



Australian Government

Department of the Environment and Heritage

Assessment of the
Queensland Mud Crab Fishery

August 2004

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This document is an assessment carried out by the Department of 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 Parts 13 and 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 Mud Crab 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 Parts 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The draft document *Ecological Assessment Queensland Mud Crab Fishery* (the submission) was received by the Department of Environment and Heritage (DEH) in April 2003 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 16 May 2003. 4 public comments were received and DPI&F provided a response to the issues raised. No changes were made to the submission as a result of public comment.

The submission reports on the Queensland Mud Crab Fishery 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: Summary of the Queensland Mud Crab Fishery

Area	Waters adjacent to the State of Queensland with the exception of Torres Strait.
Fishery status	Fully exploited (Weipa region); other regions of the fishery status unknown
Target Species	Mud crab (<i>Scylla serrata</i> and <i>S. olivacea</i>)
By-product Species	Not limited. Most numerous species are blue swimmer crab, some cod and catfish
Gear	Commercial fishers: Crab pot and collapsible trap Recreational fishers: dillies
Season	no set season
Commercial harvest 2003 (\$ value)	1134 tonnes (\$11.9M GVP)
Recreational harvest 2002	Estimated at 940-1050 t
Commercial licences issued	888 licences issues in 2002, only 514 active licences in 2003. 875 licences issued in 2004.
Management arrangements	<u>Commercial fishery</u> : limited entry ('C1' endorsement required); limits on number of pots that can be used; minimum size (150 mm carapace width – (CW)); prohibitions on take of undersize crabs, females and crab meat and claws separate from carapace; apparatus marking requirements; and some closures (specific to the fishery or as part of marine park zoning). <u>Recreational fishery</u> : minimum size (150 mm CW); gear and bag limits; apparatus marking requirements; and some area closures.
Export	small live export trade to Asia; live domestic market
Bycatch	toadfish, catfish, cod, bream (preliminary data)
Interaction with Threatened Species	turtles, little/none recorded for dugong or sea snakes, some sharks (species unspecified)

The area of the fishery includes waters surrounding the state of Queensland (both east coast and Gulf of Carpentaria) out to the outer edge of the Australian Exclusive Economic Zone. Part of the fishery area is in Commonwealth waters, however the entire fishery is managed by Queensland under an Offshore Constitutional Settlement (OCS) between the Australian Government and the Government of Queensland. Fishing activity occurs in tidal waters, and approximately 75% of the harvest occurs between December and May.

The fishery targets mud crab (*Scylla serrata*). A second species is also found in the area of the fishery (*S. olivacea*), but is smaller, has more restricted habitat requirements and is taken in small quantities. Apart from a prohibition on the retention of spanner crabs, there is no limit to the quantity or species that may be taken as byproduct by the fishery. Species currently retained by the fishery as byproduct include mainly blue swimmer crabs, some cods and catfish.

The target species is found throughout the Indo-West Pacific from Japan to northern Australia and from East Africa to Tahiti. The Australian distribution of mud crabs (*S. serrata* and *S. olivacea*) is in warm tropical to warm temperate waters from Shark Bay in Western Australia to northern New South Wales and in isolated populations south of Sydney to the Bega River (Kailoa *et al* 1993). The species is harvested in trap or pot fisheries under the management controls of Western Australia, the Northern Territory and New South Wales as well as Queensland. Genetic research at Griffith University suggests that the Queensland fishery harvests two reproductively distinct clades of *S. serrata* separated by Torres Strait.

Mud crabs typically are found in near-shore habitats, particularly in mangrove areas of sheltered estuaries, tidal reaches of waterways, mud flats and mangrove forests. The species favours a soft, muddy bottom and spends days in burrows, emerging at night to feed. *Scylla* species are carnivorous feeders whose diet changes according to maturity. Primary predators are finfish, sharks and rays, crocodiles, turtles and herons (Kailoa *et al* 1993).

Females are highly fecund (they may lay 1-8 million eggs, depending on size (Jones and Morgan 2002)), store sperm and when in berry (egg bearing) migrate up to 50 km offshore to spawn (Kailoa *et al* 1993); multiple spawnings may occur in a single season. The species grows fast, particularly in tropical waters. It may achieve sexual maturity in 12-18 months (9-10 cm) in the tropical waters of PNG and up to 27 months (13.8 cm) in sub-tropical south-east Queensland waters (Heasman, 1980). The species may live for up to four years and is reported to achieve a carapace width (CW) of 24 cm (Kailoa *et al* 1993) or 28 cm and a weight of 3 kg (Yearsley *et al* 1999).

The fishery became a limited entry fishery in 1984, although commercial harvest dates from the late nineteenth century. Commercial catches peaked in 2000 at 1,000 tonnes. In 2002, the latest year for which both commercial and recreational harvest figures are available, the total harvest was 1,932-2,042 tonnes. Of this the recreational sector took an estimated 940-1050 tonnes and the commercial sector 992 tonnes. Mud crabs are marketed mainly in domestic markets, but there is a small live export trade to Asia.

The fishery takes mud crabs with crab pots and collapsible traps. There are limits on the number of mud crab traps that can be deployed from each licensed vessel. Size and shape of pots vary but most are cylindrical and have two entrance funnels. Fishery management arrangements include a minimum size limit, a prohibition on the take of females, limited entry and prescriptions on the size of float that may be used. A number of area closures have been

established for the fishery specifically and through marine park zoning plans. Currently 875 vessels are licensed to take mud crabs. In 2003, only 514 boats harvested mud crabs.

Direct information on bycatch in the fishery is limited, but bycatch to target ratios in similar crustacean pot fisheries are low. Some species which may be affected by this fishery are currently listed protected species under the EPBC Act. Protected species interactions are likely to include entanglement of marine turtles in pot lines and some direct capture in crab pots and traps. While reported interactions with turtles are low, DEH is concerned that the actual number of interactions could be higher than that reported. Interactions with cetaceans and seabirds are not reported to occur. Protected species interactions and other bycatch are assessed under Principle Two of this report.

The take of mud crab in the recreational sectors is significant and greater than the harvest in the commercial fishery. Limited data on indigenous take currently are available, although indigenous harvest is likely to be significant.

The fishery is managed under the Queensland *Fisheries Act 1994* and the *Fisheries Regulations 1995*. Some areas of the fishery also are subject to the zoning established under the *Great Barrier Reef Marine Park Act 1975* and the *Queensland Marine Parks Act 1982*. DPI&F advises that the development of a management plan for the fishery will commence within the next twelve months and is expected to be completed by 2006.

Overall assessment

The material submitted by DPI&F demonstrates that the management arrangements for the Queensland Mud Crab Fishery meet most of the requirements of the Australian Government *Guidelines for the ecologically sustainable management of fisheries*.

While the fishery is relatively well managed, DEH has identified a number of risks that must be managed to ensure that their impacts are minimised:

- Potential uptake of significant latent effort in the fishery;
- The level and impact of recreational harvest of mud crab and the ability of existing management measures to adequately control recreational harvest;
- Uncertainty about the level of indigenous harvest of mud crab;
- Reliance on unvalidated catch and effort data;
- The absence of a robust model for the assessment of stock status;
- Risk of and inability to detect areas at risk of overfishing; and
- Lack of fishery specific objectives, performance measures and reference points.

