



Australian Government

Department of the Environment and Heritage

Assessment of the
Queensland Eel Fishery

November 2004

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This document is an assessment carried out by the Department of the Environment and Heritage of a commercial fishery against the Australian Government Guidelines for the Ecologically Sustainable Management of Fisheries. It forms part of the advice provided to the Minister for the Environment and Heritage on the fishery in relation to decisions under Part 13A of the Environment Protection and Biodiversity Conservation Act 1999. The views expressed do not necessarily reflect those of the Minister for the Environment and Heritage or the Australian Government.

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Assessment of the ecological sustainability of management arrangements for the Queensland Eel Fishery

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EXECUTIVE SUMMARY

Background

The Queensland Department of Primary Industries and Fisheries (DPI&F) has submitted a document for assessment under Part 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The draft document *Ecological Assessment – Queensland Eel Fishery* (the submission) was received by the Department of the Environment and Heritage (DEH) in November 2002 after a period of discussion between DPI&F and DEH, during which preliminary drafts were refined. The submission was released for a thirty-day public comment period that expired on 23 December 2002. Six public comments were received and DPI&F provided a response to the issues raised. Some changes were made to the submission as a result of public comment. A final submission for assessment was received in February 2003.

The Queensland Eel Fishery (QEF) consists of two components: an adult eel fishery and a juvenile eel fishery. While assessed as a single fishery, this report discusses the components separately as necessary. Where no differentiation is made between the two components, the discussion applies to both. The submission reports on the QEF against the Australian Government *Guidelines for the Ecologically Sustainable Management of Fisheries*. The DEH assessment considers the submission and associated documents, public comments and DPI&F's response to the comments. Table 1 summaries the basic features of the two adult and juvenile components.

The area of the fishery includes inland waters within the Queensland East Coast Drainage Division. Restrictions are in place on the catchments and waterways in which fishing may be conducted. The adult component of the fishery allows fishing in all Queensland East Coast Drainage Division catchments with the exception of all coastal island catchments. Within this area, trapping of adult eels is only permitted in artificially created private impoundments in those catchments listed on an eel Authority and those public impoundments listed on an eel Authority (i.e. all natural waterways are closed to eel fishing). The juvenile component of the fishery allows fishing in river basins associated with 21 rivers along the East Coast of Queensland, which represent less than 10 % of Queensland river systems. Within these basins, juveniles may only be collected at, or downstream of, the most downstream dam or weir and up to 200 m either side of the mouth of the approved rivers.

The fishery targets anguillid eels - Long Fin Eels (*Anguilla reinhardtii*) and Short Fin Eels (*A. australis*) in both the adult and juvenile stages. These are the only species permitted to be retained in the fishery. The majority of the catch comprises Long Fin Eel due to its more extensive distribution in Queensland waters. The Short Fin Eel is favoured by aquaculturalists as it is similar to the species highly sought in the Japanese market.

Female Long Fin Eels are reported to grow to a length of up to 165 cm and over 22 kg in weight. In Queensland, the average length at metamorphosis and maturity is 93 cm and 56 cm for females and males, respectively. Short Fin Eels reach a length of 110 cm (females) and a maximum weight of 6.8 kg. Female maturity occurs at around 55 cm and males at below the legal size of 30 cm.

Female Long Fin Eels occur further upstream in catchments than males. Males tend to inhabit estuarine areas, and as such are not caught as frequently as females. There is thought to be little migration of adult eels between catchments.

Table 1: Summary of the Queensland Eel Fishery

Area	Restricted to a small number of waterways in Queensland, adult eel trapping is excluded from all natural waterways, weirs and barrages, and some impoundments. Juvenile eel harvest restricted to a limited number of rivers.
Fishery status	Unknown
Target species	Long Fin Eel (<i>Anguilla reinhardtii</i>); Short Fin Eel (<i>A. australis</i>)
By-product species	None permitted
Gear	Eel traps, fyke nets, dip nets and flow traps. Restrictions differ between juvenile and adult eel components.
Season	No defined season
Commercial harvest 2003	Adult eels – 42.641 tonnes; Juvenile eels – 0.21 tonnes
Commercial harvest value 2003	Data not available
Recreational harvest	Low level harvest by recreational sector
Commercial licences issued	<ul style="list-style-type: none"> ▪ 38 adult eel trapping Authorities ▪ 34 Aquaculture licenses and 11 Culture Stock Collection Permits but only 3 permits were active in 2003 of 11 (note: to be changed to 20 transferable juvenile fishing authorities in 2005)
Management arrangements	<p><u>Adult eels</u> - Input controlled through: limited entry; permanent closures (including all natural waters); and gear restrictions.</p> <p><u>Juvenile eels</u> - Currently controlled through: quota linked to aquaculture facility capacity; permits; prohibition of fishing in some structures (e.g. weirs); and gear restrictions.</p> <p>Changing in 2005 to input controlled through limited entry, gear type and number restrictions and permanent spatial closures.</p>
Export	Major markets for live adult eels in Hong Kong and Taiwan. Small percentage of adult frozen eels exported to Europe.
Bycatch	Various but minimal
Interaction with threatened species	No known significant interactions. Some interactions with freshwater turtles, fish species and waterbirds.

The Long Fin Eel is distributed along the east Queensland coastline and found throughout the eastern states of Australia. The abundance of Long Fin Eel is greatest in Queensland and New South Wales. The Short Fin Eel is at its northern distribution limit in southern Queensland with only small numbers found in coastal streams south of the Pine River, near Brisbane. The species is more abundant in southern Australian states such as New South Wales, Victoria and South Australia. These species are also commercially harvested in Tasmania, New South Wales and Victoria.

It is believed that the Australian populations of both species exhibit panmixia, the random mating within a breeding population, and that recruitment to catchments is random. In Australian populations of anguillid eels, spawning individuals migrate to a single site for reproduction and comprise a single, randomly mating population. Adults are believed to migrate to the Coral Sea to spawn although the exact location is unknown. The larval stage of eels lasts for 12-18 months. Larvae are carried to near shore waters via the East Australian Current where they transform into glass (unpigmented) eels. Glass

eels move into estuaries and migrate upstream and grow and develop through the elver (pigmented) stage into immature adult eels. Spawning occurs only once, at which point the eel migrates to the spawning grounds, spawns and dies.

Adult eel commercial trapping has been conducted in Queensland waters since 1985 when the first commercial eel trapping Authorities were issued for artificially impounded freshwater and certain rivers in south-east Queensland. Wild stocks remained relatively un-exploited until commercial harvesting was allowed as a predator control measure as part of the Recreational Fishing Enhancement Program initiated by DPI&F in 1986. Trapping was later restricted to impounded waters due to declining catches, loss of gear and conflict with existing estuarine fisheries, and to minimise capture of non-target species. Over time, further restrictions on the waterways that may be fished and gear restrictions were introduced. The adult eel component of the fishery is now closed to new operators and fishing in natural waterways is prohibited.

Glass eels and elvers are reared under culture conditions to a marketable size by aquaculturalists. Queensland entered the market in around 1995 when the traditional suppliers of eels to the Asian market experienced difficulties in meeting market demands. The first licence for experimental eel aquaculture was issued in 1988. By 1996, 11 aquaculture farmers were licensed to grow eels and five farms had eel stocks. Today, this component of the fishery operates under permits, has a culture stock collection quota and restrictions on where stock may be collected. A new juvenile eel harvesting management policy is under development and will implement new measures to better consider impacts of the fishery on the environment and sustainability of the resource. The new policy is expected to be implemented in 2005.

The majority of Queensland's wild caught adult eel catch is exported live to Asia, principally Hong Kong and Taiwan. The market for live, Long Fin Eels is based on eels weighing more than 400 grams with large eels attracting premium prices. A small percentage of adult eels are sold frozen to European markets. There is a limited domestic market where eels are sold live, fresh or smoked. The Australian catch is believed to be less than 1% of world catch, with less than 5% of Australia's catch coming from the Queensland fishery.

