

Ownership and Innovations

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Abstract. The positive relationship between innovation and an unusually high concentration of ownership is considered in relation to the Exmouth Gulf Limited Entry Prawn Fishery. Innovation has led to the adoption of improved harvesting practices and the investigation of the potential for stock enhancement. Experiences in this fishery are consistent with orthodox economic views that effective sole ownership of a fishery is likely to improve incentives for innovations that generate real economic returns, rather than shifting shares of the sustainable catch. Experiences in Exmouth are contrasted with other Australian prawn fisheries. The implication drawn for other fisheries is that cooperative behaviour in a co-management framework may achieve similar benefits.

Keywords: Limited entry, ownership, harvesting, and enhancement.

1. INTRODUCTION

The Exmouth Gulf Limited Entry Fishery is one of the best understood prawn fisheries in the world. The tiger prawn component of this multi species fishery suffered from overfishing in the late 1970's and early 1980's to recover through reduction of effort and better fishery management. The fishery is unusual in that all but one of the licences are held by one family owned corporation. The interaction of concentration of ownership and the development of innovations in fishing practices and research directions is considered. It should be noted that sole ownership refers to the exclusive right to harvest prawns for commercial purposes and does not imply ownership of the resource itself, or of any other privileges in relation to the waters of Exmouth Gulf

1.1 Description of Fishery

The Exmouth Gulf Prawn Fishery is a limited entry fishery off the North West Coast of Australia. The principal commercial species are brown tiger prawns (*Penaeus esculentus*), western king prawns (*Melicertus latisulcatus*) and endeavour prawns (*Metapenaeus* spp.). In the late 1990's catches in the fishery have varied from 771 to 1276 tonnes and the landed value of the fishery is estimated at around 15 million Australian dollars. The principal market for tiger prawns is Japan, whereas the other prawn species are generally sold domestically. The historical catch and effort data are set out in Appendix 1.

The fishery is managed as a limited entry fishery under the Fish Resources Management Act of Western Australia. A limited entry fishing regime was brought into the fishery in 1965 with an initial 17 licences with subsequent increases

to 23 licences by 1979. Subsequent industry funded buyouts have reduced the number of licences to 16. One company, M.G. Kailis Gulf Fisheries Pty Ltd, holds 15 of the licences (the vessels fishing these licences are referred to as the 'Kailis vessels') with the one remaining vessel owned by the Correia family.

1.2 Industry Structure

The catch in the Exmouth Gulf Prawn Fishery consists of prawns taken by otter trawl from vessels with lengths from 18.18 metres (60 feet) to 22.5 metres (74.25 feet). The engine power, size and type of fishing gear are strictly controlled. In this regard the head rope length (maximum distance between otterboards) and otter board size are strictly controlled.

The Kailis vessels are operated by skippers and crew under share fishing arrangements, whereby the skippers and crew share in the proceeds and risks of the season, but the company owns the vessels.

1.3 Fishing Patterns

The fishery is open from April to mid November. The fishery is intensively managed during this period with a range of area and time closures aimed at both maximizing the value of the catch and protecting tiger prawn breeding stocks. Essentially the western part of the fishery is opened early in the season with the eastern and southern parts closed until test trawls identify that prawn sizes have reached an optimum level. The optimum level is estimated taking into account catch rates, sizes and anticipated market prices. These areas are later closed when tiger prawn catch rates fall below a pre-agreed minimum, so as to protect spawning concentrations of tiger prawns in deeper waters in the centre of Exmouth Gulf.

The Kailis vessels land their catch daily to a land based processing facility. This facilitates close management of catches, especially at times of the year critical to monitoring the size of the remaining tiger prawn breeding stock. Effectively there is an adaptive management approach based on close co-operation between company managers, research staff and the skippers of the vessels.

