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ECONOMICS, ECOLOGY AND THE ENVIRONMENT

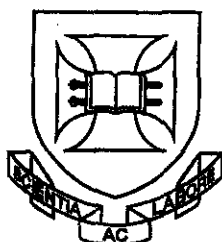
Working Paper No. 21

**A Report Prepared for the Queensland
Commercial Fishermen's Organisation**

by

**Gavin Ramsay, Clem Tisdell and Steve Harrison;
David Pullar and Samantha Sun
in conjunction with Ian Tibbetts**

January 1998



THE UNIVERSITY OF QUEENSLAND

**IMPACTS OF IMPOSITION OF RESTRICTIONS ON
GILL NETS ON THE QUEENSLAND EAST COAST
FISHERY**

**A REPORT PREPARED FOR THE QUEENSLAND
COMMERCIAL FISHERMEN'S ORGANISATION**

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and

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**The University of Queensland
September, 1997**

Documents Included

Outline of report

Summary

Acknowledgments

Terms of reference

A review of reports on optimal Australian dugong populations and proposed action/conservation plans: an economic perspective

Clem Tisdell

Compensation for the taking of resource interests: practices in relation to the wet tropics and Fraser Island, general principles and their relevance to the extension of dugong protection areas

Clem Tisdell

Economic impacts of imposition of restrictions on gill nets on the Queensland east coast fishery

Gavin Ramsay,
Steve Harrison
and Clem Tisdell

Representations of fishing effort and catch in the east coast fishery of Queensland

David Pullar and
Samantha Sun

Representations of fishery closures on the east coast of Queensland

David Pullar and
Samantha Sun

Appendices

Questionnaire

Preliminary report on economic impacts of imposition of restrictions on gill nets on the Queensland east coast fishery (8 August, 1997)

Background and outline of report

In June 1997, Senator Hill as federal minister for the environment announced proposed dugong protection areas (DPAs) on the east coast of Queensland, where restrictions would be introduced on the use of gill nets for fishing, on the grounds that dugong deaths arose from use of these nets. A number of studies by the government and fishing industry arose, to shed light on dugong biology, changes in dugong populations and possible causes. The Queensland Commercial Fishermen's Organisation (QCFO) contacted the School of Marine Science (SOMS) at The University of Queensland (UQ) concerning advice on the impacts to the fishing industry of the proposed bans. SOMS in turn contacted Professor Clem Tisdell, head of the Department of Economics concerning estimation of economic impacts, principles of compensation for the takings of property rights to natural resources, and other issues relevant to the fishing industry. A series of meetings led to the formulation of research projects in the area of economic analysis and geographical information systems, to be undertaken by independent researchers without undue influence by industry or environmental interest groups.

The project reported here, which was commissioned by the Queensland Commercial Fishermen's Organisation (QCFO), investigates the implications of the closure of the coastal gill net fishery in Queensland, and options available to the participants (i.e. the federal government, state government, fishers and dependent communities). In particular it seeks to clarify the accuracy of assumptions used in formulating the proposed strategy, and examine likely income losses in the fishing industry and the extent of consideration for compensation.

The terms of reference for the studies are included in the report to provide background information on the studies being carried out and information on the aims of the studies.

The report consists of four components. The first two components consist of papers written by Professor Clem Tisdell. The first paper examines compensation for the taking of resource interests and particularly examines practices in relation to compensation following the World Heritage listings of the Wet Tropics region of North Queensland and of Fraser Island. The application and relevance of compensation principles to extension of dugong protection areas are also examined. The second of Professor Tisdell's papers reviews reports on optimal Australian dugong populations and proposed conservation plans from an economic perspective.

Results from the survey of net fishers carried out in July 1997 are presented in the third component. In this component information on labour working in the fishing industry, fishing vessels, on-shore facilities, total annual catch and profit are presented and examined. In addition, information on the predicted response of fishers to fishing closures and willingness to accept compensation in return for surrender of fishing licenses is presented.

The fourth component is made up maps produced using a geographical information system to provide information on fishing catch and effort and fishing closures on the east coast of Queensland.

Acknowledgements

We thank; the Queensland Commercial Fishermen's Organisation for funding the studies, all fishers who attended meetings and patiently completed questionnaires, the staff of QCFO especially Ted Loveday, Daryl McPhee and Martin Breen, and the local QCFO representatives for organising and participating in the district meetings held to complete the questionnaires.

We also thank Nick Emtage, Joe Owen, Robert Harrison and Bryan Morgan who assisted in data collection, entry and analysis, and who worked long hours to ensure the survey was completed quickly.

Summary of major findings

The summary is presented under four headings which cover the components of the studies presented in this report, namely optimal dugong populations, principles of compensation, results of survey of net fishing industry and results from geographical information system studies.

1. Optimal dugong populations

An economic approach to optimality would evaluate the social economic costs and benefits of reducing the incidental catch of dugongs. Policy measures must be formulated by weighing up these two components. From a social economic perspective it is clear that too much reduction in by-catch can be forced on fishermen and excessive costs imposed on them if strategies or policies are proposed without economic assessment. This type of assessment is missing from reports prepared on the management of dugong. Economic issues should be explored further, especially given the regional repercussions likely to result from the imposition of extended dugong protection areas. In addition, more ecological research is needed and in particular research is needed to find cost-effective ways of maintaining dugong populations.

2. Principles of compensation

The availability of compensation depends on the existence of private property rights expressed or implied. The stronger the property right and the greater the owner's loss the more likely the taking will be viewed as compensable. Queensland fishers have firm licences and endorsements to use different types of nets. The dugong protection areas restrict these rights and reduces the value of businesses which rely on these rights, hence a case for compensation exists.

In the case of communities governments have no legal requirement to compensate communities which may be adversely affected by the loss of resource interests, political reality often requires that such restitution is made. The loss of exploitation of a resource can depress the local economy; therefore, adverse economic effects are not restricted to those directly affected by the withdrawal of resource rights or interests.

The rationale for the taking of resource interests should be carefully considered before a decision is made. The value to the state acting on behalf of the community should exceed the economic value to users of retaining the rights. In relation to proposed extension of DPA's, these values have not been estimated or discussed to any extent.

It is possible that fishers are not the main cause of decline in the size of dugong populations. Other factors such as spill-overs from land-based agriculture and other economic activities could be major causes of decline. If this is so it provides a further reason why the full cost of further protection for dugongs should not fall solely on fishermen because this would be inequitable.

3. Results of survey of net fishing industry

In general the Queensland east coast net fishing industry is made up small scale owner operated businesses with a small number of larger enterprises. Considerable variation is present between fishers in the level of investment in vessels, nets, the annual total value of catch and profit. Investments in on-shore assets averages a little over \$100,000. Total costs typically are of the order of \$36,000 leading to a net margin of about \$14,000 per fisher, equivalent to about 30 cents per dollar of total value of catch. All fishers own more than one vessel. Most vessels are made from aluminium and built in regional centres of Queensland.

Most of the labour force is made up of the licence holder and his spouse. Some businesses employ part-time labour while there is also a small number of larger businesses involved in the net fishing industry which employ full-time labour. However, the larger enterprises are often involved in net fishing for part of the year only, in particular during the cyclone season when it is not possible to carry out other fishing activities.

Fishers have a strong desire to continue fishing rather than take a compensation package for surrender of their licence. This was reinforced by the high value placed on their licence package by most active net fishers. While some would be prepared to accept buyout offers for licences of \$40,000 to \$60,000 or less about 75% would not surrender licences for buyout offers of \$100,000.

Most fishers believe they could survive in business with a reduced catch or increased cost of up to 10% to 15%. Information provided on debt levels was inconclusive, but it would appear some fishers would have difficulty meeting repayments if profitability were to fall.

The vast majority of fishing related expenditure is made in the home port and nearby regional centres. Restrictions on fishing while not having a major impact on the state's economy, could have considerable impact on local traders.

