articles

Combating overfishing and conserving marine biodiversity

By Vanessa L. Smith

Assessing the efficacy of marine protected areas and property rights regimes in addressing the major threat to marine fisheries

1. Introduction

Biodiversity refers to the variety of life on earth, and nowhere is this variety more extensive than in the world's oceans. Marine biodiversity however is under threat from numerous anthropogenic impacts including climate change, habitat destruction and most significantly excessive exploitation.[1] Highly competitive fishing practices combined with indiscriminate fishing methods such as trawling have had a deleterious effect on fish biodiversity, resulting in approximately 30% of stocks being classified as overexploited, depleted or collapsed.[2] Governments have subsequently sought to impose various forms of management strategies to their domestic fisheries with the view of improving the sustainability of their fish stocks and maintaining the biodiversity of the marine environment. This paper will examine the efficacy of marine protected areas and proprietary-based fisheries management approaches in addressing the threat of overfishing to marine biodiversity.

2. Marine Protected Areas (MPAs)[3]

"The establishment of representative systems of protected areas is widely regarded... as one of the most efficient mechanisms for protecting biodiversity"[4]

MPAs are areas of land and/or sea dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources.[5] Generally, MPAs are legally prescribed[6] and serve two principal roles: to sample or represent the biodiversity of each region and to separate that biodiversity from processes that threaten its persistence.[7] To combat overfishing, this effectively means the prohibition of commercial and/or recreational fishing in designated MPAs.

2.1 The benefits of MPAs

MPAs are considered to be an efficient conservation management tool for numerous reasons. Principally, they have been introduced to safeguard against the collapse of fish stocks by protecting breeding and recruitment areas, reducing human impacts on insular fish populations and in protecting critical habitat.[8] Additional related advantages include conservation of genetic diversity;[9] the promotion of fish emigration for the benefit of fishers;[10] and the establishment of

1 J.A. McNeely (2003) Assessment of the world's efforts on biodiversity. http://www.ecoagriculturepartners.org/documents/reports/McNeely%20-%20Davospaper%2011-03.pdf cited 16 March 2007.

2 Food and Agriculture Organisation of the United Nations (2006) Capture resources fisheries fact sheet. At http://www.fao.org/figis/servlet/topic?fid=3380 cited 1 March 2007.

3 The term MPA is used in the generic sense to denote aquatic reserves, marine sanctuaries and marine national parks.

4 Australian Government Department of the Environment and Water Resources (2006) Australian marine protected areas. http://www.environment.gov.au/coasts/mpa/about/australian.html#1 cited 16 March 2007.

5 This definition was originally developed by the World Conservation Union and has been adopted by the Australian Government: ibid.

6 See for example the Great Barrier Reef Marine Park Act 1975 (Cth); Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004 (Qld); Marine Parks (Great Sandy) Zoning Plan 2006 (Qld); National Parks (Cape Howe Marine National Park) Regulations 2006 (Vic) and Cobourg Peninsula Aboriginal Land, Sanctuary and Marine Park Act 1981 (NT).

7 C.R. Margules and R.L. Pressey (2000) Systematic conservation planning. *Nature* 405 at 243-253.

8 R.L. Shipp (Undated) No Take Marine Protected Areas (nMPAs) as a fishery management tool, a pragmatic perspective. http://www.thefishingparty.info/uploads/gais_shipp.pdf cited 1 March 2007.

9 Australian Government Department of the Environment and Water Resources, above n 4.

10 G.J. Edgar and N.S. Barrett (1999) Effects of the declaration of marine reserves on Tasmanian reef fishes, invertebrates and plants. *Journal of Experimental Marine Biology and Ecology* 242 at 107-144.

reference sites for scientific research.[11] These perceived benefits have resulted in extensive use of MPAs throughout Australia,[12] the US, [13] and Canada.[14]

2.2 The limitations of MPAs

Despite high levels of prescription by Western nations less than 1% of the marine environment is designated as MPAs.[15] This may be attributable to numerous factors including difficulties in implementation and zone designation, deficiencies in assessing efficacy, costs of ongoing management and regulation, and the availability of alternative management approaches to address the underlying causes of the threats to marine biodiversity.