The fishery targets adult eels using baited eel traps. Adult eel traps are set on the bottom of the impoundment and consist of a single entry mesh funnel and a floated cod-end to hold the captured eels and ensure that captured eels are not over stressed and that air breathing non-target species may access the water surface to breath. The juvenile fishery utilises a number of different gear types, including fyke nets, dip nets and flow traps. Juvenile traps must contain bycatch reduction devices to minimise impacts on non-target species.

The fishery management regime differs between the adult and juvenile components of the QEF. The adult wild caught eel component of the fishery is managed under the *Fisheries (Freshwater) Management Plan 1999*, which obtains its authority from the *Queensland Fisheries Act 1994*. Fishing activity in this component of the fishery is also controlled by the *Fisheries Regulations 1995*. In addition, polices implemented by other agencies, for example SunWater (a government owned corporation that owns and manages most dams in Queensland), the South East Queensland Water Corporation, the Gladstone Area Water Board and local Shire Councils, control the approval of the harvest of adult eels from nominated public waters.

The adult component is managed as a closed fishery with its primary management tool being the spatial closure of all natural waterways to adult eel trapping. There are also restrictions on gear type and design and a minimum size limit. No new Authorities are to be issued and existing Authorities are not transferable. In 2003, there were 38 adult eel Authorities.

The collection and grow out of juvenile eels is currently controlled through conditions stipulated on Culture Stock Collection Permits and Aquaculture Licences under the *Fisheries Act 1994*. A draft policy document – ‘Juvenile Eel Collection for Aquaculture’ (DPI&F, 2004) has recently been developed to direct future management of the juvenile eel component of the QEF.

The juvenile fishery is managed primarily through gear restrictions and a restriction on the waters that may be fished. Licences must be obtained to operate in the juvenile fishery however there appears to be no restriction on the number that may be issued. In 2002, there were 34 Aquaculture Licences issued for eel aquaculture, 11 of these licence holders have Culture Stock Collection Permits for the harvest of juvenile eels. Of these 11, only three fishers recorded catches in 2001, highlighting a large amount of latent effort in the fishery. The new policy will change the management regime from an output controlled quota based system linked to the capacity of aquaculture facilities to an input controlled fishery. Collection will be controlled by this policy under transferable authorities rather than the general fisheries permits currently used. It is expected that this policy will come into effect in 2005.

There have been no specific studies undertaken to document and quantify the bycatch taken in the adult or juvenile components of the fishery, however a qualitative risk analysis of potential impacts on bycatch species was recently conducted for the juvenile eel component of the fishery. The amount of bycatch in both components of the fishery is considered minimal due to the small scale of the fishery, area closures, fishing methods and gear used. These interactions are assessed under Principle Two of this report.

There appear to be no significant interactions with protected species, although numerous protected species occur in the fishery area. These include Platypus, the Fitzroy River Tortoise, the Mary River Tortoise, Lungfish and Mary River Cod. The Mary River Tortoise and Mary River Cod are listed as endangered under the EPBC Act and the Lungfish has been listed as Vulnerable. The tortoise species, Platypus and Lungfish are also protected under Queensland legislation. Numerous protected waterbirds are also found in the areas open to fishing. While no specific studies have been conducted on the fishery’s interaction with protected species, the fishing method and gears used are expected to pose minimal risk to these species and anecdotal evidence suggests that interactions are rare. These interactions are assessed under Principle Two of this report.

There is limited take of eels by the recreational and indigenous sectors. The Queensland Recreational Fishing Information System diary surveys during 1997 and 1999 revealed less than 1000 eels are harvested recreationally annually in Queensland. Estimates of indigenous harvest indicate that freshwater eels account for 0.05% of the total number of organisms harvested by indigenous fishers. Confirmation of this estimate was obtained from the National Recreational and Indigenous Fishing Survey (NRIFS). The NRIFS estimated that eels account for 0.03% of the total number of organisms harvested by indigenous sector.

Overall assessment

The material submitted by DPI&F indicates that the fishery operates in accordance with the Australian Government *Guidelines for the ecologically sustainable management of fisheries*. DEH considers that the QEF is a well managed fishery that is unlikely to have an unacceptable or unsustainable impact on the environment in the short to mid term. Recommendations have been developed to ensure that the risk of impact is minimised in the longer term. Overall, the management regime, which relies heavily on the closure of natural waters to adult eel trapping, the selective nature of the fishing gear and measures to reduce capture and increase survivability of bycatch, suggests that the fishery is being managed in an ecologically sustainable way.

Eel fisheries differ markedly from most other fisheries in Australia. The catadromous and presumed panmictic nature of the species raises a number of issues and difficulties regarding the management of

fisheries that exploit eel stocks. Specifically, standard stock assessment is not possible, determining spawning biomass is difficult and the stocks are significantly affected by environmental conditions and exposed to pressures from catchment disturbance and modification. These challenges mean that highly precautionary management arrangements are required to ensure that stocks are not overfished and fishing is conducted in an ecologically sustainable manner.

In making its assessment, DEH considers that the management regime applies appropriate levels of precaution sufficient to ensure the fishery is conducted in a manner that does not lead to over-fishing and that stocks are not currently overfished. Considering the research programs and management arrangements in place, DEH considers that fishing operations are managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

The assessment finds that the fishery is managed in an ecologically sustainable way and its operation is consistent with the objects of Part 13A of the EPBC Act. DEH recommends that the export of species taken in the fishery should be exempt from the export requirements of Part 13A of the EPBC Act, with that exemption to be reviewed in 5 years. DEH considers that the fishery, as managed in accordance with the management regime is not likely to cause serious or irreversible ecological damage over this period.

To further strengthen the effectiveness of the management arrangements for the QEF, and to contain the environmental risks in the medium to long term, DEH has developed a series of recommendations. The implementation of these recommendations and other commitments made by DPI&F in the submission will be monitored and reviewed as part of the next DEH review of the fishery in five years time.

Recommendations

1. DPI&F to inform DEH of any intended amendments to the management arrangements that may affect sustainability of the target species or negatively impact on bycatch, protected species or the ecosystem.
2. By the end of 2006, DPI&F to revise fishery specific objectives for the adult and juvenile eel fisheries to ensure that they specifically recognise the need to manage impacts on bycatch, protected species and the ecosystem. DPI&F to also develop performance indicators and performance measures for target, bycatch, protected species and impacts on the ecosystem.
3. DPI&F to monitor the status of the adult and juvenile fisheries in relation to the performance measures once developed. Within 3 months of becoming aware of a performance measure not being met, DPI&F to finalise a clear timetable for the implementation of appropriate management responses.
4. DPI&F to conduct a risk assessment of compliance and enforcement activities in the adult and juvenile eel fisheries. Outcomes of the risk assessment will be used to develop a compliance and enforcement strategy for the fisheries, including a timetable for the implementation of key components of the strategy.
5. From 2005, DPI&F to report publicly on the status of the fishery on an annual basis, including explicit reporting against each performance measure once developed.
6. DPI&F to undertake fishery independent monitoring of representative unimpounded rivers on an annual basis to enable trends in adult eel abundance indicative of any declining recruitment to be identified.
7. DPI&F to develop and implement sustainability indices for eel stocks within 3 years, to ensure some assessment of the proportion of adult eels that can be sustainably harvested is conducted

on an annual basis. The annual assessment of the adult eel resource will incorporate assessment of the impacts of environmental variability, where possible.

8. In the event that the current genetic study on Long Fin Eels reveals that eel stocks harvested in the fishery are not panmictic, DPI&F will investigate alternative management arrangements with a view to implementing management measures that ensure that catchment fidelity is adequately taken into account. A program for the collection of fishery dependent and independent data to inform management will also be investigated.
9. DPI&F to conduct a cost-benefit analysis on methods to facilitate juvenile eel recruitment upstream past waterway barriers. If an appropriate mechanism is identified, DPI&F to implement the mechanism and/or encourage relevant authorities to put in place measures to facilitate ongoing juvenile eel recruitment past waterway barriers.
10. Within three years, DPI&F to undertake a risk analysis of the bycatch species, including protected species, taken in the fishery to identify those species vulnerable to fishing. Management measures to mitigate threats to any species found to be at high risk from fishing operations should be developed and implemented in a timely manner.
11. DPI&F to implement the Species of Conservation Interest logbook in the adult and juvenile eel fisheries within 12 months to enable ongoing recording and monitoring of protected species interactions.