This fishery is not considered suitable for the introduction of management by a total allowable catch and individual transferable quotas (ITQ's) for a variety of reasons. Although a stock-recruitment relationship has been found in Exmouth Gulf for tiger prawns the impact of environmental variables is still very significant. Accordingly a reasonable ITQ could not be imposed until after the commencement of the season. Recruitment for king and endeavour prawns appears to be relatively independent of the previous year's effort and there is no current need to restrict effort. The main management objective is to protect a minimum size breeding stock of tiger prawns until they have spawned and in this fishery this is most easily achieved through timed area closures.

1.4 Industry Management

The fishery is formally controlled through a series of notices issued by the Minister of Fisheries, with delegated powers to the Director of Fisheries. A ministerial advisory committee, in Australian parlance called the MAC advises the Minister. The MAC includes community representatives, fishers and researchers with an independent Chair.

MAC's have become the focal point of management for many Australian fisheries, such as the Pearling Industry Advisory Committee and the Northern Prawn Fishery Management Advisory Committee. In Exmouth Gulf the MAC has developed somewhat differently due to the dominance of the Kailis fleet. In relation to issues relating solely to the fishery the MAC principally acts to formalize acts and proposals discussed and agreed in advance between industry, researchers and fishery managers. The MAC, however, has a significant and developing role in considering the interaction of the fishery with other users of the Exmouth marine environment. In addition the MAC is a key body in the reporting to industry of expenses of research, compliance and management. These costs are fully recovered from industry and represent around 2% of the value of production. The industry also pays a levy of 0.65% to a government fund and which is effectively a royalty.

2.0 History

The special factors leading to the unusual structure of this

fishery are best understood in the context of the history of the fishery.

2.1 Pre 1981

The late Michael Kailis pioneered the Exmouth Gulf Prawn fishery in 1963. The fishery commenced with modified lobster fishing vessels principally sourced from the fishing village of Dongara some 600 kilometres to the South. When the commercial fishery commenced there was no regular road transport to the major cities and towns to the South and the town of Exmouth had yet to be founded. Initially the modified Rock Lobster vessels trawled for prawns in the closed season for lobster. This practice ceased after 1971 when rock lobster vessels were no longer permitted to operate in the fishery and the fleet was replaced with specially designed prawn trawlers. Originally all the vessels fished for the Kailis factory later changes in the structure of the fishery, including the issue of further licences saw the Kailis proportion fall to 15 out of 23.

The 1970's saw steady increases in effort through a number of factors including; issue of additional licences, increased fishing efficiency. In 1978 and 1979 record high prices were being achieved on export markets for tiger prawns. Encouraged by high prices and by federal subsidies for fishing vessel construction for larger fishing vessels (over 21 metres) four 23 metre vessels entered the fishery in 1980 to 1981.

2.2 1981-1987 Fishery Collapse

In 1981 and 1982 poor catches, especially of tiger prawns were experienced. The impact on operations was so severe that in 1982 a number of the larger vessels left the fishery early in the season because it became uneconomic to operate. In 1983 two vessels did not fish and in 1984 this increased to six. The impact was greatest on the Kailis operation, which maintained a shore based processing establishment and which had proportionately a higher share of vessels in the fishery. The tiger fishery was closed in 1983.

The collapse of the tiger prawn fishery led to the Fisheries Department setting up a concerted research program to examine the role of fishing effort and environmental factors in stock recruitment relationships and recruitment stock relationships. At the time the general view was that penaeid prawn stocks were not susceptible to overfishing, principally due to the highly fecund nature of the females.

2.3 Recovery

Recovery was a slow process. Relationships between fishery researchers and managers and industry were strained. Researchers were finding increasing evidence of increasing fishing pressure on recruitment and were

convinced of the need to significantly reduce fishing effort. The Kailis Group was then of the view that the impacts were more environmentally than effort driven. In addition the political handling of the announcement of closures had done it significant financial damage undermining both the basis of cooperation and intensifying commercial pressures to fish.