2.2.1 Practical problems to MPA management

The marine environment is highly variable and dynamic resulting in continuous biotic change.[16] In addition, fish populations fluctuate dramatically[17] both spatially and temporally[18] and endemism is rare.[19] This is problematic for MPA management in numerous respects. Primarily, system variability can lead to grossly divergent views in the determination of appropriate zones and indicator species[20] for MPAs. Containment issues also mean that MPAs are not considered appropriate for migratory and wide-ranging species, which are generally the species most prone to being overfished.[21] In addition, ongoing management of MPAs necessarily involves significant monitoring, enforcement and compliance costs. Inadequate resourcing can thus defeat the purpose of any MPA designation,[22] and is likely a principal cause of lack of MPA designation in developing nations.[23]

Where implemented, MPAs have generally proven beneficial in the promotion of localised biodiversity conservation, however they are not a suitable solution for every threat to the marine environment. Rather, they serve the limited purpose of dealing with site-specific pressures and preserving samples of insular and sedentary species of marine life. On this basis, MPAs should not be used as an isolated management strategy, and to address the broader threats to the marine environment, "complementary off-reserve management is crucial."[24]

11 R.J. Davidson (2001) Changes in population parameters and behaviour of blue cod (*Parapercis colias; Pinguipedidae*) in Long Island-Kokomomohua Marine Reserve, Marlborough Sounds, New Zealand. *Aquatic Conservation: Marine and Freshwater Ecosystems* 11 at 417-435.

12 Australia has approximately 360 designated MPAs: MPA Global (2007) MPAs for the country Australia. http://www.mpaglobal.org/index.php?action=search cited 19 March 2007.

13 The US has approximately 300 designated MPAs: MPA Global (2007) MPAs for the country United States of America. http://www.mpaglobal.org/index.php?action=search cited 19 March 2007.

14 Canada has approximately 550 designated MPAs: MPA Global (2007) MPAs for the country Canada. http://www.mpaglobal.org/index.php?action=search cited 19 March 2007.

15 McNeely, above n 1; United Nations (2006) 10 Stories the world should hear more about: Overfishing a threat to marine biodiversity. http://www.un.org/events/tenstories_2006/story.asp?storyID=800 cited 16 March 2007.

16 D. Farrier (1996) Implementing the in-situ conservation provisions of the United Nations Convention on Biological Diversity in Australia. *Australasian Journal of Natural Resources Law and Policy* 3 at 1-24, 8.

17 J.F. Caddy and J.A. Gulland (1983) Historical patterns of fish stocks. Marine Policy 7 at 267-78; A. Soutar and J.D. Isaacs (1974) Abundance of pelagic fish during the 19th and 20th centuries as recorded in anaerobic sediments of the Californias. Fisheries Bulletin 72 at 257-73; J. Schnute and L. Richards (2001) Use and abuse of fishery models. Canadian Journal of Fisheries and Aquatic Sciences 58(1) at 12.

18 R. Hilborn, C.J. Walters and D. Ludwig (1995) Sustainable exploitation of resources. *Annual Review of Ecological Systematics* 26 at 54-55.

19 World Commission on Protected Areas (1999) *Guidelines for Marine Protected Areas.* http://iucn.org/themes/marine/pdf/mpaguid.pdf cited 16 March 2007 at para 5.1.

20 Margules and Pressey, above n 7 at 245.

21 Shipp, above n 8.

22 Margules and Pressey, above n 7 at 250.

23 For example Chile only has 8 designated MPAs, India only has 18 designated MPAs and Cambodia has only 2 designated MPAs: MPA Global (2007) Search results of MPAs for each country. http://www.mpaglobal.org/index.php?action=search cited 19 March 2007.