Recommendations to address these issues have been developed to ensure that the risk of impact is minimized in the longer term. Through the implementation of the recommendations and the continuation of a responsible attitude to the management of the fishery, management arrangements are likely to be sufficiently precautionary and capable of controlling, monitoring and enforcing the level of take from the fishery while ensuring the stocks are fished sustainably.

DEH commends DPI&F for its conservative minimum legal mud crab size limit, prohibition on the take of female crab, and sound data collection and monitoring of fishery dependent data on the target species. DEH also welcomes the commitment to develop a management plan for the fishery by 2006, which may significantly change management of the fishery and

mud crab resource. Overall, the management regime aims to ensure that fishing is conducted in a manner that does not lead to over-fishing and for fishing operations to be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem. The key challenges for this fishery will be the management of the latent effort issue and the adequate control of the recreational harvest of a highly sought after inshore species that is already subject to other anthropogenic pressures from large coastal populations.

On balance, the fishery is being managed in an ecologically sustainable manner and is working to address existing problems and minimise environmental risks. The operation of the fishery is consistent with the objects of Part 13A of the EPBC Act. Given the conservative minimum size limit, protection of all female mud crabs and increasing efforts to improve compliance with management measures and address potential uptake of latent effort, DEH considers that the fishery will not be detrimental to the survival or conservation status of the taxon to which it relates in the short term. Similarly, it is not likely to threaten any relevant ecosystem in the short term. DEH therefore recommends that the fishery be declared an approved Wildlife Trade Operation (WTO) with the actions specified in the recommendations to be undertaken by DPI&F to contain the environmental risks in the long term. DEH considers that the fishery, as managed in accordance with the management regime, is not likely to cause serious or irreversible ecological damage over the period of the export decision. Specifically, the WTO declaration would allow the export of product from the fishery for a period of 3 years. The WTO declaration will require annual reporting on the progress of implementing the recommendations of this report. The implementation of the recommendations and other managerial commitments will be monitored and reviewed as part of the next DEH review of the fishery in 3 years time.

As the official fishery area encompasses Commonwealth as well as State waters, consideration under Part 13 of the EPBC Act is required regarding the impact of the fishery on listed threatened species, listed migratory species, cetaceans and listed marine species.

Protected species in the area of the fishery which have the potential to interact with the fishing gear include marine turtles, sea snakes, dugongs and possibly protected elasmobranchs such as river sharks and sawfish. A low number of interactions between the fishery and marine turtles are recorded however actual interactions may be higher than reported. There are no listed threatened ecological communities in the fishery area.

DEH recommends that the management regime for the Queensland mud crab fishery, specifically the Queensland *Fisheries Act 1994* and the *Fisheries Regulations 1995*, as they relate to the fishery, be declared an accredited management plan under Sections 208A, 222A, 245 and 265 of the EPBC Act. In making this judgement, DEH considers that the fishery to which the management regime relates does not, or is not likely to, adversely affect the survival in nature of listed threatened species or population of that species, or the conservation status of a listed migratory species, cetacean species or listed marine species or a population of any of those species. DEH also considers that the management regime requires that all reasonable steps are taken to avoid the killing or injuring of protected species, and the level of interaction under current fishing operations is low. On this basis, DEH considers that an action taken by an individual fisher, acting in accordance with the management regime, would not be expected to have a significant impact on a listed threatened species or listed migratory species protected by the EPBC Act.

The assessment also considered the possible impacts on the World Heritage values of the Great Barrier Reef Marine Park World Heritage Area (WHA). DEH notes that some areas of the fishery are subject to fishing closures through marine park zoning established under the Commonwealth *Great Barrier Reef Marine Park Act 1975* and the *Marine Parks Act 1982*, and serve to protect areas of the WHA from the impacts of this fishery. In addition, the recent re-zoning of the Great Barrier Reef Marine Park has increased the extent of areas closed to fishing, providing further protection. On this basis DEH considers that an action taken by an individual fisher, acting in accordance with the fishery management regime, would not be expected to have a significant impact on the World Heritage matter protected under the EPBC Act.

The implementation of the following recommendations and other commitments made by DPI&F in the submission will be monitored annually and reviewed as part of the next DEH review of the fishery in 3 years time. Unless a specific time frame is provided in the recommendation each recommendation must be addressed within the life of the declaration (3 years).

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. DPI&F to continue to actively engage with the Northern Territory and New South Wales in pursuit of collaborative or complementary management and research of shared mud crab stocks.
3. As part of the management planning process, DPI&F to develop fishery specific objectives linked to performance indicators and performance measures for target, bycatch, protected species and impacts on the ecosystem.
4. DPI&F to monitor the status of the fishery 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.
5. DPI&F to develop a compliance strategy for the mud crab fishery. The strategy will explicitly address the following issues and provide for the periodic review of the effectiveness of the strategy:
 - Catch and effort data validation
 - Compliance with commercial pot number restrictions;
 - Compliance with restrictions on the take of female and undersize crabs;
 - The potential for Queensland harvested female and undersize crabs to be laundered in other jurisdictions with different management measures;
 - The appropriateness and effectiveness of existing recreational bag and size limits;
 - The 'black market' sale of recreationally caught crabs; and
 - The occurrence of crab pot 'drying'/stranding.

6. 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.
7. DPI&F to develop a system to ensure that catch data collected in compulsory logbooks is validated on an ongoing basis and to investigate methods for documenting and validating effort in the fishery.
8. DPI&F to develop and implement separate management arrangements for the Gulf of Carpentaria mud crab stock by 30 June 2005.
9. DPI&F to develop a strategy to remove or substantially reduce the amount of latent effort in the fishery, which includes clearly defined management actions linked to specific timeframes, by 31 December 2004. DPI&F to implement the strategy prior to the introduction of the management plan.
10. As part of the management planning process, DPI&F to review existing management measures designed to control mud crab harvest by recreational fishers to ensure that these measures are appropriate, adequately constrain recreational effort and minimise impacts on bycatch and protected species. Should the review indicate that existing measures are not appropriate DPI&F will develop new measures in a timely manner.
11. DPI&F to identify fishery areas at risk of overfishing within two years. DPI&F to undertake independent surveys in these areas with a view to detecting any significant changes in crab abundance and take appropriate management action to address resource sustainability concerns.
12. DPI&F to develop a system for the collection and monitoring of information on discarded undersize and female mud crab and key bycatch species sufficient to enable identification of long-term trends in bycatch and discards. In the event that catch levels of any bycatch species or discards change, DPI&F will investigate suitable management responses.
13. Within 1 year, to support the implementation of the Species of Conservation Interest logbooks, DPI&F to ensure that an education program for fishers, both recreational and commercial, is developed and implemented, to promote the importance of protected species protection and accurate incident reporting.
14. DPI&F to conduct a risk assessment to determine the likely impact of protected species interactions in the fishery (including the recreational sector) within two years. In the event that a species is found to be at risk, DPI&F will investigate measures to mitigate interaction with the species, to ensure that any risks to protected species can be minimised.
15. DPI&F investigate the effects of ghost fishing by lost or discarded mud crab apparatus within two years.

PART I - MANAGEMENT ARRANGEMENTS

The Queensland Mud Crab Fishery is managed by the Queensland Department of Primary Industries and Fisheries (DPI&F).

The management regime is described in the following documents, all of which are, or will be publicly available:

- The Queensland *Fisheries Act 1994*
- The Queensland *Fisheries Regulations 1995*
- Zoning arrangements under the *Great Barrier Reef Marine Park Act 1975*
- Zoning arrangements under the *Queensland Marine Parks Act 1982*.

