LESSONS LEARNED | 1910

Lessons learned and good practices in the management of coral reef marine protected areas

KEY LESSONS LEARNED

This brief presents a review of lessons learned and good practices in the management of coral reef marine protected areas based on the analysis of 20 projects funded by the Global Environment Facility (GEF) related to coral reef MPAs and 21 non-GEF funded projects. The key lessons learned and recommendations are grouped according to four broad areas of management of coral reef marine protected areas:

- Ecological objectives and impacts
- Socio-cultural objectives and impacts
- Economic objectives and impacts
- Governance issues

INTRODUCTION

The objective of this project is to formalize the experiences, outcomes and lessons learned from previous GEF projects, as well as major non-GEF initiatives involving marine protected areas (MPAs) in coral reefs and associated ecosystems. The project aims to comprehensively identify, analyze, and translate lessons into good practices and information resources, and then disseminate this information globally for use in future project design and development. Based on its history of supporting coral reef biodiversity, management and sustainable development, this project will help the GEF fulfill a major mandate to identify what has worked and what could be improved upon in supporting biodiversity conservation. In combination with other GEF projects, this effort will also help the GEF and other major non-GEF projects achieve a markedly improved return on investment for future projects involving coral reefs MPAs.

Since the 1990s, over $320 million of GEF funds were invested in projects at varying action and technical levels to improve the management of coral reef, seagrass and mangrove habitats, much of which was part of a broader portfolio of over $600 million invested in coastal-marine projects overall. During four entry periods each year, the GEF receives well over 200 concepts and project proposals annually. Even though the actual number of pipeline-approved projects is much less, the volume and diversity of those projects approved has far exceeded the Secretariat's ability to review and assess those elements that have worked and what could be improved upon.

The dissemination of good practices based on lessons learned is a strategic priority for the GEF. However, in the case of coral reef projects no comprehensive understanding of GEF successes and failures has ever been conducted. In recent reviews of GEF performance and activities, the need to utilise the results of previous project outcomes, experiences and lessons learned more comprehensively has been highlighted. Earlier works exist that extract lessons learned from previous projects, looking at both success and failure and comparing across global regions; however, such work has been neither comprehensive nor systematic.

Methods

This project initially sought to review all GEF-funded projects related to coral reefs and associated tropical marine ecosystems (65 projects in total) and about 10-20 key non-GEF funded projects. However, review of the GEF projects indicated that only 20 GEF projects had sufficient focus on coral reef MPAs, were either completed or far enough along to have gathered lessons learned information, or had sufficient available documentation. Many of the others were too recent to have gathered useful information, while several had been cancelled due to implementation problems.

In order to gather more useful information, we examined 50 non-GEF funded projects, based on a variety of criteria. Of these, 21 projects had sufficient lessons learned information to warrant including in our analysis. In addition to reviewing project documentation (progress reports, final reports), primary literature was consulted where these publications arose directly from the projects reviewed. In addition, personal interviews of project personnel were conducted. From our review of coral reef MPAs, we identified good practices in four broad areas of MPA management:

1. Ecological objectives and impacts;
2. Socio-cultural objectives and impacts;
3. Economic objectives and impacts;
4. Governance issues.

ISSUE 1: Ecological Objectives and Impacts

The primary ecological objectives of MPAs are to conserve biodiversity and to enhance fishery yields were other forms of fishery management do not work (as may often be the case in developing coastal nations with low institutional capacity for management). In the past, MPAs have typically been small no-take areas ("marine reserves") often implemented at sites with particularly healthy coral reef habitat. Management of these marine reserves involves a ban on harvesting but rarely any regulation of activities occurring outside the reserve (e.g. upland deforestation, road building, etc.). Currently, managers are moving to a paradigm of larger MPA networks implemented within a "ridge to reef" approach to ecosystem-based management, where MPAs, watershed management, and wise land-use practices are included in an integrated coastal management regime.