Notwithstanding these differences it was eventually accepted that; effort needed to be reduced, research needed to be expanded and fishing patterns in Exmouth Gulf needed to be modified to ensure the protection of tiger prawn breeding stocks. These objectives needed to be achieved while still allowing access to the valuable king and endeavour prawn stocks. Industry funded buy-backs reduced licence numbers from 23 to 16 by 1993. Fishery independent recruitment and spawning stock surveys are carried out under supervision of researchers to monitor the impacts of fishing pressure and to improve understanding of the fishery. Greater co-operation between industry and researchers allowed more flexible management approaches to be implemented over time.

2.3 Consolidation

At the beginning of 1993 the fishery was stable and well managed. Of the sixteen licences eleven licences were owned by Kailis, four by Nor West Seafoods Pty Ltd and one by the Correia family. The Nor West Seafood Pty Ltd licences came on the market as part of a divestiture of assets owned by the English Vestey family. The Kailis Group purchased the four vessels and found itself in the somewhat unusual position of being the owner of almost the whole of the fishery.

The initial impact of concentration of ownership was limited. The management regimes for Exmouth Gulf had already been adapted over time to maximize economic performance of the fishery consistent with prudent management of tiger prawn breeding stocks. The regimes were flexible enough to allow a combination of regulation and industry agreement to fine tune management of the fishery. One of the results of the crisis of the 1980's was the development of a good relationship between fishers, researchers and managers. There were no pressing problems and the Kailis Group had to manage the combination of vessels and crews into its operations.

3.0 Fishing Gear and Efficiency

The adoption of new fishing gear and subsequent reduction of vessels in the Exmouth Gulf Fishery has lead to significant additional financial benefits to the operators in the fishery while careful monitoring and testing has ensured

that the management controls and research into the fishery have not been undermined.

3.1 Initial discussions

On the Kailis Group taking control of 15 of 16 licences in late 1993 the Kailis Group was approached by senior staff of the Fisheries Department to discuss future management approaches. At that meeting the Fisheries Department indicated an openness to new approaches taking into account the new industrial dynamic in the fishery. At the time the view of the Kailis Group was, however, to implement minimal changes to fisheries management taking into account that:

- The first priority was the need to integrate the four new vessels and crew into a different management structure
- High level of integration between research and management meant there were few immediately obvious improvements that had not already been put into action on a cooperative basis
- Innate conservatism of the fishing sector and many staff to radical improvements.

The key issue was the drive for increasing financial performance and not as a result of low profitability, collapses in the fishery or significant increases in fishing effort.

3.2 Initial Phase of Considerations

Then initial phase of considerations of technical improvements with fishing gear changes occurred within the Kailis Group in late 1995. The focal point of the initial discussions within the senior management team was the difficulty of improving the financial results from Exmouth given a sustainable harvest strategy. By this stage the Kailis Group had integrated the former Nor-West Seafood vessels, the overhead associated with the land based facilities in the region and a highly variable catch from the fishery meant the Kailis Group was always keen to improve operations.

Discussions continued within the Kailis Group until 1997. The objective was to reduce the number of vessels in Exmouth Gulf, but maintaining effective effort and catches. Basic spreadsheet analysis was carried out on effort changes possible within the then effort controls on the fishery. There were a number of minor changes possible including increasing effective engine power, changing net materials and moving to stainless steel chains.

The problem with marginal fishing efficiency improvements is that they would be hard to assess, and in any event would likely lead only to one vessel being dropped from the fishery. In addition these changes generally involved increasing costs undermining the economic rationale. After many discussions and arguments (occasionally until late in

the evening) it was tentatively agreed to trial increasing net headrope lengths on a limited number of vessels while dropping a vessel from the fishery.

A preliminary assessment of the financial viability of various options was made. This involved simple spreadsheet analysis and constructing 'what if' scenarios based on different assumptions as to the efficiency of the modified vessels, and the extent to which any lost catches would be caught by the remaining vessels. Based on what was known about the tiger prawn fishery there was a high degree of confidence that total tiger prawn catches were unlikely to decline regardless of the changes implemented. As described above the tiger prawn fishery was usually closed for much of the year to prevent overfishing so even if effort was less efficient, the main result would be to increase the length of time the trawlers were targeting tiger prawns rather than a reduction in catch.