Most fishers felt they would become unemployed if they were to lose their licence. The lack of alternative employment prospects is related to their age and lack of training and skills that would enable them to gain alternative employment.

4. Results from GIS studies

As a short term objective maps were produced to show the distribution of fishing activity and fishing effort along the Queensland coast. The data for these maps is based upon Queensland Fish Management Authority Logbooks for 1996. Due to release constraints the information is not shown to a detailed level. The resulting maps provide indicative evidence of fishing activity rather than an exact qualitative description. One important indication is how marginal the catch is for offshore fishing. Any further closure of inshore waters will significantly reduce the resources available for viable fishing industry. A further exercise was to map the extent of closed waters for commercial fishing along the coast. This proved to be difficult due

to the lack of boundary information on regulated fishing closures. However an indicative map has been produced showing the scope of constraints on fishing.

Longer term objectives for the project are to develop a GIS that monitors the distribution and density of sea grass beds. This is important for both ecological reasons and for sustainable commercial fishing. A beginning has been made, new data will be added on a piecemeal basis to build up evidence for existence of sea grass beds.

Terms of Reference

Prepared by the School of Marine Science
The University of Queensland
For the Queensland Commercial Fishermen's Organisation

This project investigates the implications of the closure of the coastal gill net fishery in Queensland, and options available to the participants (i.e. the federal government, state government, fishers and dependent communities). In particular it seeks to clarify the accuracy of assumptions used in formulating the proposed strategy, examine likely income losses in the fishing industry and the extent of consideration for compensation, and provide some suggestions on the accuracy of the implied cause and effect relationship between dugong population decline and the activities of commercial fishers. The study has three components.

1. The effect of new restrictions on fishing activities

A GIS is to be created to assist in the economic analysis and to answer spatial queries related to dugong protected areas and fishing activities. Specifically the GIS will include:

- Coastal Information
- Management Areas
- Fishing Activity and Catch Impact
- Ecological Variables (seagrass habitat, dugong stock, etc.)

The GIS will be used to answer quantitative queries including: i) gross rate of production of fish by region, date, and species, and ii) relation of fishing activity to gazetted fish habitat areas, management areas, and proposed dugong protection areas. The GIS will output maps and tables useful in economic assessment. Also the GIS will provide graphical maps indicating fishing activity with respect to seagrass habitat and dugong habitats. The later will be useful to interpret various scientific findings and validate the boundaries described for protected areas, in particular to assess if dugong stock can be better protected by alternative management strategies.

2. The economic implications of changes in fishing activities

The examination of economic implications of changes in fishing activities will involve four major tasks, namely:

- Examination of proposals for dugong management from an economic perspective
- Collection of data from fishers by a questionnaire
- Determine the individual and regional consequences, and
- Examination of compensation

The aims and methods for carrying out these tasks are detailed in these terms of reference.

3. Produce anecdotal evidence from fishers on the distribution of seagrass in the affected fishing areas.

TOR Procedure

The TOR as described below have been established through the joint agreement of a committee including Dr Daryl McPhee and Mr Ted Loveday (QCFO), Professor Clem Tisdell, Associate Professor Steve Harrison and Gavin Ramsay (UQ, Department of Economics) and Dr Ian Tibbetts (UQ, School of Marine Science), and Dr David Pullar (UQ, Department of Geographical Science and Planning).

Section 1. GIS Summary of Closures

Dr David Pullar, Peter Johnson and Samantha Sun
Department of Geographical Science and Planning
The University of Queensland

Plan

The tasks involved in the GIS are:

Task	Sub-Task
Create Base Layer	Import map data for coastline, etc.
Management Zones	Import map data from GBRMPA Digitise DPI Gazetted Fish Habitat Areas Import DOE Marine Parks and Management Zones
Fishing Activity	Geocode Fish Log Data from DPI Validate DPI estimates for random regions Interpolation of seagrass maps from UQ survey Generate appropriate tables and maps
Ecological Variables	Import DOE Directory of Important Wetlands Import DPI Sea Grass Habitat Geocode AMCS Habitat Database
Review and Critique	Comment on Causal Relationships Maps and Final Report

Section 2. Economic Implications of the Closure

Prof. Clem Tisdell, Assoc. Prof. Steve Harrison and Gavin Ramsay
Department of Economics
The University of Queensland

Examine from an economic perspective the proposals for dugong management. Determine the likely changes in fishing activities as a result of the proposed regulations and the effects of those changes on incomes from fishing. The economic implications of the closure will be examined using data collected during a survey of fishers and secondary data such as data from government agencies, the QCFO and previous studies. The examination will include the direct effects of the decision on the incomes and viability of fishers in the affected areas and the indirect regional effects.

Task 1. Examination of proposals for dugong management from an economic perspective

Aims

Determine the economic validity of proposals for dugong management and the system of Dugong Protected Areas.

Method

Review dugong management proposals

Task 2. Collection of data from fishers by a questionnaire

Aims

Determine the effects of the proposed gill net restrictions on

- the catch, effort and viability of fishers currently fishing in the affected areas
- the actions they will take to ensure income
- the likely effects of actions of fishers taken to ensure income
- the likely effects on employment in local area
- effects of proposed restrictions on associated industries
- effects of proposed restrictions on local communities

Method

- develop questionnaire
- test on individual fishers in southern Queensland
- collect data from fishers in affected areas through district meetings
- analyse data

Task 3. Determine the individual and regional consequences

Aim

To determine the effect on the viability of individual fishers, associated industries and local communities of the proposed changes.

Method

Using data from the questionnaire and secondary data sources, determine the economic impact of the proposed changes on an individual and community basis. Multipliers based on those found to be applicable to the industry and region will be used in determining the economic impact.

Task 4. Examination of compensation

Aim

To determine appropriate levels of compensation for fishers should restrictions be applied.

Method

Levels of compensation desired by fishers will be estimated via questionnaire. Methods to determine appropriate levels of compensation will be examined.

Section 2. Distribution of seagrass

Aim

Determine using the local knowledge of fishers the distribution of seagrass in the fishing areas affected by DPA's.

Method

At meetings of fishers and using maps generated in the GIS component of the study obtain detailed information on the distribution and density of seagrass in the interim and proposed DPA's.

Produced maps of this information.

Budget

1. Department of Geographical Sciences and Planning

Most the work involves compilation and collating information already help by various agencies. Most information is already in a digital form and can be imported into a GIS, the one exception was the DPI Gazetted Fish Habitat Areas which are in a map form and would require digital conversion. Other information, such as fish log data, can be geocoded into the GIS based upon recorded geographical data. Most of this work and the production of maps and reports from the GIS will be conduct by a research student under the direct supervision of Dr. David Pullar. The final critique and review will be done by Dr. Ian Tibbetts and a qualified research assistant, Peter Johnson.

Cost Heading	Funding
PERSONNEL	
GIS Coordinator - Dr. David Pullar (10 Days @ \$400/Day)	4,000
Research Assistant - Samantha Sun (21 Days @ \$192/Day)	4,032
Research Assistant - Peter Johnson (8 Days @ 264/Day)	2,112
CONSUMABLES	
GBRMPA Data Extraction Costs	250
AMCS Data Extraction Costs	500
Overhead - computer usage, map output, etc. (10% of Personnel Costs)	1014
Total GIS	\$11,908

2. Department of Economics

Personnel

	Number	Days	Rate	Amount
CAT		10	500	5000
SRH		10	500	5000
GCR		20	400	8000
Interviewers	4	11	150	6600
Statistician, data entry		15	160	2400
Travel	6		500	3000
Accommodation and meals	6	12	100	7200
Phone				500
Photocopying and paper				200
Typing				300
Incidentals (taxis, parking fees etc)				400
Total				\$ 38600

3. School of Marine Science

Personnel

Dr Ian Tibbetts	5	400	2000
Grand total			\$52, 508

**A Review of Reports on Optimal Australian
Dugong Populations and Proposed Action/Conservation
Plans: An Economic Perspective***

**Clem Tisdell
Department of Economics
The University of Queensland
Brisbane 4072 Australia**

* A background paper completed for Queensland Commercial Fishermen's Organization through **The School of Marine Science**, The University of Queensland. I wish to thank Daryl McPhee for his useful comments on the first draft of this paper.