Key lessons learned and recommendations

- Address management of coral reef MPAs through integrated and holistic management of related ecosystems and land uses. Address all ecosystem components and processes to maintain the full range of ecological interactions, and to aim for resilience rather than for desired end-points.
- Implement management at ecologically relevant scales such as watersheds, monitoring the status and trends of systems over long time periods and incorporate marine protected areas into management frameworks.
- Integrate issues of sedimentation and sediment re-suspension into coastal reef protection, or further declines in resources will continue to occur. MPAs should be part of an integrated "ridge to reef" management plan that includes wise land use practices and watershed management.
- Provide fishing communities with accurate and realistic predictions of MPA benefits; avoid "overselling" MPAs on the basis that increased catches due to spillover and enhanced recruitment from spawning in the MPA will more than make up for lost fishing grounds, increased effort and higher costs of fishers displaced from the MPA.
- Obtain comprehensive biological and biophysical datasets before designing MPA networks. Where possible, conduct research to determine critical spawning and nursery habitats, connectivity pathways, and resilience of habitats, ecosystems, and livelihoods.
- Incorporate a range of fishery management tools and avoid reliance on MPAs only. Other methods of restricting catch and/or effort are valuable, do not displace fishers, and may cause fewer conflicts between fishers and other reef resource users.
- Monitor marine resources and ecosystem health within MPAs. Without monitoring, you can evaluate neither the success nor cost effectiveness of MPAs, nor carry out adaptive management if needed.
- Set up and monitor a few comparable "control" areas where no regulations or conservation activities are In place. These provide a clear baseline against which you can evaluate the cost-effectiveness of your MPA.

ISSUE 2: Socio-cultural Objectives and Impacts

MPA managers generally agree that most challenges to MPA implementation are social. Reef-dependent communities need to be resilient and coexist with the ecosystem, not suffer from bad practices. This "social resilience" is the ability of the community to deal with change, through learning, reorganizing, self-organizing, and combining knowledge. It is crucial to recognize the diversity of communities and be flexible. Thus MPAs need adaptive management and monitoring to evaluate the effectiveness of their management in meeting community goals.

Key lessons learned and recommendations

- Design MPAs to meet community goals and achieve greater compliance and subsequent conservation success.

- Collect and integrate indigenous knowledge to avoid conflicts in zoning.
- Use GIS and participatory mapping tools for zoning and rationalising roles and responsibilities among government organisations and other stakeholders.
- Educate people about the zone boundaries and permitted uses, alongside training in ways to reduce human threats.
- Base local MPA management plans on locally perceived threats/issues and sound data on local resource status.
- Focus MPA management on the socio-cultural conditions and needs of communities. Incorporate formal workshops, participatory training exercises and community development to build trust and achieve stewardship of the MPA planning process.
- Translate the goals and objectives of the MPA such that they are understandable to the target audiences and the community context.
- Create a forum for stakeholder interaction, query, and debate to provide opportunities for collaboration and mediation within the context of social interactions and conflicts.
- Involve marginalised user groups (gender and ethnic equality) and functional community leaders to promote good will, improve project management, and ensure equitable distribution of benefits.
- While permanent reserves are more effective, rotational or seasonal closures or regulations other than complete closures are often more accepted, have less immediate social impacts and are easier to monitor and enforce.

ISSUE 3: Economic Objectives and Impacts

In order for MPAs to be sustainable, management must contribute to economic returns and livelihood. Reef-dependent communities that do not see any sign of increased economic returns from their MPA are unlikely to continue to support it. MPAs are often "oversold" on the promise of higher fishery yields through increased spawning biomass and spillover. However, the value of this increased production is difficult at best to quantify at the time of implementation.

Key lessons learned and recommendations

- Clearly identify and communicate economic and other benefits of MPAs to maintain stakeholder interests and manage expectations.
- Evaluate costs and benefits of private sector involvement early in the MPA development to assure buy-in and long-term engagement.
- MPAs will have higher compliance and be more effective at conserving resources if they are easily visible to the community, and compliance is likely to increase the longer the MPA remains enforced.
- MPAs will be more effective if implemented in communities with less market influences (i.e., proportion of fish sold or bartered and involvement in formal economic activities such as teaching, government employment, and other salaried positions), lower population sizes, and less wealth.
- Where fishers or other resource users are likely to be displaced, provide realistic, long-term options for alternative livelihoods (e.g. ecotourism, catch-and-release sport fishing, seaweed farming, etc.).

ISSUE 4: Governance of MPAs

Governance of MPAs includes a wide array of policies, strategies, institutional arrangements, legislation, information and education, financing mechanisms and capacity development. It involves the delineation of the roles and responsibilities of the various agencies and stakeholder groups involved in management.

Key lessons learned and recommendations

- Explore bottom-up and co-management approaches, recognising that varying management structures and strategies improves MPA effectiveness.
- MPA regulations need to be pragmatic and address root causes but not be unrealistic in the ability of people to change their behaviour.
- Zoning requires knowledge gained through a participatory process and that is well integrated with tools such as participatory mapping and GIS.
- Policies that include more than one jurisdiction will require time to integrate and may often need to be agreed on prior to implementation.
- Rapid and fair enforcement is essential to achieve continued support, faith, and compliance in MPA management.