A number of other documents, including 'Condition and Trend' reports, research reports, scientific literature and discussion papers, and investment warnings for the east coast and Gulf of Carpentaria, are integral to the management of the fishery.

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 our assessment and decisions stemming from it.

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.*

The Crab Management Advisory Committee (CrabMAC) consists of a chair appointed by the DPI&F, the DPI&F fishery manager with responsibility for the Mud Crab Fishery, a research member, a representative of the Queensland Boating and Fisheries Patrol (QBFP), three commercial fishers, two recreational fishers, a representative of the marketing sector and a representative of the Great Barrier Reef Marine Park Authority (GBRMPA). DEH is an observer on CrabMAC. CrabMAC has the responsibility of providing advice and recommendations on management arrangements for the sustainable utilisation of the mud crab resource.

There is provision for a conservation member but the position currently is unfilled, although DPI&F has sought nominations from environmental organisations. DEH considers the lack of a conservation member on the CrabMAC may weaken the ability of CrabMAC to provide balanced advice on the management of the fishery. Similarly, there is no indigenous representation on CrabMAC and since it is highly likely there is a significant harvest of mud crabs by indigenous fishers, consultation with this stakeholder group is important. DEH therefore suggests that DPI&F reassess the representation of CrabMAC with a view to ensuring a more equitable balance of representation, for example with the inclusion of conservation and indigenous interests or that consultation with these groups is sought through other mechanisms.

There is no specific scientific advisory body for the fishery. Research and monitoring for the fishery is managed by the DPI&F and conducted by various research providers. As the same species is harvested in other jurisdictions, DPI&F cooperates with Western Australia, the Northern Territory and New South Wales in Mud Crab Workshops held as part of the

Northern Fisheries Managers meetings. DEH notes that DPI&F is engaged with the Northern Territory on issues relating to mud crab harvesting through a collaborative research project. DEH encourages DPI&F and other relevant jurisdictions to actively support and enhance initiatives such as the mud crab workshops and continue to pursue collaborative or complementary management arrangements for shared mud crab stocks.

Recommendation 2: *DPI&F to continue to actively engage with the Northern Territory and New South Wales in pursuit of collaborative or complementary management and research of shared mud crab stocks.*

The fishery is currently managed under the Queensland *Fisheries Act 1994* and the Queensland *Fisheries Regulations 1995*. Future management of the fishery is the subject of a 1999 discussion paper released by the then management body, the Queensland Fisheries Management Authority and a management plan for the fishery is to be developed in the coming years. DEH is concerned that, in light of the high existing effort and the significant latent effort in the fishery and the fact that the target species is both highly valued (as recreational or commercial catch) and readily accessed, management planning has not progressed beyond the release of the 1999 discussion document.

The delayed development of a management plan for the fishery has meant that fishery specific objectives, performance measures and reference points have not been established. DEH believes that such objectives and performance measures for target and bycatch species and protected species interactions need to be developed to ensure that the performance of the fishery can be measured and management action taken as required. In particular, performance measures and triggers should be capable of detecting and responding to changes in catch per unit effort (CPUE). Once developed and included in the formal management documents for the fishery they should be regularly reviewed and made publicly available. A clear process for responding to breaches of trigger and reference points is also required to ensure that prompt management action is taken to address any threats to sustainability.

Recommendation 3: *As part of the management planning process, DPI&F to develop fishery specific objectives linked to performance indicators and performance measures for target, bycatch, protected species and impacts on the ecosystem.*

Recommendation 4: *DPI&F to monitor the status of the fishery 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. In summary they are:

- Limited entry in the commercial fishery (875 licences in 2004);
- Closures in the Torres Strait, the Gladstone region, and other areas closed to fishing through marine park zoning plans;
- A limit on the number of pots that may be used per commercial boat;
- A limit on the number of pots per recreational fisher;
- A possession limit of ten mud crabs per recreational fisher;
- Gear marking requirements for both commercial and recreational fishers;
- Prohibition on the harvest of females;

- Prohibition on the possession of crab meat or claws separate from body; and
- A minimum legal size (applicable to both the commercial and recreational sectors).

Compliance and enforcement of the commercial fishery is primarily based on provision of compulsory daily logbook sheets and through the work of the QBFP. In recent months the QBFP has been particularly active in enforcing the prohibition on females and undersize crabs in the fishery area and has targeted both recreational and commercial fishers.

While there are sound and conservative management arrangements designed to protect stocks, the ability of existing compliance activities to enforce these restrictions requires attention. The submission suggests that compliance and enforcement tools utilised in the fishery are not comprehensive, lack validation and are focused on the commercial sector.

DEH believes that the ecologically sustainable management of this fishery depends significantly on management's ability to enforce regulations. In particular, validation of catch and effort information (commercial and recreational) and obtaining sound estimates of indigenous and illegal harvest should be a priority. There also is a risk of females and undersized animals being 'laundered' through other jurisdictions and the potential for recreationally-harvested crabs to be sold. Compliance is also particularly important in the absence of stock assessments, performance measures and triggers, with high levels of latent effort and recreational take and a reliance on CPUE data.

DEH understands that a working group within the QBFP has been established to review compliance and enforcement activities in the crab fisheries, specifically to cover the use and marking of crab apparatus to address issues such as excessive pot use, damage caused by lost apparatus, interactions with protected species and theft. DEH considers that the QBFP review and its recommendations will be particularly important for the mud crab fishery.

Recommendation 5: *DPI&F to develop a compliance strategy for the mud crab fishery. The strategy will explicitly address the following issues and provide for the periodic review of the effectiveness of the strategy:*

- *Catch and effort data validation*
- *Compliance with commercial pot number restrictions;*
- *Compliance with restrictions on the take of female and undersize crabs;*
- *The potential for Queensland harvested female and undersize crabs to be laundered in other jurisdictions with different management measures;*
- *The appropriateness and effectiveness of existing recreational bag and size limits;*
- *The 'black market' sale of recreationally caught crabs; and*
- *The occurrence of crab pot 'drying'/stranding.*

The submission does not indicate that the fishery management arrangements are subject of regular review. The fishery is subject to regular 'Condition and Trend' reports and biennial report 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 mud crab 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 3**).

Recommendation 6: *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 information relating to the target species is collected on a regular basis in the fishery. Fishery dependent data are obtained through compulsory daily commercial logbooks. Some fishery independent data are obtained through the mud crab component of the Long Term Monitoring Project (LTMP) instigated in 1999. There are a limited number of projects finalised, currently approved or seeking funding which have application to the management of this fishery. These information collection systems are discussed under Part II of this report.

Data on bycatch generally and interactions with protected species are poor, and systems to accrue better data are extremely new (the LTMP requires bycatch data from 2002) or only in development. An analysis of the fishery's capacity for 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 is contained under Principle Two of Part II of this report.

DEH considers that the current management arrangements comply with all relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy. DEH recognises the need for management arrangements to be flexible and be able to respond to changes in government policy. While there is no mechanism in the arrangements that requires compliance with any future plans or policies, DEH expects that DPI&F will change management arrangements for the fishery to take account of future changes if required.

No regional or international management regimes, to which Australia is a party, are of direct relevance to the fishery. The prime international regime affecting the fishery is the United Nations Convention on the Law of the Sea (UNCLOS). The management regime essentially complies with this. Other international regimes are applicable to fisheries management but do not explicitly involve this fishery, for example the 1992 Convention on Biological Diversity and in particular 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 application of the International Convention for the Prevention of Pollution from Ships (MARPOL) to vessels operating in the fishery is explicitly discussed under Principle 2, Objective 3.