PART I - MANAGEMENT ARRANGEMENTS

The Queensland Eel Fishery (QEF) consists of two components: an adult eel component and a juvenile eel component. Commercial eel trappers collect adult eels from impounded waters and Culture Stock Collection Permit holders collect juvenile eels from rivers to supply seed stock for grow out in aquaculture facilities. The two components harvest eels at different life stages, utilise different gear types and require different Authorities/Permits. The two components target the same stock and are managed as a single fishery with separate management arrangements, however, for the purposes of clarity, this report separates them as necessary. Where no differentiation is made between the two components, the discussion applies to both.

The QEF is managed by the Queensland Department of Primary Industries and Fisheries (DPI&F). The management regime is described in a range of documents that are, or will be publicly available. Both components of the fishery are subject to the provisions of the *Queensland Fisheries Act 1994*, the *Fisheries Regulations 1995* and relevant Gazetted notices and licence conditions. A number of other documents, including research reports, scientific literature and discussion papers are integral to the management of the fishery. The adult component is explicitly managed under the Fisheries (Freshwater) Management Plan 1999. The juvenile component is currently managed under Culture Stock Collection Permits (juvenile fishery) and Aquaculture licences, however this may change under the newly drafted policy document 'Juvenile Eel Collection for Aquaculture', which is designed to guide future management of this component of the QEF.

DEH considers it important that management arrangements remain flexible to ensure timely and appropriate managerial decisions. Due to the importance of the management plan and documents referred to above to DEH's assessment of the fishery, an amendment could change the outcomes of the assessment and decisions stemming from it. Export decisions relate to the arrangements in force at the time of the decision. In order to ensure that these decisions remain valid, DEH needs to be advised of any changes that are made to the management regime and make an assessment that the new arrangements are equivalent or better, in terms of ecological sustainability, than those in place at the time of the original decision.

Recommendation 1: *DPI&F to inform DEH of any intended amendments to the management arrangements that may affect sustainability of the target species or negatively impact on bycatch, protected species or the ecosystem.*

Management of the QEF incorporates a sound range of consultative mechanisms and a clear commitment to effective consultation with a variety of stakeholders. DEH considers the level of consultation to be adequate and is confident that DPI&F will continue to ensure interested parties are consulted appropriately.

The primary consultative mechanism is the Freshwater Fisheries Management Advisory Committee (FMAC). FMAC meets regularly to discuss issues relating to the management of the fishery. The Committee provides advice and recommendations to DPI&F on appropriate management arrangements for freshwater fisheries in Queensland. The Committee includes representatives with a range of expertise, including representatives from DPI&F, the Queensland Department of Natural Resources and Mines, the Queensland Environment Protection Agency, commercial fishers, industry associations, conservation groups, scientists, recreational fishers, fishing tour operators, aquarium fish hobbyists, fish hatchery operators, indigenous groups and other relevant Queensland agencies.

The management arrangements for the adult eel fishery were developed through a formal and statutory public consultation process that involved the FMAC, public comment on a discussion paper, a

Regulatory Impact Statement and a draft management plan. DPI&F has advised that the new policy document for the juvenile eel component of the fishery will be widely circulated and specific input from stakeholders will be sought.

DPI&F is also engaged in cross-jurisdictional consultation through the Australian and New Zealand Eel Reference Group (ANZERG). ANZERG has met sporadically in recent times to discuss matters relating to eel fishing around the region. Representatives from each of the states that have eel fisheries attend the meetings. Tasmania, Victoria, Queensland and New South Wales are represented along with scientific researchers. DEH strongly encourages the effective use of ANZERG through regular and effective meetings to ensure that cross-jurisdictional issues relating to eel harvesting are appropriately managed.

The adult eel component management plan contains clear objectives for the management of the QEF. The management plan also identifies how these objectives will be achieved and measured.

Specifically, the objectives include:

- ensuring that fishing is conducted in a way that ensures the sustainability and maintains or improves the conservation status of freshwater fish covered by the plan; and
- minimising the risk of damage to freshwater fish and their dependent ecosystems from nonindigenous and noxious fisheries resources.

The draft policy document *Juvenile Eel Collection for Aquaculture* specifies an overall management objective for the juvenile component of the fishery as ‘To ensure that eel resources within Queensland are managed within an ecologically sustainable framework.’

DEH believes the objectives, the performance criteria and measures, for both the adult and juvenile components of the QEF, could be strengthened to better take into account the principles of ecologically sustainable fisheries management and move towards a more ecosystem based approach to management. DEH believes that the existing objectives are insufficient to ensure that impacts on bycatch, protected species and the ecosystem are taken into account in managing the fisheries. Specific acknowledgement of the need to manage these components is required. In addition, with the exception of a performance measure for the juvenile fishery (i.e. the catch trigger for target species) there are no performance indicators and measures for target species in the adult fishery, nor are there indicators and measures specified for bycatch, protected species and ecosystem interactions.

Recommendation 2: *By the end of 2006, DPI&F to revise fishery specific objectives for the adult and juvenile eel fisheries to ensure that they specifically recognise the need to manage impacts on bycatch, protected species and the ecosystem. DPI&F to also develop performance indicators and performance measures for target, bycatch, protected species and impacts on the ecosystem.*

Performance indicators and measures, once developed, should be capable of detecting and responding to changes in the fishery. This requires ongoing monitoring of the fishery against such performance measures and a clear process for responding to breaches of performance measures.

Recommendation 3: *DPI&F to monitor the status of the adult and juvenile fisheries in relation to the performance measures once developed. Within 3 months of becoming aware of a performance measure not being met, DPI&F to finalise a clear timetable for the implementation of appropriate management responses.*

Management of the fishery is based primarily on input controls. The management arrangements are discussed in greater detail in Part II of this report. Table 2 below summarises the management arrangements currently in place in the adult and juvenile components of the fishery.

Table 2: Management arrangements for the adult eel and juvenile eel components of the Queensland Eel Fishery

Adult	Juvenile
<ul style="list-style-type: none"> ▪ Limited entry - Fishery closed to new applicants and licenses non-transferable; ▪ Gear type and design restrictions; ▪ Limited number of traps per Authority; ▪ Restrictions on waters open to trapping; ▪ Minimum mesh sizes for traps; ▪ Minimum size limit of 30cm; ▪ Temporal and spatial restrictions; ▪ Traps must be checked daily; and ▪ Bycatch reduction devices. 	<ul style="list-style-type: none"> ▪ Quota related to the capacity of the associated aquaculture facility; ▪ Gear type and design restrictions; ▪ Bycatch reduction devices; and ▪ Spatial restrictions on fishing areas. <p data-bbox="754 483 1316 631">Note: new arrangements to be introduced in 2005, including limited entry (20 authority holders), catch trigger point, gear type and number restrictions and permanent spatial closures. Quota system to be removed.</p>

Compliance and enforcement of critical aspects of the management of the adult and juvenile components of the fishery are the responsibility of the Queensland Boating and Fisheries Patrol (QBFP). Authority holders (commercial adult eel trappers) are required to notify the QBFP at least 24 hours before the commencement, and within 24 hours of completion, of trapping activities. This requirement does not apply to private waters (e.g. farm dams) or waters to which the public does not have access.

Holders of Culture Stock Collection Permits (juvenile eel collectors) must contact the QBFP prior to each collection trip and inform the QBFP of the date, time and place of each collection and the name of each person authorised to supervise and assist with each collection activity. These arrangements are expected to continue under the new management policy for juvenile eel collection.

The QBFP conducts field inspections of adult eel collection Authority holder's activities and aquaculture facilities. The submission states that inspections in the adult eel fishery have declined over recent years due to restrictions on fishing in public waters but that few complaints are received in relation to the activity of adult eel trappers. Under the new management regime for the juvenile eel component of the fishery, the QBFP will randomly audit operators in the juvenile eel component of the fishery to ascertain their compliance with licence conditions and fisheries regulations.

