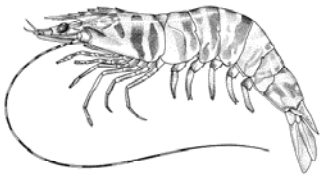
Stock Assessment of the Torres Strait Tiger Prawn Fishery (*Penaeus esculentus*)



Tiger prawn

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Non-technical summary

This report provides an update and refinement of the 2003 stock assessment of Torres Strait tiger prawns (O'Neill *et al.* 2005). It addressed specifically the recommendations from the 2003 independent stock assessment review (Table 1.1.1) and reinforced the scientific information provided to the Torres Strait Protected Zone Joint Authority (PZJA).

The Torres Strait Prawn Fishery is located to the east of the Warrior Reef complex within the Torres Strait Protected Zone (TSPZ), and in the defined 'outside but near' areas (Figure 1.2.1). It is the most valuable commercial fishery in the Torres Strait with an annual value to fishers of A$24 million. The prawn harvest consists mostly of the brown tiger prawn (*Penaeus esculentus* ≈ 650t) and the less valuable blue endeavour prawn (*Metapenaeus endeavouri* ≈ 1000t), with a minor catch of red spot king prawn (*Penaeus longistylus* ≈ 70t). The trawl fleet is mobile and at present consists of about 77 Australian vessels that operate both in the Torres Strait and on the Queensland East Coast. Seventeen of these vessels are licensed to operate in Australia's Northern Prawn Fishery. Although a total of 13,570 days of fishing access were allocated to Australian vessels in 1993 based on past fishing history, this effort cap has never been reached with maximum of about 12,000 days ever fished. Although it has been possible for up to eight Papua New Guinea (PNG) trawlers to seek endorsement to fish in the Australian area of the TSPZ and there are an additional three licences available for Torres Strait Islander participation in the fishery, none of these entitlements have been utilised.

The efficiency of this fishery increased considerably between 1980 and 2003. There have been increases in most of the general vessel characteristics, including average engine horsepower, gearbox ratios, trawl speed, fuel capacity and consumption, and adoption of propeller nozzles. The configuration of the nets towed had also experienced change characterised by a strong move to use of quad gear. Similarly, the use of flat otter boards had declined over the past 20 years particularly being replaced with louvre/kilfoil or bison type boards. Global positioning systems, computer mapping softwares, and bycatch reduction and turtle excluder devices are now fully adopted (100% of vessels). These changes and adoptions have resulted in fishing power for tiger prawns increasing at an average rate of 1.39% each year.

Average catch rates of tiger prawns, standardised for annual increases in fishing power, declined from 1980 to 1994. They stabilised between 1995 and 1999, and increased marginally each year from 2000 to 2003. The tiger prawn stock assessment, based on these catch rates, used two modelling approaches - a monthly delay difference model and an annual surplus production model. The monthly delay difference model predicted that biomass declined between 1980 and 1989, but varied around the population size that supported maximum sustainable yield (B_{MSY}) between 1990 and 2003. The delay difference model indicated the 2003 biomass was above B_{MSY}. Estimates of maximum sustainable yield (MSY) and fishing effort (E_{MSY}) were 606 and 676 tonnes, and 8245 and 9197 boat nights in 2003, for the Ricker and Beverton-Holt spawner-recruitment relationships respectively. The surplus production model predicted a declining "one-way-trip" of exploitable biomass for Torres Strait tiger prawns, and the 2003 biomass was at about $B_{MSY.}$ Calculations of maximum sustainable yield were comparable to the delay difference model. The fishery independent index of tiger prawn recruitment from February/March between 1999 and 2002 showed high agreement to the standandardised fishery catch rates and the delay difference model.

In July 2005 a workshop was run to allow fishers, scientists and managers to collaborate on the development of alternative management strategies that were likely to result in the sustainable harvest of Torres Strait tiger prawns while permitting some additional fishing directed towards endeavour prawns in southern Torres Strait waters (> 10°S). The main proposal discussed and developed at the workshop was the strategy of using two trigger points to control the allowable effort in the fishery while leaving the allocated fishing days unchanged. The first trigger point would activate a spatial closure aimed at reducing the impact of any further fishing on the tiger prawn spawning stock and the second would close the whole fishery to limit the total annual tiger prawn catch to a sustainable level.