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.

The fishery has been operating within the area of the current GBRMP World Heritage Area since its official establishment in 1984. Under the EPBC Act, a person may not take an action that has, will have or is likely to have a significant impact on the world heritage values of a declared World Heritage property. People that are taking actions that are a lawful continuation

of a use of land, sea or seabed, that was occurring immediately before the commencement of the EPBC Act, may continue to take those actions. An enlargement, expansion or intensification of a use is not a continuation of a use. The GBRMP listed World Heritage values are protected from the impacts of mud crab fishing by fishing closures and conservative management measures, including the legal minimum size and protection of all female crabs. For this reason, and the outcomes of the assessment as listed throughout Part Two of this assessment report, DEH considers that fishing activities as currently practiced in this fishery are unlikely to have a significant impact on the world heritage values of the GBRMP in the next three years. Any significant change to existing practices, which is likely to significantly impact on the GBRMP World Heritage values, may require approval by the Australian Government Minister for the Environment and Heritage.

Conclusion

DEH considers that the Queensland Mud Crab Fishery management regime is adaptable, documented, publicly available and transparent, and is developed through a consultative process. Through the implementation of **Recommendation 3**, the management arrangements will be regularly reviewed, 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 controls appropriate to the size of the fishery. The means of enforcing critical aspects of the management arrangements are in place although some attention is required to strengthen existing 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 are obtained from the commercial sector through compulsory daily logbooks which must be submitted monthly to DPI&F. Two logbooks are in use, one for the Gulf of Carpentaria and one for the east coast. Both logbooks are not specific to the mud crab fishery and include information on netting activities as well as separate fields for crabbing (which may include blue swimmer and other crabs as well as mud crabs). Logbooks contain information on daily and shot-by-shot target catch, hours fished and areas of operation for net operations, but require only the total number of pot or dilly lifts and crab catch (with a separate field for mud crab) for crab fishing operations and as such do not provide catch data on a lift-by-lift basis. Logbooks do not contain a field into which discards or release of illegal-size or female crabs may be entered. Fishers are required to record protected species interactions in the same logbook, and a separate 'Species of Conservation Interest' logbook is to be introduced. Fishers are not required to record bycatch or byproduct.

DEH considers there is scope to improve the logbook recording system through the inclusion of a more accurate effort measures (e.g. pot lifts) and through the requirement of discards reporting (**see Recommendation 12**). DEH suggests that as part of the review of management arrangements, to be conducted as part of the management planning process, DPI&F review the existing information collection system to ensure it provides more comprehensive information.

Recreational harvest data are obtained through a biennial survey. An estimate of total recreational fishers is obtained through telephone surveys and selected fishers agree to fill out a diary for a year, although considerable attrition occurs during the year. Three such surveys have been conducted. Preliminary estimates from the 2002 survey indicate that between 940 t and 1050 t of mud crab were harvested by the recreational sector. Additional information on recreational harvest has been obtained through the National Recreational and Indigenous Fishing Survey (NRIFS), which collected information over the 2000-2001 period. NRIFS data indicates that 585500 crabs (approximately 585 t) were harvested by the recreational sector and 12874 crabs (approximately 13 t) were harvested by the indigenous sectors. It is important to note however that data on indigenous take was only collected for Northern Queensland - north of Townsville, and may not be indicative of true indigenous harvest levels.

DEH is concerned that the data validation mechanisms in place for the fishery are limited as there is no validation of commercial logbook data. In view of the high degree of reliance placed on fishery dependent – particularly catch and effort - data in routine monitoring of the fishery, the lack of catch and effort data validation is an issue of concern. Validation of commercial fishers' catch data recorded in logbooks should be undertaken as a priority. DPI&F is considering introducing a generic buyer's returns logbook which, if introduced to this fishery, may provide some validation of catch. Validating effort in the fishery may prove more problematic and as a first step, DPI&F should investigate ways in which unvalidated effort data can be addressed.

Recommendation 7: *DPI&F to develop a system to ensure that catch data collected in compulsory logbooks is validated on an ongoing basis and to investigate methods for documenting and validating effort in the fishery.*

There are three main sources of fishery-independent data collection. The long term monitoring program (LTMP) commenced in 1999 to acquire fishery independent data on stock status and key habitats, and to monitor major fishery species. The mud crab component samples a total of 64 sites, with foreshore, mouth, mid- and upper estuarine habitats samples in each of the sixteen rivers distributed throughout the coastline. Gear and methods are reasonably consistent with commercial operations. Bycatch recording has recently commenced in the LTMP. Data obtained in the LTMP are used to identify changes in the stock (relative abundance, population dynamics). As the program has been running for only four years, trends are not yet apparent. The LTMP is not used to validate fishery-dependent data.

Fishery-independent data are also obtained from DPI&F's Tropical Resource Assessment Program (TRAP), established in 1995 to develop models describing stock dynamics for northern Queensland fisheries. Phase One of TRAP concluded in 1999. A habitat-alias model for mud crab biomass estimation was developed during that phase and applied to Albatross Bay in the Gulf of Carpentaria. Two reports on the application of the model and containing preliminary estimates of mud crab abundance are available. The reports suggest the stock in Albatross Bay is likely to be fully exploited.

The third source of fishery-independent data is individual research projects completed by DPI&F or other management agencies, or research providers. These projects include the large scale collaborative project between the Northern Territory Department of Business, Industry and Resources Development (NTDBIRD), the Fisheries Research and Development Corporation (FRDC) and DPI&F (the NTDBIRD-FRDC-QDPI project) to identify mud crab habitat using remote sensing techniques and to estimate crab abundance in habitat. This research is applying essentially the same habitat-alias model developed through the TRAP. Another significant ongoing research project is the genetic analysis which suggests two clades exist.

DEH considers that the research conducted in the fishery is potentially useful for refining understanding of mud crab biology and developing management responses, but notes that the three main projects all are relatively recent endeavours and have yet to deliver clear results. Other research conducted in the fishery during the past twenty-five years includes some work into genetics, aspects of the general biology and fishery for mud crab, disease affecting mud crabs, and analysis of marketing mud crabs. While these areas of research have refined understanding of the fishery and target species, a more strategic approach into mud crab

biology, distribution and fishery interactions would appear prudent. The submission notes that a three-phase 'Five-Year Research Strategy for Australian Mud Crabs' has been developed by the Mud Crab Workshops to maximise research potential and minimise duplication. That strategy applies to and is supported by all jurisdictions in which mud crab are harvested, but the submission is silent on whether it has attracted ongoing funding. DEH considers that the research strategy is a useful approach and encourages its support by funding organisations. DEH further considers that research requirements in the fishery include a more robust understanding of the stock dynamics, but also believes directed research into the environmental impacts of the fishery would be prudent, notably the potential impact of a skew in sex ratio. DPI&F, in its response to public comments, advises that it is investigating population sex ratio and size structure through the LTMP, and that preliminary results should be available in September 2004.

Overall, given the independent data and range of fishery independent data gathered by DPI&F, DEH considers that there is a reliable information collection system in place appropriate to the scale of the fishery. Continuation of existing data collections and research programs, combined with some extension and refinement of such activities will be important for the future management of the fishery.