CONCLUSIONS AND FUTURE DIRECTIONS

Coral reefs have received much attention lately as the areas of highest marine biodiversity and are among the world's top conservation priorities. Hundreds of millions of people and thousands of communities all over the world depend on coral reefs for food, protection, and jobs. For example, over 150 million people live within the 'Coral Triangle' of Southeast Asia and Melanesia, of which over 2,600,000 are fishers who are dependant on marine resources for their livelihoods. Over the past 15 years, over one billion dollars have been spent on coral reef management projects worldwide ($320 million from the GEF alone).

One new concept that has been introduced in the past decade is 'resilience'. The central concept of 'resilience' may be defined as "the capacity of a complex system to absorb shocks while still maintaining function, and to reorganize following disturbance". To date, concepts of resilience have generally been applied only to corals, in terms of their resilience to climate change, sedimentation, pollution, etc. In the context of coral reefs, "management for resilience" should prevent a coral reef system from failing to deliver benefits (i.e. biodiversity conservation, ecosystem function, food and income for poverty reduction) by preserving ecological and social features that enable it to absorb shocks (climate change, natural disasters, user conflicts, etc.) and maintain function.

Another key area for future research is identifying and mapping critical spawning and nursery habitats for a range of ecologically and commercially important species. Also important is a better understanding of the connectivity between spawning (source) and nursery (sink) habitats. This information is essential to designing effective MPA networks. Connectivity is also important in transboundary management, where MPAs or networks of MPAs span more than one jurisdiction.

Current MPA management practice does not place sufficient emphasis on threats that arise from outside the reef area. Climate change will have a profound affect on coral reefs and the coral reef resource (fishery) dependent peoples that live there. Any approach to biodiversity conservation and development must account for these impacts. In a development (i.e. poverty reduction) context, climate change must be viewed as a fundamental threat to human security in countries already vulnerable to social and economic dislocation and conflict.

WorldFish Lessons Learned briefs are executive summaries of research projects with particular focus on lessons learned. These briefs play a role in knowledge management and sharing.

gefll.reefbase.org www.reefbase.org

This project has been funded by the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP),

and is carried out in partnership with International Waters Learning Exchange and Resource Network (IW:Learn), The Nature Conservancy (TNC), World Wildlife Fund (WWF), Conservation International (CI), Reef Check, International Coral Reef Action Network (ICRAN), Global Coral Reef Monitoring Network (GCRMN), National Oceanic and Atmospheric Administration (NOAA).

For more information, please contact Dr. Mark Tupper at m.tupper@cgiar.org.

The WorldFish Center
PO Box 500 GPO, 10670 Penang, Malaysia
Tel: +(60-4) 626 1606 Fax: +(60-4) 626 5530
Email: worldfishcenter@cgiar.org

Reducing the Footprint

Moving towards Low Impact Fisheries

SEAS AT RISK

Moving towards low impact fisheries

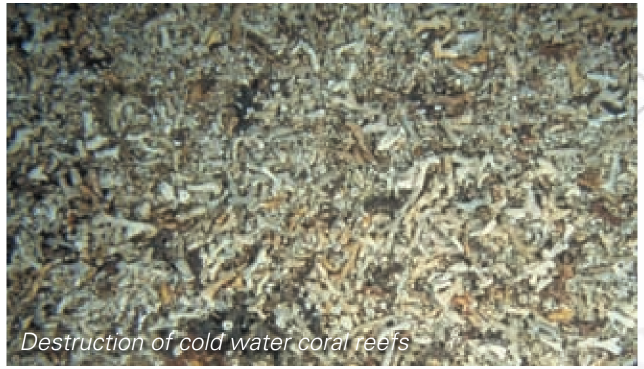
Marine biodiversity is rapidly declining, and because of their impacts on the marine environment, fisheries are a key contributor to that decline. Simultaneously, the effects of climate change on marine ecosystems are already visible and will place substantial additional pressure on fish stocks which are already heavily stressed by overfishing. Fisheries also contribute to climate change due to the large amounts of fuel used, resulting in considerable emissions of greenhouse gases.

By changing gears, the fishing industry can decrease the damage it inflicts on marine ecosystems, reduce its greenhouse gas emissions and lower its fuel costs. The 2012 reform of the Common Fisheries Policy (CFP) provides a unique opportunity to adopt well designed policy measures which promote a shift to low impact fisheries.

Impacts of fisheries

Fisheries have direct and indirect impacts on the environment. Direct impacts are the most obvious and include by-catch of juveniles and untargeted species such as other fish species, birds and mammals, as well as destruction or modification of habitats. Indirect impacts are less evident and refer to the contribution to climate change by fishing vessels due to the carbon emissions resulting from their fuel use.