Simulations of various fishing strategies showed that from 2003, when the tiger prawn biomass was above B_{MSY} (the biomass which supports maximum sustainable yield), fishing at 80% E_{MSY} would be effective at maintaining tiger prawns above B_{MSY}, but not exceedingly, resulting in lower risks of over fishing, maintaining harvests and improving catch rates. Fishing for tiger prawns at E_{MSY} and allowing extra effort for endeavour prawns had higher risk of tiger prawn biomasses falling less than B_{MSY}, higher variation between annual harvests and lower catch rates.

The overall key objective in undertaking this study was to reinforce the scientific advice provided to the Torres Strait Protected Zone Joint Authority (PZJA). This project successfully achieved this by updating the tiger prawn stock assessment to 2003. In total 16 out of 21 of Dr Die's high, medium and low priority recommendations were incorporated into the assessment (Table 7.1.1). Of the five recommendations not completed, three were being addressed by the Torres Strait CRC task 1.5, the collection of landings data for the years prior to 1980 was not feasible as we were unable to locate any operators from that period who had retained their catch records and the recommendation to use a target reference point of either 75% or 80% E_{MSY} was a management recommendation yet to be employed. After incorporating the recommendations the results from the updated assessment were the same as from O'Neill *et al.* (2005) in terms of biomass ratios between 1980 and 2001 and estimates of MSY.

KEYWORDS: Fishing power, effort creep, standardised catch rates, prawns, otter trawling, regression analysis, stock assessment, reference points, management strategy evaluation.

1 Introduction

1.1 Background and need

In October 2003 the results of the Torres Strait component of the Fisheries Research and Development Corporation project (FRDC 1999/120) 'Reference point management and the role of catch-per-unit effort in prawn and scallop fisheries' was presented to industry, managers and other stakeholders in the Torres Strait prawn fishery (O'Neill *et al.* 2005). This project was successfully completed between 1999 and 2003 by researchers within the Department of Primary Industries and Fisheries (DPI&F), Queensland. This research investigated ways of standardising catch rates provided from logbook catch records, developed stock assessment models for the eastern king, saucer scallop and Torres Strait tiger prawn trawl sectors, and examined a range of model-based and data-based reference points. This three-year project represents the most significant contribution to the assessment of Queensland's and Torres Strait's trawl stocks. The reasons are as follows:

1. The Report included, for the first time in the assessment of these stocks, the application of internationally recognised fisheries stock assessment reference points, including Maximum Sustainable Yield (MSY), measures of the effort associated with MSY (E_{MSY}), and fractions thereof, including $2/3E_{MSY}$ and $3/4E_{MSY}$. The work contrasts these with the reference points currently prescribed in the Queensland Trawl Fishery Management Plan; referring to the "70% of average catch rates". The work reported on the accuracy and robustness of both the model-based and database reference points.
2. For the first time in the Queensland and Torres Strait trawl fishery, annual changes in fishing power were quantified and published in *Fisheries Research 65;(O'Neill et al. 2003)*. While fishing effort is recorded in logbooks, it had never before been adjusted to take account of increases in fishing power due to such technologies as vessel size, GPS, try gear etc. The increases in fishing power were measured and applied to standardise fishing effort and catch rates for each trawl sector.
3. For the first time in the trawl fisheries management, stock-recruitment relationships were considered in stock assessments and management evaluations.
4. Never before have management alternatives in the Queensland and Torres Strait trawl sectors been modelled to predict future outcomes on sustainability, industry catches and management activity. The management modelling scenarios presented in the report give managers and fishermen information about likely impacts of future management decisions.
5. Finally, the project had gone to considerable lengths to incorporate uncertainty in key population parameters and model outputs, certainly more than any other previous modelling of the trawl stocks. It has achieved this by extensive use of Monte Carlo and boot-strapping methods.