Compliance is also required with all conditions on Authorities and Aquaculture licences issued to fishers. In particular, compliance with catch return sheets is monitored. If catch returns are not provided after a reminder letter is sent, or if other breaches of conditions are detected, an Authority or licence holder may be asked to show cause as to why they should be allowed to remain in the fishery. If sufficient reason cannot be provided, re-issuing of the Authority or licence may be refused. The submission states that compliance in this area is high due to the risk that Authorities and licences may not be re-issued.

DEH considers the ability to enforce critical aspects of the fishery management regime to be an important component of effective management. Given the small scale of the fishery, existing mechanisms provide a good basis for ongoing compliance and enforcement work in the fishery. However, the extent of compliance activities undertaken in the fishery could be improved, in particular, to ensure that fishing activity across the fishery is monitored. A risk assessment of compliance and enforcement activities in the adult and juvenile fisheries is required and the outcomes of the risk assessment should be used to develop and implement a compliance program across the entire fishery.

Recommendation 4: *DPI&F to conduct a risk assessment of compliance and enforcement activities in the adult and juvenile eel fisheries. Outcomes of the risk assessment will be used to develop a compliance and enforcement strategy for the fisheries, including a timetable for the implementation of key components of the strategy.*

The entire management plan must be reviewed after five years but before nine years have lapsed. Aspects of the management plan may be reviewed at any time if considered appropriate. A review of some aspects of the plan, including bag limits, size limits, closed seasons and closed waters was recently undertaken. There are no annual review of stocks or stock assessments conducted in the fishery. Stock assessment is discussed in detail in Part II of this report.

The performance of the fishery is not subject to regular and public review. The fishery is the subject of regular 'Condition and Trend' reports and biennial reports on the outcomes of the Long Term Monitoring Program. DEH notes that while the Condition and Trend Reports provide valuable information about the status of fish resources under Queensland management, public reporting of performance on a fishery-by-fishery basis would enhance transparency and public accountability. It is also unclear if the existing reporting framework is intended to be ongoing. DEH suggests that for each fishery, including the eel fishery, DPI&F publicly report against each fishery performance measure on an annual basis (note that a requirement for the development of performance measures for the fishery is expressed in **Recommendation 2**).

Recommendation 5: *From 2005, DPI&F to report publicly on the status of the fishery on an annual basis, including explicit reporting against each performance measure once developed.*

Fishery dependent data relating to eel harvest is collected on a regular basis in the fishery. Some fishery independent information is also collected. Discussion of the information collection system for both the adult eel and juvenile eel components of the fishery can be found in Part II of this report.

Eel stocks and the proportion of stocks that can be sustainably harvested are not assessed in this fishery. The inherent difficulties in eel stock assessment and uncertainties surrounding population dynamics have meant that management must rely on other precautionary measures to ensure overfishing does not take place. This issue is discussed in greater detail in Part II of this report.

An analysis of the fishery's capacity for assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider ecosystem in which the target species lives and the fishery operates is contained under Principle Two of this report.

With the exception of the National Policy on Fisheries Bycatch, there are no relevant threat abatement plans, recovery plans or policies relating to bycatch or protected species interaction in this fishery. The submission is silent on how the management arrangements require compliance with the National Policy on Fisheries Bycatch. DEH expects that DPI&F will ensure compliance with any future plans or policies as they are developed.

Some international regimes are applicable to fisheries management but do not explicitly involve this fishery, for example the 1992 Convention on Biological Diversity and the 1995 Jakarta Mandate requiring that, in relation to the sustainable use of marine and coastal biological diversity, the precautionary principle should apply in efforts to address threats to biodiversity. While these agreements are not specifically addressed in the submission, the fishery's compliance with their requirements can be assessed by examination of Part II of this report.

The submission describes how the QEF is guided by ANZERG. ANZERG is the appropriate body to ensure the conservation and management of eels as 'straddling stocks' in the South Pacific region in accordance with the United Nations Agreement for the "Implementation of the Provisions of the

United Nations Convention on the Law of the Sea (UNCLOS) of December 10, 1982, Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks”. 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. DEH is satisfied that while ANZERG is functional, its role and terms of reference are relevant to ensuring a sustainably managed eel fishing regime throughout the region. However, if ANZERG is unable to achieve its Terms of Reference, DEH suggests that DPI&F continue to cooperate with other relevant jurisdictions to pursue complementary management and research of shared stocks.

DEH considers it is incumbent on all authorities to develop a thorough understanding of the framework of national, regional and international agreements and their applicability to export-based fisheries for which they are responsible.

Conclusion

DEH considers that the QEF management regime is documented, publicly available and transparent, and is developed through a consultative process. The implementation of **Recommendation 2** will ensure that the management arrangements are adaptable and underpinned by appropriate objectives and performance criteria by which the effectiveness of the management arrangements can be measured, enforced and reviewed.

The management arrangements are capable of controlling the harvest through a combination of input and output controls appropriate to the size of the fishery. Periodic review of the fishery is provided for, as are the means of enforcing critical aspects of the management arrangements.

The management regime takes into account arrangements in other jurisdictions, and adheres to arrangements established under Australian laws and international agreements.

DEH considers that there is scope to further refine the management arrangements and has provided a number of recommendations for improvements in the longer term.

PART II – GUIDELINES FOR THE ECOLOGICALLY SUSTAINABLE MANAGEMENT OF FISHERIES

Stock Status and Recovery

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’*

Maintain ecologically viable stocks

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

Fishery dependent data to inform management of the adult eel component of the fishery is sourced from compulsory adult eel trapping and catch returns. Separate sheets are completed and returned monthly for each area of water trapped. Catch return sheets provide information on the waterway fished, total number of trap checks (whether eels have been captured or not), date transferred to buyer, weight transferred to buyer and the details of the buyer. This system provides a paper trail from the catcher to the buyer, validating catch returns.

The adult eel component of the fishery also collects fishery independent data. A research project on adult eels is underway through the DPI&F Animal Science Business Group, in conjunction with the Fisheries Research and Development Corporation (FRDC). The aim is to determine demographic factors important for management modelling of the long fin eel fishery in Queensland and throughout Australia. It also aims to develop a system to determine a sustainability indicator for long term monitoring and an index of abundance of long fin eels that can be used in the management of the resource in Queensland and New South Wales with possible extension to the Victorian eel fishery. The project is also conducting some mark-recapture experiments in sections of impoundments, streams and rivers to attempt to estimate eel population density. The preliminary results and implications of this study are discussed later in this Objective.

Further fishery independent data on adult eels is collected through the DPI&F Long-Term Monitoring Program (LTMP), however these survey are not conducted in impoundments, nor are the surveyed areas necessarily representative of unimpounded systems. Fishery independent monitoring of freshwater fish, including eels, using boat-based electrofishing is carried out annually through the LTMP. The LTMP aims to monitor population changes of key recreational and commercial species by monitoring catch per unit effort (CPUE) and age and size structure. It also aims to monitor changes in species diversity, water quality and habitat conditions. A total of ten freshwater river systems throughout Queensland are surveyed annually. Six of these occur in the east coast drainage division where eels are found.

DEH considers the mix of independent and dependent information collected in the adult eel component of the fishery reasonable. The fishery dependent information collected appears relatively robust and should provide a reasonable record of fishing activity. Given the problems associated with monitoring CPUE in eel fisheries as a means of tracking stock status, fishery independent monitoring would seem a useful tool for obtaining estimates of eel abundance and recruitment success. DEH notes that DPI&F already conducts some independent monitoring of adult eel stocks in natural waterways, but that these areas are not necessarily representative of where eels would be expected to occur. DEH considers that independent monitoring should be conducted in areas known to be representative of where eels should naturally be found to enable trends in adult eel abundance indicative of any declining recruitment to be identified. DEH also notes that environmental conditions are believed to

significantly affect eel recruitment and where possible the impact of environmental variability should be taken into account in the management of the resource.

