

## The Reserve Effect on Fisheries: In Light of Recent Studies, Should It Be Considered Settled Science?

The concept that no-take marine reserves can benefit nearby fisheries by supplying them with larvae and adult fish is central to reserves' potential role in fisheries management. According to the theory of the *reserve effect*, fish that are protected inside reserves live to maturity and reproduce, and some of the young and/or adults cross the reserve boundary into unprotected waters. There they can be caught by fishers. Much of the attraction of the reserve effect is that it offers benefits both for conservation and fisheries.

Research on the effect has typically been difficult to carry out. This is due to multiple challenges, including tracking very small larvae and distinguishing potential reserve effects from other variables (including management- and gear-related ones) that can also affect fisheries yield. However, a handful of studies in 2009 offered some evidence of the reserve effect in action:

- Robin Pelc of the University of California at Santa Barbara led a study that demonstrated higher catches of mollusks in South Africa due to the reserve effect (this was described in "What mollusks can tell us about larval export from marine reserves", *MPA News* 10:11). The abstract of this study, published in the journal *Marine Ecology Progress Series*, is at [www.int-res.com/abstracts/meps/v394/p65-78](http://www.int-res.com/abstracts/meps/v394/p65-78); and
- Richard Cudney-Bueno of the Packard Foundation (and formerly the University of Arizona) found enhanced recruitment of fished species "downstream" from a network of reserves in the Gulf of California, consistent with modeled predictions. The study, published in the free journal *PLoS ONE*, is at [www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0004140](http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0004140).

In light of these studies, should the reserve effect no longer be viewed simply as a theory but as a documented, expected phenomenon — as "settled science"? Importantly, can it now be used to plan MPAs to meet conservation and fisheries goals? Over the years, *MPA News* has asked experts for their views on the reserve effect (*MPA News* 6:9; 5:7; 5:6). Here, we check back with three scientists and one manager for their thoughts on the latest developments:

- **Louis Botsford**, fisheries biologist, University of California at Davis;
- **Trevor Ward**, marine ecologist, University of Queensland (Australia);
- **Russ Babcock**, marine ecologist, CSIRO Marine and Atmospheric Research (Australia); and
- **Fiona Gell**, senior wildlife and conservation officer, Department of Agriculture, Fisheries, and Forestry, Isle of Man Government, British Isles.

In most cases, their comments below were excerpted by *MPA News* from longer responses. Those longer responses, some of which included journal references, are available on the *MPA News* website as indicated.

### Loo Botsford: Not every site will produce a reserve effect

[Editor's note: Botsford co-wrote his response with Will White, a post-doctoral researcher. Their full response is at <http://depts.washington.edu/mpanews/Botsford.pdf>.]

"One cannot conclude from those two studies [Pelc *et al.* and Cudney-Bueno *et al.*] that every MPA will produce a so-called reserve effect for every species and every system of MPAs. In fact, one of the three MPAs examined by Pelc *et al.* did not produce a reserve effect, because larval production was similar inside and outside of the reserve. The lack of a reserve effect in that case is consistent with model predictions, and it illustrates why the reserve effect is not 'settled science'.

"We would say that the set of interacting factors (and associated parameters) that determine whether there will be a reserve effect *is* settled science. But one must examine the specific combination of those factors in a specific MPA to determine whether there will be a reserve effect in each case.

"There are several factors relevant to the interpretation of the Cudney-Bueno and Pelc publications that MPA scientists and decision-makers should be aware of. First, the overall effect of the MPAs on population distribution and abundance will be seen only after the ecosystem

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has gone to equilibrium. The current level of recruitment as reported in Cudney-Bueno *et al.* likely depends on increased reproduction from individuals recruited before the MPAs existed. In the future it will depend on how MPAs affect recruitment at the source location, which in turn will depend on the dispersal matrix (i.e., the fraction of larvae leaving each location that settles successfully at each other location) and the future distribution of fishing effort.

“Another implication of the question of whether MPAs will have the ability to *benefit* adjacent fished populations is whether they increase overall yield in the fishery. Does the increase in yield over the local (still fished) area outweigh the loss of fishing due to the closed area within the MPAs? Modeling results to date indicate that MPAs are more likely to provide a direct benefit if the population was heavily fished (or overfished) prior to MPAs. This is the rationale

underlying the point made by Pelc *et al.* that there was not a detectable increase in recruitment outside the MPA, where the fishery was well-managed. Related to this point, another important question regarding benefit is whether the implementation of MPAs is the best approach of those possible. For example, in some cases reducing fishing could provide the same benefits at less cost.