In October 2003 Dr David Die, an international recognised stock assessment expert from the Miami University (Florida, USA), independently reviewed the Torres Strait component of the above project ("Review of the Stock Assessment of the Torres Strait Prawn Fishery"; (Die 2003). He provided a number of recommendations aimed at improving the stock assessment and addressing the concerns of fishers about the model and the data used. In his review Dr. Die states…

"*The new assessment presented by O'Neill and Turnbull (2003) are a considerable improvement from the previous assessments. Major improvements were obtained by:*

- *Extending the estimation of relative abundance to a larger time period (1980-2002) and updating the effort creep analysis for the same period*
- *Using a seasonal delay-difference model that captures more of the information contained in the data and allows for the explicit incorporation of stock recruitment functions in the assessment.*
- *Conducting extensive estimation of the uncertainty in the assessment results through bootstrap analyses*
- *Developing a framework for quantitative evaluation of management strategies*

The scientific advice produced by such assessments is therefore of high quality and is sustained by the use of state of the art statistical analysis and simulation modelling.

As for any assessment there are improvements that can be made in the analyses and presentation of results. Although some of the improvements suggested may change the details of the advice on stock status it is unlikely that the general conclusions reached by the recent assessment will change."

The purpose for this report was to address Dr David Die's list of recommendations to strengthen the assessment by O'Neill *et al.* (2005). The assessment estimated a potential large reduction in the current allocations of fishing nights to operators. The fishery managers have expressed an urgent need to address the key recommendations made by Dr Die, so as to maximise the confidence in the results obtained from the assessments. All recommendations from the review were qualified with the priority that the reviewer placed on them. Table 1.1.1 lists the high, medium and low priority recommendations.

The most important priority recommendations from Dr Die relate to estimating fishing power and standardising catch rates. For this report we re-estimated average annual changes in fishing power (effort creep), compared alternate analyses to standardised catch rates, and applied the delay difference and surplus production models with these estimates of relative abundance. A further key high priority recommendation was that the working group should develop target objectives for the fishery and alternative management strategies to reach the targets and that these strategies should be evaluated by the Management Strategy Evaluation (MSE) method. This recommendation was addressed by means of an industry workshop aimed at developing a more strategic management of the fishery that would potentially allow more fishing effort to be applied to the endeavour prawn stock whilst ensuring that the tiger prawn stock was not overfished. This may reduce the impacts of the proposed effort reduction on industry whilst ensuring that the tiger prawn harvest was sustainable. The outcomes of the workshop were simulated using the delay difference model.

Collation and incorporation of catch and effort data administered by Papua New Guinea was a recommendation arising from the review. Although Dr Die rated this as a low priority, the Australian prawn operators have repeatedly requested that PNG data be added into the stock assessment. Whilst it is unlikely that the inclusion of this data will significantly change the results from the models, this recommendation still holds a very significant level of political weighting.

Table 1.1.1 The David Die stock assessment recommendations. High priority was given to those recommendations that, when followed, may significantly change the scientific advice provided and that can be followed up in a short space of time (weeks). Medium priority was given to those recommendations that can lead to significant change in the advice but that require months of work. Low priority was given to those that are unlikely to change the advice. * flags that the priority was not addressed due to time constraints.