A REVIEW OF REPORTS ON OPTIMAL AUSTRALIAN DUGONG POPULATIONS AND PROPOSED ACTION/CONSERVATION PLANS: AN ECONOMIC PERSPECTIVE

1. Introduction

Two important ecological reports, *The Dugong Dugong dugon: An Action Plan for its Conservation* (Marsh *et al.*, *n.d.*) and *A System of Dugong Sanctuaries for the Recovery and Conservation of Dugong Populations in the Great Barrier Reef World Heritage Area* (Preen and Morissette, 1997) have been prepared in recent times on the status of the dugong in Australia. Each is accompanied by proposals to foster conservation of populations of dugong. The latter report proposes ten dugong sanctuaries for the southern Great Barrier Reef and Hervey Bay (see Figure 1). Gill nets are recommended to be banned in these sanctuaries.

Of the two reports, that by Marsh *et al.* (*n.d.*) is the least categorical. It points out that while dugong numbers have declined in The Great Barrier Reef (GBR) region south of Cooktown, 'the causes of the decline are unknown, but could include habitat loss, incidental drowning in commercial gill nets and indigenous hunting', (p. 2). It states that 'apart from dugongs drowned in shark nets in Queensland, there are *no* quantitative data on anthropogenic impacts' (pp. 1-2). A well thought out list of research priorities essential for informed management of dugong populations are set out (Marsh *et al.*, *n.d.*, pp. 5-6).

Despite the fact that this research has not been completed, Preen and Morissette (1997) make major policy recommendations for a system of dugong sanctuaries which are expected to impact adversely on the livelihood of a large number of fishermen in Queensland, as well as resulting in displacement of fishermen and possible crowding of fishermen in areas not set aside as dugong sanctuaries. Flow-on adverse economic consequences for local communities in

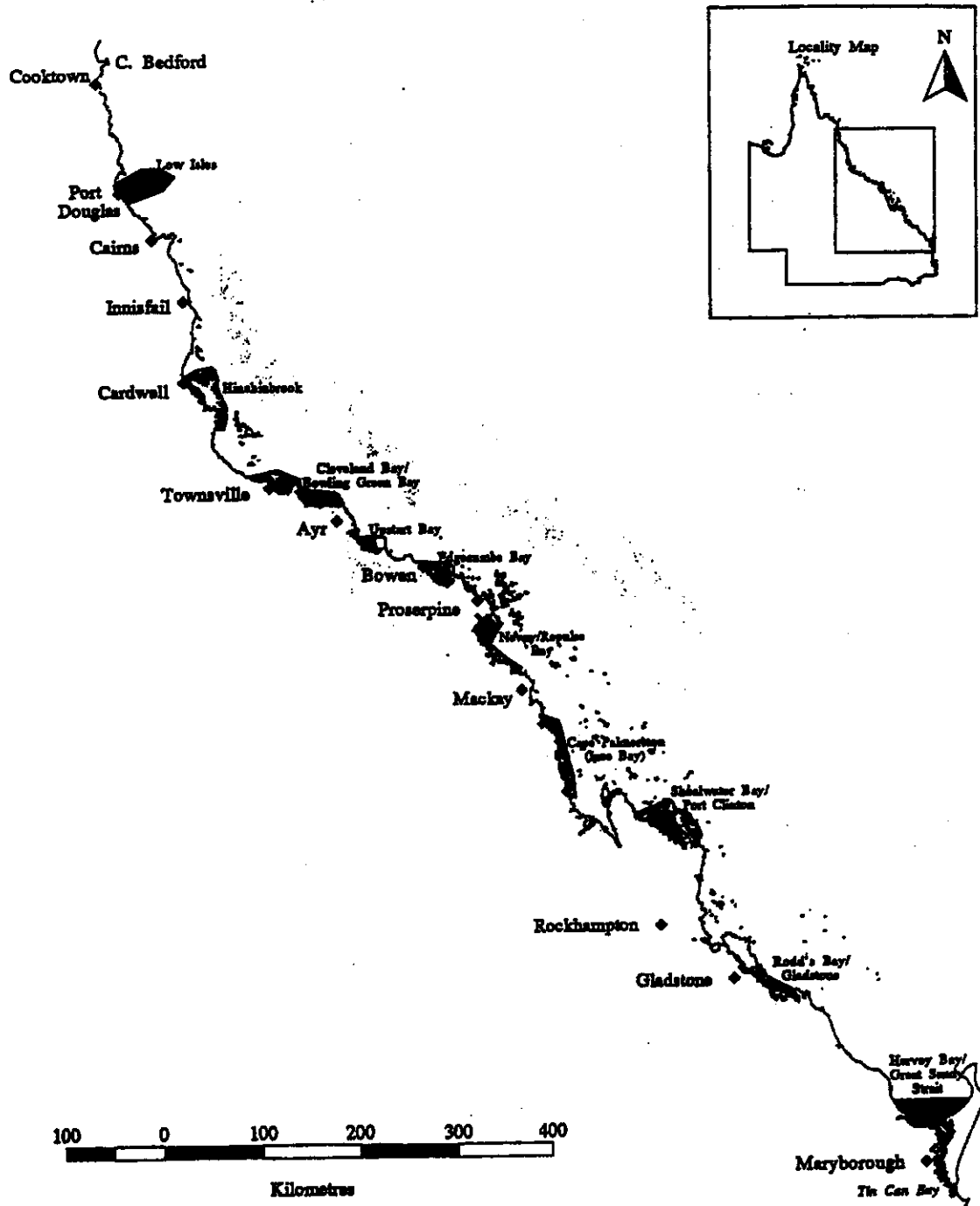


Figure 1 Location of the ten Dugong Sanctuaries proposed for the southern Great Barrier Reef and Hervey Bay.

regional coastal Queensland are anticipated. They make these recommendations with a view to achieving an optimal population of dugongs. For them this seems to imply the requirement that dugongs be not critically endangered locally anywhere within their current population range in Australia. This however, begs the question of how the 'optimal' population of dugongs is to be determined.

2. The Optimal Population of Dugongs

Figures given by Marsh *et al.*, indicate that Australia's total dugong population is of the order of 83,245 head. Most of this population is located in the 'top' of Australia from the north of Cape Bedford in Queensland around to Shark Bay in Western Australia. The population in southern Great Barrier Reef region is estimated to be relatively low at about 1,642 head and in *this region* dugong is listed by Marsh *et al.* (*n.d.*) as a critically endangered species (not IUCN). The IUCN Red book describes a critically endangered species as a one 'facing extremely high risk of extinction in the wild in the immediate future'. Because dugongs in the southern GBR probably do not form an isolated described population, they are unlikely to achieve separate classification as critically endangered under IUCN criteria. In any case, the dugong is not endangered throughout the whole of its population range in Australia according to Marsh *et al.* (*n.d.*) (see Figure 2). The exact contributors to low numbers of dugong in the southern GBR region are not clear as yet, although a cyclone in the Hervey Bay area significantly lowered dugong numbers there by reducing the extent of seagrass meadows. Periodic destruction of seagrass meadows by cyclones and then their subsequent recovery along with that of the size of local dugong populations appears to be normal.