“Finally, another aspect that makes this question difficult is the multi-species nature of MPAs. When designing or evaluating MPAs one must consider the effects on a variety of species, and they will all have different movement rates and levels of fishing. Because of these differences they will have different responses to MPAs — i.e., an increase in MPAs beyond some point may increase yield for one species but decrease yield in another.”

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### Research spotlight: Why are older reserves more effective than younger ones at building biomass?

A recent study in the *Journal of Applied Ecology* (“Effects of marine reserve age on fish populations: a global meta-analysis”) found that no-take marine reserves older than 15 years consistently harbored more fish compared with unprotected sites, whereas younger reserves were less effective at building biomass. We asked one of the study’s authors, Isabelle Côté of Simon Fraser University (Canada), why older reserves are more reliably effective.

“There are a number of potential reasons,” says Côté. “First, true protection may take a while to be implemented (via patrolling or community acceptance of the reserve), so reserves might become better protected over time. Second, if reserves have positive effects on habitat quality, these might take a while to manifest themselves. Third, it may be that periods of time on the order of a decade or more are needed for an area to experience strong recruitment pulses which occur asynchronously across species, and which are so important in determining population levels. It could also be a combination of these things — for example, recruitment success could become enhanced as habitat quality improves.”

Côté’s is the latest research to draw a link between reserve age and fish abundance. Ronald Maliao of the Florida Institute of Technology (US) led a similar study, with findings published in the journal *Coral Reefs* in 2009 (“Trajectories and magnitude of change in coral reef fish populations in Philippine marine reserves: a meta-analysis”). “Our own paper also pointed out that fish density is higher in older reserves,” says Maliao. The conclusions of both papers are encouraging, he says, and appear to coincide with those of earlier studies of MPAs in Kenya and the Philippines. “The finding on reserve age is probably a global trend,” he says.

#### For more information:

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### Trevor Ward: Three central dilemmas that need to be resolved

“To secure benefit for fisheries from the reserve effect, there are three central dilemmas that need to be resolved in applying the potential embodied in spillover and larval export.

“First, capturing the benefits of adult spillover or larval export to create substantive benefits for both conservation and fisheries (the *double-payoff reserve*) requires a high level of process understanding in both the ecology of the reserved systems as well as the fished species and their management. In many cases, a revision of fishery management systems may be required to be able to capture such benefits. For example, in fisheries where there is maintenance of breeding biomass of the fished species through escapement rules (such as application of a minimum size/age at capture), it may be more efficient and cost-effective to abandon (or simplify) size constraints of fished species. These constraints can be replaced (or supplemented) with a system of space/time closures that deliver the same level of breeding biomass. While space/time closures are widely used in fishery management systems, they are usually established to protect habitats that are important for purposes of recruitment, breeding, etc. Their biodiversity conservation benefits are usually coincidental at best. There is therefore a very significant challenge in simultaneously optimizing fishery production benefits and biodiversity conservation benefits within reserve design processes.

“Second, the fine-scale design parameters (size, placement, network span, inter-reserve distances, etc.) can have a very significant impact on the potential for delivery of spillover or larval dispersal to fisheries, and

hence on the potential value to a fishery. Designing reserves that contribute to both fisheries and biodiversity conservation therefore requires an optimization across both sets of objectives. To be robust, this is a data-rich process that requires the clear specification of the conservation objectives for any such reserves, as well as the mechanisms for the reserves to deliver effective spillover or larval dispersion into the production system.

“Third, in many countries there are jurisdictional issues that have long prevented effective ecosystem-based management of marine living resources. Biodiversity conservation is not the principal focus of a fishery management agency, and fishery management is not the principal focus of a conservation or environment management agency. Thus there are often substantive differences in the science base and expertise (not least in the sciences of fishery management and ecology) that separate such jurisdictions, making achievement of a genuinely integrated approach to marine reserve design a difficult problem.