In relation to king and endeavour prawns the issue was slightly different. These prawns did not exhibit the more predictable aggregating characteristics of tiger prawns. In relation to these fisheries the main concern was that an increase in headrope length would lead to a decrease in efficiency per unit of net used.

3.3 Industry/Government Discussions and Agreement

The first task in implementing change was to initiate discussions with the government researchers and managers involved in the fishery. From the beginning the Kailis Group's approach was for no overall increase in effort with increased head rope length for a number of vessels traded off in return for the temporary removal of one vessel from the fishery.

Initial discussions in 1997 with Fisheries Research staff including the Director, Dr Jim Penn, lead to a modification of the initial trials in 1998 to include the use of quad gear as well as increases in head rope length. Quad gear (confusingly sometimes also called double gear) involves two nets on each side of the vessel connected by a sled in the middle. This provides for three towing points being the two boards and the sled rather than the two otterboards. Sterling(1997) calculated that theoretically the relative swept area per unit of time using the same power engine could be up to 55% greater with quad gear compared to double gear.

3.4 1998 Results

The next phase of consultation was discussion with the Exmouth Gulf prawn MAC as to the introduction of the system. A recommendation from the MAC lead to the Minister approving the appropriate exemptions for the 1998 prawn season.

The changes implemented in the 1998 season were to increase the headrope length by 20% on two vessels, from 15 fathoms to 18 fathoms and the introduction of quad gear on one vessel which meant an increase in headrope length of 33%, from 15 fathoms to 20 fathoms.

Two sets of comparisons were made. The modified vessels were compared to the performance of the rest of the fleet over the whole year, and side by side trawl comparisons. In this regard two measures are important the effectiveness of the vessel towing the modified gear in catching prawns and the efficiency per unit of headrope length.

In the side by side fishing experiments the vessel with quad gear was between 17 and 27% more effective. Comparing the catch rate over the full year the quad gear was between 16 to 22% more effective than standard gear, but the standard gear was between 8-13% more efficient. Interestingly in the side by side fishing comparison the large double gear and the standard gear vessels caught similar amounts of prawn, in other words were similarly effective and per unit of headrope length the standard gear was between 19 and 27% more efficient than the enlarged gear. From both the side by side and annual catch data there was no evidence of a change in species composition due to any of the gear changes.

The results indicated that in its first year of operation the quad net configuration was considerably less efficient than it theoretically could have been and less efficient than standard gear.

3.5 Results 1999

The 1998 results were considered sufficiently promising to warrant further experimentation with quad gear. In the opinion of the skipper of the quad gear equipped vessel, John Prolongeau, efficiency improvements on the use of quad gear were likely, especially if the net head rope length of each of the nets was reduced slightly from 5 to 4 1/2 fathoms. In 1999 five vessels were selected for adaptation to quad gear. Again a vessel was withheld from fishing in 1999 to ensure that effective effort was not increased.

In 1999 comparative analysis was again undertaken comparing the performance of vessels with quad gear against those with standard gear both over the whole year and engaged in monitored side by side test fishing. In gauging the overall performance of the vessels with modified gear they were compared with the vessel's relative performance as against the fleet in previous seasons (1995-1998) was taken into account. This allowed a better estimate of what the vessel would have caught if it had retained standard gear and maintained its relative position stable compared to the rest of the fleet. Vessels were excluded from this analysis if significant changes had

occurred between the years in ways that would be expected to affect effective effort, such as a change of skipper or engine changes. This type of analysis is greatly facilitated by the standardisation of fishing gear and engine power under the strict implementation of effort restrictions under limited entry rules.

