VRFISH (recreational fishing Peak Body), the inland net fishery and conservation/environmental interests.

The Steering Committee, appointed by the Secretary for the purpose of developing the EFMP, included one representative of the Inland Fishery Committee of the FCC, representatives from Seafood Industry Victoria, the Victorian Aquaculture Council and VRFish (Peak Bodies) respectively, and four representatives from DPI Fisheries, including the Steering Committee Chair. Representation was sought from the Victorian National Parks Association, and consultation in the development of the EFMP was undertaken with the Framlingham

Aboriginal Trust, a key indigenous group with strong cultural links to the use of eel, in the absence of an indigenous Peak Body.

Although not directly represented on committees of the Fisheries Comanagement Council, any interested third party may review the eel fishery management regime, or seek information regarding the eel fishery or its management directly through the Peak Bodies, the Fisheries Comanagement Council or any of its Fisheries Committees, or through the Minister. Any submissions from interested third parties to the Fisheries Comanagement Council relevant to the management of the eel fishery will be considered in the annual reviews of the EFMP.

The role of ANZERG includes the development of a coordinated approach to eel management across the region, thereby ensuring consistent management regimes are maintained. Outcomes of annual reviews of the Victorian eel fishery and the EFMP will be presented at regular ANZERG meetings for discussion, and directives from ANZERG will be incorporated where appropriate into the management of the Victorian eel fishery.

- be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements are measured;

The EFMP sets out to manage for the sustainable harvest of eels, and has an expected life of five years. The EFMP puts in place management systems and responses for management of the Victorian eel fishery over the short, medium and long term, which are outlined in the objectives of the EFMP. The effectiveness of the management arrangements as set out in the EFMP are measured by the improved catch effort reporting framework, as well as a range of reference points and management decision tools detailed in the EFMP. All commercially fished waters will be identified through a GIS linked database and grouped by catchment. Catch effort reporting by fishers is made monthly on a water by water basis, providing a means of monitoring fishery production by water and by catchment.

The EFMP and its recommended implementation targets are given authority under Sections 28 and 29 of the Fisheries Act (1995). However, any amendments to Fisheries Regulations recommended by the EFMP will require a Regulatory Impact Statement (RIS) which itself is subject to extensive public consultation under the Fisheries Act 1995.

The performance of the management arrangements and implementation targets detailed in the EFMP is to be assessed during each annual review of the EFMP. Management performance criteria include the degree to which implementation targets, as specified in the EFMP, are achieved. Specifically, management performance criteria ensures the "Precautionary Principle" is maintained in management of the eel fishery. That is, in order to avoid recruitment overfishing, approximately 50% of major coastal rivers in Victoria are closed to commercial eel fishing. Of the remaining rivers and streams in which commercial eel fishing occurs, only the lower estuarine sections are permitted to be fished commercially for eel, accounting for approximately 5% of stream length in rivers open to commercial eel fishing. In addition to limiting the area of water available to commercial eel fishing, the use of gear is heavily restricted to avoid overfishing. A maximum of 50 nets may currently be used under each EFAL.

The current blanket 50 net cap per licence will be reviewed as part of the implementation of the EFMP, and instead, the maximum number of nets per water fished will be determined through a consultative process, and specified on licences. This process will include the

consideration of the sustainability of eel stocks within each allocated water, bycatch issues and serviceability of gear. In many waters it is expected that the maximum number of nets able to be deployed at any one time will be less than the current potential 50 nets per licence. Where any water is allocated to more than one EFAL holder, a maximum number of nets will be determined as an aggregate between the relevant EFAL holders.

Management is responsive to changing environmental conditions, which may affect the fishery and/or the stock, such as drought. An “Accountability Map” of the implementation of the EFMP, as described by set implementation targets, has been developed and a designated officer appointed to ensure implementation of the management plan. The responsibilities of this position include the direction of reporting arrangements against which the progress of the implementation of the EFMP will be measured.

In addition to reviewing the performance of the management arrangements, an assessment of the fishery as a whole, and an assessment of each component of the fishery will be undertaken as part of the annual review. The key components of the fishery are stock enhanced shortfinned eel, wild shortfinned eel, wild longfinned eel, and glass eels. The management review panel is to comprise fisheries and regional managers within DPI. Each review will include an analysis of the production of each sector and the total fishery production in comparison to the average production over the preceding three years. A trigger point of 20% of this moving average has been arbitrarily set, below which a review of the respective fishery component must be undertaken. The fishery review panel will include fisheries and regional managers within DPI, industry representatives and the FCC. Any review will involve the input of representatives of key stakeholder groups.

The EFMP recommends the reporting of catch by species and by individual, specified water or catchment. Such a reporting mechanism allows for close monitoring of production from individual water bodies and individual river catchments, and will be included in the annual review of the fishery. Provision is made in the EFMP for adaptive management in response to the needs of the fishery. For example, under extreme drought conditions recently experienced in Victoria, provision was made for an increased level of fishing effort in particular waters to harvest eels which would otherwise have perished.

- be capable of controlling the level of harvest in the fishery using input and/or output controls;

The commercial eel fishery is governed by the Fisheries Act (1995) and the Fisheries Regulations (1998) enforceable under the Fisheries Act (1995). The commercial eel fishery is a limited entry, input controlled fishery, with enforceable restrictions on effort, gear construction and use, and waters able to be fished.

- contain the means of enforcing critical aspects of the management arrangements;

The EFMP specifies the policies and strategies for the management of the fishery, and contains the means of enforcing management arrangements under the Fisheries Act 1995. Enforcement of management arrangements is enacted under the Fisheries Regulation 1998. Fisheries Victoria supports a substantial compliance, extension and education effort in both the commercial and recreational fishing sectors, including on-ground enforcement and covert operations which are backed by significant legislative powers.

- provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria;

The EFMP provides for regular review of the performance of the fishery management arrangements and the management strategies, objectives and criteria, as outlined in the "Performance Indicators, Targets and Monitoring" section of the Plan. The performance of the management arrangements under EFMP will be reviewed annually as described above. In addition, the plan will be formally reviewed after 5 years. Fisheries Victoria is represented on a regular basis at bi-monthly meetings of the Victorian Eel Fishers' Association (VEFA), at which consultation with the eel fishers in the progress of the implementation of the EFMP is undertaken. The Fisheries Act 1995 also provides for *ad hoc* reviews of management plans, undertaken through a consultative process.

- be capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates

The capability of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates are detailed in the "Ecosystem Critical Components and Threats" section of the EFMP. Environmental impacts of activities undertaken as part of the fishery are minimal. Potential impacts may include damage to riverine habitats, riparian and instream vegetation, and disturbance of the substrate and river banks due to deployment and retrieval of gear and the use of four-wheel-drive vehicles, boats, and water pollution due to the operation of outboard motors. Routine monitoring of fishing activities by compliance officers will form part of the Service Agreements between Fisheries Victoria and regional Departmental offices. Such monitoring will enable assessment of fishing operations, including bycatch monitoring.

- require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy.

As identified in Victorian government policy, management of the Victorian Eel Fishery requires compliance with the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy. The Victorian Eel Fishery Management Plan has identified the development of a Bycatch Action Plan (BAP) for the fishery (see draft in the attached appendices), which identifies bycatch issues and makes recommendations for addressing such issues in the fishery. Voluntary codes of practice for bycatch management are presently being developed for the Victorian Eel Fishery, and these are discussed further in the Draft BAP. A code of conduct for the Victorian Eel Fishery is planned for implementation by December 2003. The current management arrangements contained in the draft plan reflect a range of bycatch avoidance strategies, particularly for threatened and endangered species. The primary threat abatement strategy for minimising effects on threatened and/or endangered species in the eel fishery, is to close waters containing populations of such species to commercial eel fishing. Bycatch reduction devices are also used in the fishery, in sensitive areas in particular, such as Wildlife Reserves.

Consistency of management of the Victorian Eel Fishery with Environment Australia's ESD Principles

PRINCIPLE 1.

A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover .

Objective 1.

The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.

Information requirements

1.1.1 There is a reliable information collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring.

Total landed weight of each species of eel, and total effort expended are currently reported on a monthly basis as a conditions of each eel licence. Other mandatory information reported by fishers include the location of fishing activities, quantity of introduced bycatch species caught, details of disposal of catch (domestic and export), and any details of undersized eels retained under permit for restocking purposes. Production from the fishery is reported annually in Fisheries Victoria's Catch and Effort Information Bulletin. Production from stock-enhanced "culture" waters, undertaken by licensed eel fishers, but under a separate Aquaculture Licence, is reported separately. Monthly returns are submitted by Licence holders, and summarised annually in Fisheries Victoria's Aquaculture Production Information Bulletin. Figure 2 details the annual commercial landings of eels in Victoria since 1970.

The Eel Fishery Management Plan proposes changes to the reporting structure to include GIS linked codes for each individual water and/or catchment fished, separate logbooks respectively detailing fishing activities in both allocated and stock enhanced waters, receipt of product from fishers, and disposal of product to domestic and export markets, and as restock to stock-enhanced fisheries. This will allow improved determination of production and fishing effort by individual water, and by catchment, and more accurate estimates of production from stock-enhanced fisheries. This in turn will provide for effective management of the fishery on a catchment by catchment basis. The relevant changes and improvements to the reporting system are expected to be in place by April 1st, 2003, the commencement of the new commercial fishing year.