Recommendation 6: *DPI&F to undertake fishery independent monitoring of representative unimpounded rivers on an annual basis to enable trends in adult eel abundance indicative of any declining recruitment to be identified.*

Recreational fishing surveys are also conducted by DPI&F biannually to provide an independent estimate of recreational catch of adult eels. The NRIFS has collected information on recreational and indigenous harvest of eels and this information is publicly available (Henry and Lyle, 2003).

Fishery dependent data is collected in the juvenile eel component of the fishery through the reporting of catch and effort information to DPI&F. Holders of Culture Stock Collection Permits are required to keep records of all movements of glass eels and elvers. For each collection activity, records must include details of the permit holder, date and location of collection, the number of eels requested and collected, the details of the person in charge of collection and transport details to the approved Aquaculture Licence. The holder must provide a catch return for each day they fish, which must be forwarded to DPI&F monthly. Each catch return must include information about the date and location of the collection trip, weight of eels caught and estimated number of eels per kilogram taken. It is not clear how the information collected in catch returns is validated. Validation of catch and effort information is important for effective management of fisheries. As part of the development of a new management regime for the juvenile eel component of the fishery, DPI&F should investigate methods for validating catch and effort of juvenile eel collection activities.

There appears to be no collection of fishery independent data specifically for the juvenile eel component of the fishery. However, it is expected that the independent data collected in the adult component of the fishery provides relevant information to the collection of juvenile eels from the population.

Assessment

No assessment of eel stocks is undertaken in the QEF. The reasons provided for this are twofold: that the nature of the species makes assessment and estimates of spawning stock biomass impossible; and that the precautionary management arrangements in place ensure that the fishery has limited impact on the species' reproductive capacity.

The unusual features of eel population dynamics, including catadromy, presumed panmixis, environmental sex determination, low natural mortality, late female maturation and death after spawning mean that assessment and management of stocks requires different strategies to most other commercial fisheries. In addition, the eel resource is highly fragmented and the presumed panmictic nature of the species means that recruitment to the fishery is not predictable and is highly influenced by the access of adults to the sea, physical barriers to recruitment and environmental conditions.

Some attempts have been made in overseas fisheries to estimate densities of eels on local scales with mixed success although estimates are often unreliable due to large variation in catchability. To date, no broad-scale eel fishery in the world has successfully determined a robust estimate of spawning stock biomass.

Eel population models for New Zealand eel species have been developed. These demonstrate that the New Zealand long fin eel management system, involving substantial areas closed to fishing, is robust to existing uncertainties regarding the species population dynamic and status and the current and future impacts of the fishery on the population. The model works to ensure that sufficient unfished

areas are maintained to supply viable levels of egg production. The model yielded similar results for the Australian Long Fin Eel.

Similar to the New Zealand model described above, DPI&F have adopted a precautionary management approach that relies on egg production from eels from unfished areas to ensure sustainability. DPI&F have adopted this approach to manage the difficulties in stock assessment, managing eel trapping effort effectively and preventing overfishing of long-lived, late maturing females. The management arrangements for the QEF are discussed in detail in the following section.

DEH recognises that DPI&F is working towards developing a system by which it can achieve some estimates of stock abundance and sustainable harvest levels for the eel resource. DEH notes that the current Adult Eel Project (FRDC 2000/145) is expected to yield results that will aid the development of a methodology for measuring indices of abundance and sustainability. DEH strongly encourages work in this area and believes it will be a crucial step in the future management of this fishery.

Recommendation 7: *DPI&F to develop and implement sustainability indices for eel stocks within 3 years, to ensure some assessment of the proportion of adult eels that can be sustainably harvested is conducted on an annual basis. The annual assessment of the adult eel resource will incorporate assessment of the impacts of environmental variability, where possible.*

DEH recognises the inherent difficulties associated with assessing the spawning biomass of eel stocks and notes the potential development of the indices mentioned above. Nonetheless, management is still needed to ensure that overfishing of these stocks is not occurring. It is also important that DPI&F are able to publicly demonstrate that this is not occurring. In the absence of a reliable stock assessment method for the species some form of analysis and reporting of catch and effort information should be undertaken. The data collected through the catch and effort returns should receive regular analysis to identify catch trends in the fishery and this information should be made publicly available. A recommendation requiring annual reporting of the performance of the QEF is provided in Part I of this report (see **Recommendation 5**).

The qualitative risk analysis for juvenile eel collection for aquaculture, contained in the draft management policy for the juvenile component of the fishery, identified inadequate recruitment of juveniles to replenish adult eel populations as a potential risk of juvenile eel collection activities. This risk is believed to be minimal due to the limited number of licences issued, restrictions on gear type and use and limited number of river systems open to fishing, which are likely to result in only a small percentage of juvenile eels removed from the system. DEH considers this a reasonable assumption but notes the lack of detailed knowledge of the species and its population and recruitment dynamics, which signals a need for precautionary management.

The spatial distribution of Long Fin and Short Fin eel stocks is well established. The submission provides an adequate summary of the distribution of stocks and current understanding about the genetic differentiation between stocks. East coast and south-west Pacific Long Fin eel stocks are believed to comprise a single interbreeding stock with recruitment into Australian rivers determined by the East Australian Current system.

The distribution and spatial structure of the stocks has been taken into account in the management of the fishery. Australian anguillid eels are believed to be panmictic. Panmixia is defined as random mating within a breeding population. The submission states that there is no evidence to suggest catchment fidelity in Australian species so recruitment to catchments is assumed to be random. In addition, adult eels do not appear to migrate between catchments. Under these assumptions, the primary management tool for the adult component of the fishery is the closure of all natural waters to eel trapping, leaving these waters as eel refuges to provide adequate spawning biomass to ensure the sustainability of stocks.

As noted above, the QEF is managed under the assumption that all anguillid eels are panmictic. However, recent work on European eels appears to refute the panmixia assumption on those species. DPI&F assert that while studies undertaken in the region to date provide a lack of evidence to refute the panmixia assumption in Australian species, it is possible that panmixia is not exhibited. Genetic studies underway at Southern Cross University to test the panmixia hypothesis may clarify the matter for Long Fin Eels and allow identification of the risks that catchment fidelity may pose to the current management regime. Given that management to ensure the sustainability of eel stocks in the QEF is largely dependent on the panmixia assumption, DEH considers that, should the current study determine that eel stocks harvested in the fishery are not panmictic, DPI&F should develop alternative management arrangements to ensure that catchment fidelity is adequately taken into account.

Recommendation 8: *In the event that the current genetic study on Long Fin Eels reveals that eel stocks harvested in the fishery are not panmictic, DPI&F will investigate alternative management arrangements with a view to implementing management measures that ensure that catchment fidelity is adequately taken into account. A program for the collection of fishery dependent and independent data to inform management will also be investigated.*

Australian eel stocks are also harvested by other States, namely, New South Wales, Tasmania and Victoria. Estimates of the number of adult eels harvested in these jurisdictions are available and used for ongoing monitoring in each of their respective fisheries. At the July 2002 meeting of ANZERG, a recommendation was made to integrate catch and effort data from all sectors and start an ongoing program of comparing and validating State catch return data against Australian Quarantine and Inspection Service export data. DEH strongly encourages uptake of this recommendation and believes that ensuring that multi-jurisdictional harvest of eels is adequately considered and validated by all sectors is an important step in the future management of all Australian eel fisheries.

Since 1985, commercial catch and effort data has been collected in the adult eel component of the fishery. Data is obtained from the compulsory Commercial Eel Trapping Returns, which is validated against buyer records. This information collection system ensures that reliable estimates of eels harvested in the QEF are available.

Catches of adult eels have fluctuated markedly over recent years. As the fishery developed, catches increased until 1989 when the availability of eels in public impoundments declined. Catches peaked in 1993 as fishers moved into private impoundments but have declined since then. In 2003, the catch of adult eels was 42.641 tonnes. The submission states that catches are likely to continue to decline as the limited areas available to fishing are exploited. Environmental conditions, such as the 1994-95 drought are also believed to negatively impact on catches.

Since 1996, adult trapping effort has increased while catches have declined. The submission states that these declines may be the result of localised overfishing and limited recruitment from elvers migrating upstream, especially into larger impoundments where access by elvers is more difficult. Management measures to address these issues are discussed in the following section.