By-catch



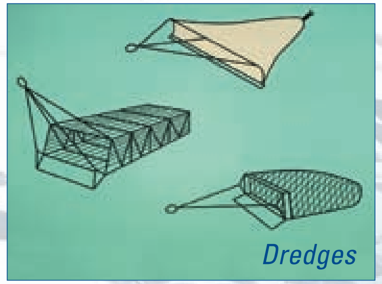
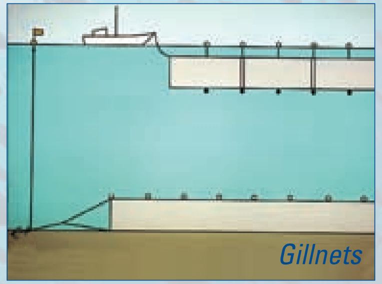
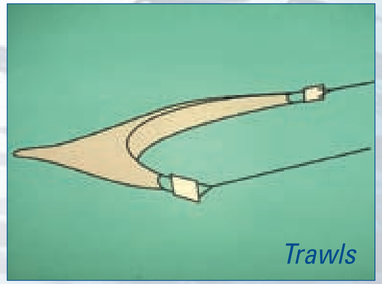
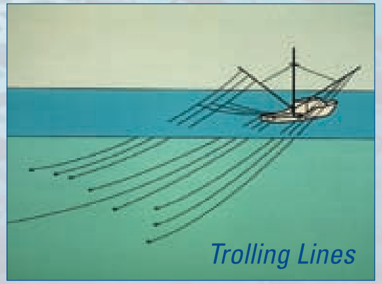
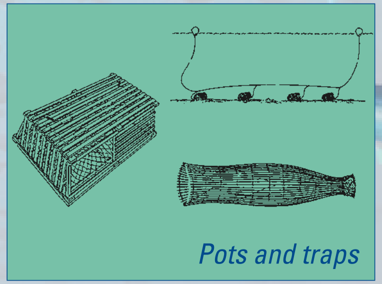
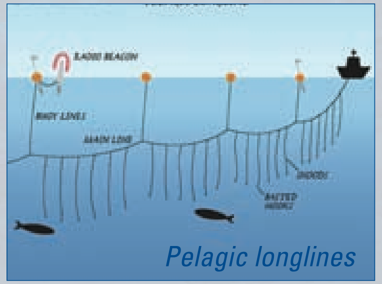
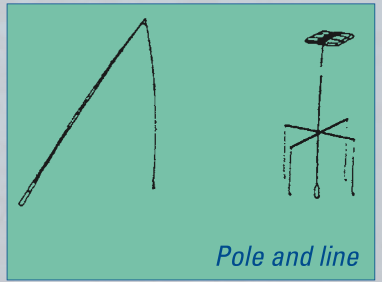
Destruction of cold water coral reefs

CO2 emissions

It is estimated that in 2000 global fisheries accounted for at least 1.2% of global oil consumption.

Common fishing gears in Europe

The European Commission categorises fishing gears into active, mobile and passive gears.

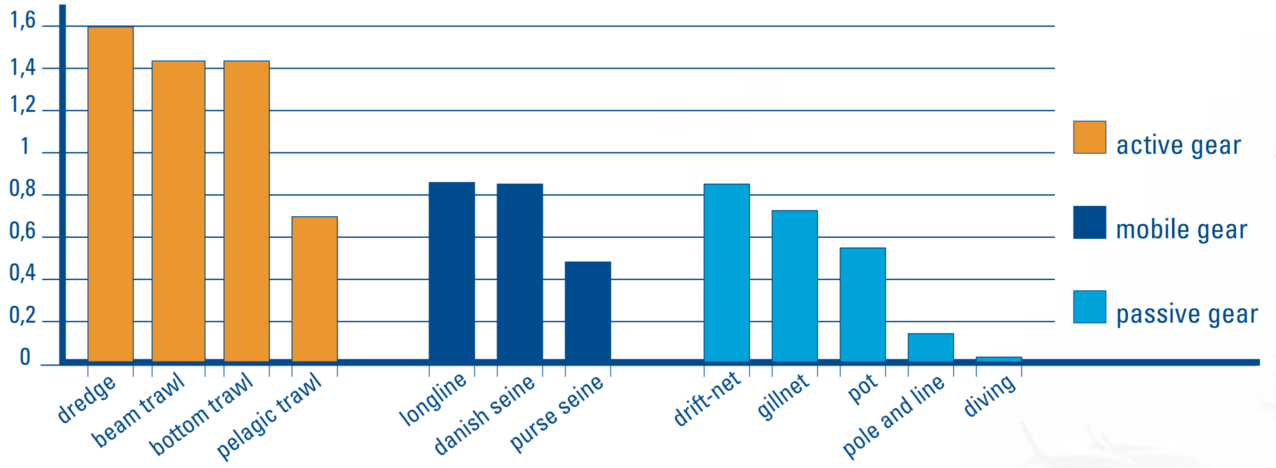
ACTIVE GEAR	MOBILE GEAR	PASSIVE (FIXED) GEAR
Gears towed across the seabed.	Gears that involve movement of the fishing vessel to deploy but are not actively towed.	Gears which are placed on the seabed and which do not move until lifted by the fishing vessel.
 *Dredges*	 *Seine Nets*	 *Gillnets*
 *Trawls*	 *Trolling Lines*	 *Pots and traps*
	 *Pelagic longlines*	 *Pole and line*