Independent monitoring of the eel fishery *per se* in Victoria is currently not undertaken due to the small size of the fishery and its relatively small contribution to the Victorian and national economies. However a number of extensive independent research projects examining various aspects of eel biology and industry development have been conducted, including glass eel resource assessment and aquaculture, and species distribution and ecology. No specific long term, fishery-independent monitoring has been undertaken so far, however records of the distribution and abundance of both anguillid eel species in Victoria are maintained on existing Departmental databases through regular broad species surveys of coastal and inland

waterways. Such surveys are undertaken by both the Freshwater Ecology Section of Parks, Flora & Fauna Division, and the Freshwater Fisheries Program of MAFRI.

The EFMP specifies a range of new information required to be gathered in the fishery. This includes the development of new reporting logbooks where catch and effort is to be reported by specific water and/or catchment, and stocking rates and are to be recorded for stock-enhanced waters. In addition, the four main eel processors and exporters have agreed to maintain formal logbooks in which records of all eels received and disposed of from other fishers, are maintained. Such record-keeping is neither a condition of their licence, nor a legal requirement under the Fisheries Act 1995, but has been agreed to by these operators on a voluntary basis. This is consistent with the EFMP and forms a major component of the implementation of the management plan. As described in the EFMP, the revised catch-effort reporting system will improve the accuracy of the data, improve capacity to monitor fishing pressure and effects on individual waters and catchments, improve the management response system, and provide an important opportunity to monitor and maximise the productivity of stock-enhanced waters. The implementation of the new reporting system was effective as of April 2003.

Assessment

1.1.2 There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and /or reproductive capacity. Review should take place at regular intervals but at least every three years.

Fishery dependent data is routinely collected from each licence holder as a condition of their licence. At present there is no specific stock assessment of the eel fishery in Victoria, however the management planning process itself addresses the status of the fishery and provides for review of the management regime and operation of the fishery. It is suggested that traditional stock assessment methods are not applicable to eel fisheries due to the discrete nature of eel populations in individual, non-connected catchments, and the catadromous, semelparous (single-spawning) life history of anguillid eels. In addition, a significant proportion (up to 40%) of the fishery's production is from stock enhancement. Together with the anticipated development of the glass eel fishing sector and increased subsequent eel aquaculture and stock enhancement opportunities, stock assessments for the purposes of assessing the status of the fishery have little relevance. Figure 2 shows the commercial catch of eels in Victoria. The performance of the Victorian eel fishery is strongly driven by environmental factors, and the decline in total catch of shortfinned eel since the mid 1990's is due to protracted drought conditions in western Victoria. This area of the state produces over 70% of the shortfinned eel catch, from both wild and stock-enhanced fisheries, and current drought conditions have reduced the fishing area by an estimated 60%. An apparent recovery in the wild shortfinned eel sector in 2001 suggests that the effects of drought may have been mitigated in riverine habitats in coastal Victoria, while the stock enhanced shortfinned eel sector, although comparatively low, appears to have stabilised at between 40-50 tonnes under continuing drought conditions in western Victoria (Figure 2). In addition, ongoing drought conditions have not adversely affected longfinned eel production (Figure 2).

An assessment of the fishery as a whole, and an assessment of each component of the fishery will be undertaken as part of the annual review of the fishery and of the management arrangements. The key components of the fishery are stock enhanced shortfinned eel, wild

shortfinned eel, wild longfinned eel, and glass eels. Each review will include an examination of the catch return data for each component of the fishery, and for the fishery as a whole for the year to date. An analysis of the production of each sector and the total fishery production, based on commercial catch records, will be undertaken in comparison to the average production over the preceding three years. A trigger point of 20% of this moving average has been set, below which a review of the respective fishery component must be undertaken. Such a method was chosen as fishery-dependent data is the predominant form of information available to assess the status of the fishery. No information is available with which to estimate biomass, and this is unlikely to be achieved within the life of the EFMP. Thus, setting reference points in relation to biomass estimates will not be possible for the eel fishery. The fishery review panel will include fisheries and regional managers within DPI, industry representatives and the FCC. Any review will involve the input of representatives of key stakeholder groups.

The glass eel component of the eel fishery is a relatively new sector and is still in a developmental phase. Substantial research has been undertaken into the identification of glass eel resources in Australia, and at least one location in Victoria has been found to provide commercial quantities of glass eels of both species (McKinnon *et al.* 2002). The management response for this sector of the fishery is to permit commercial glass eel harvesting in allocated waters, and in the Snowy River in east Gippsland, which is otherwise closed to commercial eel fishing, but has been found to produce substantial quantities of shortfinned and longfinned glass eels. Consideration will not be given to accessing other waters for glass eels unless existing glass eel resources are exploited at a maximum sustainable level, or existing allocated waters prove to be unviable for glass eel harvesting. (McKinnon *et al.* 2001) detail best practice methods for the sustainable harvest and early rearing of glass eels, including the efficient separation and release of bycatch.

As directed in the EFMP, a condition of each glass eel collection permit states that, of any quantity of glass eels collected from any location within Victoria, a minimum of 10% by number of the catch must be returned to the same water, upstream from the point of collection, as ongrown elvers (minimum individual weight 2.0g). This must be undertaken at the operator's expense, and under the supervision of DPI staff. This is a further precautionary step to ensure the long term viability of eel stocks where glass eels are harvested.

1.1.3 The distribution and spatial structure of the stock(s) has been established and factored into management responses.

The distribution of shortfinned and longfinned eel is well established in Victoria, and fishery dependent catch returns are presently quantified by allocated water and/or stock enhanced water fished, or more broadly by regions where unspecified Crown waters and private waters are fished. The EFMP details the need for the identification of all waters routinely fished by licence holders, including all unspecified Crown waters and private waters. All waters commercially fished for eels will be incorporated into a GIS linked coding system. This will enable more accurate reporting of catch by water, improved monitoring of eel stocks and management of the fishery on a catchment basis. The completion of the water/catchment identification and coding process, and commencement of the new reporting arrangements are expected to be in place by April 2003.

Reproduction of both shortfinned and longfinned eel is believed to occur in oceanic areas, and recruitment to freshwater habitats is random. It is presently assumed that both shortfinned and longfinned eels belong to panmictic stocks respectively. Thus biological

diversity and reproductive capacity are unlikely to be affected by the level of fishing pressure in individual fresh waters. In addition, the protection of both immigrating glass eel stocks and emigrating adult eel stocks in defined closed waters and catchments is expected to contribute significantly to the sustainability of eel resources in Victoria. Of 48 major Victorian rivers, 21 are closed to commercial eel fishing. No estimates of the relationship between spawning stock biomass (SSB) and recruitment have been established for Victorian eel populations, however fishery independent monitoring of glass eel resources in south eastern Australia, (Gooley *et al.* 1999), has found that recruitment of shortfinned glass eels (as indicated by CPUE) is not significantly different between rivers which are commercially fished, and those which are not (McKinnon unpublished data). Thus it is expected that significant populations of eels exist in unfished rivers, which contribute to the SSB which support eel populations across each species' respective range.

1.1.4 There are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

Commercial catch data for the fishery have been collected in detail since 1979 (Figure 2). There is however, limited information on the level of recreational eel fishing in Victoria. Anecdotal evidence suggests that the recreational take of both species of eel is significant. The recently completed NRFS has determined an interim estimate of eels taken by recreational fishers in Victoria, however complete analysis of the data is yet to be undertaken. As described earlier, the analyses were not complete at the time of writing, and potential outliers exist in the raw data. Consequently the estimated recreational eel take in Victoria is, at best, expected to be inconclusive. Management of the recreational eel fishery includes a bag limit of 10 eels per fisher per day, and all other rules under the General Angling Licence apply. A minimum legal length of 30cm TL for eel currently applies to the recreational eel fishing sector, as it does to the commercial eel fishing sector. Recreational eel fishing is permitted in all Crown waters which are open to recreational angling, including waters which are stock enhanced by the commercial sector.

Indigenous catch of eel is not reported and is consequently unknown. It is believed that a small number of indigenous communities regularly fish for eel, particularly in western Victoria, however it is felt that the take of eel by this sector is not significant in comparison to the commercial fishing sector. Anecdotal evidence suggests that the "illegal commercial" take of eel in Victoria may be considerable however the quantities of eels taken illegally is difficult to determine. Discrepancies between sales of eel through domestic markets, and quantities reportedly disposed of domestically cannot be determined. That is, quantities of eels sold on the domestic market as reported by licence holders, more than account for the volumes of eels sold through the major fish markets (eg Melbourne and Sydney).

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested.

For the last two decades the eel fishery in Victoria has been relatively stable, in terms of production, with total catch ranging from 125-450 tonnes annually, and a mean annual total catch of 280 tonnes. The production of shortfinned eel has been particularly affected by drought, however longfinned eel production has been stable, and may be tending to increase at present. It is considered that the wild fishery is operating at an optimum level, and that

production from the fishery could be significantly increased through stock enhancement and aquaculture. Traditional stock assessment methods are not applicable to eel fisheries due primarily to the discrete nature of eel populations in individual, non-connected catchments, and the unique life history of anguillid eels. In addition, up to 40% of the fishery's production is presently from stock enhancement. The use of yield-predictive models for production from eel stock enhancement in western Victoria has been investigated, and results indicate that productivity through stock enhancement could be increased significantly (Skehan *et al.* 1998). A key objective of the EFMP is to promote and assist the anthropogenic enhancement of eel fisheries utilising sustainably harvested glass eel resources to contribute a significant proportion of eel fishery production in Victoria. The development of the fishery in this way, whilst maintaining protection of natural eel populations in about 50% of major Victorian rivers diminishes the need for traditional stock assessments in the Victorian eel fishery.