Preen and Morissette (1997, p. 8) state 'To allow dugong populations to recover to their optimum sustainable level all significant dugong habitat, both past and present, should be

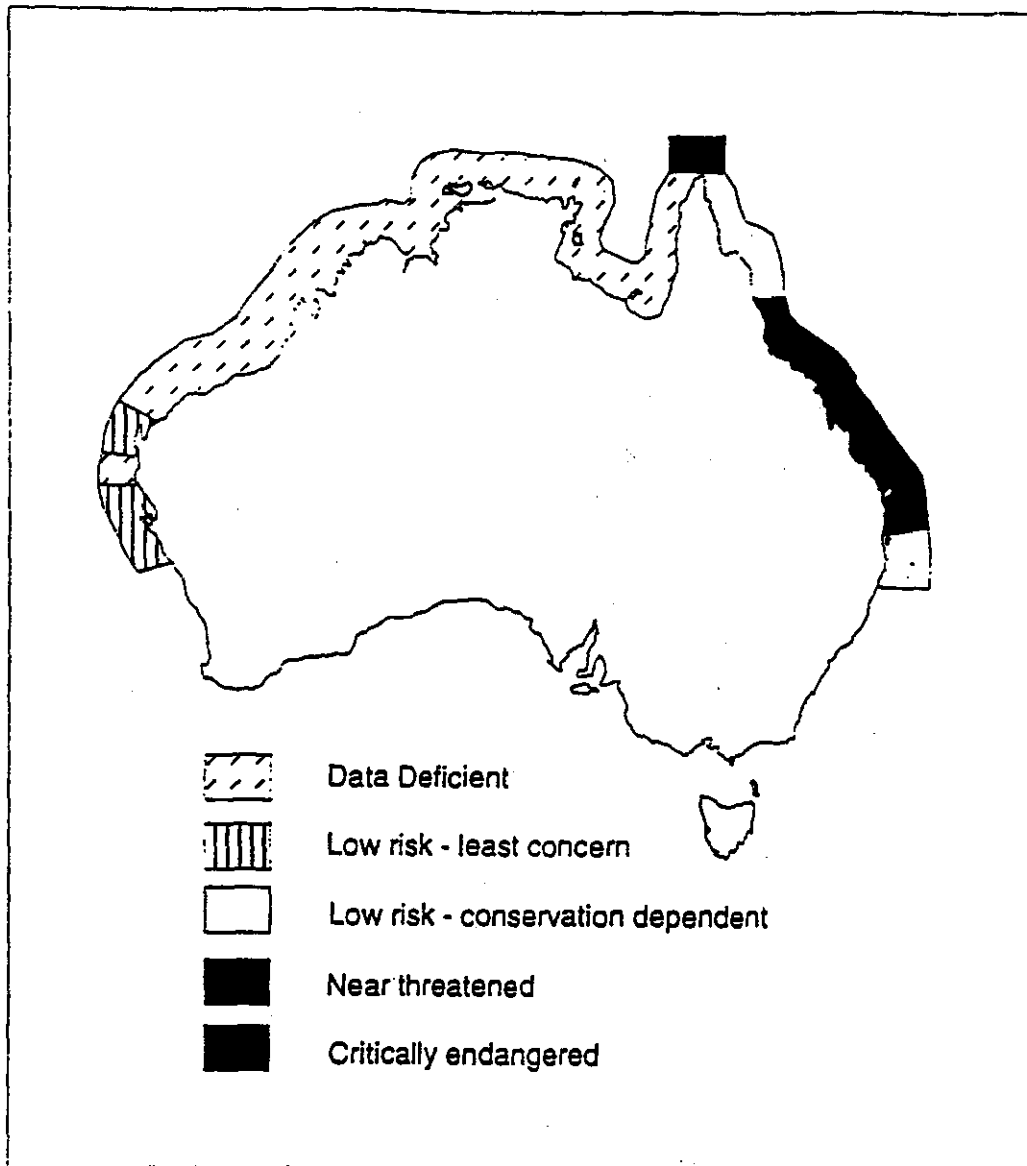


Figure 2 Map showing the status of the dugong in various parts of Australia according to the IUCN (1995) criteria as interpreted by Marsh *et al.* (n.d.).

protected in sanctuaries. Protection of only a subset of dugong habitats, like those that contain substantial dugong numbers may prevent dugong extinction in the southern GBR, but will not allow for recovery'. Elsewhere they also speak of the optimum sustainable population of dugong, but nowhere does their concept of the optimum population appear to be defined.

From their text, it is clear that Preen and Morissette want not just to maintain the minimum population of dugong required to ensure the reasonable probability of survival of dugong in Australian waters as a whole, but at least the minimum populations of dugong throughout their whole range in Australia considered necessary for their survival in every region where they now occur. Their aim is to try to *prevent any local extinctions*. Whether or not their proposals are sufficient or more than sufficient to prevent local extinctions is a matter for ecologists. What is the probability that local extinctions will occur without the DPAs proposed and where? What difference do the restrictions make to these probabilities? Could similar reductions in probabilities be obtained by alternative means and more cheaply? No specific information seems to be available in relation to these questions.

Preen and Morissette (1997) *seem to waiver* between two ideas about optimum populations of dugong in the southern GBR region, which is the main focus of their attention and policy recommendations. These are:

- (1) The minimum populations of dugong required to ensure the survival of dugong throughout their range in the southern GBR region, taking into account the mobility of these animals.
- (2) The (maximum sustainable) population which would emerge in the absence of anthropogenic disturbance.
- (3) A dugong population somewhere in between these.

What we are not told is what criterion is used to decide that these populations are optimal. From what point of view or points of view are they optimal? From the point of view of dugongs? How is the human interest factored in? Are humans to be considered as part of the ecological system or not? What human values should be factored into the optimisation problem and how? Without account being taken on these factors, proposals for optimisation of dugong populations are very narrowly based and unclear. Economic and social evaluation is not included in the problem by Preen and Morissette unless they assume that saving of dugongs is of infinite value.

It is true that some appeal is made to Australia's obligations under international conventions but there is no discussion of how legally binding they are and how these are to be interpreted. In any case, it is doubtful if the international Convention on Biodiversity Conservation obligates nations to 'save' species *throughout their entire range*.

It should furthermore be noted that there is usually no minimum population of a species that guarantees its future existence (Hohl and Tisdell, 1993). All that one can conclude is that the probability of survival of a species can be expected to rise as its habitats and its population are more fully protected. So we have to ask what probability of survival of a species, in this case dugong, are we aiming for and why? In addition, the above theory implies that application of the *precautionary principle* requires an assessment of the weighted risk of various management options. No attempt to do this has been made in the policy recommendation of Preen and Morissette.

3. Economics and the Optimal Population of Species, in this case, Dugong

Economics, not considered in the reports mentioned above, can be factored into decisions about optimal population or conservation of species in two different ways. These are:

- (1) *Cost minimisation* in relation to some standard or target for population of a species and,

(2) *economic optimisation* of the population of the species.

Neither of these approaches have been applied in determining the optimal population of dugong in Australia or in the GBR region.

Cost minimisation involves searching for strategies which will minimise the cost of achieving the population of dugong aspired to. This for example, would involve search for conservation strategies which would minimise costs imposed on fishermen. Has for example, the best configuration of DPAs been proposed to achieve protection of dugong populations and minimise the cost imposed on fishermen? Should research be undertaken to search for effective methods to deter dugong from entering the area of gill nets? Are there techniques available or which could be developed to reduce unwanted incidental catch? Why is such research not being funded and why is there not a programme for such research? The incidental catch problem is a widespread problem and more attention needs to be given to it from a scientific research point of view.

The second approach to this type of problem adopted by some economists is to treat it as an economic optimisation problem using social cost-benefit analysis (Cf. Campbell *et al.*, 1997). For this method to be applied, it is ideal if all social costs and benefits can be expressed in monetary units. If this is not possible, then one goes as far as is practical in quantifying social costs and benefits in monetary terms and makes a list of the 'intangibles' that cannot be quantified so these can be taken into account in the final judgement.