Side by side comparisons were expanded in 1999 to include not only vessels of different configurations fishing side by side, but vessels of the same configuration. This enabled a comparison of variability in catches of side by side fishing. The side by side fishing experiment was conducted in close cooperation with researchers from the Fisheries Department of Western Australia to ensure that they had enough information on relative fishing efficiencies to maintain long term data sets as to spawning stock surveys.

3.6 Results and Implementation

In 1999 the quad gear showed to have comparable efficiency with that of standard gear. This was a significant efficiency improvement on 1998 when the standard gear was shown to be 8-13% more efficient. This means that a vessel with quad gear was more effective in catching prawns, as it could carry a greater headrope length of net. It should be noted that this result was still significantly less than theoretical efficiency increases for using quad gear.

Based on the results in 1999 three vessels were removed from the fleet in 2000 and the remaining 12 Kailis vessels converted to quad gear. Using some spare head rope length capacity left over a commercial arrangement was reached with the remaining non-Kailis operator enabling that operator to also use quad, but for a fee. The result has been to increase the economic returns from this fishery and benefit the environment through a reduction in greenhouse gas emission. Ongoing assessment is necessary to prevent creep in effective effort associated with the gear changes.

4.0 Discussions Impact of Sole Ownership on Change

4.0 Comparison

In considering the impact of the changes in the Exmouth Gulf Fishery it is interesting to contrast the changes, not only against the management of the fishery prior to 1993, but also with the management of the Shark Bay Limited Entry Prawn Fishery to the South of Exmouth.

4.1 Shark Bay

The Shark Bay prawn fishery shares many similarities in nature and industrial development to the Exmouth Gulf Prawn Fishery, although king prawns are the dominant species at around 70% of catches. There was a change of ownership in 1993 of the major participant and who holds 18 vessels of 29 licences in this limited entry prawn fishery.

Although there is a high level of concentration of ownership the other licence holders participate vigorously in cooperative management arrangements through the Shark Bay prawn MAC.

4.2 Economic Theory and Observed Changes

Economic theory suggests that in a sole ownership, or effective sole ownership, fishery and with long term and secure access rights the holder of those rights should seek to maximise economic returns from the fishery rather than be focused on increasing effort. Maximising returns includes minimising costs (including the amount of capital employed) as well as considering gross catch and revenue. In addition the fisher's profit objective, allowing for externalities and potential differences in discount rates, should approximate the maximum economic value that could be generated from the fishery by the community as a whole. Even with secure access rights and strict limited entry effort rules participants in a fishery have an economic incentive to seek to substitute capital to chase a greater relative catch share.

Changes in 1998 in the Shark Bay and Exmouth fisheries are consistent with these economic theories. In 1998 in Exmouth Gulf a fishing vessel was removed in order to trial improved lower cost more efficient fishing methods. In the same year the Shark Bay fishery saw the major company replacing two of its less powerful vessels with new and improved vessels that were carefully designed to maximise fishing power and efficiency within the rules for the fishery.

Although the cash running costs could potentially be lower on these new vessels in Shark Bay they certainly represented a significant additional capital investment in a fishery that is already fully exploited. In the fishing industry the motivation for the introduction of these vessels was seen as a move to reduce the relative under performance of that company's fleet compared to the independent vessels. In its 1998/99 State of the Fisheries Report the Fisheries Department commented in respect of Shark Bay that:

‘The effective effort in the fishery is increasing, which may affect the more vulnerable tiger prawn stocks. Fisheries W.A.(1999)’

The experience of implementing improved harvesting practices in Exmouth Gulf suggests that over time there is a change of behaviour consistent with the economic theories cited above. The comparison with Shark Bay strongly suggests that the changes resulting in greater economic efficiency were facilitated by the ownership structure of the Exmouth Gulf Prawn Fishery.

4.3 Limited Entry and Sole Ownership

Notwithstanding the difference in ownership structure it is still in the economic interests of the Shark Bay fishers, and especially of the dominant operator, to pursue increased profitability through the adoption of improved harvesting methods. It should be noted that significant benefits from cooperation had already been achieved in Exmouth Gulf prior to the change in ownership in 1993.