Assessment

The submission states that no stock assessment model or estimate of stock size is available, and as a consequence robust assessment of the dynamics and status of the fishery currently is not possible. The submission argues that fishers systematically fish and rest local areas, and that as a result fishing is non-random, therefore models and assessments based on catch rate data are not appropriate. A stock assessment model is in development through the NTDBIR-FRDC-QDPI project, but until that is developed there is essentially no assessment of the fishery status and management relies on catch monitoring. DEH strongly encourages the completion of the project and uptake of results into the future management and assessment of the fishery.

'Condition and Trend Reports' are produced regularly and have highlighted issues relating to the reduction in habitat area and quality, and the effect of climate on the stock. Status reports using both fishery dependent and independent data are also produced for CrabMAC, but not on a regular basis. The LTMP began producing biennial status reports in 2002.

While no stock assessment exists, catch and CPUE are monitored in the fishery. In the commercial sector, effort fluctuates; it showed significant increases in 1992-1993 and 1996-2000, but has since decreased to 1999 levels. Catch has similarly reduced from a peak in 2000 to 1999 levels. In 2002 the CPUE dropped, although still remaining within the general mean for the fishery. The submission indicates that 50% of the harvest is landed by the top 10% of boats, but is silent on whether these vessels are evenly distributed along the coast or whether they are concentrated in particular areas.

DEH notes that the drop in CPUE of 5 kg/day in 2002 at first glance does not appear significant and is within the mean CPUE for the fishery. DEH is concerned that this drop is significant relative to other declines in CPUE since 1988, and would be greatly concerned if the fishery continued to show such a decline. DEH notes that the decline appears to have occurred largely in the three northernmost east coast regions, and that the drop in both catch and CPUE suggests there may be an issue developing. DEH therefore strongly encourages

DPI&F to develop contingency management measures that can be put in place should CPUE continue to decline.

The submission notes that the total harvest (commercial and recreational) in 2002 was around 1932 to 2042 t and that without a stock assessment model it is not possible to accurately estimate the percentage of the sustainable harvest the current take represents. The submission suggests a high exploitation rate is achievable because mud crabs are resilient to fishing pressure (high fecundity, protracted spawning period, rapid growth, early maturation), and cites the independent assessment done for the NT fishery that there was little risk of recruitment overfishing even at an exploitation rate estimated to be over 70%.

The submission notes that genetic research suggests there are two clades of *S. serrata*, one in the Gulf of Carpentaria (GoC) and further westward, and one on the east coast. Current management does not take this into account, although consideration has been given to separate management arrangements for regions within the fishery. DEH believes that, in light of the probability that there are two clades of the target species separated by Torres Strait, management arrangements should treat the two clades separately. An investment warning is in place for the GoC component and this region may be subject to separate management arrangements when the management plan is developed. DEH believes that where possible, the structure of stocks should be factored into management. Given the declines in catches and potential for activation of latent effort, it would be prudent for DPI&F to develop management arrangements for the GoC independent of those applied on the East Coast.

Recommendation 8: *DPI&F to develop and implement separate management arrangements for the Gulf of Carpentaria mud crab stock by 30 June 2005.*

Potential removals from the mud crab population include direct harvest by this fishery, recreational and indigenous harvest, direct harvest of the species by mud crab fisheries in other jurisdictions and discarding of the species in this fishery.

The quantity of mud crabs harvested by commercial fishers in Queensland is obtained through compulsory logbooks. Unvalidated, fishery-dependent data on commercial catches have been obtained since 1988. The submission indicates that the recreational harvest is estimated at about the same as the commercial harvest. Data on recreational catches are from two biennial estimates and indicate a similar distribution pattern to the commercial sector, with the exception of a heavier fishing pressure in the Moreton Bay region. The indigenous take is unknown. Estimates of mud crab discards is also unknown and is addressed under Principle Two of this report.

As mentioned above, dedicated mud crab fisheries also operate in other jurisdictions. Ideally, management arrangements affecting a single stock should be under a single jurisdiction, or at least complementary across jurisdictions. DEH believes it would be beneficial, for both mud crab stocks and DPI&F governance, for DPI&F to be involved in cross-jurisdictional actions to address shared stock concerns. DEH notes that work in this area is already underway and **Recommendation 2** further addresses this issue.

One issue that is not addressed in the submission is whether technological creep is occurring, and if so, what implications this may have for management. The fact that collapsible pots are now being used in targeted mud crab fishing, which would be expected to mean more pots could be carried per boat, is less of an issue of concern due to the limitation on the number of

pots that may be carried per vessel. Nonetheless, that there has been a change in gear since the 1980s suggests some technological change is occurring. DEH suggests that DPI&F establish a means of monitoring and factoring into relevant assessments any technological creep in the fishery.

Management response

The current Queensland Mud Crab Fishery management regime aims to maintain ecologically viable stock levels through a range of input and output controls. These measures are outlined in Table 1 and Part I of this report. DEH considers that the combination of controls should ensure adequate protection of the target stocks, but notes that this is contingent upon effective compliance and enforcement measures.

Concerns were raised during the public comment phase that there is no total allowable catch in place for the fishery. DPI&F in its response suggests that management arrangements (notably the prohibition on the harvest of females and the minimum legal size) place a cap on the proportion of the total stock available to the fishery. DEH agrees that these arrangements should limit the potential harvest.

The Submission indicates that the minimum legal size of 15 cm CW is larger than that in place in Western Australia or the Northern Territory. DEH supports the use of a minimum legal size that is greater than the approximated size of first maturity of the slower-growing sub-tropical and temperate zone animals, but notes that the smaller legal sizes in adjacent jurisdictions may encourage 'laundering' of undersize animals caught in the Queensland fishery in those jurisdictions. The sale of Queensland-caught female mud crabs could similarly be done in adjacent jurisdictions. The submission does not address this eventuality however a recommendation relating to compliance and enforcement activities has been made (see **Recommendation 5**).

The submission indicates that the current management regime contains neither performance indicators nor measures. Nor are performance indicators and measures included in the management issues outlined in the 1999 discussion paper. The submission indicates DPI&F anticipates biological reference points will flow out of the NTDBIRD-FRDC-QDPI project, due to be completed in 2004 and DPI&F has advised that the proposed management plan will contain performance indicators and measures, including reference levels or trigger points. DEH considers their development to be an important factor in the assessment of the fishery and has made a recommendation to this effect (see **Recommendation 3**).

DEH notes that the number of commercial licences, while limited, includes a very high proportion of inactive licences that represent a serious latent effort issue in the fishery (468 active in 2002 out of 793, or about 59% of the potential effort). In addition, DEH considers the potential effort in the recreational fishery to be high. Management measures for the recreational sector, by focusing on gear restrictions and a very generous recreational bag limit but not limiting the number of fishers, do not adequately constrain effort. DEH is similarly concerned that there is limited data available on indigenous and illegal harvest, yet ready access to mud crab habitat and its wide distribution along the entire coast of Queensland suggest such harvest may be significant. DEH is concerned that in light of these factors, the fishery management regime does not adequately control effort and sees this as the major shortcoming of management of this fishery.

DPI&F, in its response to public comments acknowledges that latent effort is one of the most urgent issues to be addressed, but suggests the degree of latent effort is not as large as might be supposed. It notes that commercial mud crab licences are attached to primary licences that are utilised full time in other fisheries, and argues that a large number of inactive licences have never landed mud crabs and are unlikely to become activated *en masse*. DEH appreciates this dimension to the latent effort issue, but notes that there appears little in current management controls to prevent commercial licence activation and the gradual activation of licences over time would be expected to pose a risk to sustainability.