Management responses

1.1.6 There are reference points (target and/or limit), that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.

The development of reference points assumes that there is a relationship between spawning stock and recruitment. The majority of reference points require information on several population parameters including age structure, growth, natural mortality, spawning stock size and recruitment size. The limited knowledge of these parameters and population dynamics of both shortfinned and longfinned eel are consequently a major impediment in the development of specific reference points for eel. The mechanisms determining sex differentiation of eels are uncertain, but may include growth rate, density, temperature, or a combination of factors. It is unclear exactly how recruitment to freshwater occurs and whether there are regional stock and recruitment linkages, or whether indeed the assumption of panmixia in both species is correct. (An investigation of the panmixia hypothesis is currently being undertaken for longfinned eel, as part of an FRDC funded research project into the management of longfinned eels in Queensland and NSW). Natural mortality rates would be expected to vary with age and are likely to be high for the early life stages and decrease with age and size. Finally, there is little or no quantitative information on carrying capacity of habitat types for eels or indeed what habitat variables determine carrying capacity. Under such data poor conditions the "Precautionary Approach" has been adopted in managing the Victorian eel fishery and includes restricting the number of rivers open to eel fishing and the permissible methods used for eel fishing, and encouraging stock enhancement in the fishery in appropriate waters. The geographic area within which the Victorian eel fishery operates, is a relatively minor portion of the overall distribution of both longfinned and shortfinned eels. It is believed therefore, that the Precautionary Approach allows for sufficient escapement of spawning stock, under the existing data-poor environment to accommodate the presumed, but as yet undefined, associated recruitment.

In the absence of reliable estimates of biomass, the EFMP recommends a precautionary trigger point be set for the fishery at 20% reduction in catch, based on the mean catch for the preceding 3 years. The trigger will be set for each component of the fishery (wild shortfinned eel, wild longfinned eel and stock-enhanced fishery), for the combined catch in the fishery, and for each catchment respectively. Once the trigger point is reached for any component of the fishery, a review of the fishery will be initiated. The fishery review panel will include fisheries and regional managers within DPI, industry representatives and the FCC. Any review will involve the input of representatives of key stakeholder groups. There is no TAC

for the fishery, however a blanket cap on effort applies to all licence holders. The EFMP aims to refine the cap on effort with respect to determining the appropriate level of effort for individual waters fished.

The EFMP recommends that a research and monitoring strategy be developed for eels in Victoria, as part of the Plan's implementation, which addresses both population biology and management, in line with ANZERG's recommendations for eel R&D on a regional scale. The greatest impediment for undertaking any future eel research is the provision of funding.

1.1.7 There are management strategies in place capable of controlling the level of take.

The EFMP details the current licensing arrangements for the eel fishery, including licence conditions and the allocation of waters to licences. There are 18 transferable Victorian EFALs issued by Executive Director Fisheries, renewable on an annual basis, and no new EFALs are to be issued. Waters allocated to individual licences are listed on each licence and may only be fished commercially by the holder of the EFAL, or by nominated operator(s) (Table 1). In addition, unspecified waters which can be commercially fished for eels by holders of EFALs and their nominated operators include:

- 1) All Crown lakes, dams, swamps, marshes and morasses south of the Great Dividing Range*, except:
 - a) Lake Wendouree,
 - b) those water bodies forming part of any Wildlife Reserve unless specified in a permit issued by the Executive Director, Fisheries,
 - c) any water allocated to another licence holder,
 - d) any water subject to a Fish Culture Permit under the *Fisheries Act, 1968* specifying eels, or an Aquaculture Licence under the *Fisheries Act, 1995* specifying eels.
- 2) All rivers, creeks, channels and drains downstream of the South Gippsland Highway between Dandenong and the junction of the South Gippsland and Bass Highways.
- 3) All rivers, creeks, channels and drains downstream of the Bass Highway between the junction of the South Gippsland and Bass Highways, and Wonthaggi.

*Crown lakes, dams, swamps, marshes and morasses located in the Portland and Glenelg River Basins may only be fished under Licence Nos. 2, 8, 9 & 10.

Other unallocated Crown waters, including Wildlife Reserves, may currently be fished under permit issued by Executive Director Fisheries. On renewal of, or application for permits for eel fishing in Wildlife Reserves, Fisheries Victoria is required to consult with Parks Victoria as the land manager of Victorian Wildlife Reserves to ensure the inclusion of any special conditions where required. Permits may also be issued to EFAL holders for the use of oversized fyke nets to take migrating adult eels, and for the use of glass eel nets to take glass eels in allocated or unallocated waters. Conditions on all permits are determined on a case by case basis. Aquaculture licences (Crown land) are issued to EFAL holders for the stocking of juvenile eels into specified Crown waters for ongrowing.

There are 16 Drainage Basins in coastal Victoria (Figure 1) comprising 48 major river catchments, plus tributaries, of which 27 sustain commercial eel fishing, either as allocated waters as listed on all EFALs, stock-enhanced waters, or under permit (see Appendix). The

remaining 21 catchments include 16 declared rivers, plus rivers draining into Port Phillip and Western Port Bays, which are closed to eel fishing. Other waters as listed in the former schedule of regulations may be commercially fished for eels, and may include private and Crown waters.

The management regime of the Victorian eel fishery ensures the “Precautionary Principle” is maintained. That is, in order to avoid recruitment overfishing, approximately 50% of major coastal rivers in Victoria are closed to commercial eel fishing. Of the remaining rivers and streams in which commercial eel fishing occurs, including allocated waters and unspecified waters open to commercial eel fishing, only the lower estuarine sections are permitted to be fished commercially for eel. This accounts for approximately 5% of stream length in rivers open to commercial eel fishing. The total proportion of available riverine habitat open to commercial eel fishing is less than 2.5% (Table 2). In addition to limiting the area of water available to commercial eel fishing, the use of gear is heavily restricted to avoid overfishing. A maximum of 50 nets may currently be used under each EFAL, and the Fisheries regulations (1998) clearly specify the limitations to gear usage to avoid the risk of overfishing (see below).

The eel fishery is managed using input controls which include restricted access to waters for commercial eel fishing and gear restrictions, including a cap on the number of fyke nets able to be used by each licence holder. Specific conditions of every EFAL, and as described in the Fisheries Regulations 1998 include:

1. An Eel Fishery Access Licence is subject to the conditions specified in this regulation, in addition to any other conditions imposed on the licence by these Regulations and by the Secretary under section 52 of the Act.
2. The licence holder:
 - 2.1. must not use any equipment other than a fyke net to take eels, carp, roach or tench; and
 - 2.2. must ensure that every fyke net used is clearly marked with:
 - 2.2.1. a surface float marked with the access licence number; and
 - 2.2.2. a net identification tag issued to that licence holder by the Secretary; and
 - 2.3. must not use or possess on board a boat in, on or next to Victorian waters, more than 50 fyke nets; and
 - 2.4. must ensure that all fish are cleared from nets at least once in every 48 hour period; and
 - 2.5. must return fish other than eel, carp (including goldfish), roach, tench or any noxious fish to the water immediately;
 - 2.6. when using any fyke net in a river, stream, creek or other watercourse must ensure that:
 - 2.6.1. the fyke net or any fleet of fyke nets is not set so as to block more than half of the total width of the stream or more than half of the width of the main channel of the river; and
 - 2.6.2. no more than 3 fyke nets are tied together to form a fleet of nets; and
 - 2.6.3. any fyke net or fleet of fyke nets is not set within 5 metres of any other fyke net or fleet of fyke nets.

The present cap on effort of 50 nets per licence is to be reviewed under the EFMP. In place of a blanket 50 net cap per licence, an appropriate maximum number of nets per water or catchment fished will be determined in consultation with the appropriate authorities and

stakeholders. This review will determine the maximum level of effort in relation the sustainability of eel fishing in each waterbody or catchment fished.

Table 1. Allocation of waters to Eel Fishery Access Licences

Eel Fishery Access Licence No.	Allocated Waters	Basin Name (Basin No.)
1	Tarwin River downstream from Mardon Rd Bridge (West Branch). Albert River downstream from the railway bridge 2.4 km west of Alberton. Gippsland Lakes.	South Gippsland (27) "
2	Eumerella River downstream from the Princes Highway Bridge, including Lake Yambuk. Shared allocation (see below).	Portland (37)
3	Lake Purrumbete.	Otway Coast (35)
4	Lower Barwon River between Queen's Park and Grab Hole Drain. Reedy Lake Section of Lake Connewarre. Lake Connewarre.	Barwon (33) " "
5	Lower Barwon River (inc. section of Connewarre Game reserve).	Barwon (33)
6	No specific allocation.	
7	Tarra River downstream from Pound Rd Bridge. Gippsland Lakes. Lower Lake Mallacoota.	South Gippsland (27) East Gippsland (21)
8	Shared allocation (see below).	
9	Lake Gilliar. Shared allocation (see below).	Hopkins (36)
10	Merri River (inc. Kelly Swamp), downstream from the Wollaston Weir. Shared allocation (see below).	Hopkins (36)
11	No specific allocation.	
12	Aire River downstream from the Great Ocean Road. Lake Corangamite.	Otway Coast (35) Lake Corangamite (34)
13	Hospital Swamp. Lake Learmonth.	Hopkins (36) Barwon (33)
14	No specific allocation.	
15	Deep Lake. Lake Tooliorook.	Hopkins (36) "
16	LaTrobe River downstream from Yallourn Storage Dam to the Swing Bridge at Sale. Moe Drain downstream from the Princes Highway Bridge. Gippsland Lakes.	LaTrobe (26) "
17	No Specific allocation.	
18	Curdies River downstream from "The Narrows". Curdies Inlet. Gellibrand River downstream from the Great Ocean Road.	Otway Coast (35) "