In the absence of crisis, and notwithstanding the example of Exmouth Gulf, this process may take considerable time for the Shark Bay fishery. Change will need to be pursued through political processes within and outside the Ministerial Advisory Committee and may well involve economic trade-offs amongst fishers to reach a sufficient consensus for Government to change the rules of the fishery. In this instance the effectiveness of the advisory and management committee structure represent a key factor in both individuals and the community maximising the economic benefits from this fishery.

4.4 Change and Sole Ownership

Although changes improving harvest efficiency and economic benefits from the fishery were implemented in the Exmouth Prawn Fishery this process took over six years. There was a clear need for caution and slow implementation in the interests of maintaining responsible effort levels. In addition, however, the rate of change had to take into account the need to get internal consensus within the firm and the commitment of the skippers of the vessels. It needs to be noted that sole ownership internalises conflicts of interest within a corporate structure and reduces transaction and external costs, it does not wholly eliminate the inevitable conflicts and stresses arising from change. A move to sole ownership will not immediately change long held attitudes about competitive fishing practices, and may give rise to internal conflicts that need to be managed.

4.5 Lessons for other fisheries

A number of lessons can be drawn from the above. Firstly that where there are attractive economic incentives fisheries will adopt improved harvesting arrangements. The ability to implement these arrangements in a limited entry fishery is significantly improved in a sole ownership situation, although the benefits are also likely to be achievable over time in limited entry fisheries through a co-management process. In the Australian context MACs are a key means by which both the community and industry can achieve real economic benefits from implementation of improved management.

Secondly that even where there are strong economic incentives improvements take time to plan and implement.

Where changes are made for reasons of economic efficiency and not as a response to a crisis considerable patience is required to see the benefits at the other end.

5.0 Stock Enhancement

Enhancing fish stocks has the potential to be a useful management tool to increase fishery yields, although it is normally considered in relation to depleted or collapsed stocks. The pursuit of high cost (risk) and high return research is considered in connection with the Exmouth Gulf prawn fishery.

5.1 Enhancement Prospects

Enhancement of stocks in a productive fishery is possible if the enhancement circumvents some natural restriction on recruitment. Many prawn fisheries, such as the Exmouth Gulf Tiger prawn fishery, show highly variable recruitment. If it is possible to stock juveniles at an age or size that circumvents a key limiting factor in recruitment such as; pre-recruit predation, weather related mortalities or juvenile habitat limitations then there could be significant benefits in terms of enhanced catches.

Scientists at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Cleveland laboratories had been interested in enhancement of penaeid prawn stocks since the early 1990's. CSIRO had participated in workshops to assess the potential of enhancement of king prawns in Venus Bay (South Australia) and tiger prawns in Moreton Bay (Queensland).

5.2 Involvement/Initial Results

The Kailis Group had been aware for some time of CSIRO's interest in prawn stock enhancement, but was initially content with the risks being taken up by other Australian industry and government groups. For a variety of reasons, however, the CSIRO did not proceed with the other projects past the workshop phase. With the likelihood that research would be wound down in this area the Kailis Group approached CSIRO and suggested Exmouth Gulf fishery as a potential candidate. In 1997 a workshop was held with participation of the Kailis Group, Fisheries Department of Western Australia and CSIRO. The result of the workshop was the development of a detailed research project examining the feasibility of stock enhancement in Exmouth Gulf.

The initial project, with the financial assistance of the Fisheries Research and Development Corporation of Australia looked at:

- Developing a bio-economic model of enhancement
- Examining risks including disease introduction and genetic impacts of release strategies

- Identifying further work that needed to be carried out, especially in relation to the identification of juvenile nursery habitat

The initial report showed that given the existing facilities and infrastructure available in Exmouth Gulf that stock enhancement of juvenile tiger prawns could be profitable. Independent review of the project has also confirmed high risks to the practical feasibility of this research. The project is now proceeding with an aim of the first release of juveniles in 2001 or 2002. Significant spin off benefits have already been generated with more information about pre-recruit tiger prawns and in research into high-density production of juvenile prawns.