This approach is illustrated by diagrams which look at *possible* costs and benefits of reducing the incidental catch of dugong by fishermen. There are several possibilities to consider. Firstly, it is possible that the economic costs imposed on fishermen in terms of reduced profit, income and so on exceeds the willingness of conservationists to pay for any reduction in the

incidental catch of dugong in an area. This would imply that on purely economic grounds that no reduction in the incidental catch of dugong would be justified. This case is illustrated in Figure 3. Line DEF represents the additional costs imposed on fishermen of having to reduce their incidental catch of dugong and line ABC represents the additional benefits to

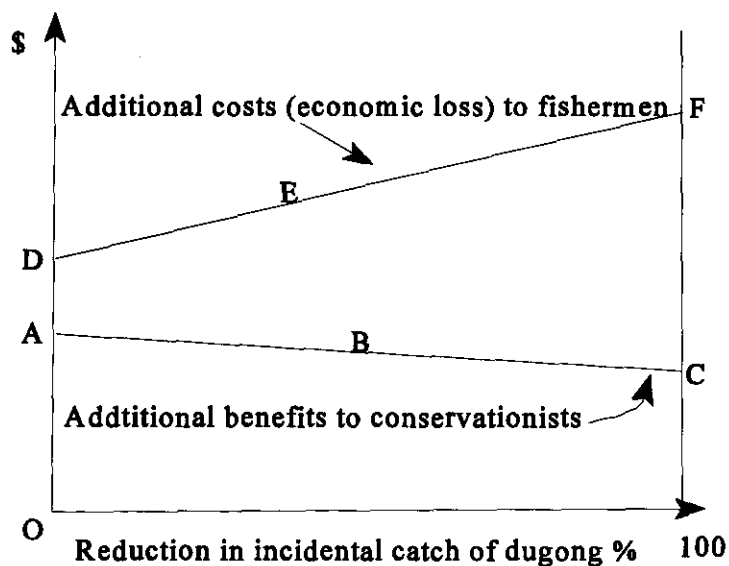


Figure 3 No reduction in the incidental catch of dugong is optimal (economic) in this case.

conservationists (e.g., their marginal willingness to pay) for a reduction in the incidental catch of dugong. In this case, it is not economic to reduce their incidental catch of dugong. This is because the cost imposed to fishermen always exceeds the *economic* benefit to conservationists.

Although in the case shown in Figure 3 no reduction in the incidental take of dugong is economic, if a new method of reducing the incidental take of dugong happened to be developed, this could reduce the cost to fishermen of reducing the incidental catch of dugong. Consequently, it may become economic to reduce the incidental catch of dugong. Such a new

method would move the line DEF downward possibly sufficiently far to intersect line ABC, other things constant. Its an intersection point would correspond to the optimal economic reduction in the incidental catch of dugong after the introduction of the technique. A reduction in the incidental catch of dugong would then be economic. New techniques of this kind result in a 'win-win' situation, that is benefit both conservationists and fishermen. However, little or no sustained research appears to have been undertaken to find such methods.

Figure 4 illustrates a case in which it is economic from a social point of view to reduce the incidental catch of dugong. Line OAB represents the additional costs to fishermen of reducing their incidental catch of dugong and line CAD represents the additional benefit to conservationists of doing this. In this case, a reduction in the incidental catch of dugong by x_1 per cent maximises social net economic benefit: for this reduction the marginal benefit to

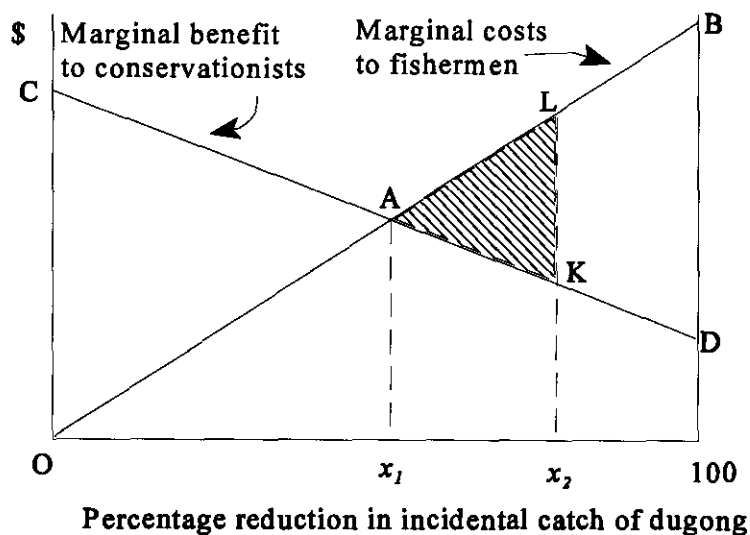


Figure 4 In this case some reduction in the incidental catch of dugong is economic socially but any greater reduction results in a social deadweight loss.

conservationists equals the marginal cost imposed on fishermen¹. If the incidental catch of dugong is reduced further, a social deadweight economic loss occurs. If, for example, authorities require and achieve a reduction in the incidental catch of x_2 per cent, the social deadweight loss is equal to the equivalent of area of triangle AKL, the hatched area in Figure 4.

4. It is clear from the above discussion that without proper attention to the costs and benefits of reducing the incidental catch of dugongs, a social economic loss can occur. It is even possible for regulation to be socially less favourable than no regulations from an economic standpoint.

In addition, if the measures, means and techniques for reducing the incidental catch are *prescribed*, they may not be the most efficient or cost-effective ones from an economic point of view. For example, the prescribed methods may, in relation to the case shown in Figure 4, result in higher extra costs being imposed on fishermen so that their additional (marginal) cost is than those shown by line OAB. For ease of illustration a similar diagram to Figure 4 is shown as Figure 5. The prescribed methods may result in extra costs being imposed on fishermen. When these are accounted for, their marginal costs might be as shown by line OEF. If this is so and authorities reduce the incidental catch by x_2 per cent, the deadweight economic loss from regulation is equal to the equivalent of the dotted area, the area of triangle OLM, plus the equivalent of the area of the hatched triangle AKL². Consequently, 'social loss' is raised by even more than the area of triangle AKL due to cost-effective methods not being prescribed. There is a high risk of this occurring as far as the present policy recommendations for attaining 'optimal' population of dugongs is concerned.

Observe that the steeper is the additional cost imposed on fishermen of having to reduce the incidental catch of dugong, the smaller is the optimal reduction in the by-catch of dugong.

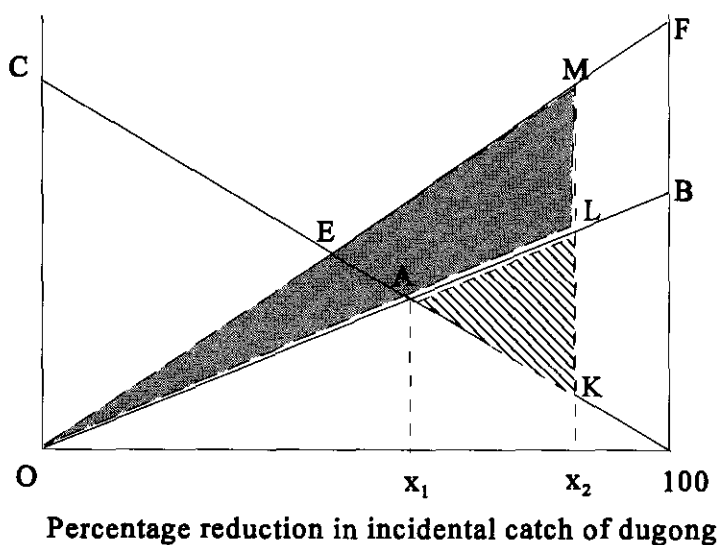


Figure 5 Public regulation of incidental catch can be excessive from an economics point of view and add unnecessarily to the cost imposed on fishermen.

If an economic approach to optimality is adopted, it is important to evaluate the social economic costs and benefits of reducing the incidental catch of dugongs. Policy measures must be formulated by weighing up these two components; costs and benefits. It is clear from a social economic standpoint that too much reduction in the by-catch can be forced on fishermen and that excessive costs can be imposed upon them if strategies or policies are proposed without economic assessment. These type of assessments are missing in the reports prepared by Marsh, *et al.*, and Preen and Morissette.

4. Concluding Comments

From the above, it seems that *not* even the *precautionary principle* requires that hasty emergency action is needed to save dugongs from imminent extinction in Australian waters. Even the likelihood of local extinctions could be a subject for serious debate. Note also that proper attention to the precautionary principle requires an assessment of the weighted risks of

alternative management options; something which has not been done by policy-makers in this case.