Table 2. Total length of major streams and tributaries within each River Basin, and proportion of length fished commercially for eels

Basin Name	Basin No.	Total Stream Length (km)	Approx. Total Length of Stream Open to Commercial Fishing (km)	% Total Stream Length Commercially Fished
East Gippsland	21	746	5	0.67
Snowy	22	932	0	0.00
Tambo	23	669	15	2.24
Mitchell	24	844	0	0.00
Thomson	25	1213	0	0.00
LaTrobe	26	1052	40	3.80
South Gippsland	27	1049	110	10.49
Bunyip	28	336	22	6.55
Yarra	29	874	0	0.00
Maribyrnong	30	458	0	0.00
Werribee	31	496	0	0.00
Moorabool	32	500	0	0.00
Barwon	33	558	30	5.38
Lake	34	490	0	0.00
Corangamite				
Otway Coast	35	556	40	7.19
Hopkins	36	1146	15	1.31
Portland	37	428	50	11.68
Glenelg	38	1096	0	0.00
Total		13,443	327	2.43

1.1.8 Fishing is conducted in a manner that does not threaten stocks of by-product species. (Guidelines 1.1.1 to 1.1.7 should be applied to by-product species to an appropriate level)

The byproduct species in the Victorian Eel Fishery are carp (*Cyprinus carpio*), tench (*Tinca tinca*) and roach (*Rutilus rutilus*), each of which is introduced. Each byproduct species has low commercial and recreational value, and zero conservation value. Carp is listed as noxious in Victoria. A small commercial fishery exists for carp, and is concentrated in the Gippsland Lakes. Potential for impact on commercial carp stocks from eel fishing activities is minimal. The mean annual catch of carp from the entire eel fishery from 1980 to 2000 was approximately 1.5 tonnes, which is less than 0.2% of the mean commercial carp catch in Victoria. The mean annual catch of roach and tench was approximately 10 tonnes and 6.5 tonnes respectively from 1980-2000. Guidelines 1.1.1 to 1.1.6 do not apply to the management of these species in Victoria, with respect to the maintenance of ecologically viable stock levels of byproduct species in the Victorian Eel Fishery.

1.1.9 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

It is considered that the management strategies in place, and those proposed in the EFMP, including management responses to triggers as outlined above, will achieve the objective. The key features of the management response include:

- Protection of spawning stock biomass through closure of major rivers to commercial eel fishing
- Improved catch reporting arrangements, and management of fishery by catchment
- Annual assessment of fishery performance
 - Monitoring of “trigger” catch levels and management action where appropriate
 - Reduction of fishing effort
 - Closure of waters
- Strategic annual review of management performance under EFMP
- Adaptive management response to needs of the fishery (eg. mitigating effects of drought)
- Development of sustainable glass eel harvesting, eel aquaculture and stock enhancement

The tools used to achieve the management response include conditions on licences, which detail where commercial eel fishing may be undertaken, and the Fisheries Regulations 1998 (see 1.1.7) which provide enforceable rules by which Eel Fishery Access Licence holders must abide in the undertaking of eel fishing activities. The Fisheries Act 1995 provides the management direction for the fishery and gives the EFMP power to be implemented.

Objective 2.

Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

Management responses

1.2.1 A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock.

Historical catch data indicates the production from the Victorian Eel Fishery is highly variable and depends on many factors, including fishing pressure and habitat degradation, and environmental effects such as drought. Figure 2 indicates the variable production of the fishery, ranging from 125 -450 tonnes since 1979. Since 1994 production of shortfinned eel, from both the wild fishery and from stock enhancement, has declined steadily. This is largely due to persistent drought conditions in the western district of Victoria, in which over 70% of shortfinned eel production occurs. This protracted drought period has resulted in an estimated loss of 60% of productive eel waters, many of which are now completely dry. A recent increase in eel production has occurred in the wild fishing sectors (longfinned eel and shortfinned eel) however eel production from stock enhancement remained at a low level (Figure 2), indicating the vulnerability of this sector of the fishery to severe drought.. Management of the fishery by catchment will enable closer scrutiny of eel production at the catchment level and will allow for management responses to be effected at that level.

The precautionary approach to management of the Victorian eel fishery will prevent overfishing as approximately 50% of major rivers in Victoria are closed to eels fishing, and up to 40%, historically, of eel production is from anthropogenic stock enhancement. This latter

sector of the fishery is expected to increase with the development of sustainable glass eel fishing and the aquaculture of seedstock for stock enhancement.

Under the EFMP, a precautionary trigger point has been set for the fishery at 20% reduction in catch, based on the mean catch for the preceding 3 years. The trigger will be set for each component of the fishery (wild shortfinned eel, wild longfinned eel, glass eel and stock-enhanced fishery), for the combined catch in the fishery, and for each river catchment respectively. The fishery, including all components will be assessed annually in relation to If the trigger point is reached for any component of the fishery, the Secretary of the Department of Primary Industries (DPI) will initiate a review of the fishery to be undertaken by a fishery review panel which will include fisheries and regional managers within DPI, industry representatives and the FCC. Any review will involve the input of representatives of key stakeholder groups. The review will examine the decline in the fishery and provide advice within a period of 3 months to the Minister, including recommendations and options for management. The proposed improvements to the data reporting and management system will enable the rapid identification of any decline in the fishery, and subsequent management response. Management responses may include, as necessary, reduction in effort, closure of any component of the fishery including the closure of a water or catchment to eel fishing, or closure of the entire fishery.

1.2.2 If the stock is estimated as being at or below the biological and / or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a 'whole of fishery' effort or quota reduction are implemented.

The eel fishery, or any component thereof, will be determined to be below the precautionary biological and/or effort bottom line when catch from any component of the fishery is less than 20% of the 3-year moving average catch. This trigger point represents a substantial decrease in catch, such as has occurred in recent years (Figure 2). If any component of the eel fishery, including wild shortfinned eel, wild longfinned eel, glass eels, stock enhanced components, or production by individual catchment, reaches the predetermined trigger point, management responses as recommended by the review of the eel fishery as described above may be implemented by the Secretary. Such responses may include reduction in effort, closure of any component of the fishery including the closure of a water or catchment to eel fishing, or closure of the entire fishery. , Such management responses would be implemented under Section 152 of the Fisheries Act 1995 through publication of a Fisheries Notice in the Government Gazette, and delivered to the relevant peak body, which for the Victorian eel fishery, is Seafood Industry Victoria.

PRINCIPLE 2.

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

Objective 1.

The fishery is conducted in a manner that does not threaten bycatch species.

Information requirements

2.1.1 Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch.

Bycatch Action Plan (BAP)

Reliable information on bycatch is sparse, with compliance officers monitoring commercial operators infrequently. A draft BAP for the Victorian eel fishery has been developed as recommended in the EFMP. The draft BAP is appended to this document for information as part of the consultation process for the strategic assessment of the Victorian eel fishery by Environment Australia (this report). The draft BAP summarises bycatch related issues in the eel fishery and makes a number of recommendations, including the monitoring of bycatch in the eel fishery by compliance officers as part of regional service agreements with Fisheries Victoria. In addition, recommendations for bycatch exclusion and reduction are also made in the draft BAP. The completion time for the BAP is December 2003.

To assist with filling bycatch knowledge gaps in the fishery, eel fishery return logbooks will include formal provision for bycatch reporting by EFAL holders from 2003 onwards, and recording of fishery-dependent bycatch information on existing fisheries databases will commence in 2003.

Fishery dependent information appears to be the most viable option, through cooperation between the fishers, managers and researchers. Provisions for bycatch information to be included on eel returns will come into effect in 2003. The logbooks presently state 'that all species caught while engaged in commercial fishing activities and not returned live to the water must be reported on the fishing return'. Without provisions for recording bycatch data, the practice of recording such events is considered as rare.

Fisheries Officers frequently attend commercial eel fishing operations to observe and report on the operations, including reporting on the range and quantities of bycatch species in the operations. The draft Management Plan recommends the reporting of native bycatch species with the commercial returns provided by licensed operators.

Assessments

2.1.2 There is a risk analysis of the bycatch with respect to its vulnerability to fishing.

There is clearly a need for a succinct bycatch risk analysis of all waters allocated to the commercial fishery. This is a key recommendation of the draft BAP. However, the absence of both fishery dependent and fishery independent data on bycatch composition in the Victorian eel fishery renders an effective risk assessment of the sustainability of bycatch in the fishery

largely unworkable at present. A major outcome of the risk assessment will be the identification of potential bycatch indicator species to be monitored in the fishery. The provision for reporting fishery dependent bycatch data, to be included in catch returns from 2003, will enable the ongoing collection of bycatch data upon which a robust risk assessment will be based. These data will be corroborated with random field observations by DPI compliance staff as part of regional service agreements with Fisheries Victoria from 2003/04. In addition, analysis of existing freshwater fisheries and wildlife databases, which contain information pertaining to potential bycatch species in waters fished commercially for eel, will contribute data to the risk assessment process. An example of an appropriate risk assessment tool is that used by Stobutzki *et al.* (2001), which ranks bycatch species by their susceptibility to capture and mortality, and the capacity for recovery of each population after depletion.

Presently the management of the Victorian eel fishery practices a precautionary approach to bycatch. Bycatch avoidance strategies include the closure of waters to eel fishing, if those waters contain threatened, endangered or protected species, or significant populations of species vulnerable to capture.