“So for this question, the answer can be best summarized as yes, but no. The potential is certainly demonstrated, but the costs of using double-payoff reserves in fishery management systems are still largely perceived by fishery managers to outweigh the benefits. The science of reserve design to optimally benefit both conservation and fisheries remains embryonic. Despite extensive theoretical research and advocacy, there appear to be few initiatives underway targeting double-payoff reserve designs, so progress in this area will continue to be slow.”

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### Russ Babcock: Is the effect large enough to be meaningful?

[Editor's note: Babcock's full response is at <http://depts.washington.edu/mpanews/Babcock.pdf>]

“The reserve effect is contingent on increases in the biomass of the parent stock in a reserve. This effect is common but not a given. So the question has to be asked, are the species of interest responding? In my experience this often has to be determined on a case-by-case (reserve-by-reserve, species-by-species) basis.

“Then there is the question of how large any such larval export effect might be. Is it big enough to have a meaningful ecological effect on the exploited population? How about a meaningful economic effect on the fishery? Is it big enough to compensate for changes in fishing practice, displaced effort, etc.? Is it even big enough to measure using the methods we have at our disposal? Recruitment is highly variable, notoriously so in fact, and variations in larval supply are caused by a wide range of factors, not just stock size. Consequently all these questions need to be answered with reference to

time series of data that take into account variability before and after changes in reserve management, link recruitment to spawner biomass, and provide data on the relevant fishery.

“Spillover of adult fish is usually not well demonstrated. While there must be cross-boundary movements of fish, the question of relevance to commercial fishers may be: what is the direction of net movement of biomass? (For trophy recreational fishers the question might be slightly different: what is the modal size of fish moving out?) I believe it is important to be clear how ‘spillover’ is defined: i.e., whether or not we are talking about density-dependent directional movements since density-dependent behaviors have important implications for the questions above. Many of the papers referring to spillover are equivocal due to limitations of sampling design (e.g., before-after-control-impact design, or BACI) and replication, not to mention population-level evidence of density-dependent effects.

“There are a lot of open questions here, not least because species-level variation and differences between sites (e.g., sources and sinks) are likely to mean very different responses in different locations. While larval export and spillover are possible and even likely, the devil is in the detail of the question ‘how much?’. We must do the necessary science if reserves are to be used in an informed, practical sense as an active part of a fisheries or conservation management system.”

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### Fiona Gell: Fishermen believe in the reserve effect

[Editor's note: Gell's full response is at <http://depts.washington.edu/mpanews/Gell.pdf>. In contrast to the other people interviewed for this article, Gell works solely on the management side of the MPA field. *MPA News* asked her what role the consideration of reserve effects plays in her management work.]

“In the Isle of Man, there are two complementary Marine Protected Area programs being implemented by the Department of Agriculture, Fisheries and Forestry. These are Fisheries Closed Areas (specifically for scallop fisheries management) and Marine Nature Reserves (primarily for habitat and species conservation). The Port Erin Closed Area, for example, has been closed to scallop fishing for 20 years and the effects of closure — including build-up of biomass and spawning potential — have been well documented through the work of Andy Brand and his research team at the former Port Erin Marine Laboratory.

“After about 15 years of closure, fishermen's support for the Port Erin Closed Area began to grow as they

### Study finds spillover of lobster from closures in Atlantic Canada


A study of lobsters inside and outside of closed areas on the Atlantic coast of Canada concludes that the closures have produced several benefits over the past decade, including the spillover of adult lobsters to adjacent fished areas. The study, published by Fisheries and Oceans Canada, also found a higher abundance of large lobsters, a broadening of population size, and increases in average size of lobsters inside the closures. A report on the study, “Assessing Marine Protected Areas as a Conservation Tool: A Decade Later, Are We Continuing to Enhance Lobster Populations at Eastport, Newfoundland?” is available at [www.dfo-mpo.gc.ca/Library/336567.pdf](http://www.dfo-mpo.gc.ca/Library/336567.pdf).



witnessed benefits to fisheries in adjacent areas, including increased catches. There is not yet conclusive scientific evidence that the Closed Area is supporting the increased catch per unit effort that has been recorded. However, the fishermen believe that they are benefiting from increased larval supply, and this is supported so far by particle tracking work carried out by Bangor University scientists. This has culminated in the industry-led closure of a second site (Douglas Bay) in 2008, two further sites (Niarbyl and Laxey Bay) for scallop ranching in October 2009, and a fifth site (Ramsey Bay) closed temporarily in December 2009.