DEH notes that an investment warning for the mud crab and blue swimmer crab fisheries was issued in September 2003 as part of a longer term intention of removing latent effort in both fisheries. The investment warning was designed to limit involvement in the fishery to those with a demonstrated historical reliance and remove the potential for effort transfer from other fisheries. DEH commends DPI&F for taking this first step to address the problem but believes a longer term and clearly defined strategy is required.

Recommendation 9: *DPI&F to develop a strategy to remove or substantially reduce the amount of latent effort in the fishery, which includes clearly defined management actions linked to specific timeframes, by 31 December 2004. DPI&F to implement the strategy prior to the introduction of the management plan.*

As stated above, DEH considers the potential effort in the recreational fishery to be high but is also concerned about the ability of current management measures to adequately control existing effort in this fishery. Gear restrictions across such a vast fishery area and the generous bag limit (10 crabs per person) may not be appropriate if enforcement activities cannot guarantee adequate compliance. Management measures, by focusing on gear restrictions and a very generous bag limit but not limiting the number of fishers, do not adequately constrain effort. DPI&F in its response to public comments proposes to review the recreational fishery management regime as part of the introduction of the management plan for the commercial fishery. DEH considers this pertinent, given the level of harvest by the recreational sector and the potential for increasing recreational effort over time.

Recommendation 10: *As part of the management planning process, DPI&F to review existing management measures designed to control mud crab harvest by recreational fishers to ensure that these measures are appropriate, adequately constrain recreational effort and minimise impacts on bycatch and protected species. Should the review indicate that existing measures are not appropriate DPI&F will develop new measures in a timely manner.*

The submission argues that fishers systematically fish and rest local areas, and that as a result fishing is non-random. The references cited as demonstrating this both relate to the NT mud crab fishery, where the number of fishers and the pressure on the coastal environment are significantly less than on the east coast of Queensland. DEH is concerned that this assumption, which appears to underlie much of the fishery management, may be false. DEH therefore suggests DPI&F make its own investigation into the randomness or otherwise of fishing patterns throughout the fishery.

This concern is exacerbated by the fact that the bulk of the harvest is taken by a relatively small number of vessels. A change in fishing behaviour within this subset of fishers has the potential to profoundly impact on overall fishing effort distribution. DEH further notes that the validity of the data collection system may also be at risk from the fact that the bulk of the

catch is taken by a small number of operators. Under these circumstances, changes in fishing behaviour by these operators may have undue influence on data. DEH suggests that DPI&F develop a mechanism to manage the risk that changes in fishing behaviour by the small number of operators taking the bulk of the catch may unduly influence stock assessments and management.

Furthermore, with the concentration of commercial and recreational effort near areas of high population density there is a risk that some areas may be locally overfished. It is not clear how DPI&F manage this risk. DEH believes that this issue should be addressed, especially with the potential for activation of latent effort and increased recreational harvest. To do this, an understanding of regional stock sizes may be required, as well as confidence in catch and effort information. DEH understands that the collaborative (NTDBIRD-FRDC-QDPI) research project is expected to provide this information.

Recommendation 11: *DPI&F to identify fishery areas at risk of overfishing within two years. DPI&F to undertake independent surveys in these areas with a view to detecting any significant changes in crab abundance and take appropriate management action to address resource sustainability concerns.*

The submission indicates that there is little direct information on byproduct levels. DPI&F believes by-product levels to be minimal. Preliminary results flowing from the LTMP suggest an average non-target CPUE of about one individual per three or four pot lifts. The management regime allows any species other than spanner crabs to be retained as by-product if the operators are able to find a market.

The major by-product species is blue swimmer crab. Fishers taking blue swimmer crab as a by-product are subject to the same management requirements (e.g. size limit) as fishers targeting that species. DPI&F note that the two crab species do not generally inhabit the same habitat, blue swimmer crabs tending to be more offshore and over sandy bottoms. The submission suggests this habitat separation will minimise the risk posed to blue swimmer crabs. DEH concedes this is likely and is not aware of any sustainability concerns regarding blue swimmer crab in Queensland. In addition, the harvest of blue swimmer crabs by the pot and trawl fisheries is being assessed separately under the EPBC Act.

While total quantities of by-product may be low, ongoing monitoring of by-product is needed to ensure that changes in by-product and fisher targeting behaviour can be detected. A recommendation to improve by-product, bycatch and discard monitoring has been made and is discussed and presented in the bycatch section of Principle 2 of this report (see **Recommendation 12**).

Conclusion

DEH considers that the management regime in the Queensland Mud Crab 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 stock assessment 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 applicable to the fishery at present, although DEH notes concerns that the Moreton Bay CPUE is two thirds the fishery average, which may indicate that a sustainability issue is developing. Performance indicators and measures are required to avoid the risk of over fishing the mud crab stock off Queensland (see **Recommendation 3**). DEH notes the assessment that mud crab stocks in the Weipa region (Albatross Bay) are fully exploited, and is concerned that activation of latent effort in the fishery has the potential to push stocks into an over fished state.

Conclusion

DEH considers that the mud crab stock is 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

The submission states that there has been little effort made to quantify bycatch in the fishery on the basis that researchers and fishers believe minimal bycatch is taken. To address this gap, DPI&F has introduced bycatch monitoring to the LTMP from the 2002 fishing season. DEH supports this commitment. Preliminary data are available for the south east coast, north east coast and Gulf of Carpentaria and support the assumption that the most frequently caught bycatch species is blue swimmer crab. There is some variation in species mix between the various sites, but bycatch largely appears to consist of scalefish and other crustaceans. Bycatch data are also collected in fishery-independent mud crab surveys in northern waters as part of the NTDBIRD-FRDC-QDPI project.

The submission indicates that mechanisms have recently been instigated to obtain fishery-independent data on bycatch. Furthermore, the submission indicates that some of these data are obtained through catch sampling work undertaken as part of a research project. DEH is satisfied that a degree of bycatch information now is collected for the fishery, but is concerned that the lack of historical data will impede DPI&F’s capacity to detect significant impacts on bycatch species in a timely manner.

DEH notes that no real data are collected on fishery discards (bycatch and discarded undersize or female crab species); this issue is not addressed in detail in the submission. These data are

important for stock assessment purposes and to measure the overall impact the fishery may be having on not only the target species, but other components of the marine environment.

Recommendation 12: *DPI&F to develop a system for the collection and monitoring of information on discarded undersize and female mud crab and key bycatch species sufficient to enable identification of long-term trends in bycatch and discards. In the event that catch levels of any bycatch species or discards change, DPI&F will investigate suitable management responses.*

Assessment

The submission states that no specific assessments are made of bycatch. Some data are available from the LTMP which suggest an average bycatch CPUE of one bycatch item every three or four pot lifts, although some items are likely to be opportunists utilising the pot rather than being caught by it.

The submission also indicates that bycatch generally are likely to survive capture, as the time in captivity (during which organisms would be in the water) would no be more than twenty-four hours, and the pots themselves would inflict little damage as they operate by trapping. This assertion is borne out by preliminary results from the population surveys conducted as part of the NDBIRD-FRDC-QDPI project. Given the above and the minimal depths at which mud crab pots are set, DEH considers the rate of survivorship of released bycatch is likely to be high, providing fishers ensure time out of water is kept at a minimum. DPI&F do not consider a formal risk assessment to be warranted at this time. DEH considers that the monitoring system required under **Recommendation 12** should provide adequate information to conduct assessments in the future.