24 Farrier, above n 16 at 7; see also the Australian Government Department of Environment and Water Resources (formerly the Department of Environment, Sport and Territories) (1996) *National Strategy for the Conservation of Australia's Biological Diversity.* http://www.environment.gov.au/biodiversity/publications/strategy/index.htmlat cited 16 March 2007 at para 1.4.

2.2.2 Underlying problems with MPA management

MPA management facilitates biodiversity conservation through the 'locking away of resources' in reserves, effectively externalising the problem of biodiversity loss.[25] In addition MPAs generally focus on negative restrictions on human activity.[26] These prohibitions, combined with the uncertainties inherent in attempting to regulate the marine environment,[27] can cause friction and opposition from stakeholders, resulting in a lack of endorsement of MPAs by industry. In this respect, MPAs are considered to be a superficial management tool, in that fishers are neither educated nor empowered to take action in regards to their impacts on fish stocks. Farrier argues that the creation of reserves encourages exploiters to believe that conservation is "merely a system of trading environmental write-offs against large protected areas".[28] Subsequently MPA management becomes a symptom of the overfishing problem by maintaining a discord between social, economic and environmental imperatives.[29]

The role of industry in effective fisheries management and biodiversity conservation cannot be undermined. The acceptance of management policy by fishers is often determinative of the effectiveness of the regulatory regime.[30] It is therefore important to understand why traditional fisheries management has experienced limited success in receiving endorsement from industry. Opposition by fishers to top down regulation can be explained in terms of the short term economic incentives that traditional management frameworks promote. That is, while the government retains property interests in the resource and therefore values conservation and sustainable long-term management practices, fishers have no incentive to reduce their race for fish or participate in conservation measures because there is no economic incentive for them to do. This underlying conflict, and profound disconnect between the values of decisionmakers and those of the exploiters needs to be resolved if biodiversity conservation is to succeed. The answer lies in integrating exploiter activities and conservation measures.[31]

3. Property rights in fisheries

"Perhaps the biggest failure in natural resource management has been the widespread neglect of the dynamics of the exploiters."[32]

Biodiversity conservation is significantly a socio-economic problem,[33] and it is argued that allocating property rights to fishers, and therefore engaging them in active and adaptive management is a preferable and more effective means of addressing the threat of overfishing to marine biodiversity, than simply designating MPAs for the recovery of overfished stocks.

Economic analyses of fisher behaviour argue that if proprietary entitlements to fish (or a proportion of the available fish) were vested in private individuals, incentives would exist to stop the race for fish and conserve the stocks because the gains from stock and biodiversity preservation would accrue directly to the rights holders.

3.1 The benefits of allocating property rights in fisheries

"Successful management...will rest...on the implementation of better institutional arrangements for controlling exploiters and creating incentives for them to behave more wisely."[34]

In fisheries, the benefits of assigning property rights to fishers include: removal of the incentive of operators to race for fish, as operators enjoy the certainty that their proportion of the catch will not

25 Farrier, above n 16 at 14.
26 Farrier, above n 16 at 5.
27 See paragraph 2.2.1 above.
28 Farrier, above n 16 at 1.
29 Margules and Pressey, above n 7 at 244.
30 S. Kerr, K. Johnson, J. Side, M. Baine, C. Davos, and J. Henley (2006) Resolving conflicts in selecting a programme of fisheries science investigation. *Fisheries Research* 79 at 315.
31 Farrier, above n 16 at 10.
32 Hilborn et al. above n 18 at 59.
33 Farrier, above n 16.
34 Hilborn et al, above n 18 at 61-62.

be subsumed by competitors;[35] provision of the incentive for fishers to adopt sustainable practices in the interests of improving the value of their rights in the long-term; aggregate efficiency gains within the fishery through the trade and acquisition of rights by more efficient operators;[36] increased levels of self-regulation with participation of fishers in deterrence of non-compliant behaviour;[37] reduced fishing haste; reduced by-catch; improved fish quality;[38] and reduced levels of overcapitalisation in vessels and equipment.