5.3 Impact of Ownership

The initial report into the selection of Exmouth Gulf as a suitable candidate for enhancement identified a number of factors as to why enhancement should be trialed in the Exmouth Fishery. These included factors such as the high but sustainable exploitation rate, existing facilities and infrastructure and the high quality and extensive research carried out on the wild stock fishery. Significantly the reasons for likely success also included that the Kailis Group held 15 out of 16 licences. This improved the feasibility of the project through:

- Providing a strong research partner
- Economic incentive to undertake the research
- Likely partner to implement a long term program in the event of successful results

The latter point was especially important to the Fisheries Research and Development Corporation who were contributing to the costs of the research program that the results not only prove to be economically feasible, but that any resulting innovation would actually be taken up by industry.

5.4 Discussion- Enhancement

Experience involving the selection of Exmouth Gulf over other potentially promising areas such as Moreton Bay (Queensland) suggests that notwithstanding the potential benefits of research programs of this nature to individuals and society they are be difficult to implement. This is likely to be the result of two factors. Firstly there are considerable transaction costs and practical difficulties involved in getting a consensus with a large group of individual operators. Secondly, there is difficulty with ensuring that those who take on the risks will capture the benefits, the free-rider problem.

Research of this nature is costly and highly risky (in terms of feasibility) but potentially of high commercial benefit to the commercial fishery, and the community. Where there is prospectively the likelihood of a high degree of capture of the economic benefits of the research in a particular fishery then the research is more likely to proceed. This is likely to be the case even if there are other potential fisheries in which objectively similar or greater benefits could be achieved.

Notwithstanding the above it should still be noted that the inability to capture all the benefits from the intellectual property generated from the project meant that some public assistance through the Fisheries Research and Development Corporation and CSIRO was still essential for the project's continuation.

6.0 Conclusions

Traditional economic thinking in fisheries management is that a significant source of poor economic performance is the competition by fishers for the fish. Frequently the result is over-capitalisation even where fisheries do not collapse from over fishing. Effective market based fishing right regimes, and in particular those involving Individual Transferable Quotas, can theoretically improve the economic performance of fisheries by reducing fisher to fisher competition. ITQ based arrangements, however, have significant practical problems in implementation in fisheries based on stocks that are highly variable and have short lifecycles.

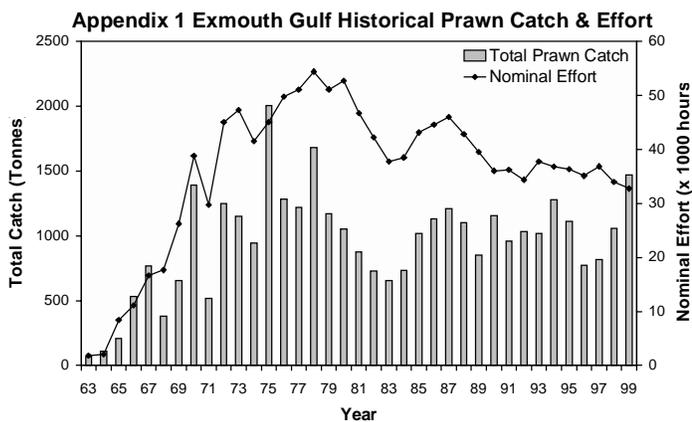
Experiences from the Exmouth Gulf Prawn Fishery generally confirm orthodox economic views about limited entry fisheries and the common property 'problem'. Even in established and well managed limited entry fisheries there may be significant scope for economic improvement in the management of the fishery and for investment in research on ways to enhance the economic value of the fishery. As there are usually a number of participants in a limited entry fishery and quota management may not be a legally or practically sensible option the alternative would appear to be a strong emphasis on co-management and the implementation of effective management structures to enable change.

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