Management response

The submission indicates that DPI&F do not consider bycatch reduction measures necessary at the moment given the low bycatch levels. The submission further indicates DPI&F consider that, under current effort levels and using current gear, the fishery does not threaten bycatch species and accordingly no specific indicator species have been identified. However, should bycatch levels show a significant increase, specific management responses will be developed. DEH believes that **Recommendation 12** should ensure that the need for such management responses would be detected.

DEH notes that the management regime does not require that mud crab pots include escape gaps through which bycaught animals might escape. DEH also notes that research in the Tasmanian rock lobster fishery suggests escape gaps reduce bycatch by approximately 80% in that fishery (Frusher and Gibson, 1999). It is unlikely these data can be directly applied to the Queensland mud crab fishery and there may be valid reasons why escape gaps are considered inappropriate for mud crab pots. DEH believes it would be prudent to explore the effect of entrance funnels as bycatch reduction measures. DEH understands that DPI&F, in conjunction with the QBFP and CrabMAC, will be examining the use of escape gaps and trap entrance dimensions in the fishery, particularly in relation to the mitigation of turtle capture. DEH suggests that DPI&F consider mandating the inclusion of bycatch reduction measures (such as entrance funnels or escape gaps) in mud crab pots for both recreational and commercial sectors following this investigation.

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 monitoring 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

Provision is made in both logbooks used in the fishery for the collection of data on protected species interactions. As these are fairly generic logbooks these data cannot be traced to the mud crab fishery in particular. As a result, in the past fishery-dependent information on protected species interactions in the mud crab fishery (as opposed to all fisheries in which the logbooks are used) has not been collected in a structured form, although there is some anecdotal information that suggests minimal risk.

DEH notes that a separate Species of Conservation Interest (SOI) logbook has been developed to enable comprehensive recording of protected species interactions across Queensland fisheries and has recently been introduced to this fishery. DEH considers that this logbook will provide fishery-dependent information on interactions with protected species. DEH suggests that to accompany the introduction of the SOI logbooks, an education program for fishers be implemented to enable accurate reporting, promote appropriate handling techniques and highlight the importance of minimizing interactions with protected species.

Recommendation 13: *Within 1 year, to support the implementation of the Species of Conservation Interest logbooks, DPI&F to ensure that an education program for fishers, both recreational and commercial, is developed and implemented, to promote the importance of protected species protection and accurate incident reporting.*

DEH also notes that the data obtained from the new logbook will be from fishery-dependent sources. As there has been no formal fishery-dependent protected species data collection in the fishery in the past, a method of validating these data in the short term may be prudent to ensure that accurate information is used when monitoring levels of interaction and assessing the impact of the fishery on those species. This should be pursued across all Queensland fisheries and is not an issue unique to this fishery.

Fishery-independent data are obtained from LTMP surveys and the surveys conducted as part of the NTDBIRD-FRDC-QDPI project. In addition, researchers are required to record any interactions with protected species.

The depths at which the fishery operates suggests a minimal amount of fishing takes place in Commonwealth waters, where it is compulsory to report interactions with EPBC-protected species (Part 13 of the EPBC Act).

Assessment

Protected species in the area of the fishery and which appear to have potential to interact with the gear include marine turtles, sea snakes, dugongs and possibly protected elasmobranchs such as river sharks and sawfish. The data obtained to date suggest that very few interactions take place, confined largely to entanglement of marine turtles in crab apparatus (particularly float lines). As a consequence DPI&F has not undertaken a formal assessment of impacts of the fishery on protected species, although it notes that the issue of turtle interactions is a standing matter on the CrabMAC agenda. DEH welcomes the use of a standing agenda item as a mechanism to bring forward further information on protected species interactions, and notes that in its response to public comments, DPI&F advised that at the June 2003 CrabMAC meeting the agenda item was expanded to include interactions with all protected species found in the fishery area.

While interactions with protected species are considered low in the fishery, there is some evidence of interaction with marine turtles. The potential for activation of latent effort, increasing recreational activity in the fishery and increasing abundance of certain species (cetaceans) in the fishery area may result in increases in protected species interaction. DEH believes that DPI&F should conduct a risk assessment to determine the likelihood of significant interaction with protected species and investigate possible mitigation measures for any species found to be at risk.

Recommendation 14: *DPI&F to conduct a risk assessment to determine the likely impact of protected species interactions in the fishery (including the recreational sector) within two years. In the event that a species is found to be at risk, DPI&F will investigate measures to mitigate interaction with the species, to ensure that any risks to protected species can be minimised.*

The submission recognises that the large number of pots set in the fishery (both recreational and commercial sectors) will increase the risk of entanglement. DEH concurs with this conclusion and notes that the risk of entanglement will be further exacerbated should the substantial latent effort in the fishery become activated.

It is possible that interactions with turtles will increase with high potting densities, such as those used in the NTDBIRD-FRDC-QDPI project surveys. It appears likely that high potting densities, and hence high bait densities, may attract turtles to the area. Commercial operations tend to have potting densities less than half those of the surveys, and if the above is true would be expected to have little impact. The submission makes no comment on potting densities in the recreational sector. DEH recognises that the number of pots per recreational fisher is significantly less than that per commercial vessel, but is aware that recreational fishing is likely to be more concentrated on local areas. DEH suggests that DPI&F investigate recreational potting density and assess its likely impact upon protected species as part of the risk assessment required under **Recommendation 14**.

As there are no threatened ecological communities in the fishery areas, no fishery-specific assessments into impacts on threatened ecological communities are being done or are planned.

Management response

Management of protected species interactions in the fishery relies upon the limited number of commercial fishers and pots, combined with the relative frequency with which pots are checked. DEH concurs that this may be an appropriate approach to managing protected species interactions, provided active effort levels remain as they are at present. DEH believes that, while it is unlikely that the fishery will have a significant impact on protected species, there are minimal data available to demonstrate that this is the case.

DEH believes that the introduction of the SOCI logbooks, the education program required under **Recommendation 13**, the risk assessment required under **Recommendation 14**, and the data validation system required under **Recommendation 7**, should improve knowledge and data reliability over the coming years.

The management response is to continue to collect fishery-dependent and fishery-independent data. DEH notes that the LTMP data are comparable with commercial operations, but that the NTDBIRD-FRDC-QDPI survey data are not because they use a more intense potting regime that will affect interactions. DEH further notes that the absence of validation of logbooks and the general sensitivity to reporting capture of protected species brings into question the reliability of fishery-dependent data.

Closures (e.g. marine protected areas) within the fishery area also should reduce the potential for interactions with protected species. The submission is silent on what proportion of the fishery area is subject of closures, although a number of areas are closed to fishing under the marine parks zoning regulations.

DEH notes that Dr Col Limpus, a leading marine turtle biologist, has been requested by CrabMAC to examine pot entrance and escapement dimensions to find optimal sizes for excluding marine turtles and other bycatch species. DEH welcomes this initiative and believes that with industry's cooperation, regulation of pot openings could be a useful protected species interaction mitigation measure.

Current management arrangements generally are consistent with all threat abatement plans, national plans of action and recovery plans. DEH notes that one potential interaction, which is not addressed in the submission, is with EPBC-protected sawfish or river sharks. These species are believed to be in the area of the fishery (i.e. estuaries, rivers and nearshore habitats of tropical waters), and are the subject of a National Plan of Action currently under development. Sawfish in particular are susceptible to net-based fisheries and there appears some potential for mud crab bait netting to interact with these species, however there are no data to confirm this. DEH suggests that DPI&F, in monitoring protected species interactions, ensures interactions with river sharks and sawfish are also monitored.