Reliable estimates of juvenile eel collections are also available for the QEF. Reports on catch and effort in the juvenile component of the fishery are collected through the compulsory catch return sheets and reported annually through the DPI&F publication 'Aquaculture Information: Report to Farmers'. This information has been collected since 1996. Juvenile eel harvest levels have fluctuated over the short history of the fishery. In 2001, 0.21 tonnes of glass eels were harvested.

Estimates of recreational and indigenous take of eel species have been established and reveal that there is a limited recreational and indigenous take of the target species. Estimates of take from these sectors

are conducted on a regular basis but are not incorporated into the management of the fishery due to the low level of harvest.

As stock assessments are not conducted in the adult or juvenile components of the fishery, it is not clear how commercial catch and effort information is taken into account in the management of the QEF. Recommendations to provide some mechanisms to assess stocks and monitor the fishery have been made (see **Recommendations 2, 3, 6 and 7**).

The submission provides no indication of the status of eel stocks harvested in the fishery. As stock assessment is not practical at this time, obtaining an accurate indication of stock status is difficult. DPI&F do however assert that the precautionary nature of the management regime ensures that sufficient spawning biomass is protected from exploitation and that overfishing is not occurring. The submission states that the harvest of juvenile eels in the fishery may have limited effect on eel populations as elver natural mortality rates are extremely high. Up to 99.5% of elvers may die in the first few months due to predation, density dependence effects and environmental conditions. While these factors have significant impacts on the population, the construction of weirs and dams may compound the impacts and limit recruitment upstream. Furthermore, DEH considers that the impact of these factors on the stock further highlight the need for precautionary management of eel harvesting in Queensland waters. These issues are discussed in detail in the following section.

While there has been no estimate of the potential productivity of the fished stock and the proportion that could be harvested, research through the Adult Eel project has provided preliminary results to indicate that the exclusion of adult eel trapping from natural waters can effectively maintain eel spawning biomass and limit the proportion that can be harvested. In the absence of formal estimates of productivity, DEH has recommended action to improve the ability of management to make some estimates of productivity (see **Recommendation 6**).

Management response

The current management regime for the fishery aims to maintain ecologically viable stock levels through a range of input and output controls that vary between the adult and juvenile components of the fishery. These measures are summarised in Table 2 of this report. The management arrangements in the QEF are precautionary, due largely to the closure of most waters to eel fishing.

The adult component of the fishery is managed as a closed fishery and no new Authorities may be issued or transferred. The areas open to adult eel trapping are heavily restricted. Trapping is prohibited in all natural waters and may only be undertaken in a limited number of artificially impounded public and private waters. The sustainable management of the QEF relies heavily on these two measures.

DPI&F advise that this approach is considered highly precautionary on the basis that the closure of all natural waters to trapping provides refuge for sufficient numbers of eels to maintain viable levels of spawning biomass and that the overall effort in the adult fishery has been capped, thereby limiting the potential harvest from waterways.

Other measures to control the level of harvest of adult eels include a limit on the number of traps permitted to be used by each Authority holder and restrictions on the type and design of traps used. A minimum size limit of 30 cm is also applied to all eels harvested. A recent study on the various combinations of maximum and minimum size limits on commercial eel harvesting in New Zealand was undertaken. The submission states that the results of this study when available may be used in the future development of management arrangements in the QEF.

The limited migration of adult eels from impounded waters to natural waters, combined with the fact that few female eels of spawning age escape harvest and migrate past impoundment structures to the spawning grounds, provides some uncertainty about the contribution of impounded eel stocks to the

spawning biomass of the overall eel stocks. Furthermore, the risk that recruitment to impounded waters is limited through juvenile eel harvest and barriers to upstream migration, suggests that the adult eel stocks in impounded waters may continue to decline.

In addition, the refuge argument, while a precautionary approach to management of the stocks, assumes that the available natural waterways contain sufficient spawning adults to replenish stocks. Although independent surveys provide some indication of the density of eels in some natural waters, there is uncertainty about the actual spawning biomass available in natural waters.

These issues combined cause some concern about the stocks ability to withstand continued harvesting of adult eels in impounded waters. Without performance indicators and performance measures to identify and act on detected declines in adult eel abundance in impoundments, and if management of the juvenile component cannot ensure sufficient juvenile eels are left to mature and move upstream, there is a risk that adult eel trapping may become unsustainable under the current management regime.

The juvenile component of the fishery is managed through a range of input and output controls. A quota system is in place, which links quota issued with Culture Stock Collection Permits to facility production capabilities. It is not an overall quota designed to limit total harvest, rather to ensure that individual farmers match their harvest with their grow out facilities.

Commercial harvesting of juvenile eels is also controlled spatially. More than 90% of Queensland river systems are closed to juvenile eel collection. In those rivers where fishing is permitted, further restrictions on where fishing can occur are in place, including fishing downstream of weirs and avoiding fishway areas.

DEH is concerned that there are currently no real constraints on the amount of juvenile eels that may be harvested, nor is there an understanding of the proportion of stocks that can be sustainably harvested in the fishery. In the absence of knowledge of stock sustainability, a precautionary approach should be adopted. DEH acknowledges that DPI&F have recognised the need for more precautionary management of juvenile eel collection and that DPI&F is developing new management arrangements for that component of the fishery.

The new management regime proposed for the juvenile eel component of the fishery is due to be released for public comment in November 2004. The *Juvenile Eel Collection for Aquaculture Policy* document outlines new measures including the removal of the quota system, restriction to 20 transferable authorities, restrictions on the type and number of fishing apparatus and the adoption of a trigger catch limit. The trigger prescribes that if the annual catch in any one river system exceeds 100 kg a review of management arrangements in the river system will be conducted and appropriate management action taken as required. DEH considers these new measures, in particular the catch trigger limit, a significant step forward in the precautionary management of the juvenile eel component of the fishery and looks forward to seeing the arrangements finalised and implemented.

DEH considers that the proposed new management regime for the juvenile eel component of the fishery is sufficient to ensure viable numbers of juveniles are not harvested. There remains however, some concern about the ability of juvenile eels to move past waterway barriers and recolonise areas.

Barriers to upstream migration limit the recruitment of juvenile eels into impounded and natural waters. The submission recognises this limitation but asserts that obstacles are passable and that eels are known for their ability to traverse over land in wet conditions and utilise fishways so that there is some level of natural recruitment into most impoundments. Fishways are one mechanism that may aid recruitment of juvenile eels upstream of waterway barriers, as is the stocking of impounded waters with juvenile eels. These methods have both potential environmental costs and benefits and should be

investigated with a view to implementing, or encouraging relevant authorities to put in place, suitable measures in the future.

Recommendation 9: *DPI&F to conduct a cost-benefit analysis on methods to facilitate juvenile eel recruitment upstream past waterway barriers. If an appropriate mechanism is identified, DPI&F to implement the mechanism and/or encourage relevant authorities to put in place measures to facilitate ongoing juvenile eel recruitment past waterway barriers.*

In addition to the management arrangements described above for the adult and juvenile eel components of the fishery, under the management plan DPI&F has various mechanisms to respond in a timely manner to threats to the sustainability of the fishery. For example, DPI&F have the power to declare closed seasons, implement quota, make emergency fisheries declarations, refuse to issue Authorities and impose additional conditions on Authority holders. DEH expects that DPI&F would act appropriately to any threats to sustainability.

Management of the QEF prohibits the retention of species other than eels in the QEF and consequently there are no by-product species relevant to the fishery. All species other than eels captured in the fishery must be released. These species are covered under the assessment of bycatch under Principle 2 of this report.

As mentioned in the previous section, there are difficulties associated with assessing eel stocks and determining the proportion of the stock that can be sustainably harvested. Consequently, catch limits and trigger points, such as a biological bottom line or reference point have not been established in the adult or juvenile components of the fishery.