Good and bad gears

Not all fisheries affect the environment to the same extent. They vary greatly depending on gear and operating environment. There is much information about direct environmental impacts of different gears. Less is known about the carbon emissions during deployment of different gears. Still it is possible to produce rankings, which provide an indication for the harmfulness of a type of gear.

OVERALL IMPACT

size and species selectivity, habitat impact, non-commercial by-catch, and carbon emissions per kg fish



Source: ICES (2006), Report of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour

Heavy trawls and dredges that scrape over or dig into the bottom have most impact on the environment, both in terms of habitat destruction and selectivity and in terms of carbon emissions. In general, active gears have more impacts than mobile or passive gears and larger offshore vessels emit more greenhouse gases than smaller inshore vessels, especially when expressed in terms of carbon emission per value of the catch. Where stocks are depleted and poorly managed, fisheries have bigger negative impacts than those fisheries on well-managed stocks.

Same stocks, different gears

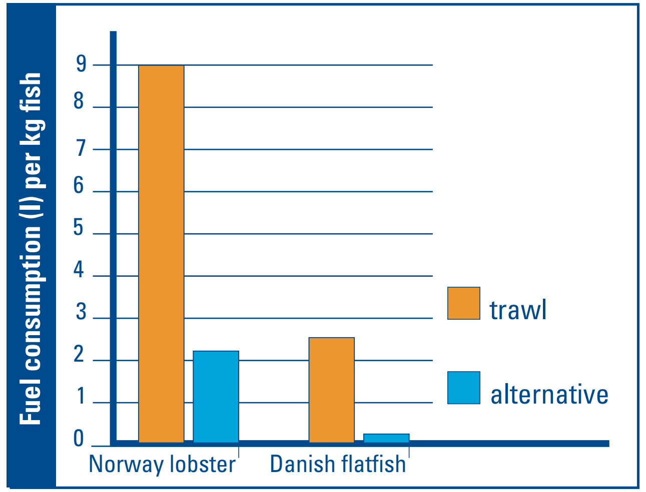
The same stock can often be targeted with different types of gears. Different gears have different impacts. Overall, gears for pelagic species mainly have impacts on vulnerable species such as marine mammals, while demersal gears mainly have impacts on habitats. Discard impacts are most likely with active gears, while selectivity is lowest for trawls and drift-nets. A reduction of direct impacts from fisheries can be achieved by switching from the "bad" gears in the table to the "good" gears.

Impacts	Pelagic (mid-water) fish	Demersal (bottom) fish	Burrowing bivalves	Shellfish, octupus, etc.
Bad	drifting gillnet	beam trawl	mechanic dredge	beam trawl
	midwater trawl	otter trawl	boat dredge	otter trawl
	purse seine, pelagic longline	trammel net	hand dredge	trammel net
	trolling line	set gillnet		trap
	handline	demersal seine		dive
		demersal longline		
Good		trap, handline		

A significant reduction of greenhouse gas emissions can be achieved by switching from fuel-intensive active gears such as dredging, bottom trawling and beam trawling, to mobile or passive gears, which use less fuel.

Both fishers and the environment will benefit from a shift to low impact fisheries: it will lower fuel costs whilst reducing greenhouse gas emissions and decreasing the damage to marine ecosystems. The resulting environmental benefits can in turn produce higher fish yields and therefore improve economic benefits.

Case studies



Norway lobster fishery

The fuel needed to catch and land a kilo of Norway lobster can be reduced from 9 litres to 2.2 litres by switching from conventional trawl fisheries to creel (trap) fisheries. Such a switch would also reduce the impacted seafloor area from 33,000 m^2 to 1.8 m^2 per kilo landed Norway lobster. Similarly the amount of discard would be reduced from 4.5 kilo to 0.36 kilo per kilo landed Norway lobster. Not only would such a switch to creel fisheries significantly reduce environmental impacts, it would provide the consumer with a Norway lobster that has not been squashed in a trawlers net and is thus of a better quality.