A decision to create or extend DPAs and tighten controls on fishing effort is bound to have major economic repercussions regionally. Therefore, there is a need and time to assess economic factors, take these into account and gather further ecological evidence before coming to policy conclusions. This appears not to have been done in most cases by those making recommendations for management of dugong.

While economics cannot be the sole arbiter on social decisions, it is nevertheless unreasonable to ignore it, especially given that many of the impacts of regulations are likely to have irreversible economic consequences. The economic issues should be explored further, more ecological research is needed and in particular research is needed to find cost-effective methods of maintaining populations of dugong. Hasty decision-making in this area seems both unwise and unnecessary.

5. Notes

1. The optimality condition can easily be outlined in mathematical terms. If $h(x)$ represents the costs imposed on fishermen of reducing the incidental catch of dugong and if $g(x)$ represents the benefit to conservationists, then the net social benefit (NSB) of reducing the incidental catch of dugong is $NSB = g(x) - h(x) = f(x)$. The necessary condition for a maximisation of this (given an interior solution) is $\frac{df}{dx} = \frac{dg}{dx} - \frac{dh}{dx} = 0$.

The rate of change of benefits to conservationists should be equal to the rate of increase in costs imposed on fishermen.

The second order condition for the maximum is that $f'' < 0$. Since $g'(x)$ is downward sloping and $h'(x)$ has a positive slope, this condition will be automatically

satisfied if the first order condition is met.

Mathematically the optimisation problem is straightforward. In practice, the main problem that is likely to occur is to estimate the functions accurately from an empirical point of view. Furthermore, there is scope for philosophical argument about how best to specify benefits to conservationists. Should for example willingness to pay form the basis of such estimates or should willingness to accept compensation be used for specification (Tisdell, 1991). Observe that deadweight social loss (DSL) shown by the hatched area in Figure 4 would mathematically be obtained as follows:

$$DSL = \int_0^{x_2} h'(x)dx - \int_0^{x_2} g'(x)dx .$$

2. Let $r(x)$ represent the extra cost imposed on fishermen by regulation, that is costs in excess of the efficient ones. Then the total economic loss from regulation equals

$$\int_0^{x_2} r(x)dx$$

plus DSL as specified in note 1.

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1. Summary of Major Findings

Net fishing in the Queensland east coast fishery is predominantly an industry of small scale, owner operated businesses. Most enterprises rely on family labour, although employed part-time or casual labour with a few employing full time labour.

Fishers and their families rely principally on fishing for their livelihood, and most work full-time in the industry.

Investments in offshore and on-shore assets averages a little over \$100,000. Total costs typically are of the order of \$???, leading to a net margin of about \$14,000 per fisher, equivalent to about 30 cents per dollar of total value of catch.

Fishers have a strong desire to remain in the industry. While some would be prepared to accept buyout offers for licenses of \$40,000 to \$60,000 or less, these appear to be small scale operators. About 75% would not surrender licenses for buyout offers of \$100,000.

Most fishing inputs appear to be purchased locally. Restrictions on fishing, while not having a major impact on the state's economy, could have considerable impact on local traders.

Most fishers believe they could survive in business for a reduced catch or increased cost of up to 10% to 15%. Information provided on debt levels was inconclusive, but it would appear some fishers would have difficulty meeting repayments if profitability were to fall.

2. Background to Study

In June 1997, Senator Hill as federal minister for the environment announced that new proposed dugong protection areas (DPAs) along the east coast of Queensland, where restriction would be introduced on the use of gill nets for fishing, on the grounds that dugong deaths arose from use of these nets. A number of studies by government agencies and the fishing industry were initiated, to shed light on dugong biology, changes in dugong populations and possible causes. The Queensland Commercial Fishermen's Organisation (QCFO) contacted the School of Marine Science (SOMS) at The University of Queensland (UQ) with regard to advice on the impacts on the fishing industry of the proposed bans. SOMS in turn contacted Professor Clem Tisdell, head of the Department of Economics, concerning estimation of economic impacts, principles of compensation for the takings of property rights to natural resources, and other issues relevant to the fishing industry. A series of meetings led to the formulation of research projects in the area of economic analysis and geographical information systems, to be undertaken by independent researchers without undue influence by industry or environmental interest groups.

This project reported here, which was commissioned by the Queensland Commercial Fishermen's Organisation (QCFO), investigates the implications of bans on the use of various forms of fishing nets though to pose a risk to dugong, and options available to the participants (i.e. the federal government, state government, fishers and dependent communities). In particular it seeks to clarify the accuracy of assumptions used in formulating the proposed strategy, and examine likely income losses in the fishing industry and the case for and appropriate extent of financial compensation. The study has three components.

1. The effect of new restrictions on fishing activities

28 August, 1997

**COMPENSATION FOR THE TAKING OF RESOURCE
INTERESTS: PRACTICES IN RELATION TO THE WET TROPICS
AND FRASER ISLAND, GENERAL PRINCIPLES AND THEIR
RELEVANCE
TO THE EXTENSION OF DUGONG PROTECTED AREAS¹**

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- ² I wish to thank Dr Steve Harrison, Tatjana Kehren, Daryl McPhee, Gavin Ramsay and Dr Ian Tibbets for providing copies of some relevant background documents, or for comments.
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Compensation for Taking of Resource Interests

1. Introduction

The question of whether compensation should be paid for the taking or abrogation of natural resource rights or interests and how much should be paid and on what basis is complex. The *Report of the Commission of Inquiry into Compensation for the Taking of Resource Interests* (British Columbia, 1992) indicates that the availability of compensation depends upon the existence of private property rights expressed or implied. It points out (p. 17), 'Property is a bundle of legally defined mutable right. The owner is free to exercise those rights and is free from interference by others in their exercise. These rights range from strong to weak, and even the strongest are subject to restrictions. When rights are modified there is commonly an effect on the value of the property'. These rights are often modified by government.

The report goes on elsewhere (p. 19) to state that 'not all [government] interferences with property can possibly be compensable... The definition of (whether defined by statute, judicial interpretation, or custom) of a compensable taking is influenced strongly by pragmatism. There are no hard and fast rules, but some generalisations are possible. The stronger the property right, and the greater the owner's loss, the more likely the taking will be viewed as compensable.'

Queensland fishers have firm licences and endorsements to use different types of nets. The proposed dugong protection areas limit these rights. Therefore, the value of businesses which rely on these rights will be reduced, in many cases substantially. Hence, a *prima facie* case for compensation exists.

In the Australian case, a number of precedents exist in relation to the taking of natural resource interests by the state. Consider for example, the loss of private rights (expressed and implied) in relation to the World Heritage listing of the Wet Tropics region of North Queensland and similarly in relation to Fraser Island.

2. The Wet Tropics Structural Adjustment Packages

The Wet Tropics Structural Adjustment Package consisted of three basic components:

- (1) Business compensation;
- (2) Labour adjustment assistance; and
- (3) Alternative employment creation strategies.

All three components can be regarded as attempts to compensate community members for the taking of resource rights from which they previously enjoyed benefits.

Labour adjustment assistance included:

- (1) Dislocation allowances;
- (2) Early retirement benefits;
- (3) Retraining subsidies, and
- (4) Relocation allowances.

In order to create alternative sources of employment for displaced timber workers, the Commonwealth Government, in addition to the above initiatives, began public sector and local community programmes, and provided subsidies to the private sector to foster employment in the local regions affected. Apart from providing compensation to displaced timber workers, these initiatives also incidentally provided some compensation to local communities for the loss of economic injections (and multiplier effects) due to cessation of logging operations.

Let us consider each of the three components of the Wet Tropics Structural Adjustment Package (SAP) in more detail and consider its relevance to the proposed extension of Dugong Protected Areas (DPAs).