Management responses

2.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

As detailed above in 1.1.7, the same regulations which control the level of take in the eel fishery also reduce the impact of fishing activities on bycatch (Fisheries Regulations 1998 and licence conditions). These regulations and conditions include:

- Use of fyke nets only permitted to take eel
- A blanket cap of 50 nets per licence (to be reviewed to limit the number of nets per water fished, as described above)
- Closure of approximately 50% of major Victorian rivers and streams to commercial eel fishing
- Closure to commercial eel fishing of waters containing known populations of indicator bycatch species at risk from eel fishing – “Precautionary Approach”. Such indicator species to be identified in the risk assessment process as described (see 2.1.2 above and 2.1.5 below).
- Restriction of fishing activities to lower estuarine sections of rivers
- Input controls on gear usage
 - No more than 3 nets used to form a fleet
 - No more than 50% of width of stream to be blocked by nets
 - No net or fleet of nets within 5m of another net or fleet
- Nets to be cleared at least once every 48 hours
- Inclusion of bycatch reduction devices and/or fishing methods in Wildlife Reserves including:
 - Exclusion grids
 - Cod end of net raised above water surface, or raised and open above water surface
 - Escape tube(s)
 - Clearing nets within 24 hours
- Immediate closure of waters where platypuses caught as bycatch (eg Barham River)
- All bycatch species to be returned to the water immediately

- Reporting of bycatch on commercial eel fishing logbook returns to be introduced in 2003
- Independent random monitoring of bycatch in fishing operations to be introduced in 2003/04

Gear type and setting regulations detailed in the EFMP and Fisheries Regulations 1998 are designed to minimise the threat of capture to bycatch species. These regulations prevent fishing saturation of a watercourse by commercial fishers and the use of gear that has highly negative environmental impacts.

Commercial eel fishing is not permitted in waters in which populations of platypuses (*Ornithorhynchus anatinus*) and native fish species such as estuary perch (*Macquaria colonorum*), Australian grayling (*Prototroctes maraena*) and Australian bass (*Macquaria novemaculeata*) may be threatened by the practice of commercial eel fishing (Table 4).

The development of efficient BRD's will aid in the reduction of capture and/or mortality of all bycatch including endangered, threatened or protected species. Presently all commercial licence holders permitted to fish in Wildlife Reserves in western Victoria are required to use BRD's, and all Wildlife Reserve fishing permit holders must clear their nets every 24 hours.

Another bycatch reduction method is to raise and/or open the codend of a fyke net creating an opportunity to escape and/or to breathe for air reseparating bycatch (ie. birds, water rats and platypus.) This practice is a condition for eel fishing permits issued for Wildlife Reserves.

A number of eel permits include conditions for times when eel fishing is allowed to take place. Such conditions aim to minimise conflicts between other resource users, and is a practical approach that can be used to minimise the impacts of eel fishing at specific times of the year, such as during the migrations of species at risk of bycatch.

Canadian eel fishers have developed three devices to reduce the problem of catching juvenile salmon migrating downstream (Leadbitter 1999). These devices could be suitably modified for the Victorian eel fishery. Such devices include:

- a) Escape cone exclusion device: A plastic cone (ie. end of a plastic drink bottle) is attached to the end of the net to allow fish to exit. The size of the exit can be varied according to the sizes of the fish and eels involved. This method only applies to fish and other taxa that are smaller than the eels targeted. A similar method is presently used by at least one operator in their commercial fishing practices, particularly in stock enhanced waters, to reduce the catch of smaller size class eels.
- b) Separator grid device: Similar to the bycatch exclusion grid, this device is an aluminium grid at the opening of a fyke net that excludes fish smaller than the eels. The device has a forward sloping grid and a passage underneath for eels to enter the next chamber. The smaller fish pass through the grid and down a passage at the top of the device where they can escape the netting. This design is very similar to the Nordmore-grid which follows a similar principle however is designed for the release of bycatch larger than the target species in prawn trawls.
- c) Rubber band device: A rubber band is stretched around the guiding funnel tight enough to close it off. Large eels can push past the obstruction but smaller fish cannot. Debris can stretch the rubber band opening up the guiding funnel allowing

more fish to enter, however the simplicity, cost and general effectiveness of the device makes it a worthwhile consideration.

Fyke net BRD's have to prevent bycatch both larger (depending on species and size of eel targeted) and smaller than eels; this suggests a need to increase the selectivity of the fyke nets.

The potential exists for significant quantities of bycatch in the glass eel fishing sector of the fishery to occur (Gooley *et al.* 1999; McKinnon *et al.* 2002). To minimise the mortality of bycatch species in the glass eel fishery, the draft BAP recommends that bycatch exclusion devices, such as the Nordmore grid, be included in glass eel nets, and that bycatch species be released without delay. The priority release of bycatch reduces strain on gear and potential damage to catch. In addition, to minimise sorting times it is recommended that aluminium sorting trays be installed onto boats to allow the quick release of bycatch. (McKinnon *et al.* 2001)) detail best practice methods for the sustainable harvest and early rearing of glass eels, including the efficient separation and release of bycatch.

2.1.4 An indicator group of bycatch species is monitored.

The precautionary approach in the management of the Victorian eel fishery is centred around bycatch avoidance. In particular, commercial eel fishing is not permitted in waters where known populations of estuary perch, Australian bass or platypuses exist. It is unlikely however, that independent monitoring of such indicator species as bycatch in the eel fishery will occur. However the provision for fishery dependent recording of bycatch will provide basic information on the diversity and abundance of bycatch in the eel fishery. Verification/monitoring of bycatch, and the accuracy of fishery dependent records, will be achieved through routine monitoring of fishing activities by DPI compliance officers. Such monitoring activities will be included in Service Agreements between Regional offices and Fisheries Victoria. Data collected and maintained in existing fisheries and wildlife databases (eg Dept. Sustainability & Environment and Dept Primary Industries) will also be used to assist with the validation of fishery dependent bycatch data (see 2.3.2 below). All data collected on the monitoring of indicator bycatch species will inform management decisions through analysis and discussion through the annual fishery review process.

2.1.5 There are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers.

A number of indicator species (see above) have been identified which may trigger a management response. Other species which may be included as indicator species include those listed under the Flora & Fauna Guarantee (FFG Act 1988) which may include: broad-finned galaxias (*Galaxias brevipinnis*), freshwater herring (*Potamalosa richmondia*), pouched lamprey (*Geotria australis*), pipefish and seahorses (*Syngnathid* species), and Tasmanian mudfish (*Galaxias cleaveri*). However it is unlikely that these species would be reliably recorded in fishery dependent data.

To address this guideline, a staged approach is proposed. Stage 1 is the establishment of a data collection system which, as described above, comprises the analysis of existing fisheries and wildlife databases, collation of fishery-dependent bycatch data, and bycatch data independently collected by Fisheries Victoria compliance officers on routine inspections of eel fishing activities. Included in the annual review of the Victorian eel fishery will be a

comprehensive review of all bycatch data. This will provide input into management decisions and provide the basis for Stage 2, risk assessment. The risk assessment is expected to lead to the identification of a number of indicator species for further monitoring in the fishery, and provide management with indications of potential vulnerability in the fishery. Decision rules will then be enacted and/or developed where necessary, to support management decisions resulting from the risk assessment.

Decision rules, which have been employed historically, include the partial or complete closure of any water to commercial eel fishing in which indicator species are recorded in significant numbers. Such decision rules may be enacted, subject to agreement by the fishery review panel, when indicator species were recorded in significant quantities. For example the death of a single platypus as a result of eel fishing, would require immediate reporting to the eel fishery review panel, and would trigger the immediate closure of that water. A review of the situation and/or risk assessment would then be undertaken by the eel fishery review panel to determine the immediate and long term future of eel fishing in the water in question.

2.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Fisheries Victoria is confident that the development of a staged approach to management of bycatch, as recommended in the EFMP and the BAP, and detailed in sections 2.1.3-2.1.5, will lead to clear and measurable management responses which have a high chance of achieving the objective.

Objective 2.

The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.

Information requirements

2.2.1 Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

Reliable information is available for the distribution of endangered, threatened or protected species and threatened ecological communities. The distribution of eel fishing activities is also known, and the level of interaction will be quantified as described in 2.1.1-2.1.5 by June 2004. No known threatened ecological communities have been identified upon which the Victorian eel fishery may impact. Where populations of threatened, endangered or protected species have been identified, such as those of platypuses, estuary perch and Australian bass, the respective waters have been closed to commercial eel fishing. Examples of such management response includes the closure of the Barham River in the Otway Coast Basin due to the presence of platypuses in the lower sections of the river, and closure of the Hopkins River (Hopkins Basin) to commercial eel fishing due to the presence of significant populations of estuary perch.

As of 2003, provision for reporting of bycatch, including threatened, endangered and protected species, will be made on commercial eel fishing logbooks. This data will be corroborated with random inspections of eel fishing activities, in particular the monitoring of

bycatch, by fisheries compliance officers as part of service agreements between Regional DPI offices and Fisheries Victoria.

Assessments

2.2.2 There is an assessment of the impact of the fishery on endangered, threatened or protected species.

The impact of the commercial eel fishery on endangered, threatened or protected communities is to be reviewed annually under the EFMP. This will be undertaken through combined reviews of bycatch reports from fishers, and random inspections of fishing operations by Fisheries Officers (a minimum of two inspections per year per licence holder). Such data will provide the basis for risk assessments to be conducted where required.

2.2.3 There is an assessment of the impact of the fishery on threatened ecological communities.

No known threatened ecological communities have been identified upon which the Victorian eel fishery may impact. However, assessment of ecological communities will be treated in the same manner and at the same time as endangered, threatened or protected species as described in 2.2.2 above.

Management responses

2.2.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

The key bycatch avoidance strategies and measures which apply equally to threatened, endangered and protected species are described in 2.1.3.