Many practical examples demonstrate that the allocation of proprietary rights operates to enhance the viability of fish stocks and the operations of the fishing communities and nations that are dependant upon them. For example, in Iceland after 15 years of proprietary based management, participation in the herring fishery had contracted from 200 to 30 vessels, with productivity increasing by five-fold and total harvests doubling the yield of 1980, indicating thriving fish stocks.[39] Similarly in New Zealand, restructuring and the introduction of property rights, promoted the recovery of overfished stocks and cooperative conservation measures while increasing the value of the industry to NZ$2 billion within a decade.[40]

Where they are applied, property rights have had considerable practical success in reducing the race to catch fish and thus improving the sustainability of the fish resources. Case studies from Australia,[41] the US,[42] New Zealand,[43] Iceland,[44] Canada,[45] Namibia[46] and the Netherlands[47] demonstrate the ability for fisheries to become economically rationalised; for fishers to shift to more altruistic and participatory fishing practices, with benefits to both the marine environment and industry through improved efficiencies, increased profits and importantly replenished stock abundance.

3.2 The limitations of property rights regimes

"The ways and extent to which fishing rights can be useful will depend on the setting in which they are applied and on the design of the rights system."[48]

Despite the extensive documentation of the benefits associated with property rights management strategies, the majority of the world's fisheries are not managed using this formula. The physical, biological and structural conditions that pre-exist in a fishery appear to be indicative of the success to which a property rights program can be implemented. The case studies and literature suggest

35 F. Alcock (2006) Property rights and equity in fisheries management: The significance of vertical integration. Sharing the Fish – Allocation Issues in Fisheries Management Conference 2006, Western Australia. http://www.fishallocation.com/assets/pdf/papers/FrankAlcock.pdf cited 1 March 2007; D. Leal (2000) Homesteading the Oceans: The case for property rights in U.S fisheries. PERC Policy Series PS-19, United States.

36 R. Hannesson (2004) The Privatization of the Oceans. MIT Press, Cambridge, USA; Alcock, above n 35; Leal, above n 35.

37 A. Iyambo (2000) Managing Fisheries with Rights in Namibia: a Minister's Perspective. In R. Shotton (ed.) Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1, Rome.

38 Alcock, above n 35.

39 Leal, above n 35.

40 T. McClurg (1997) Bureaucratic Management versus Private Property: ITQs in New Zealand after Ten Years. In L. Jones and M. Walker (eds.) Fish Or Cut Bait. Fraser Institute, Vancouver, BC at 91–105.

41 B. Muse and K. Schelle (1989). Individual fishermen's quotas: a preliminary review of some recent programmes. Alaska Commercial Fisheries Entry Commission, Juneau, Alaska; Leal, above n 17; North Pacific Management Council and NMFS. (1991) Appendix I: Survey of Individual Quota Programs. In *Environmental Impact Statement. Regulatory Impact Review. Initial Regulatory Flexibility Analysis for Proposed Individual Fishing Quota Management Alternatives for the Halibut Fisheries in the Gulf of Alaska and Bering Sea/Aleutian Islands.* Anchorage, Alaska.

42 Leal above n 35; National Research Council (1999) Sharing the Fish: Toward a National Policy on Individual Fishing Quotas. National Academy Press, Washington, DC; P.J. Smith (2000) The Alaska Halibut and Sablefish Experience. In R. Shotton (ed.)(2000) Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1, Rome.

43 R. Arnason (1996) Property Rights as an Organizational Framework in Fisheries: The Cases of Six Fishing Nations. In B. Crowley (ed.) Taking Ownership: Property Rights and Fishery Management in the Atlantic Coast, Halifax, Nova Scotia. Atlantic Institute for Market Studies: 99–144; Leal above n 35; T. McClurg (1997) Bureaucratic Management versus Private Property: ITQs in New Zealand after Ten Years. In L. Jones and M. Walker (eds.) Fish Or Cut Bait. Fraser Institute, Vancouver, BC: 91–105.