“In the consultation sessions I hold about Marine Nature Reserves for conservation, Manx fishermen are not questioning the mechanism by which closed areas could benefit fisheries. But they are concerned about MPAs for conservation. We are currently working toward the Isle of Man’s first Marine Nature Reserve designed primarily for conservation purposes. It also has the potential to play a role in fisheries management if we can get the design right. Research looking specifically at designing MPAs to maximize conservation *and* fisheries benefits — and at how MPAs for conservation can contribute more widely to healthier ecosystems and more sustainable fisheries — is most useful for my current work.

“In the Isle of Man we can use our scallop Closed Area experiences to illustrate the potential for MPAs to show similar effects for other species of conservation and commercial interest. What we do not have is clear evidence to show how protecting other marine habitats could affect fisheries. We need to protect maerl (red algae) beds, horse mussel reefs, seagrass meadows, and many other habitats for their conservation importance. There is now great science on the value of maerl beds for juvenile scallops and some fish species. But for other habitats we do not really know whether protecting them will lead to tangible benefits for our current fisheries, now almost exclusively limited to a few species of shellfish.

“What I say to fishermen is that I think that we can work together to design conservation MPAs that can offer fisheries benefits, combining fishermen’s knowledge and the latest science. There is real potential for our Isle of Man combination of Fisheries Closed Areas and conservation MPAs to improve wider ecosystem health in our territorial sea, giving us more resilience against climate change and more options in an uncertain future.” 

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## Notes & News

### UK passes Marine and Coastal Access Act

In November, the UK passed the Marine and Coastal Access Act, establishing a wide-ranging policy to enhance protection of the marine environment, improve fisheries management, and allow for easier coastal access. Among other measures, the Act prescribes the planning and designation of a national network of MPAs (called Marine Conservation Zones under the Act) to protect important species and habitats. The Act is available at [www.defra.gov.uk/environment/marine/legislation/index.htm](http://www.defra.gov.uk/environment/marine/legislation/index.htm).

UK governmental statutory advisors Natural England and the Joint Nature Conservation Committee (JNCC), in partnership with the UK Department for Environment, Food, and Rural Affairs (Defra), have formed a national project to identify and recommend Marine Conservation Zones for designation ([www.jncc.gov.uk/page-2409](http://www.jncc.gov.uk/page-2409)). The project consists of four regional initiatives that are working with sea users and interest groups. The NGO sector has initiated parallel projects to analyze and propose sites as well, such as the Marine Conservation Society’s “Your Seas Your Voice” campaign ([www.yourseasyourvoice.com](http://www.yourseasyourvoice.com)).

In a separate but concurrent planning process, Natural England, JNCC, and the Countryside Council for Wales have proposed designation of 12 new marine conservation sites to help meet UK commitments under the EU Habitats and Birds Directives. Ten of the sites are designed to protect habitats, and two to protect bird species. The 12 sites are undergoing public consultation until 26 February 2010, and are described at [www.naturalengland.org.uk/ourwork/marine/sacconsultation/default.aspx](http://www.naturalengland.org.uk/ourwork/marine/sacconsultation/default.aspx).

### Bahamas and Dominican Republic each announce new MPAs

In late 2009, the governments of the Caribbean island nations of the Dominican Republic and the Bahamas each designated swaths of their nearshore waters as protected areas. As part of a massive designation of 31 new protected areas (which included both terrestrial and marine sites), the Dominican Republic set aside more than 11,000 km<sup>2</sup> of marine habitat. Now 56% of the Dominican Republic’s nearshore habitat is in protected areas. Meanwhile the Bahamas expanded the boundaries of two island parks and designated a new park that straddles land and sea. The designations by each nation were partially in response to the Caribbean Challenge, a goal embraced by several Caribbean nations in 2008 to protect 20% of their marine and coastal habitats by the year 2020. For more information on the Challenge and the recent designations, go to [www.nature.org/wherewework/caribbean/press/press4298.html](http://www.nature.org/wherewework/caribbean/press/press4298.html).