Site specific permit conditions are also used to reduce potential ecological impacts. For example, in Clydebank Morass and Heart Morass State Game Reserves, a 14 day period between clearing nets and reusing them in different waters is required. In addition all gear including nets and boats must be thoroughly cleaned prior to use in any other waters. These measures are in place to prevent the translocation of fauna and flora between wetlands.

Where threatened, endangered or protected species are recorded, a risk assessment will be undertaken by the eel fishery review panel to determine the immediate and long term future of eel fishing in the water or catchment in question. In the event of platypuses being impacted by the fishery, reporting of such would be required to be immediate, with subsequent immediate closure of the respective water pending further assessment and investigation by the eel fishery review panel.

The draft BAP recommends a bycatch reduction workshop be run for the Victorian eel fishing industry in June 2004. Such a workshop would be designed to showcase eel bycatch reduction devices and methods which are employed in eel fisheries within Australia and overseas. A key aim of the workshop would be to identify and, where necessary, develop or improve BRDs and associated methods to suit the Victorian eel fishery. Subsequent implementation and field evaluation by industry of recommended BRDs and associated methods would then be undertaken.

2.2.5 There are measures in place to avoid impact on threatened ecological communities.

N/A

2.2.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

No known threatened ecological communities have been identified upon which the Victorian eel fishery may impact. The Victorian eel fishery is managed in such a way as to avoid the impact on threatened, endangered or protected species, through a number of management responses as described above.

Fisheries Victoria believes the existing bycatch avoidance strategies, combined with the utilisation of random field observations of fishing activities by Fisheries Officers, will ensure that the eel fishery is conducted in a manner that avoids mortality, or injuries to endangered, threatened or protected species. In addition the management responses provide a mechanism under the EFMP to regulate significant bycatch problems through the closure of waters/reserves through the annual fishery review process.

Objective 3.

The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.

The precautionary approach to management of the Victorian eel fishery ensures that the fishery is conducted in a manner that minimises the impact of fishing operations on the ecosystem generally. The key management tools, as described above, include the closure of approximately 50% of major streams to commercial eel fishing, restricting commercial eel fishing to the lower estuarine sections in rivers, and restrictions on gear usage. The latter includes a caps on the number of nets able to be used at any one time, and restrictions on how nets are set to avoid saturation of any one area with nets, and to avoid significant obstruction to fish passage. The current blanket cap of 50 nets per licence may however, potentially lead to the risk of overfishing in any given water, particularly where more than one EFAL holder may operate. The 50 net cap per licence will be removed as an implementation target of the EFMP. In its place, the appropriate number of nets for each water or catchment fished commercially for eel will be determined through a consultation process involving key stakeholders, and will consider ecological issues relevant to the water in question. This process will further ensure that any impacts of the commercial eel fishery on ecosystem values will be minimised, while maintaining a viable fishery.

The only gear permitted for use in the commercial Victorian eel fishery are fyke nets which are fixed gear, not active, and consequently have minimal negative impact on the ecosystem generally.

Information requirements

2.3.1 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the fisheries impact on the ecosystem and environment generally.

In addition to potential general ecosystem impacts of the eel fishery, the common practice of translocation of eels as a function of stock enhancement may potentially impact on ecosystems through the anthropogenic enhancement of eel populations in natural waters. Draft guidelines for the translocation of eels into and within Victoria have been prepared (see attached for information), as recommended under the EFMP, and are being developed in line with the National Policy of Fisheries Bycatch and the Draft Victorian “Guidelines for Assessing Translocations of Live Aquatic Organisms in Victoria”.

Assessment

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

Fisheries independent data is routinely collected by the Arthur Rylah Institute (ARI, Parks, Flora & Fauna, Dept. Sustainability and Environment) and MAFRI (Snobs Creek) on the aquatic community composition of waterways. Data collection includes monitoring of threatened, endangered and protected species. The eel fishery is considered to have minimal impact on the ecosystem generally due to the precautionary approach to management. That is, restricting commercial eel fishery operations (50% of major rivers closed to eel fishing), and permitting eel fishing only in the lower estuarine reaches of those rivers open to eel fishing. In addition, restrictions on gear used, including cap on the number of nets to be used, spacing of gear and providing for fish passage by limiting gear placement. Where eel fishing is permitted in static waters such as wetlands and lakes, in general it is undertaken under an aquaculture licence where stock enhancement occurs, or special enforceable permit conditions apply (eg Wildlife Reserves).

1. Impacts on ecological communities

- Benthic communities: Passive gear only used in the fishery, thus potential impacts on benthic communities where fishing occurs is considered to be negligible. Negligible known impact.
- Ecologically related, associated or dependent species: Information is unreliable and incomplete, ecological impact is dependent on the biological communities present and the practices of the fisher. Using the precautionary approach impacts are less likely to be detrimental to the community as a whole.
- Water column communities: Negligible known impact.

2. Impacts on food chains

- Structure: Eels are large predatory and scavenger species. Removal of eels from the food chain may have small scale, temporary impacts on the structure of the food chain, but larger individuals removed from the fishery are quickly replaced, thus the potential for extinction of eels in individual waters is unlikely. Fishing for eels removes a top order predator (adults) and a high-density prey item (juveniles) for many other species. Bycatch depending on composition and quantity can cause an ecological imbalance in the food chain, however in the majority of situations the disturbance is expected to be temporary. Riverine based fishing tends to remove eels which would be removed from the fishery through migration.

3. Productivity/flows:

Ecosystem flows may be impacted over the short term through the removal of large predator/scavenger eels. Heavy fishing would result in a proportional drop in production, however the broad range and panmictic nature of the stock would make lasting effects rare. Stock enhanced fisheries are continually replenished through routine stocking of juveniles in balance with removals through the fishery.

4. Impacts on the physical environment

- Physical habitat: Some impacts on aquatic macrophytes, erosion of banks, and/or disturbance of the benthic environment, may occur through the use of small boats, however consideration for the surrounding environment by the fishers generally minimises any significant impact by fishers. Gear used is passive, set fyke nets. Active fishing (eg trawling) does not occur in the fishery, thus impacts on the physical habitat is minimal.
- Water quality: No known impacts, other than what may be expected through the use of small boats, outboard motors etc., considered minimal.

Positive impacts on the ecosystem include the mandatory removal by eel fishers, of introduced bycatch fish species including carp, roach and tench.

Management responses

2.3.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

The precautionary approach to management, as described above, limits commercial eel fishing activities to clearly defined reaches of a limited number of waters, using closely regulated gear which is passive and operated in such a way as to have minimum ecological impact. The draft BAP and draft translocation guidelines each address specific issues related to the eel fishery, and provide management measures to reduce and/or avoid damage to ecosystems by minimising impacts. Copies of these documents are appended for the information of the reader.

2.3.4 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

The precautionary approach has been adopted in management of the Victorian eel fishery, and operational aspects of the fishery are considered to have relatively little impact on the ecosystem. The main area of concern with the operation of the fishery is the bycatch of threatened, endangered or protected species, such as platypuses or estuary perch. Such impacts are managed through the avoidance of known populations of such species through closure of relevant waters to commercial eel fishing, and the immediate closure of waters if and when the eel fishery impacts on such populations. The increased surveillance of eel fishing activities by compliance staff as part of service agreements between Fisheries Victoria and regional offices, due to be implemented in 2003/04, will provide further opportunities for independent monitoring of the fishery. Any discernible impacts on the ecosystem through the operation of the eel fishery will be reported by compliance officers, and management actions

taken accordingly. It is expected that such a “common sense” approach to monitoring of the eel fishery is well suited to the precautionary approach to management of the fishery.

2.3.5 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective

The precautionary approach to management, as described above, limits commercial eel fishing activities to clearly defined reaches of a limited number of waters, using closely regulated gear which is passive and operated in such a way as to have minimum ecological impact. It is considered that the fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally, and that the management response will continue to achieve this objective.