44 Leal, above n 35.

45 D.L. Burke and G.L. Brander (2000) Canadian Experience with Individual Transferable Quotas. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

46 Iyambo, above n 37.

47 Arnason, above n 43; Leal, above n 35.

48 I. Nomura, FAO Assistant Director-General for Fisheries quoted in FAO Newsroom (2006) Wider use of fishing rights needed to safeguard fishery resources. http://www.fao.org/newsroom/en/news/2006/1000239/index.html cited 1 March 2007.

that this is largely dependant upon the economic development[49] and political organisation[50] of the nation; the distribution of fishing interests within the industry;[51] the level of regulatory exclusivity that exists within the fishery;[52] the spatial aspects of the fishery; the water temperature and ecology of the target fish species;[53] and the available scientific data. As a result, no single property rights management strategy can be prescribed as a remedy for all cases of resource overexploitation. Rather, the geographic, economic, cultural and ecological context of the fishery will define the scope and type of the property rights system to be implemented.

To address recoverable levels of overfishing by industry, a property rights organisational framework is essential to empower fishers with the economic incentives to sustainably manage fish stocks. It is clear however that the world's fish stocks are also being threatened by fishers operating outside of prescribed management regimes. To deal with those engaging in illegal, unregulated and unreported fishing, some form of top-down regulation is required. In addition where fish stocks have been depleted to levels bordering collapse, blanket prohibitions on fishing activity may be preferable. In these circumstances, adequately resourced and enforced MPAs would provide complementary protection for fish biodiversity alongside proprietary-based management. Accordingly, nations such as Australia, New Zealand and Canada have recognised the importance of adopting a combined management approach in response to overfishing.[54] For example, in Australia the *East Coast Trawl Management Plan 2001* (Qld) introduced both a tradeable quota system and closed an additional 96,000km^2 of the Great Barrier Reef Marine Park to prevent further expansion of the fishery. The threat of overfishing to marine biodiversity was subsequently alleviated by a 37% reduction in trawl effort and fleet reduction of almost 50%.[55]

4. Conclusion

Protected areas management has been used extensively by Western nations in the marine context, but has not been overly prescribed as a conservation tool for the world's oceans generally. This is arguably a reflection of the fact that MPA management is plagued with costs, uncertainties and limitations and does not comprehensively address the dynamics and incentives of the exploiters which underlie the cause of biodiversity loss. In contrast, property rights management has emerged as an effective tool to align commercial and environmental interests. Ownership entitlements to the resource means that fishers are motivated to modify their fishing behaviour and conserve fish stocks so that they may reap the economic and environmental rewards in the long term. Where the physical, biological and structural conditions are considered favourable, the implementation of a property rights program consolidates exploitation and conservation functions within an industry to create an efficient self-adapting system in which maximum benefits accrue to the fishers and the fish stocks.

It is clear however, that no single management or conservation technique will ubiquitously address the threat to marine biodiversity caused by overfishing, and "the way forward lies in designing policy instruments which contain a mix of regulation and incentives, and which rely on a combination of 'top-down' and 'bottom-up' strategies",[56] so as to comprehensively address and monitor both legally endorsed and extra-legal fishing activities. In this respect, complementary and integrated management approaches using both MPAs and property-based methods will prove most successful in combating overfishing and conserving marine biodiversity.

49 F.T. Christy (2000) The Use of Fixed Gear as a Basis for Property Rights Management. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

50 Alcock, above n 35.

51 Alcock, above n 35.

52 A.D. Scott (2000) Moving through the narrows: from open access to ITQs and self-government. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

53 Christy, above n 49.

54 Australian Government Department of the Environment and Water Resources, above n 4.

55 Australian Government represented by the Great Barrier Reef Marine Park Authority (2005) Protecting Biodiversity Brochure. http://www.gbrmpa.gov.au/corp_site/info_services/publications/brochures/index.html cited 15 March 2007.