BUSINESS COMPENSATION: This scheme allowed for payment of up to \$24.4 million to companies and businesses adversely affected by cessation of logging. Compensation was 'only

paid to those businesses who could clearly demonstrate that the Commonwealth Government decision to cease logging in the World Heritage Listed forests resulted either:

- The closure of their operation;
- The forced rationalisation of their businesses; or
- A substantial reduction in their business viability' (Lynch-Blosse *et al.*, 1991, p. 46).

It would be a reasonable expectation given this case that those with similar adverse effects on their business due to extension of DPAs should be compensated by the Commonwealth Government.

About three-quarters of businesses which sought compensation under the Wet Tropics SAP were successful in that they were ruled to be eligible for compensation, Lynch-Blosse *et al.*, (1991, p. 47) observe: 'The types of businesses which were successful in their claim for compensation include larger timber mills, factories and manufacturing establishments which were end-users of rainforest timber, contract timber cutters, sleeper cutters, and organisations which were involved in the maintenance and repairs of the timber-related equipment (e.g., Saw Doctor)'. This meant that businesses either having a relatively direct forward or backward economic linkage with logging in the Wet Tropics World Heritage listed areas were eligible for compensation. By analogy, processors and others dependent on the supply of fish from extended DPAs would have a case for compensation as would those involved in the maintenance and repair of equipment used in areas to be converted to DPAs, as well as of course fishers themselves.

A two-staged process was involved in determination of business compensation claims. Firstly, a government body (the Rainforest Unit of DASETT) determined whether in terms of the criteria an applicant was eligible for compensation. Then an accounting firm (Price Waterhouse), hired by the Government, was asked to assess the level of compensation considered to be fair and reasonable on the basis of:

- A detailed analysis of the earnings in recent years of the business being assessed and an

- estimate of likely future earnings in the absence of World Heritage Listing;
- An assessment of the value of assets used by that business in deriving income from rainforest logging and milling activities; and,
 - An assessment of other compensation claims made by that business'.

If a parallel procedure were adopted to the extension of DPAs similar information would need to be collected in relation to fishing in DPAs. Account would need to be taken of loss of supply of fish from DPAs, business closures, lost contracts and business.

Unfortunately, the method of determination of compensation is not precisely specified above. It is more specific for the loss of timber rights on Fraser Island. In that case (as discussed below) the basis of business compensation was basically the anticipated reduction in the capitalised value of the business as a result of the loss of timber rights.

LABOUR ADJUSTMENT ASSISTANCE: For employees adversely affected by the cessation of crown rainforest operations in the nominated World Heritage Area this consisted of:

- Dislocation Allowance;
- Early Retirement Allowance;
- Retraining Subsidy; and
- Removal and Relocation Assistance.

To be eligible applicants had to have been employed in the timber industry or a closely related business for at least 12 of the 18 months before retrenchment and have been retrenched as a result of the cessation of logging in the area included on the World Heritage List. Given this precedent, a similar labour adjustment package should be available to employees adversely affected by extension of the DPAs.

ALTERNATIVE EMPLOYMENT CREATION STRATEGIES: Means used to obtain alternative employment for displaced timber workers included:

- Public Sector Projects such as new or additional local council projects;
- Tree planting projects funded by the Commonwealth Government;
- Financial assistance ‘to individuals, private sector enterprises and other organizations who could propose feasible and economically viable initiatives which would employ eligible displaced timber workers’ \$3.7 million was allocated for this; and,
- Wage subsidy payable to employers (*outside* the timber industry) of eligible displaced timber workers. (The subsidy was payable for six months).

The Wet Tropics Structural Adjustment Package was comprehensive. It provided compensation to all those directly or closely affected by cessation of logging in the World Heritage Area, and indirectly reduced the economic impact of this cessation on local communities. It is a benchmark Australian case for the taking of resource interests by the state, in this case the Commonwealth Government. On the basis of this precedent one would expect similar types of compensation to be available should DPAs be extended in Queensland as is proposed. Decisions on compensation following the Fraser Island Report to stop logging there and to proceed with application for World Heritage Listing of Fraser Island provide additional guidelines for compensation in Australia in relation to the taking of resource interests.

3. Compensation for the Loss of Timber Rights on Fraser Island

Following the Fraser Island Report, it was decided that logging on Fraser Island would cease by the end of 1991, and a compensation package described as ‘A Special Growth and Development Package for the Great Sandy Region’, was devised. In consequence, total financial assistance of \$37 million was proposed for the region. Of this \$21.2 million was to be contributed by the Queensland Government and the remaining \$16.5 million by the Commonwealth Government.

As in the case of the Wet Tropics, the package involved *three* basic elements:

- Workers’ Adjustment Package;
- Schemes to create alternative employment opportunities; and,

- Compensation for businesses directly and substantially affected by phasing out of logging on Fraser Island.

However, there were some differences in 'Fraser Island' packages compared to the Wet Tropics settlement. For example, workers were not offered a retirement allowance in the Fraser Island case. Emphasis was on obtaining alternative employment for displaced workers. Furthermore, in the Fraser Island case, special mortgage assistance could be made available to displaced workers. The Special Workers' Adjustment offered the following:

- Dislocation assistance of up to \$35,000 based on years of service;
- Priority for alternative employment in government funded schemes;
- Relocation assistance of up to \$5,000;
- Income supplement for 12 months [to displaced workers sufficient to bring their income to its previous level]; and
- Special mortgage assistance for up to three years to ensure that repayments do not exceed 30 per cent of gross household incomes' (The Queensland Government, 1991, p. 3).

Government-funded employment initiatives were designed to provide alternative employment to displaced workers if they wished to take advantage of these. However, employment in projects resulting from these initiatives was not confined to displaced workers even though they were given priority in employment. The schemes were intended to compensate or more than compensate, for any decline in regional incomes as a result of the cessation of logging on Fraser Island.

It is *worthwhile considering the basis of compensation for businesses directly or substantially affected by the phasing out of logging on Fraser Island*. The State Government claimed that, 'there is no legal obligation to pay compensation to affected businesses', (Queensland Government, 1991, p. 11). Whether or not that is so is however probably unclear given the practices adopted in the case of the Wet Tropics. Nevertheless, the State government was prepared to consider *ex gratia* payments to businesses directly or substantially affected by the decision to phase out logging on Fraser Island.

The criteria for eligibility of businesses to be considered for compensation were *narrower* than in the case of the Wet Tropics. To be eligible for consideration, a business had to depend heavily on the timber industry for its income. In the Dugong Protection case, if the same rule applied, a business would have to be heavily reliant for its income on fishing for it to be considered for compensation. The exact position in relation to Fraser Island was as follows:

‘To be eligible for compensation, about 50 per cent of a business’s income would need to be reliant on the timber industry. The Treasurer would consider particular cases involving less than 50 per cent if it could be shown the viability of the business had been substantially affected.’ (Queensland Government, 1991, p. 11).

The basis of compensation was intended to be the loss of value of business due to the cessation of logging on Fraser Island.

Im the case of a business forced to close as a result of the decision to phase out logging, Price Waterhouse would:

- [1] Value the existing business as a going concern based on capitalisation of future maintainable earnings;
- [2] Deduct from this value the net book value of the physical assets retained by the business; and,
- [3] Then adjust for any extraordinary expenses incurred by the business relating to closure, (Queensland Government, 1991, p. 11).

In this case [1] - [2] - [3] would be the basis of compensation.

However, the Government did not necessarily pay the loss in value of business as determined by Price Waterhouse. It decided on a case by case basis taking account of Price Waterhouse’s assessment and other factors such as:

- Avenues available for mitigation of losses and other business opportunities;

- The commercial risks associated with operating the business in an environmentally sensitive area. – e.g., if expensive assets were acquired recently, it may not be appropriate to compensate the party for full loss of value; and,
- The Government's overall objectives for industry rationalisation in the region.

Compensation payments would be staged to avoid the situation where a lump sum is paid up front but actual losses do not materialise in line with the original projection.' (Queensland Government, 1991, p. 11).