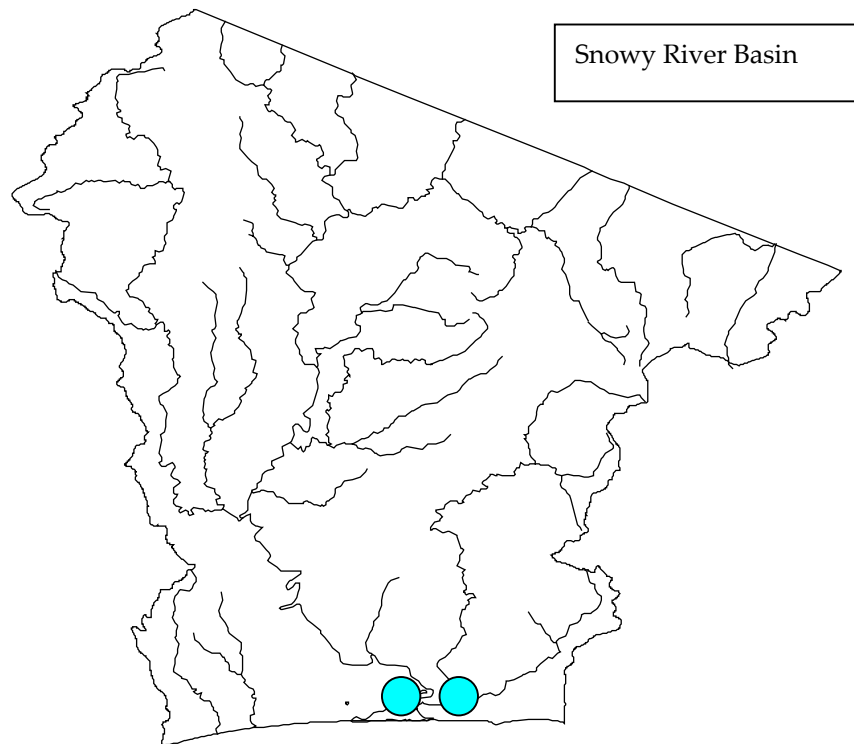
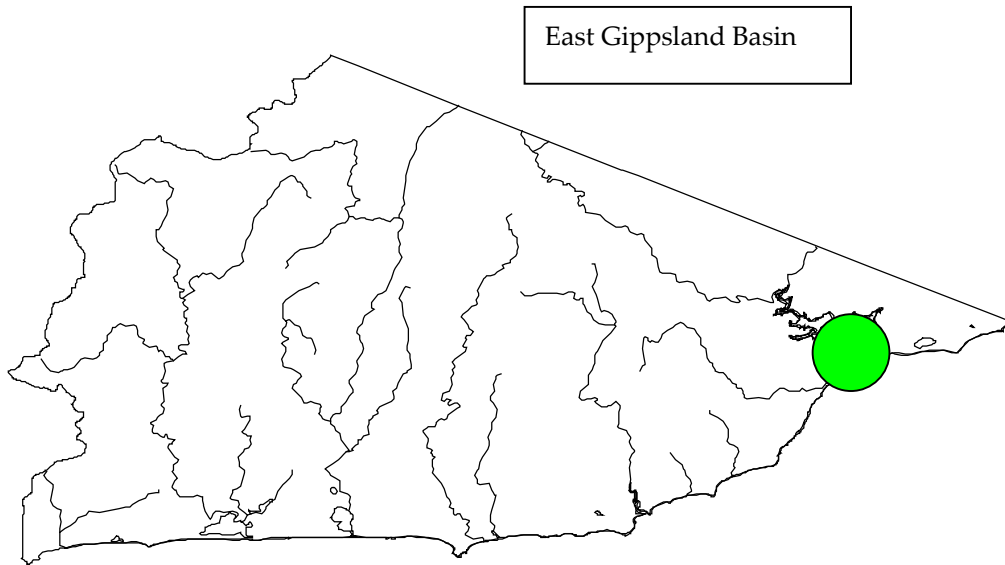
Acknowledgements

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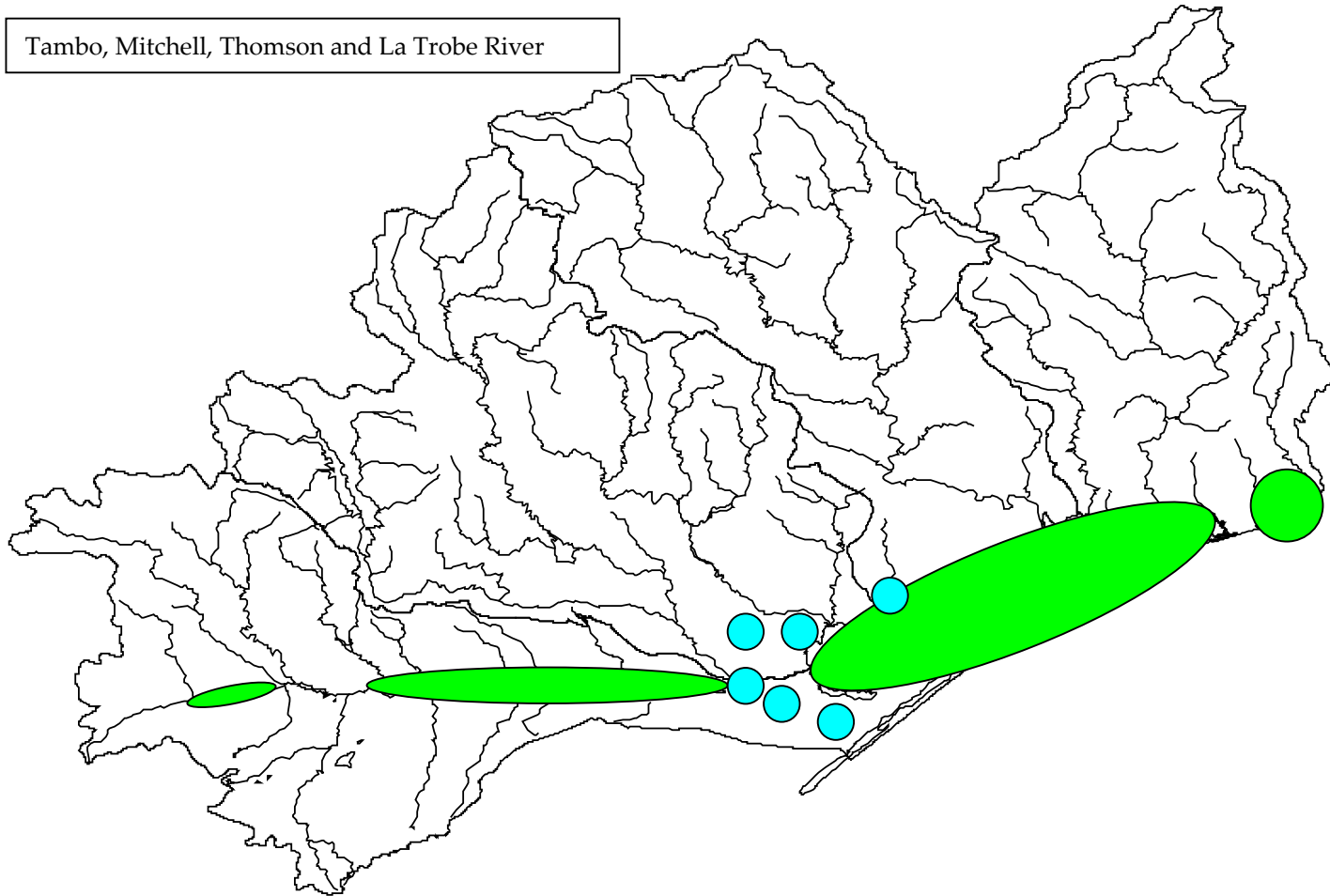
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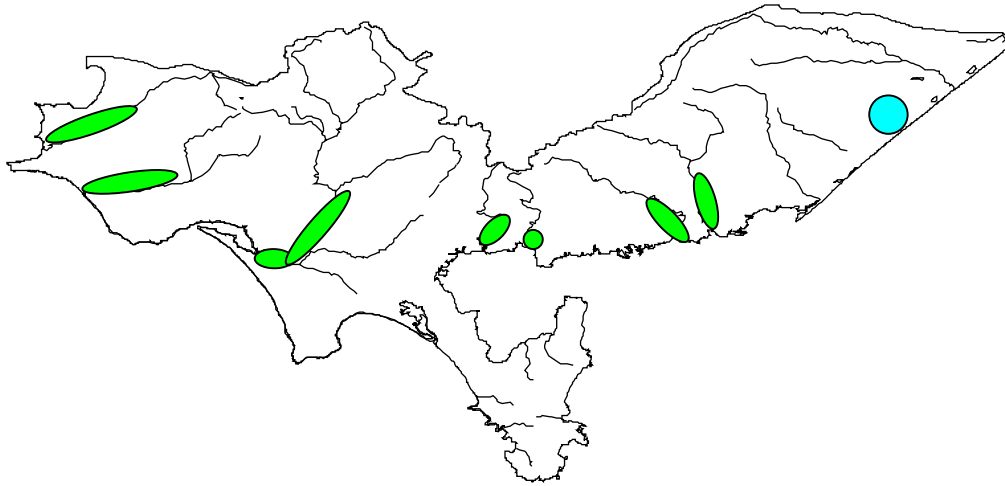
Appendix 1. AWRC Basins with allocated and stock enhanced waters indicated (green, allocated; red, stock enhanced; blue waters fished under permit).



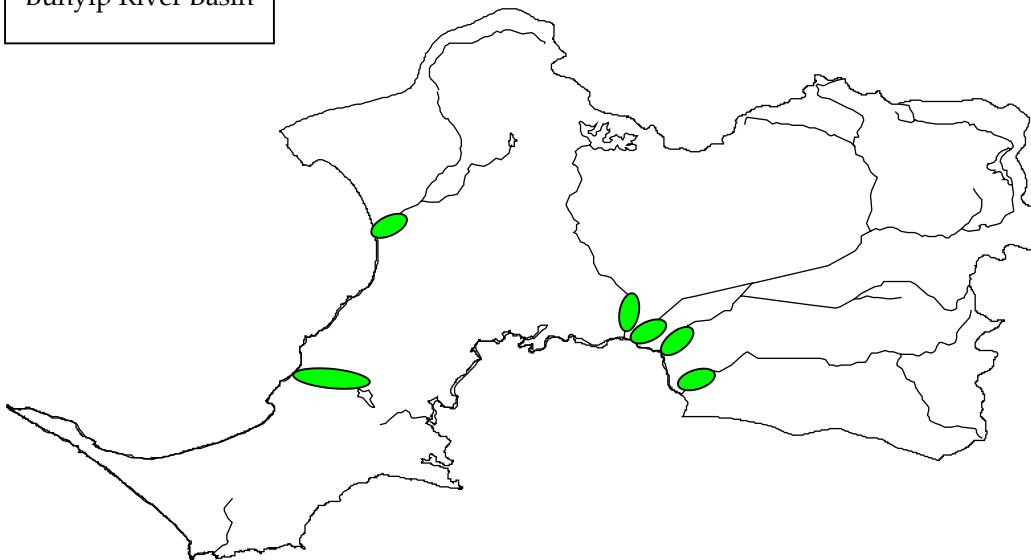
Tambo, Mitchell, Thomson and La Trobe River