56 Farrier, above n 16 at 5.

References

Alcock, F. (2006) Property rights and equity in fisheries management: The significance of vertical integration. *Sharing the Fish – Allocation Issues in Fisheries Management Conference 2006*, Western Australia. http://www.fishallocation.com/assets/pdf/papers/FrankAlcock.pdf cited 1 March 2007;

Arnason, R. (2004) Property Rights Quality and Economic Efficiency of Fisheries Management Regimes: Some Basic Results. *Conference in honour of Professor G.R. Munro,* University of British Columbia. http://www.econ.ubc.ca/gmconf/paarnaso.pdf cited 1 March 2007.

Arnason, R. (1996) Property Rights as an Organizational Framework in Fisheries: The Cases of Six Fishing Nations. In B. Crowley (ed.) *Taking Ownership: Property Rights and Fishery Management in the Atlantic Coast*, Halifax, Nova Scotia. Atlantic Institute for Market Studies: 99–144.

Australian Government Department of the Environment and Water Resources (2006) Australian marine protected areas. http://www.environment.gov.au/coasts/mpa/about/australian.html#1 cited 16 March 2007.

Australian Government Department of Environment and Water Resources (formerly the Department of Environment, Sport and Territories) (1996) National Strategy for the Conservation of Australia's Biological Diversity. http://www.environment.gov.au/biodiversity/publications/strategy/index.htmlat cited 16 March 2007.

Australian Government represented by the Great Barrier Reef Marine Park Authority (2005) Protecting Biodiversity Brochure. http://www.gbrmpa.gov.au/corp_site/info_services/publications/brochures/index.html cited 15 March 2007.

Burke, D.L. and Brander, G.L. (2000) Canadian Experience with Individual Transferable Quotas. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

Caddy, J.F. and Gulland, J.A. (1983) Historical patterns of fish stocks. *Marine Policy* 7 at 267-78.

Christy, F.T. (2000) The Use of Fixed Gear as a Basis for Property Rights Management. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

Davidson, R.J. (2001) Changes in population parameters and behaviour of blue cod (*Parapercis colias; Pinguipedidae*) in Long Island-Kokomomohua Marine Reserve, Marlborough Sounds, New Zealand. *Aquatic Conservation: Marine and Freshwater Ecosystems* 11 at 417-435.

De Alessi, M. (1999) Saving fisheries without property rights: Surgery with a baseball bat. *Onpoint,* 27 Competitive Enterprise Institute, Washington http://www.cei.org/gencon/004,01558.cfm cited 1 March 2007.

Edgar, G.J. and Barrett, N.S. (1999) Effects of the declaration of marine reserves on Tasmanian reef fishes, invertebrates and plants. *Journal of Experimental Marine Biology and Ecology* 242 at 107-144.

Farrier, D. (1996) Implementing the in-situ conservation provisions of the United Nations Convention on Biological Diversity in Australia. *Australasian Journal of Natural Resources Law and Policy* 3 at 1-24.

Food and Agriculture Organisation of the United Nations (2006) Capture resources fisheries fact sheet. At http://www.fao.org/figis/servlet/topic?fid=3380 cited 1 March 2007.

Hannesson, R. (2004) *The Privatization of the Oceans*. MIT Press, Cambridge, USA.

Hilborn, R., Walters, C.J. and Ludwig, D. (1995) Sustainable exploitation of resources. *Annual Review of Ecological Systematics* 26 at 54-55.

Iyambo, A. (2000) Managing Fisheries with Rights in Namibia: a Minister's Perspective. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

Kelly, A. and Farrier, D. (1996) Local Government and biodiversity conservation in New South Wales. *Environment and Planning Law Journal* 13 at 374-389.