Danish flatfish fishery

In the Danish flatfish fishery the amount of fuel per kg of caught fish can be reduced by a factor of 15 by switching from beam trawling to the Danish seine. The Danish seine is a semi-passive fishery which has less impact on the seabed than beam trawling.

Hurdles to change

In order to promote a shift to low impact fisheries the reformed CFP should include:

- Preferential access to fish resources for low impact fisheries;
- Elimination of overcapacity using environmental and social criteria, ensuring that the most sustainable vessels remain in the fleet;
- Phase-out of fuel tax exemptions and other perverse subsidies;
- Redirection of subsidies to training/education programs promoting low impact fisheries;
- Introduction and promotion of spatial planning, with zones set aside for low impact fisheries, especially those using passive gears.

Fishermen often face hurdles when trying to switch to less damaging fishing techniques. Well designed policy measures can significantly contribute to reduce such hurdles and encourage a shift towards environmentally sustainable fisheries.

Common problems faced by fishermen involve costs, a lack of knowledge on best practices, gear conflicts (passive gear cannot be used where a large number of towed gears are in operation), and practicalities (less harmful gear can be more difficult to use than harmful gear). These hurdles can often be tackled by national policy-makers. For example in the Netherlands, the government facilitates exchange of knowledge and experience between fishermen through so-called knowledge-circles. These are partly financed through the European Fisheries Fund.

Policy can also act as a hurdle to a shift to more sustainable fisheries. Currently, the most serious policy hurdle to low impact fisheries is the inflexible nature of the EU fisheries management system. The current short-term micro-management system based on TACs, quotas and effort should therefore be replaced by a more flexible and long-term management system, which supports low impact fisheries. The 2012 reform of the Common Fisheries Policy (CFP) provides a unique opportunity to recognize this and put environmental sustainability at the heart of European fisheries policy.

This brochure is based on the report 'Moving towards low impact fisheries in Europe: policy hurdles and actions', which was commissioned by Seas at Risk in 2009. The report suggests possible gear shifts to reduce direct and indirect environmental impacts of fishing activities, gives an inventory of hurdles preventing fishermen to shift based on case studies, and proposes policy measures to overcome these hurdles and promote low impact fisheries. The report can be downloaded from www.seas-at-risk.org and paper copies can be delivered on request.

SEAS AT RISK

Rue d'Edimbourg 26
1050 Brussels Belgium
secretariat@seas-at-risk.org
www.seas-at-risk.org

Credits for pictures:
W.J. Strietman, E. Willsteed,
Fisheries and Oceans Canada,
LLH Denmark

Text by Maja A. Dittel, Christien Absil,
Monica Verbeek

Graphic design: www.podivium.nl

This brochure was made possible through the support of the European Commission (DG Environment) and the Dutch Ministry of Housing, Spatial Planning and the Environment.

Declines in bivalve populations in northern Moreton Bay

Dr B K Diggles
DigsFish Services Pty Ltd
www.digsfish.com

Briefing note presented to QLD Fisheries, January 2011

I have been observing the distribution of Sydney rock oysters (*Saccostrea glomerata*) and other bivalves such as mussels (*Trichomya hirsuta*) and cockles (*Anadara* spp.) in the Pumicestone Passage in the Moreton Bay Marine Park since 2004 and have discussed their former distributions with several long time residents of Bribie Island, including Mr Ted Clayton, who has lived here since the 1940's. I have also examined other historical records of abundance of *S. glomerata* in the area, such as photos from Oxley Library and Lergessners (2006) detailed account of the historical abundance of oysters followed by decline of oyster farming in the region since its peak in 1910. Particularly over the past 2 years, ever since we have started to get decent rains again in the catchment, I have noted increased mortality and changes in the distribution of rock oysters, mussels and cockles that have correlated with the decline in water quality in Pumicestone Passage since 2008 as documented in the Healthy Waterways monitoring programme.

My concern is that the current flood situation is simply an acceleration/exaggeration of a significant longer term decline that has become particularly apparent in the northern part of Moreton Bay/Pumicestone passage over the past two years. To quantitate the decline biologically, I attach pictures of oyster clumps, many decades old, from the intertidal area at Ningi in the Pumicestone Passage (Fig 1). As you can see the clumps are dying from the bottom up, forming a mushroom shape where previously they were monolithic. This fits in nicely with observations of local oyster farmers who have to place their stock higher and higher in the water column in recent years in order to get any survival[1]. While it is very likely the ultimate cause of death for the wild oysters is QX disease caused by the haplosporidian parasite *Marteilia sydneyi*, disease due to *M. sydneyi* is known to be caused by immunosuppression (Peters and Raftos 2003, Butt and Raftos 2007), due to reduced salinity (Green and Barnes 2010) and as yet unidentified water born contaminants carried in runoff (Butt and Raftos 2007). A hypothesis for the mechanism involved in formation of mushroom shaped oyster clumps is that oysters lower in the intertidal zone are exposed to contaminated water for longer, and thus are more stressed and succumb to QX first, and are not being replaced due to spatfall failure resulting from increased eutrophication and silt/sedimentation. This results in an upwards compression of the zone suitable for oyster habitation, signalling a significant reduction in both the area and quality of habitat for not only oysters, but all other fisheries resources that rely on biogenic reef.