Assessment Component and Priority	Recommendation
Catch Data	
1. Medium*	That unloading data are obtained, even if it is only samples for some vessels, and that a GLM model is run to determine the significance of correction factors for estimates of landings obtained from logbook data. Factors to be considered in the GLM model could be month, year, area (may not be possible if vessels fish in more than one area during a single unloading period), and possibly type package used to pack prawns. The dependent variable should be the logbook catch for a vessel and the independent the unloading catch for the same vessel in the same period of time. If enough size-grade data is present in logbooks size grade could be also used as a factor. If yearly factors are significant this may put into question the catch rate estimates from logbooks.
2. Low	Data from the PNG side of the fishery should be collated to estimate the annual catch harvested by PNG boats so that this catch can be included in the assessments made by the Torres Strait Prawn Working Group. Also cpue data should be collected so as to start developing indices of abundance from the PNG side of the fishery.
3. Low	That possible biases (time shifts and smoothing) in the procedure to allocate unloading data to particular time periods is investigated by using data for vessels/years when both unloading and logbook data is available.
4. Low*	Analyse commercial grading data from logbooks and unloading data to determine the size composition of the catches to initially estimate annual indices of the timing of recruitment. Use these data on recruitment timing in the delay difference model. If the grading data is of high quality and abundant, develop catch at size matrices to develop a fully size/age structured model.
Fishing Power and Standardised Catch Rates	
5. High	That the current database on chain size is used to calculate the expected reduction in fishing power resulting from chain size reductions that occurred in 2001.
6. High	That a 4% decrease in fishing power as a result of the decrease in net size that occurred in 2002 is adopted as the best available estimate for this effect and used in the stock assessment.
7. High	That the effort creep schedule is re-estimated for the last two years and that the delay difference models be run with the new estimates of relative abundance for 2001 and 2002.
8. High	Use a unit of fishing effort in the past (e.g. 1980 effort unit) as the reference for effort creep calculation and reporting. Include a table with the annual nominal effort and the effort corrected for effort creep (in appropriate reference-year units) in the all the reports of the assessment.
9. Medium	That a standardized catch per unit of effort be estimated for endeavour prawns to estimate relative abundance for this species. Use GLM method as for tiger prawns.
10. Medium	That a new GLM is carried out to estimate standardized catch per unit of effort by creating two new area strata as follows: a) Split northern strata in two by choosing grids that are inside the Warrior reef closure and outside of it, and b) split southern strata in two by choosing grids that are in the areas where the highest king prawn catches exist (closer to the reef), To examine if the resulting standardized catch per unit of effort is significantly different to the one obtained in the current assessment.
11. Medium	That the results from the GLM used to estimate effort creep factors are used to estimate an alternative standardised cpue series. This series should be compared to the one used in the current assessment (corrected for effort creep) and used as a sensitivity analysis.
12. Medium	That a new GLM is run by using only data from vessels that were providing data in the early part of the season. This series should be compared to the one used in the current assessment and used as a sensitivity analysis.
13. Medium	That the vessel characteristics database is updated every year.
14. Medium*	That old data on landings and catch rates are sought from industry for the period prior to 1980 and these data are used to develop priors for the stock biomass ratio in 1980.
Stock Models and Management Strategy Evaluation (MSE)	
15. High	Further testing of the production model implementation in MATLAB and EXCEL should be made and comparisons to other implementations of the production model implementations such as ASPIC, BIODYN (Punt and Hilborn 1996) or FISHLAB (Kell and Smith 2000) should be conducted to confirm that the production model results are repeatable.
16. High	That only production models with all data be considered to estimate reference points. Also, that the best fits to the data, those of the Fox model, be considered as offering optimistic views of the productivity of the stock.
17. High	Use delay difference model as base case for assessments. Use B_{MSY} and E_{MSY} as limits reference points. The prawn biomass should always be maintained above B_{MSY} and the standardised effort below E_{MSY}.
18. High	Use a target reference point of either 75% or 80% E_{MSY}.
19. High	Working group should develop alternative management strategies to reach target reference points. These strategies should be evaluated by the MSE method.
20. Medium	Management strategies to be tested need to be develop by working group MSE should then be repeated for those strategies
21. Medium	The status quo strategy should be estimated with the 2001 and 2002 data, not the 1999-2002.

1.2 Description of the trawl fishery

1.2.1 Main features of the 2003 fishery

Target catch composition	Tiger prawn (45%), endeavour prawn (48%) and king prawn (7%)
Total catch and effort	1,597 t from 9,000 days of effort; observed CPUE 177 kg/day
Current value	$23.5m, both export and domestic markets
Current fleet	77 Australian licensed vessels assigned 13,486 fishing days
Papua New Guinea licences	Potentially 8 licences equating up to 2,200 fishing days
Torres Strait Islander licences	Potentially 3 licences equating up to 825 fishing days
Location	Torres Strait Protected Zone and outside but near area
Fishing method	Vessels <20m; quad or double otter gear, net size 80m; mesh 48mm
Main by-product	Bugs and squid
Market	Export tiger prawns to Japan and endeavour prawns to Europe. Endeavour, king and smaller tiger prawns sold domestically.
Management	Input controls: limited entry, gear and vessel size restrictions, allocated days of fishing access, seasonal and area closures.
Stock assessment	Delay difference and surplus production models.