DEH considers that, should interactions increase or be found more prevalent than originally thought, DPI&F would develop management strategies to address the impact of the fishery on such species.

There are no declared threatened ecological communities in the mud crab fishery area, and therefore these provisions in the Guidelines are not applicable.

Conclusion

DEH notes the number of interactions with protected species in this fishery is low 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 suggests that appropriate actions be undertaken to ensure the fishery avoids mortality or injury to these species and avoids or minimises impacts on threatened ecological communities.

Recommendations have been developed to ensure that the risk of unacceptable impact on protected species is 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

The submission indicates that available data suggest the impact of the fishery on the environment generally is likely to be low. Sources of data include fishery logbooks, the LTMP, the NTDBIRD-FRDC-QDPI project and other research work, and anecdotal advice. DEH understands that although little effort has been directed to accumulate data on environmental impacts, some may be obtained from the LTMP and other research work. An examination of the logbooks sheets given as appendices to the submission suggests they would not provide information on impacts on the general environment.

The NTDBIRD-FRDC-QDPI project will generate information on mud crab habitat. It is possible the project will be extended to include a comparison of fished and unfished areas, although the level of support for this proposal is not clear. DEH considers a comparison of fished and unfished areas to be a useful approach in estimating impacts of a fishery upon the marine environment generally. DEH therefore strongly recommends that DPI&F actively promote and support the proposed comparison of fished and unfished areas to estimate the impact of the fishery on the broader marine environment as a priority.

DEH is concerned that, notwithstanding the fact that mud crabs mature rapidly and are highly fecund, the current high levels of harvest and potential for even greater effort through activation of latent effort may have long-term impacts on the marine environment. DEH notes that there is no trend information on bycatch or other impacts to suggest whether or not the fishery impacts on the marine ecosystem are at a constant level, rising or falling. DEH is concerned at the lack of information collection and research covering the fisheries 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

DEH recognises that, as in most pot fisheries, the potential of the mud crab fishery to impact unacceptably and unsustainably on the environment generally is considered low. As a consequence, DPI&F has not conducted a formal risk assessment of these issues in this fishery.

Impacts are assumed minimal because mud crab pots are relatively lightweight and stable, pots are checked on a daily basis and are moved regularly. Impact on the marine environment is further reduced by protection afforded mangroves and seagrasses. DEH concurs that the fishing gear generally is not likely to pose a significant risk to the physical environment, although in areas of high tidal flux there may be potential for some dragging along the substrate to occur.

The impact of the fishery on ecological communities, related species and the structure and productivity of food webs is unknown. Little work has been done on the trophic role of mud crabs. The submission indicates that the main potential threat to the marine environment is the removal of a large quantity of male mud crabs, and cites work by Walters (Walters, 1996, cited in the submission) that suggests it would be possible to harvest the entire legal-sized biomass of mud crabs without crashing the fishery. The rationale for this is that undersized crabs grow fast, although DEH notes that this would require a high level of redundancy in the system that has yet to be proven.

The submission suggests there have been no noticeable substantial changes resulting from the fishery. Kailoa *et al* (1993) note that juvenile mud crabs prey on zooplankton, benthic molluscs and crustaceans, and that adult mud crabs prey on bivalve and gastropods, small crabs, and polychaetes. As mud crabs are generalist feeders, a significant degree of redundancy may be reasonable and other predators may be expected to fill any gap created by mud crab removal. Mud crabs are prey to sharks, crocodiles, turtles, large fish (eg cod and grouper), and herons (Kailoa *et al* 1993). The submission identifies no detrimental effects on those species despite the large removals of mud crabs through the fishery. No estimate has been made of the ratio of undersize to legal size mud crabs, nor of the amount of virgin total biomass left in the marine environment after fishing removals. DEH suggests that DPI&F undertake work to assess the risk of removing large quantities of mud crabs from the ecosystem. Particular attention should be given to identifying the impacts on ecologically dependent and related species.

Ghost fishing generally is not considered an issue, in part because the collapsible pots in use deteriorate rapidly and must be replaced about twice a season. In addition, pots (particularly in high flow areas) become clogged with debris, and animals are not attracted to the pot unless there is bait. DEH considers that there is a risk of a lost pot becoming re-baited by animals which enter it and are unable to escape. DEH notes that work has been done on ghost fishing in the blue swimmer crab fishery in Moreton Bay. DPI&F in its response to public comments undertakes to review the result of that analysis as a guide to further future research, but that no similar research is planned for the mud crab fishery. DEH recommends DPI&F consider extending such work into the mud crab fishery. DEH believes similar research should be conducted in this fishery.

Recommendation 15: *DPI&F investigate the effects of ghost fishing by lost or discarded mud crab apparatus within two years.*

Water quality and air quality are not considered at significant risk from the mud crab fishery operators due to the gear used and small vessels operating in the fishery.

Management response

The submission indicates that no management actions or strategies are in place specifically to address the effect of the fishery on the marine environment generally. The nature and scale of the fishery causes little impact to the physical environment, however, the impact of removing large quantities of mud crab on the ecosystem is unknown. The management regime makes no provision for contingency planning if the fishery is found to be having system impacts.

QDPI relies upon existing monitoring programs and the NTDBIRD-FRDC-QDPI project to identify changes in bycatch and habitat. The submission indicates DPI&F will develop management responses if actual or potential threats are identified.

As the fishery area contains Commonwealth waters, operators are required to comply with the International Convention on Marine Pollution (MARPOL). The submission is silent on specific actions and requirements in the fishery related to the prevention of marine pollution from vessels. Given the nature and scale of the fishery DEH is satisfied that the fishery is unlikely to be in breach of MARPOL obligations.

DEH considers that the future management of the fishery would be enhanced if a specific system based management objective relating to ecosystem impacts were to be developed. Such an objective would also form the basis for the development of performance indicators and measures relating to ecosystem impacts. The need for ecosystem based objectives, performance indicators and measures has been addressed through **Recommendation 3**.

Conclusion

DEH considers that the fishery is conducted in a sufficiently precautionary manner to minimise the impact of fishing operations on the ecosystem generally. A recommendation and a number of suggestions have been developed to ensure that the risk of significant impact by the fishery on the marine environment generally is minimised in the longer term.

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LIST OF ACRONYMS

CPUE	Catch per unit effort
CrabMAC	Crab Fisheries Management Advisory Committee (Queensland)
CW	carapace width
DEH	Australian Government Department of the Environment and Heritage
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FRDC	Fisheries Research and Development Corporation
GBRMPA	Great Barrier Reef Marine Park Authority
LTMP	Long Term Monitoring Program
MARPOL	International Convention for the Prevention of Pollution from Ships
NRIFS	National Recreational and Indigenous Fishing Survey
NTDBIRD	Northern Territory Department of Business, Industry and Resource Development
OCS	Offshore Constitutional Settlement
QBFP	Queensland Boating and Fisheries Patrol
DPI&F	Queensland Department of Primary Industries and Fisheries
SOCI	species of conservation interest
TRAP	Tropical Resource Assessment Program
UNCLOS	United Nations Convention on the Law of the Sea
WHA	World Heritage Area
WTO	wildlife trade operation