Currently, catch trends are monitored through analysis of CPUE data but this is of limited value due to the fluctuating catches and ongoing management changes. DEH has previously recommended that the performance of the QEF be monitored and reported on annually (see **Recommendation 3 and 5**) and that performance indicators and performance measures be developed (see **Recommendation 2**). The submission states that the Adult Eel Project currently underway will provide some guidance on appropriate trigger points and DEH has recommended that DPI&F determine suitable sustainability indices to ensure that some assessment of the proportion of adult eels that can be sustainably harvested is conducted annually (see **Recommendation 7**).

Conclusion

DEH considers that the management regime in the adult and juvenile component of the fishery is appropriately precautionary and provides for the fishery to be conducted in a manner that does not lead to over-fishing. DEH considers that the information collection system and management arrangements generally are sufficient to ensure that the fishery is conducted at catch levels that maintain ecologically viable stock levels with acceptable levels of probability.

DEH considers that there is scope to further refine some of the existing information collection, assessment and management responses and has provided a number of recommendations for improvements in the longer term.

Promote recovery to ecologically viable stock levels

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’*

This Objective is not currently applicable to the fishery. While no defined reference points have been established, DPI&F assert that the fishery is operating at sustainable levels and the precautionary management strategies in place ensure that ecologically viable stock levels can be maintained. In

particular, large refuge areas are enforced to ensure that sufficient spawning eels are protected and a precautionary catch trigger is proposed for the juvenile component of the fishery. DEH considers that the current management regime affords sufficient protection to the spawning biomass of eels to ensure that overfishing of stocks is not occurring.

Conclusion

DEH considers that the adult and juvenile components of the eel stock are not below a defined reference point but should that occur in the future, the fishery is conducted such that there is a high degree of probability the stock would recover to ecologically viable stock levels within nominated timeframes.

Ecosystem impacts

Principle 2: *'Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem'*

Bycatch protection

Objective 1: *'The fishery is conducted in a manner that does not threaten bycatch species'*

Information requirements and assessment

No dedicated information on bycatch has been collected in the adult and juvenile components of QEF. The submission states that for the adult component, the small scale of the fishery, the nature and configuration of the gear used and the area in which the fishery operates (i.e. impoundments) make the likelihood of bycatch low and the need for bycatch monitoring less of a priority. Similarly, bycatch information is not collected in the juvenile component as the operation of the fishery, including gear types, use and fishing locations, results in minimal bycatch.

There have been no formal assessments of the vulnerability of bycatch species to eel fishing in Queensland waters although anecdotal evidence, and a research study, suggest that impacts of eel harvesting on bycatch species is expected to be low.

The submission states that the incidental take of fish species, freshwater turtles, waterfowl and native water rats may occur during adult eel trapping in the QEF. Isolated public reports have suggested that some incidental capture of non-target species occurs in low numbers but that reports do not necessarily reflect non-target species mortality.

An assessment of bycatch by New South Wales (NSW) Fisheries is currently being undertaken in central and northern NSW to document bycatch species taken in the NSW eel fishery. The study recorded numerous species including freshwater turtles, crayfish and fish in unimpounded waters. No bycatch was taken in the impounded waters surveyed. The submission asserts that the preliminary results from the northern NSW rivers may be indicative of bycatch in the adult component of the QEF. While similarities may exist DEH believes it is important that the assumption that bycatch is minimal is verified through data collection in the QEF.

While no work has been undertaken regarding bycatch in the juvenile component of the QEF, previous work undertaken by McKinnon et al (2000) has identified numerous bycatch species in varying abundances. The study by McKinnon et al (2000) documented bycatch in eastern Australian rivers relating to glass eel fishing activities. The study identified numerous species taken as bycatch, including freshwater fish species, freshwater turtles and crustaceans. Anecdotal evidence suggests that the incidence of bycatch mortality is minimal in the juvenile component of the fishery. A qualitative

risk analysis of juvenile eel collection for aquaculture has been conducted by DPI&F and is included in the draft management policy for that component of the QEF. The assessment found that if collections are conducted in accordance with the management regime, the probability of impacts on bycatch species is very low and consequences less significant because fyke nets are not used in upstream areas where the risk of capturing non-target species is higher.

Bycatch appears to be minimal in the adult and juvenile fisheries, however some bycatch is taken and certain species may be vulnerable to fishing. DEH considers that, while the NSW and McKinnon et al (2000) studies may provide some insight into what bycatch may be expected in the QEF, and while the qualitative assessment of the juvenile component of the fishery suggests likely impacts are low, an assessment is still required to identify those species most at risk from adult and juvenile eel trapping in Queensland waters. A risk assessment to confirm assumptions that impacts of the fishery on bycatch species is low should be undertaken and appropriate management measures implemented to minimise impacts on those species found to be high risk.

Recommendation 10: *Within three years, DPI&F to undertake a risk analysis of the bycatch species, including protected species, taken in the fishery to identify those species vulnerable to fishing. Management measures to mitigate threats to any species found to be at high risk from fishing operations should be developed and implemented in a timely manner.*

Management response

A range of management measures to minimise the capture and mortality of bycatch species is in place in the QEF.

In the adult component of the fishery, artificially impounded waters are fished and these are thought to contain fewer native species than natural waterways. The closure of natural waters to adult eel trapping was implemented not only to maximise sustainability of the target species but also to minimise the chance of capturing non-target species. The submission indicates that restricting fishing to artificial impoundments results in less potential bycatch due to less favourable and unnatural habitats for species.

Substantial restrictions relating to the traps that may be used for adult eel trapping are also in place and appear effective in reducing non-target species capture and mortality. Traps used to capture adult eels are regulated in terms of dimensions, mesh size, material used, cod-end dimensions, flotation and access to the water surface. These restrictions aim to exclude bycatch from the traps and to maximise the chance of survival of any bycatch species captured. All traps must provide water surface access through the cod ends for air breathing bycatch species such as turtles, birds, platypus and water rats. This measure is believed to dramatically increase survivability of these species if caught.

In both the adult and juvenile components of the fishery, bycatch must be released immediately and no bycatch species may be retained. This requirement maximises the survivability of bycatch taken which is further maximised through the requirement for regular checking of nets and traps.

Bycatch reduction devices (BRDs) are fitted to all nets used in the collection of juvenile eels. Use of BRDs is compulsory and required under the conditions of permits. Research undertaken by McKinnon et al (2000) indicates that the bycatch reduction devices fitted to nets and other gear used in the juvenile component of the fishery may be effective in reducing bycatch.

Restrictions on fyke nets used in the juvenile component of the fishery also include size restrictions and a requirement that all nets are checked at least every 30 minutes once submerged. Flow traps must be checked at least every 24 hours. Other measures to minimise bycatch in the juvenile component of the fishery include a restriction on the waters that may be fished, thereby reducing the effort in the fishery and impacts on bycatch.

DEH expects that following the risk assessment required under **Recommendation 10**, further measures to minimise bycatch would be introduced if risks were proven greater than previously assumed. DPI&F have advised that if bycatch becomes an issue for the fishery that appropriate management responses will be considered.

Conclusion

DEH considers that there is a high likelihood the fishery is conducted in a manner that does not threaten bycatch species. Should this situation change, or a risk assessment process indicate otherwise, DEH expects that DPI&F would undertake appropriate actions to ensure that bycatch species are not threatened by this fishery.

A recommendation has been developed to ensure that the risk of unacceptable impact on bycatch species is detected and minimised in the longer term.

Protected species and threatened ecological community protection

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

No information collection systems are in place that require the recording or reporting of interactions with, or capture of, protected species. There are also no monitoring systems in place to detect interactions with these species. The submission states that some anecdotal reports of capture of non-target species such as freshwater turtles have been received in the adult fishery. Given that protected species, in particular platypus, waterbirds and freshwater turtles, are known to occur in areas of the fishery, DEH believes that collection of interaction information is required to ensure that any significant interactions can be detected and management action taken to minimise impacts on such species. DEH notes that the Species of Conservation Interest logbooks have been developed to enable comprehensive recording of protected species across the Queensland fisheries but are yet to be introduced into the adult and juvenile eel components of the fishery. While protected species interactions in the QEF may be low, collection of information on interactions should be undertaken to enable changes in the type and level of interactions to be detected.