Kerr, S., Johnson, K., Side, J., Baine, M., Davos, C. and Henley, J. (2006) Resolving conflicts in

selecting a programme of fisheries science investigation. *Fisheries Research* 79 at 315.

Kincaid, J. (2004) A note on some determinants of property rights in U.S. marine fisheries. *Economics Bulletin,* 17(6): 1-11.

Leal, D. (2000) Homesteading the Oceans: The case for property rights in U.S fisheries. *PERC Policy Series PS-19*, United States.

Margules, C.R. and Pressey, R.L. (2000) Systematic conservation planning. *Nature* 405 at 243-253.

McClurg, T. (1997) Bureaucratic Management versus Private Property: ITQs in New Zealand after Ten Years. In L. Jones and M. Walker (eds.) *Fish Or Cut Bait.* Fraser Institute, Vancouver, BC at 91–105.

McNeely, J.A. (2003) Assessment of the world's efforts on biodiversity. http://www.ecoagriculturepartners.org/documents/reports/McNeely%20-%20Davospaper%2011-03.pdf cited 16 March 2007.

MPA Global (2007) Search results of MPAs for each country. http://www.mpaglobal.org/index.php?action=search cited 19 March 2007.

Muse, B. and Schelle, K. (1989). Individual fishermen's quotas: a preliminary review of some recent programmes. Alaska Commercial Fisheries Entry Commission, Juneau, Alaska.

National Research Council (1999) *Sharing the Fish: Toward a National Policy on Individual Fishing Quotas.* National Academy Press, Washington, DC.

Nomura, I. FAO Assistant Director-General for Fisheries quoted in FAO Newsroom (2006) Wider use of fishing rights needed to safeguard fishery resources. http://www.fao.org/newsroom/en/news/2006/1000239/index.html cited 1 March 2007.

North Pacific Management Council and NMFS (1991) Appendix I: Survey of Individual Quota Programs. In *Environmental Impact Statement. Regulatory Impact Review. Initial Regulatory Flexibility Analysis for Proposed Individual Fishing Quota Management Alternatives for the Halibut Fisheries in the Gulf of Alaska and Bering Sea/Aleutian Islands.* Anchorage, Alaska.

Schnute, J. and Richards, L. (2001) Use and abuse of fishery models. *Canadian Journal of Fisheries and Aquatic Sciences* 58(1) at 12.

Scott, A.D. (2000) Moving through the narrows: from open access to ITQs and self-government. In R. Shotton (ed.) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

Shipp, R.L. (Undated) No Take Marine Protected Areas (nMPAs) as a fishery management tool, a pragmatic perspective. http://www.thefishingparty.info/uploads/gais_shipp.pdf cited 1 March 2007.

Smith, P.J. (2000) The Alaska Halibut and Sablefish Experience. In R. Shotton (ed.)(2000) *Use of Property Rights in Fisheries Management - FAO Fisheries Technical Paper 404/1*, Rome.

Soutar, A and Isaacs, J.D. (1974) Abundance of pelagic fish during the 19th and 20th centuries as recorded in anaerobic sediments of the Californias. *Fisheries Bulletin* 72 at 257-73.

United Nations (2006) 10 Stories the world should hear more about: Overfishing a threat to marine biodiversity. http://www.un.org/events/tenstories_2006/story.asp?storyID=800 cited 16 March 2007.

World Commission on Protected Areas (1999) *Guidelines for Marine Protected Areas.* http://iucn.org/themes/marine/pdf/mpaguid.pdf cited 16 March 2007.

Legislation

Cobourg Peninsula Aboriginal Land, Sanctuary and Marine Park Act 1981 (NT).

East Coast Trawl Management Plan 2001 (Qld).

Great Barrier Reef Marine Park Act 1975 (Cth).

Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004 (Qld).

Marine Parks (Great Sandy) Zoning Plan 2006 (Qld).

National Parks (Cape Howe Marine National Park) Regulations 2006 (Vic).