The Torres Strait Prawn Fishery (TSPF) is a multi-species prawn fishery which operates in the eastern section of the Torres Strait Protected Zone (TSPZ) Figure 1.2.1 and the defined 'outside but near' area. It is the most valuable commercial fishery in Torres Strait with an annual value to fishers of AUD$18-23 million. A mobile fleet of about 77 Australian vessels operates both in the TSPF and on the Queensland East Coast. Seventeen of these vessels are also licensed to operate in the Northern Prawn Fishery. The main prawn-trawling ground in Torres Strait is to the east of the Warrior Reef complex, centred on Yorke Islands that form one of the main anchorages for the prawn trawl fleet. Australian-licensed trawlers can remain in the Torres Strait fishing grounds for extended periods because they are supported by mother-ship and fuel-barge supply services.

The Torres Strait licenses are transferable and have an allocation of fishing days attached to them. Although a total of 13,570 days of fishing access were allocated to Australian vessels operating in the fishery in 1993, this effort cap has never been reached. Under the Torres Strait Protected Zone Treaty Papua New Guinea is also entitled to harvest approximately 25% of the catch from the Australian area of the TSPZ and similarly Australia is entitled to harvest to 25% of the catch of the PNG area of the TSPZ. To give effect to this entitlement, an agreed number of PNG trawlers can be endorsed to fish in the Australian waters of the TSPZ for the full season (275 days). The number of PNG vessels that can be endorsed is based on the current three year average catch of Australian waters of the TSPZ plus an adjustment for Australian operators opting not to cross-border fish in PNG waters of the TSPZ. Currently up to eight PNG trawlers could be endorsed under the cross border fishing arrangements which potentially represents an additional 2,200 days of fishing effort in Australian waters. Despite the cross border fishing arrangements only a few PNG vessels have sporadically fished in the TSPZ and their area of operation has been confined to PNG waters (north of the fisheries jurisdiction line). Although three additional licences were reserved for use by Torres Strait Islanders these licences were never activated. The islander licenses were for a full season and hence represented a potential 825 additional days of fishing effort that could have been activate in the Australian section of the fishery. Although the potential effort of the Australian section of the fishery has reduced since the early 1980's the 2005 management arrangements still allowed a potential level of fishing effort that was substantially higher than both the historic annual effort and the level of fishing that is generally considered by researchers, managers and industry to be sustainable and economically viable.