Recommendation 11: *DPI&F to implement the Species of Conservation Interest logbook in the adult and juvenile eel fisheries within 12 months to enable ongoing recording and monitoring of protected species interactions.*

Assessment

There have been no formal assessments of the impact of either the adult or juvenile components of the fishery on protected species.

The submission identifies a number of protected species found in those Queensland catchments that are open to adult eel trapping and provides some discussion of the perceived risks to these species. These include Fitzroy River Tortoise (*Rheodytes leukops*), Mary River Tortoise (*Elusor macrurus*), Platypus (*Ornithorhynchus anatinus*), Lungfish (*Neoceratodus forsteri*) and Mary River Cod (*Maccullochella peelii mariensis*).

The submission states that the distribution and preferred habitats of these species make capture unlikely. The risk of capture of Platypus is also thought to be low as the bait used to capture eels is unlikely to be attractive to the species. Furthermore, no interactions with the species were encountered during the Adult Eel Project or in New South Wales studies. Lungfish and Mary River Cod are unlikely to be encountered by eel trappers as the majority of fishing operations occur in artificial impoundments that are not favoured by these species.

The qualitative risk analysis conducted on bycatch for the juvenile eel component of the fishery also took into account likely impacts on species of conservation concern. The assessment found that if eel collections are conducted in accordance with the management regime, the probability of impacts on protected species is very low and consequences less significant because fyke nets are not used in upstream areas where the risk of capturing protected species is higher.

DEH believes that the combination of management measures in place to minimise interactions with, and mortality of, the protected species discussed above, combined with the closure of all natural waterways to adult eel trapping, ensures that the risk of significant interaction with these species is low. The implementation of a data collection system for protected species interaction (see **Recommendation 11**) should provide valuable information to be used in the risk assessment for bycatch, including protected species, required under **Recommendation 10**.

No threatened ecological communities occur in the area of the QEF.

Management response

The measures in place to avoid the capture and/or mortality of protected species are the same as those for the minimisation of bycatch in general. These measures were described under Principle 2, Objective 1. DEH considers that these measures are appropriate and appear effective in minimising impacts on protected species. DEH also considers that, should significant interactions with protected species be identified, DPI&F have the capacity to take appropriate and timely action to mitigate these threats.

Conclusion

DEH notes that there are minimal interactions with protected species in this fishery and considers that 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. Should this situation change, or a risk assessment process indicate otherwise, DEH expects that appropriate actions would be undertaken to ensure the fishery avoids mortality or injury to these species and avoids or minimises impacts on threatened ecological communities.

A recommendation has been developed to ensure that the risk of unacceptable impacts on protected species can be detected and minimised in the longer term.

Minimising ecological impacts of fishing operations

Objective 3: *'The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally'*

Information requirements

No information is collected from either the adult or juvenile components of the fishery regarding fishery impacts on the ecosystem and environment generally.

Fishing is conducted in areas where there has been significant change in the natural ecosystem, for example through dam construction, and towards artificially dense populations of eels in artificial habitats. DPI&F assert that the fishery therefore has minimal impact on natural waterways and habitats and the small scale of the fishery does not warrant data collection on ecosystem impacts. This approach assumes that there has been little colonisation of artificially impounded waters by native wildlife. Further discussion of this issue is provided in the following section.

DEH notes the lack of information collection and research covering the fishery's impact on the ecosystem and environment generally. However, DEH understands that this lack of information is the case across a range of Australian and International fisheries and until appropriate research techniques and programs are developed and implemented this will continue to be the case. DEH strongly supports research in this area.

Assessment

Due to the scale of the fishery and perceived lack of environmental impact, a formal risk assessment to determine the susceptibility of ecosystem components to fishing activities has not been conducted. The submission does however provide some assessment of the perceived risks.

The submission recognises, and DEH agrees, that the most significant impact on the natural ecosystem is likely to be the exploitation of the target species and its impact on the size of the spawning biomass of eels. Throughout the submission however, DPI&F assert that impact of the fishery on the biomass is significantly reduced through the closure of all natural waterways to adult eel trapping, thereby ensuring that the natural waterway populations are left to provide spawners sufficient to sustain the species. There are however some concerns about the impact of removing large numbers of juveniles from the system. Ensuring that sustainable populations of eels remain, and that juveniles are able to move upstream past waterway barriers, were issues discussed under Principle 1 of this report.

Food chain interactions may also be affected by operations of the fishery. A significant impact on the environment that may be expected from this fishery is the removal of a large predator from the system. The submission recognises that eels are likely to be the most important predator in many freshwater ecosystems and play a key role in regulating the populations of other species. Given that other species besides eel may be expected to occur in the artificial impoundments, changes in eel densities in impoundments may impact on populations of, and interactions between, other species in these systems. Juvenile eels are not as significant predators as adult eels.

DPI&F asserts that natural systems and food chains should not be affected by reductions in biomass in impoundments as eel numbers in natural waterways should not be impacted by fishing. This view relies on the assumption that natural waterways contain and will continue to sustain sufficient eel populations. DEH considers that the impact of urban and industrial development in the catchments may impact on the capacity of natural waterways to sustain sufficient levels of both eel species to supply sufficient recruitment to maintain a sustainable fishery. While DEH understands that activities within catchments not directly related to the QEF are beyond the control of DPI&F, DPI&F should be aware of this risk, and in the event that the LTMP detects declines in eel densities in the natural waterways, take appropriate management action.

There also appears to be an assumption that artificial habitats have limited value for native wildlife and in turn little consequence in terms of environmental impact. The submission suggests that because fishing is not permitted in natural waterways, the impacts on the broader environment could be expected to be low. Without information to support this assumption, for example surveys to identify the species found in impoundments; it could be expected that native wildlife do colonise artificial habitats and that the fishery may in fact have impacts on the general environment.

Impacts of the fishery on the physical environment are considered low although some limited damage may be expected through the setting and retrieval of nets and traps. The juvenile component of the fishery requires that nets are staked or weighted to minimise impacts on riparian, instream or benthic habitats. Given that juvenile eel fishing is restricted to 21 streams, and of these, only two were actively fished in 2001, impacts of this nature would be minimal.

Impact of the fishery on water quality is also expected to be low. Adult eel trapping is conducted in impounded waters, primarily farm dams where waters are naturally turbid, and localised sediment re-suspension may occur while setting and retrieving nets and traps. However, the overall impact on water quality would be minimal.

Management response

The primary tool for minimising impacts of the fishery on the ecosystem is the closure of all natural waterways to adult eel trapping. The submission asserts that restricting trapping to artificial impounded waters ensures that the impacts on natural ecosystems is negligible. DEH believes that the impact is expected to be low but there may be some potential impacts expected if insufficient numbers of females are able to escape impoundments and successfully complete their spawning migration. In particular, waterway barriers may impede migration and recruitment of juveniles upstream. This issue was covered in **Recommendation 9**.

The impact of the juvenile eel component of the fishery on the environment is minimised through net size and placement restrictions, requirements for regular checking of nets to ensure other species are released early and the prohibition of by-product.

DPI&F advise that if significant impacts were identified that appropriate management responses, such as closing waterways, would be implemented. DEH considers that measures are in place to minimise impacts on the environment and that the gear used is relatively benign.

Conclusion

DEH considers that the fishery is conducted in a sufficiently precautionary manner to minimise the impact of fishing operations on the ecosystem generally. Recommendations have been made throughout this report that should help to ensure that the risk of significant impact by the fishery on the environment generally is minimised in the longer term.

REFERENCES

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LIST OF ACRONYMS

ANZERG	Australian and New Zealand Eel Reference Group
BRD	Bycatch reduction devices
CPUE	catch per unit effort
DEH	Department of the Environment and Heritage
DPI&F	Queensland Department of Primary Industries and Fisheries
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FMAC	Freshwater Fisheries Management Advisory Committee
FRDC	Fisheries Research and Development Corporation
LTMP	Long Term Monitoring Program
NRIFS	National Recreational and Indigenous Fishing Survey
NSW	New South Wales
QBFP	Queensland Boating and Fisheries Patrol
QEF	Queensland Eel Fishery
UNCLOS	United Nations Convention on the Law of the