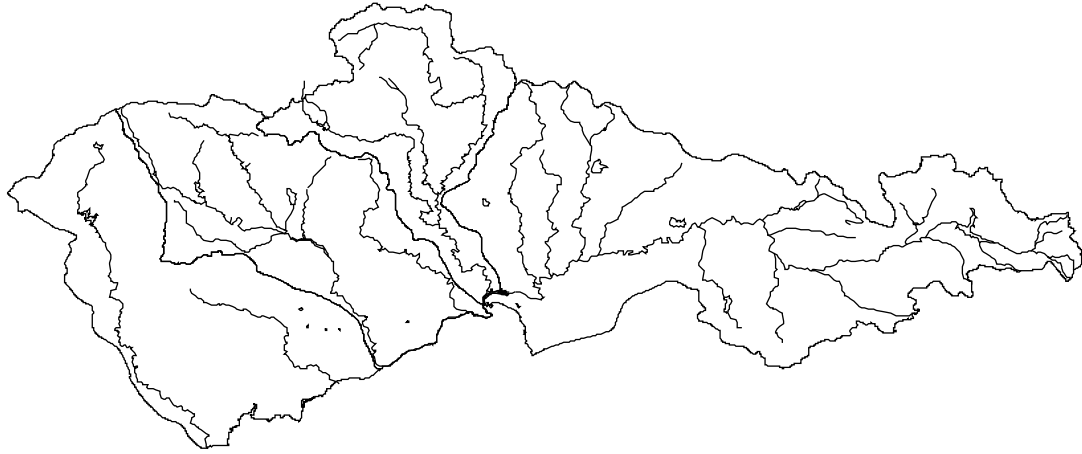
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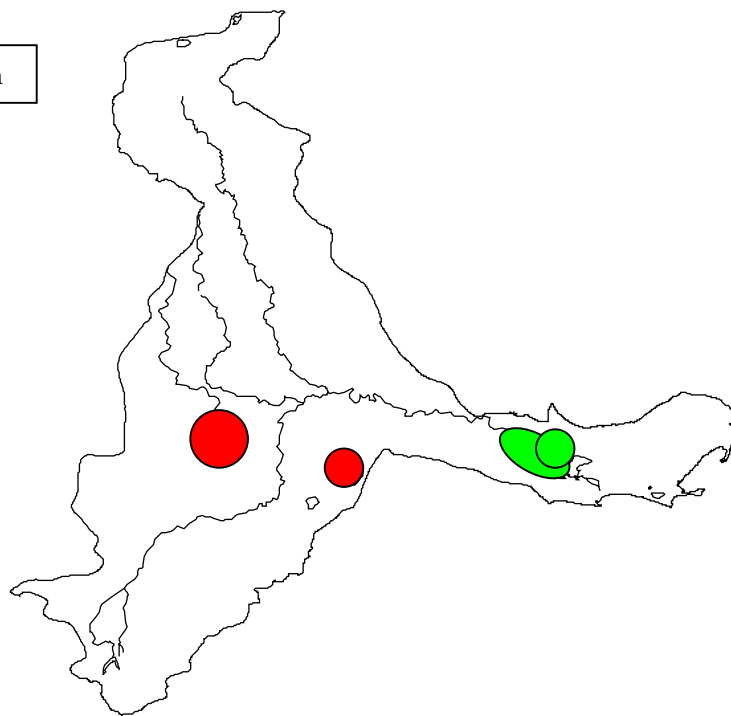
Bunyip River Basin



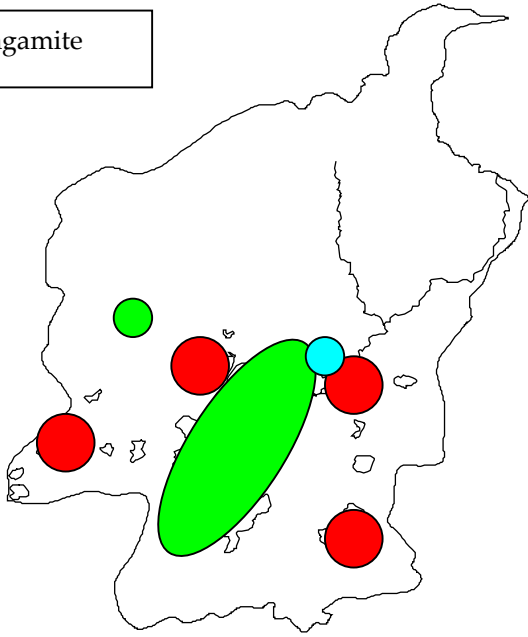
Yarra, Maribyrnong, Werribee and Moorabool Basins



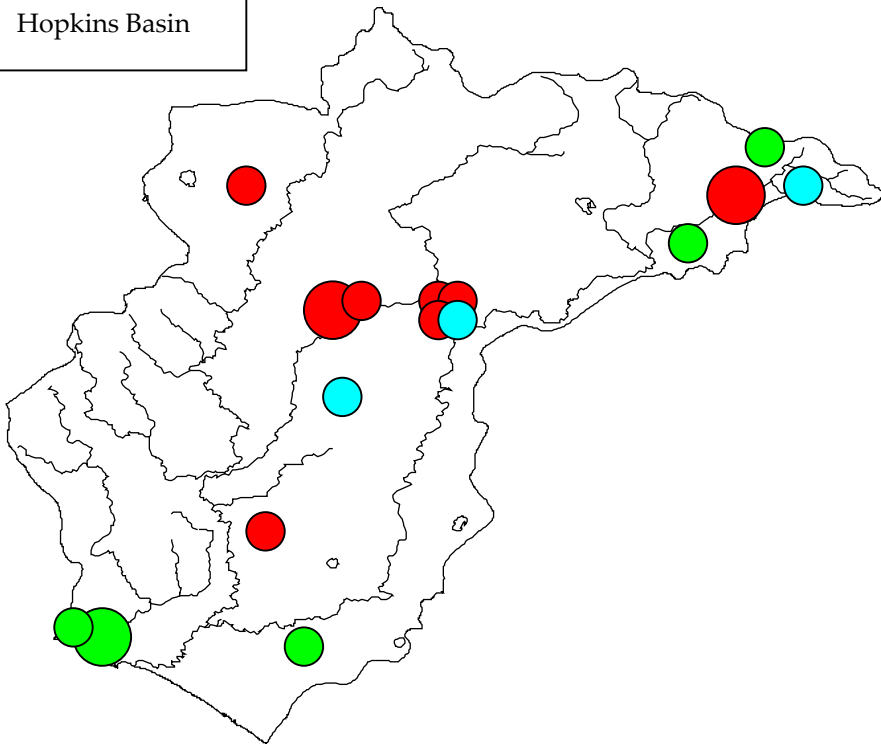
Barwon River Basin



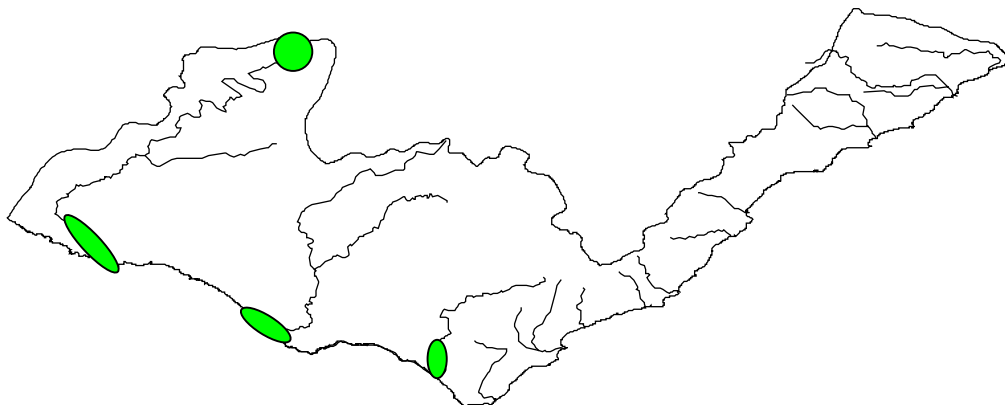
Lake Corangamite
Basin



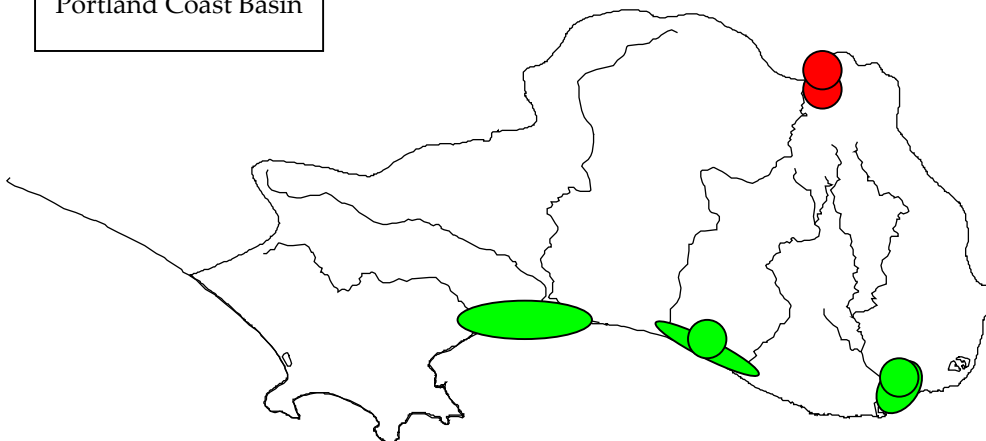
Hopkins Basin



Otway Coast Basin



Portland Coast Basin



Glenelg Basin