# Letters to the Editor: Seismic Surveys and MPAs

Our November-December 2009 article on seismic surveys and MPAs resulted in several letters from readers (*MPA News* 11:3). The article highlighted a case involving Canada's Endeavour Hydrothermal Vents Marine Protected Area, where an academic research team sought to conduct a seismic survey to study the seabed and plate tectonics of the region. A legal challenge by conservation organizations attempted to block the study, arguing that its noise would harm marine mammals. Ultimately, the research team agreed to a government scientist's recommendation that the safety zone around the survey be expanded to 7 km, and the survey proceeded.

## It is time to research and promote airgun alternatives

### Dear MPA News:

I have been specializing in underwater noise issues since 1994, and am the author of one of the scientific papers cited at the end of your article "Seismic Surveys and MPAs". I have a few corrections/comments to your article:

1. Low-frequency active naval sonar has not been associated as much with whale strandings and deaths-at-sea as mid-frequency naval sonar has.
2. While the source levels of these naval sonars are very high, the best estimate of the levels the stranded whales received was only moderate, yet likely high enough to cause their death.
3. Mitigation measures such as safety zones, ramp-ups, etc. can be imperfect, even inadequate, in protecting whales from harm. Most are based on little to no scientific evidence, such as that whales will avoid airguns [which produce the sound waves used in seismic surveys]. If airguns stun whale prey, for instance, whales may be attracted to the survey area, even to the detriment of their hearing.
4. While I applaud the stricter mitigation measures in the case of the Endeavour Hydrothermal Vents MPA, a 7-km radius of safety zone is very difficult to monitor practically for whales.
5. Whale and fish disturbance is well documented at received levels of 130 decibels (dB) and below — in contrast to the 160-dB threshold used at Endeavour, which is 1,000 times louder.
6. While not definitive, there is highly suggestive evidence connecting whale strandings and deaths with seismic airgun noise.

It is not my position that seismic surveys should never be allowed in areas with marine mammals. Many

factors enter into that decision, such as the conservation status of the species present, their sensitivity to noise, the source levels of the seismic array, and length of the survey. However, in some cases, any addition of noise may be too much. It is time to seriously research and promote more benign airgun alternatives such as, perhaps, controlled sources, passive seismic [the detection of natural low-frequency earth movements], electromagnetic surveys, etc. — especially in sensitive habitats.

### Lindy Weigart

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## What level of sound is safe for animals in MPAs?

### Dear MPA News:

I read with interest the recent article on ways that MPA managers might respond to seismic surveys or other noise events within or outside their boundaries. The fundamental question presented was, what level of sound is safe for animals in MPAs? It is very clear that injuries to the auditory system, or other physiological injuries from direct exposure to sound, occur only at very close ranges to airguns, military sonars, or pile-driving — on the order of tens or at the most hundreds of meters. As Leila Hatch [of Stellwagen Bank National Marine Sanctuary] notes in the article, for MPA managers the main concern is how much behavioral disruption is acceptable for the particular species resident in an MPA. In most areas, displacement due to aversion to noise may be of minimal concern (food sources may be widely available), while in some smaller MPAs it may be more of a problem. These far less predictable patterns of behavioral disruption can be caused by relatively moderate sound from more distant noise sources — up to tens of kilometers.

The 160-dB "safe" criterion noted in the article and widely used in mitigation plans likely represents roughly the sound level at which half the population will be expected to change its behavior in noticeable ways. Unfortunately, the correlation between sound level and behavioral disruption is not at all linear. Many individuals (and some species, particularly harbor porpoises and beluga whales) respond with aversion or foraging disruptions at much lower levels, down to 120dB. There will always be a subset of a population that is more sensitive to noise. This may be of special consideration in MPAs that are addressing chronic noise intrusions or several weeks/months of airgun or construction noise. That is, are the management goals of the MPA met if a more sensitive subset of a population is being impacted repeatedly?

## MPA News

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*MPA News* is published  
bimonthly by Marine Affairs  
Research and Education  
(MARE), a 501(c)(3) not-for-  
profit corporation, in  
association with the School of  
Marine Affairs at the University  
of Washington.

Financial support for *MPA  
News* is provided in part by a  
grant from the David and  
Lucile Packard Foundation.

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MPAs offer a potentially rich arena in which ocean managers can incorporate careful analysis of noise impacts on marine life. There are a slew of factors that make this a challenging task. But it is well worth the effort for MPA managers to learn more about this burgeoning field of research.