A recent (28 January, 2011) survey of oysters from Ningi Creek and Toorbul Point in northern Moreton Bay found 100% prevalence of moderate to heavy infections of QX in oysters aquacultured in Ningi Creek, and 20% prevalence of light infections of QX in wild oysters at the mouth of Ningi Creek and at Toorbul Point. These data suggest the oyster farmers in the area are almost certain to have a total crop failure this year due to the poor water quality bought down by the floods. Together with their inability to sell existing stock due to public health concerns, the oyster industry of Moreton Bay will be the hardest hit of all the bay fisheries during this event.

[1] Local oyster farmers this year in Pumicestone Passage have reported 99% mortality of stock due to QX disease.

Figure 1. Decades old oyster clumps at the mouth of Ningi Creek, Jan 2011, decaying from the bottom up due to oyster death and spatfall failure, forming a mushroom shape.

Densely packed beds of hairy mussels (*T. hirstula*) were common features of deeper sections of many estuarine ecosystems on Australias east coast in the middle of last century (McIntyre 1959). Reports from long term residents at Bribie confirm that large numbers of these mussels occurred in densely packed beds along virtually all hard bottom and sandstone ledges of Pumicestone Passage until around 15 years ago, after which time the mussels began to vanish from their usual locations (T. Clayton, personal communication 12 August 2010). Today, small clumps of these mussels are encountered only occasionally in the area, and it would appear important that the cause for this decline is investigated and the extent of remaining populations of *T. hirstula* be quantified. The cause for recent mortalities of 70% of *Trichomya hirstula* in clumps at Toorbul Point (Figure 2) and large numbers of cockles in Pumicestone Passage (Figure 3) remains to be determined. Surface water salinity in Toorbul Point in Pumicestone Passage during the recent floods decreased to 9 ppt for around a week between 12 and 20 January 2011, before increasing to 13 ppt by the 24^{th} and 22 ppt by 30^{th} Jan (B. Diggles personal observations). *Trichomya hirstula* is relatively tolerant of low dissolved oxygen (McIntyre 1959) but susceptible to mortality at salinities below 15 ppt (Wallis 1976). While low salinity is a potential cause for the mortalities observed in mussels, disease (e.g. *Perkinsus olseni*) or toxicity are both plausible differential diagnoses, meaning the deaths of mussels and cockles requires a proper pathological and epidemiological investigation. Roger Chong, DEEDI aquatic animal pathologist, has been alerted of both the QX infections and also the problems with the mussels and cockles.

Figure 2. In 3 mussel clumps from Toorbul Point Jan 28 2011, 48 of 68 mussels were dead (70%). Of the dead mussels, 11 were old morts and 37 were fresh morts, some with meat still inside.

Figure 3. Large numbers of dead cockles are apparent adjacent to the decaying oyster beds at the mouth of Ningi Creek, Pumicestone Passage.

In summary, the changes to decade old oyster clumps, together with declines in populations of other bivalves, provide a biological record of long term declines in Moreton Bay water quality and fisheries productivity. These events, together with continuing seagrass losses and mangrove dieback, are alerting us to the slow march of this ecosystem towards a system dominated by the algal/microbial loop. Oysters and other filter feeding bivalves are important ecosystem engineers and are needed for a healthy bay ecosystem. They used to occur in massive numbers throughout the bay, including in biogenic reefs up to 12 feet below the low tide mark, but now only remnant populations remain. The historic natural subtidal oyster reefs are functionally extinct (Beck et al. 2011), and those that remain in intertidal areas are being compressed upwards as water quality declines. The recent floods have simply exaggerated an ongoing decline and the issue is a serious one for the bay as a whole as it will not get better unless the underlying water quality issues begin to be addressed.

While halting the decline is by no means an easy task, there are some good examples of community based restoration programs from Chesapeake Bay, east coast of USA, where they are combating virtually identical problems to those occurring in Moreton Bay. The way that groups such as the Virginia Institute of Marine Science, the Chesapeake Foundation and other non-government and government institutions have gone about the business of restoration of the Chesapeake Bay should be closely examined to provide a template for restoration of our bay. See Schulte et al (2009), and http://www.chesapeakebay.net/restrtn.htm for more information on what can be done.