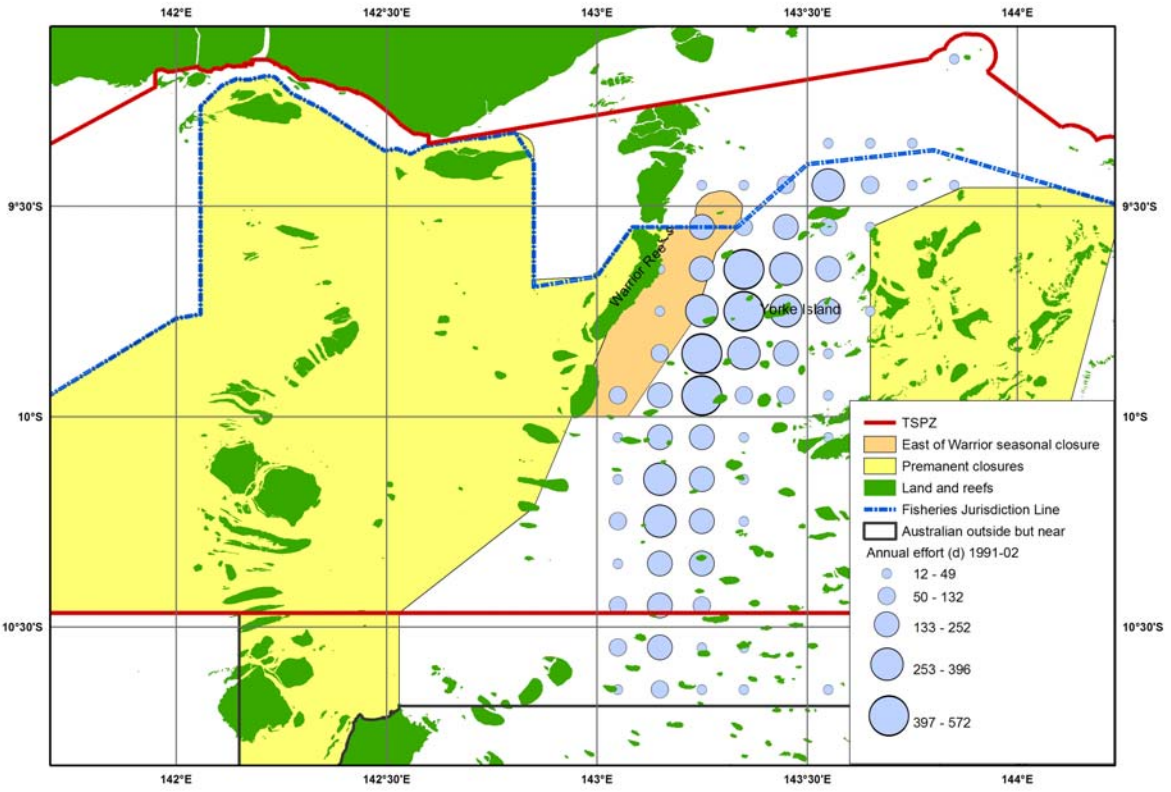

Figure 1.2.1 Location of the Torres Strait Prawn Fishery indicated by the annual fishing effort summarised by six-minute grids, the Torres Strait Protected Zone, the Fisheries Jurisdiction Lines, and the Australian outside but near area of the prawn fishery.

1.2.2 History and management

The prawn trawl fishery in Torres Strait began in the mid-1970s, extending northward from the prawn fishery along the Queensland east coast. When the Torres Strait prawn fishery began, all east coast and Northern Prawn Fishery prawn trawlers were entitled to fish in Torres Strait, effectively allowing access to all of about 1200 vessels. When the Torres Strait Treaty was ratified in 1985 approximately 500 vessels had obtained a licence to operate in the Torres Strait Prawn Fishery (TSPF).

Since 1985 the Australian and Queensland Governments under the Torres Strait Treaty have jointly managed the TSPF. In 1987 the Protected Zone Joint Authority (PZJA) introduced limited entry and licences were restricted to the 150 vessels that had any history of fishing in Torres Strait. In 1989 an industry supported freeze on licences was implemented and by June 1992 around 110 vessels were licensed in the fishery. Days of fishing access to Australian vessels, based on the maximum of previous fishing history plus 10%, was introduced at the start of 1993 and in 1994 arrangements to allow trading of licences and fishing access days were implemented. As at January 2004, there were 77 Australian licensed vessels assigned 13,486 fishing days, compared with 110 licensed vessels in June 1992 with a potential 30,250 fishing days (Kung *et al.* 2004).

Seasonal and area closures have played an important role in the management of the fishery. In 1980 the area to the west of the Warrior Reefs was closed at the request of industry, to protect juvenile prawn stocks. The first seasonal closure to trawling in the TSPF and the Queensland East Coast Otter Trawl fishery (ECOTF) extended from 1st January to 28th February 1985 and coincided with the time when small less valuable prawns recruited into the fishery. A similar closure was implemented for the 13th December 1985 to 28th February 1986. There was no closure in 1986-87 in the TSPF and ECOTF as northern-based operators were concerned that effort was being aggregated into the first months after the closure, causing a pulse fishing effect. The seasonal closure was reintroduced however for subsequent years. In 1989 a split seasonal closure was implemented; 23rd December to 15th April 1989 north of 10° 13' S and from the 23rd

December to 7th March south of that latitude. At industries request the spilt closure was replaced with a total seasonal closure from 15th December 1989 to 15th April 1990. Catches at the start of that season and the result of prawn tagging conducted by DPI&F during February and March indicated that the 1990 season opened too late, resulting in a decreased harvest. Based on research conducted by DPI&F during the late 1980's and consultation with Islanders, industry proposed the east of Warrior Reef Closure and a reduced seasonal closure from 1st December to 1st March. The combined effect of these closures allows most prawns migrating from west to east through the Warrior Reefs to reach export grade size before they are fished.