Consequently the compensation available to businesses for the taking of resource rights was relatively uncertain.

Regarding the treatment of physical assets in the case given above, one could question whether these should be deducted at net book value. Market values would provide a better indicator of their worth and could well be smaller than net book value.

4. Comparisons Between Compensation in the Wet Tropics and Fraser Island Cases

The basis of eligibility for business compensation in the Wet Tropics was more generous than in the Fraser Island case and actual payment of the compensation less restricted and qualified.

Whereas early retirement allowances was available to displaced labour in the Wet Tropics area, this was not so for the Great Sandy Region. In the latter case emphasis was on finding displaced workers alternative employment. To find such alternative employment in the Great Sandy Region may have been easier than in some regions affected by the Wet Tropics World Heritage listing.

The creation of alternative employment opportunities in the Hervey Bay Region were only partly intended to absorb workers displaced as a result of cessation of logging on Fraser

Island. New projects also directly created employment for other workers as well. In the case of the Wet Tropics, more weight was placed on the absorption of displaced timber workers by the alternative employment schemes devised. Therefore, the Fraser Island Package seems to have been designed to provide greater community-wide compensation and benefits with these not all tied specifically to displaced workers. The process of compensation is to a considerable extent a political process. It is influenced by the political power of the parties involved; both those directly affected and the communities in which they live.

5. General Observations on Compensation for the Taking of Resource Interests and Relevance to DPAs

It was observed in the introduction that a good deal of pragmatism is involved in the payment of compensation for the taking of resource interest by the state. The greater however the economic loss sustained by a party affected by loss of resource interest and the more established or definite are these rights, the more likely that compensation will be paid.

Furthermore, 'government is likely to respond to the demands of well-defined, compact interest groups whose members clearly recognise either the benefits or costs which will fall on them as a result of a particular policy, while ignoring or discounting the benefits or costs occurring to ill defined, diffused interest groups who do not clearly recognize the impact of the policy upon them' (Buchanan, *et al.*, 1980; British Columbia, 1992). Therefore, compensation is more likely to be paid to those damaged by a resource expropriation if they form well-defined interest groups that 'are capable of clearly and forcefully making their interests known to policy makers'. This indicates that it is essential that all who will be adversely affected by extension of DPAs form or belong to such groups. Otherwise, they are more likely to suffer uncompensated economic loss. Furthermore, the case for compensation must be put clearly and forcefully to policy makers.

Assessing the economic loss occasioned by the taking of resource interests is a complex task not least because of the considerable economic and other uncertainties involved. While a complete coverage of the subject is not possible there some specific matters that are worth raising

because of their possible relevance to government decisions to extend the DPAs. Let us consider in turn business compensation; compensation for displaced workers and community-wide impacts and restitution.

BUSINESS COMPENSATION: The most important thing to consider in assessing the economic loss incurred by a business as a result of the taking of its resource interests is the reduction in its capitalised value as a consequence of this loss. This reduction (R) is equal to the difference of net present value of its anticipated future net earnings should its resource interests be maintained (V_R) and this if its resource interests are lost. In other words $R = V_R - V_E$.

It is however difficult to estimate the reduction (R) in the capitalised value of the firm due to loss of its resource interests because future income is uncertain. Furthermore, the size of R depends on the rate of interest used to discount future earnings.

The reduction of capitalised value, R, does not take account of the value of assets physical or otherwise retained by the firm. To the extent their assets can be sold they reduce the loss suffered by the business. Ideally such assets should be valued at realizable or market value once the business loses its resource interests. There does not seem to be any logic in valuing them at net book value as in the Fraser Island case. If the business' assets are rather *specific* to exploitation of its natural resource interests, then after loss of these resource interests these assets may have little use elsewhere. Hence, their market or realizable value may be much less than their book value after expropriation of the natural resource under consideration. Hence, it is appropriate to deduct, only the realizable value of the business' assets from its reduction in capitalised value in determining the business' economic loss (EL). In addition, to estimate a business' economic loss, it may be appropriate as mentioned in the Fraser Island case, to add any special expenses (C_s) a business has to incur either because it must close down or restructure substantially due to its resource loss.

Taking these matters into account, the economic loss of a business due to loss of resource interests would be estimated as:

$$\begin{aligned}
EL &= R - A_M + C_S \\
&= (V_R - V_E) - A_M + C_S.
\end{aligned}$$

In relation to the extension of DPAs, it has been suggested that reduction in the value of licences and endorsements might be used as a basis for compensation or the Commonwealth might buy back entitlements from fishermen at their market value prior to moves to extend the DPAs. This, however, would be inadequate to compensate fishers for their loss.

First the market for fishing entitlements is thin and therefore a far from a perfect market. Secondly and more importantly no allowance is made for *asset specificity* - that is for the losses of fishers on their physical capital, geared specifically to the netting operations in new areas to be included in DPAs. At the most, the sale price of entitlements represents capitalised resource rents and does not capitalise the normal return on capital used to exploit the resources in question. The normal return from the capital will be lost on the taking of the resources and even the undepreciated value of this capital may not be realisable in the market. Furthermore, no allowance is made for the special cost factor, C_S , mentioned above.

The specificity of capital needs to be given particular attention in claims for compensation for loss of resource interests. This is not only true of physical capital but of other forms of capital too. Not enough attention has for example been given to human capital in the past. Owner/managers as well as employees embody much human capital which may be *specific* to their business operations reliant on natural resources. Their next best employment may not be able to use this capital. So this capital becomes a sunk cost to individuals just as physical capital may have a sunk cost. The longer individuals have been operators in an industry, the larger is their human capital (as a rule) *specific* to those operations and the greater their loss is likely to be when those operations are no longer possible. This needs to be taken into account for example in the case of owner/operators.

COMPENSATION FOR DISPLACED WORKERS: While compensation for the taking of resource interests from businesses may have a quasi-legal basis, the case for compensating

workers seems to be more a question of equity. Compensation packages have included measures to find alternative employment for displaced workers, payments to compensate for lost income in alternative employment (Fraser Island case) and allowances to cover expenses included in finding alternative employment. Similar types of compensation could be expected for fishermen displaced by extension of DPAs.

COMMUNITY-WIDE IMPACTS AND RESTITUTION: While governments have no legal requirement to compensate communities which may be adversely affected by the loss of resource-interests, political reality often requires that such restitution be made. This is especially so when a regional economy depends heavily on use of the resource as a source of economic injections. The loss of exploitation of this resource through various multiplier effects can depress the local economy. Therefore, adverse economic effects are not confined to those directly affected by the withdrawal of resource rights or interests.

Because of asset specificity or capital specificity, including that of human capital, one problem that can arise when natural resource rights are restricted is that displaced business and workers increase their exploitation of closely related resources. If for example, fishers are restricted in one fishery, they may crowd into other fisheries, thereby causing over exploitation in these fisheries and depressing incomes in these to below normal levels. In a sense, this exacerbates the social and biological damage caused.

6. Concluding Comments

Commissioner Richard Schwindt (British Columbia, 1992) indicates that the rationale (including the economic rationale) for the taking of resource interests ought to be carefully considered before a decision is made. Clearly the value to the state (government), acting on behalf of the community, in taking resource interests should exceed the economic value to users of these resources of retaining the rights. In relation to the proposed extension of DPAs these values have not been estimated or even discussed to any extent.

Second note that community values are changing in relation to the economic exploitation

of natural resources. There is now less emphasis on the direct economic benefits to be obtained from the use of these resources and more emphasis on indirect non-use values. While this may be reasonable, it may be unreasonable to expect those given specific resource-interests not be compensated for a change in community or government attitudes affecting their previously settled interest.

Third, it could well be that fishers are not the main cause of the decline in the size of dugong populations. For example, habitat change brought about by spillovers from land-based agriculture and other economic activities could be a major cause of such a decline. If this is so, this would be a further reason why the full cost of further protection for dugongs should not fall solely on fishermen. To impose the full cost of dugong protection on fishermen would be inequitable.

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