This is the sort of stuff that healthy waterways should be working towards with Government and the various fishing industries - long term restoration goals that all stakeholders set and work towards with community involvement. This contrasts to the current state of play in Moreton Bay which amounts to establishment of marine parks while authorities simply measure water quality declines. These latest declines demonstrate that local attempts at catchment management (e.g. Appendix 1) have not been successful to date and that a more concerted effort is required by the whole community, supported by local and state Governments, if we are to firstly halt the decline and then attempt to restore critical ecosystem processes in Moreton Bay Marine Park and Pumicestone Passage. We are nearing a new low point for the bay, which means its time to learn from the mistakes of the past and make plans for the future to try to turn it around.

References

Beck MW and 14 other co-authors (2011). Oyster Reefs at Risk and Recommendations for Conservation, Restoration, and Management. *Bioscience* 61: 107-116

Butt D, Raftos DA (2007). Immunosuppression in Sydney rock oysters (*Saccostrea glomerata*) and QX disease in the Hawkesbury River, Sydney. *Mar. FW. Res*. 58: 213–221.

Green TJ, Barnes AC (2010). Reduced salinity, but not estuarine acidification, is a cause of immune-suppression in the Sydney rock oyster *Saccostrea glomerata*. *Marine Ecology Progress Series* 402: 161-170.

Lergessner JG (2006). Oysterers of Moreton Bay. Schuurs Publications. 235 pgs.

McIntyre RJ (1959). Some aspects of the ecology of Lake Macquarie, NSW, with regard to an alleged depletion of fish. VII. The benthic macrofauna. *Aust. J. Mar. FW. Res*. 10: 341-353.

Peters R, Raftos DA (2003). The role of phenoloxidase suppression in QX disease outbreaks among Sydney rock oysters (*Saccostrea glomerata*). *Aquaculture* 223: 29-39.

Schulte DM, Burke RP, Lipcius RN (2009). Unprecedented Restoration of a Native Oyster Metapopulation. *Science* 325: 1124-1128.

Wallis RL (1976). Aspects of the thermal tolerance of the tropical mussel Trichomya hirsute L. – a multivariable approach. *Aust. J. Mar. FW. Res*. 27: 475-486.

Appendix 1. Moreton Bay farmers clean up the stream
http://www.nrm.gov.au/projects/qld/seq/2006-02.html


Planting oats as 'living mulch' between rows on pineapple farms will help minimise runoff

The last oyster leases on north Moreton Bay will benefit from a pilot program that focuses farmers on water quality in the small coastal Ningi Catchment.

Located between Caboolture and Bribie Island, the catchment covers just 3,079 hectares. Around eight farmers are involved in the pilot and their actions should prove beneficial for the region.

Funding

In 2005 the Ningi Catchment Sustainable Production Partnership received $95,000 from the Australian Government. It is managed by South East Queensland (SEQ) Catchments and the Queensland Department of Primary Industries & Fisheries.

Declining water quality is an issue for the rapidly urbanising region which includes strawberry and pineapple growers, chicken farmers, nurseries and 'life-stylers.'

Activities and achievements

"The impact of how we manage our land doesn't stop at the property boundary," said Project Officer Ian Layden.

"Through this project we've been working with farmers and the community to increase awareness of what and who is in the catchment. "We're also encouraging the community to appreciate what farmers are doing."

One of three oyster farmers in the catchment, Jerry Crandall, knows all too clearly the impacts of poor water quality. "Before this pilot program many people didn't even know there was an oyster industry in the catchment," he said. "Now they do. And they're much more aware of the links between what happens upstream with what ends up downstream."

The project's technical leader, John Bagshaw, sees one of its main aims as increasing regional industry awareness of potential water quality issues in the catchment.

"We're trying to get people to take a close look at their businesses through environmental eyes," he said. One practical step he suggests farmers take to treat runoff before it reaches waterways involves running it though a vegetated drainage area, or wetland. "This removes the sediment and allows nutrients to be absorbed by the vegetation," he said.

Ian Layden has helped farmers develop management plans and initiated some trials to reduce erosion.

These have included planting oats as a 'living mulch' between rows on pineapple farms to minimise runoff and alternative irrigation methods on strawberry farms to cut down nutrient leaching.

Poultry grower Barry Benbow is an enthusiastic participant in the project. "I think it's important to understand how the catchment operates," he said.

"It's good to know we're all working together as a team to improve our catchment's water quality."