1.3 Past stock assessments

Early assessment of tiger prawns in the Torres Strait was based on estimation of the Maximum Constant Yield (MCY) produced by DPI&F in 1991 (Turnbull and Watson 1995). Research trawl data collected during the years 1986 to 1989 were used to calculate an MCY for each species. The MCY for the fishery was estimated to be 1370 t consisting of 585 t tiger prawns, 685 t endeavour prawns and 100 t king prawns. A summary of this assessment, 1992 Fishery Status Report for Torres Strait Prawns, is contained in Turnbull and Watson (1995). The second formal stock assessment was conducted in 1994 and is described in detail in Turnbull and Watson (1995). That assessment showed that a natural mortality of 0.2 per month (the value used in the 1991 assessment and widely reported in the literature) will produce an MCY for the fishery of 1,903 t, consisting of: 682t tiger prawns, 1035t endeavour prawns, and 186t king prawns. Estimates of the effort required to produce an annual fishing mortality equal to $F_{0.1}$ were 106,400 hours (88,700 - 133,300 h) for catchability estimates of 2.5 x 10^{-5} h^{-1} (2 x 10^{-5} - 3 x 10^{-5} h^{-1}). These equate to 9,900 (8,200 - 12,400) unstandardised days, as the average number of hours trawled per night in Torres Strait during the years 1998-2002 was 10.8. More recent estimates of average fishing effort required for catching maximum-sustainable-yield (MSY and E_{MSY}) of tiger prawns were calculated from more formal stock assessment methods (Table 1.3.1). The predictions compared overall suggest fishing effort, standardised to 2002 fishing power, should be below 10,000 nights. These results were produced from a range of model fits and further sensitivity results documented by O'Neill *et al.* (2005) suggest a similar tendency of sustainable fishing effort below 10,000 nights.

Table 1.3.1 Past stock assessment estimates of maximum harvest and fishing effort for tiger prawns. ^{nom} indicates unstandardised fishing effort; ^{2002} indicates fishing effort standardised to 2002 fishing power; ^{2} model assumed 1980 was at virgin stock size; $^{1.7}$ model assumed 1980 was at 85% of virgin stock size; ^{Beverton} represents Beverton-Holt spawner-recruitment relationship; ^{Ricker} represents Ricker's relationship. Note other model sensitivity results are presented in O'Neill *et al.* (2005).

Report Reference	Stock Assessment Method	Assessment Year	Management Quantity	Harvest (Tonnes)	Fishing Effort (Nights)
(Turnbull and Watson 1995)	Research Trawl Survey	1991	MCY	585	-
		1994	MCY and $E_{0.1}$	682	$9{,}900^{nom}$ (8,200 – 12,400)
	Schaefer Production Model	2000	MSY and E_{MSY}	665 (628 – 710)	$10{,}308^{nom}$ (9,131 – 13,256)
(O'Neill *et al.* 2005)	Fox Production Model	2002	MSY and E_{MSY}	643 t (607 - 689)	$11{,}353^{2002}$ (8,548 – 12,806)
(Die 2003)	Schaefer Production Model^{2}	2002	MSY and E_{MSY}	572 (374 – 630)	$9{,}235^{2002}$ (6,340 – 10,373)
	Schaefer Production Model$^{1.7}$	2002	MSY and E_{MSY}	532 (353 – 575)	$8{,}170^{2002}$ (5,091 – 8,975)
(O'Neill *et al.* 2005)	Delay Difference Model^{Beverton}	2002	MSY and E_{MSY}	698 (490 – 958)	$8{,}257^{2002}$ (5,797 – 11,333)
	Delay Difference Model^{Ricker}	2002	MSY and E_{MSY}	611 (426 – 808)	$7{,}228^{2002}$ (5,040 – 9,559)

1.4 Objectives

The overall key objective in undertaking this study was to reinforce the scientific advice provided to the Torres Strait Protected Zone Joint Authority (PZJA).

This was to be achieved by:

1. Addressing most of the high and medium priority recommendations from the independent review of the Torres Strait Tiger prawn stock assessment to minimise uncertainties in the scientific advice on sustainable fishing levels in the prawn fishery.
2. Developing via the Prawn Working Group (PWG)/ Industry Workshop, alternative management strategies to cap effort directed at tiger prawns at sustainable levels while investigating an increase or diversion of effort towards endeavour prawns.
3. Assessing the impact of the alternative management strategies developed in point two above using state of the art modelling techniques.
4. Collate the commercial harvest data from the Papua New Guinea (PNG) side of the fishery to factor into the stock assessment.

Due to circumstances beyond the control of the principal investigators the "Alternative Management Strategy Workshop" was delayed until July 2005. The outputs from this study provided a major contribution to the workshop.