**Jim Cummings**

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**Little if any research is truly risk-free**

**Dear MPA News:**

When used for purely academic pursuits, airguns are a highly significant tool for environmental science. The sub-bottom mapping of geological structures on the ocean floor has provided, and should continue to provide, data critical to understanding the evolution and dynamics of the planet. This includes many significant concerns related to earthquakes, tsunamis, and climate change.

While academic researchers essentially use the same seismic sound source as the offshore oil/gas industry does for its seabed exploration, significant differences exist in terms of the extent the airguns are used and, above all, the intended use. Environmental concerns regarding the exploration and global overconsumption of oil should not justify halting the limited use of airguns for academic research purposes. Halting the research use of airguns would be one-sided and short-sighted — comparable to viewing X-rays only as a radiation threat rather than as a vitally important diagnostic tool for our personal health.

I fully agree that underwater noise is both a valid concern and has potential for significant negative impacts. I also agree that the use of seismic sources in MPAs should be reserved to research specifically linked to that location, as was the case for Endeavour. If a non-MPA location can serve research purposes, that site should be pursued along with minimal use of sound energy to achieve goals, and there should be preference for deeper water when possible.

However, little if any research is truly risk-free. The concept that “any possibility of harm to the ecosystem should be avoided when possible” is not something that should be applied as a selective policy tool for MPA management. An MPA’s use of patrol boats, for example, represents a risk of both disturbance noise and collisions. When MPA managers and government officials are faced with statements such as “Government must ensure that potentially harmful scientific experiments are not permitted on the basis of a lack of full scientific certainty of the likelihood or magnitude of harmful impacts,” the reality is that “full scientific certainty” coupled with “likelihood” is rather contradictory.

The likelihood of benefits from research using active seismic sources is perhaps greater than that of harm, particularly with mitigation and precautionary measures in use. In fact, there are risks, and potential harm, associated with not pursuing research. This needs to be balanced.

**Bill Lang**

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**MPA Tip: On setting up a monitoring plan**

The LMMA Network is a group of practitioners — including traditional leaders, conservation staff, university researchers, and others — working to improve locally-managed marine areas in the Indo-Pacific through the sharing of experiences and resources ([www.lmmanetwork.org](http://www.lmmanetwork.org)). The Network recently released *The LMMA Network Community Storybook* featuring lessons and experiences gathered at a network-wide meeting held in November 2008. It offers an array of useful tips on initiating planning processes, monitoring programs, and enforcement systems, among other subjects.

The following advice on setting up a monitoring plan was adapted by *MPA News* from the *Storybook*, which is available at [www.lmmanetwork.org/Site\\_Page.cfm?PageID=64](http://www.lmmanetwork.org/Site_Page.cfm?PageID=64).

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- Monitor things in the marine area that are important to the community. Monitoring plans should consider topics, items, and/or species of local interest and importance.

- To ensure consistency, try to use the same people for monitoring every time.
- Involve poachers in monitoring to get them to see the importance of the conservation work. Often poachers have special skills and knowledge of spawning areas. In Fiji, poachers are invited to participate in awareness and management activities so that they can gain an understanding of these efforts.
- Present results back to the community in simple language and visuals that they can understand; don't use lots of technical terms and complicated graphs.
- Take pictures or video of the marine life while monitoring, and use these to show community members how species and corals are coming back. 

# Following Copenhagen, Publications and Other Resources Available on Climate Change

Leading up to last December's UN Climate Change Conference in Copenhagen, a variety of institutions published reports on the environmental and socioeconomic impacts of climate change, as well as strategies for addressing those impacts. A list of (mostly) new publications is below, adapted from one

published last month by *Marine Ecosystems and Management* ([www.MEAM.net](http://www.MEAM.net)), the sister newsletter of *MPA News*. Although not all of these publications and other resources focus specifically on MPAs, their lessons are applicable to the MPA field.

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## General sources

- **The Ocean and Climate Change: Tools and Guidelines for Action (2009, IUCN)**

[http://cmsdata.iucn.org/downloads/the\\_ocean\\_and\\_climate\\_change.pdf](http://cmsdata.iucn.org/downloads/the_ocean_and_climate_change.pdf)

- **Managing Our Coastal Zone in a Changing Climate (2009, Australian House of Representatives)**

<http://www.aph.gov.au/house/committee/ccwea/coastalzone/report.htm>

- **Marine Ecosystems and Management, December 2009 – January 2010 (MEAM 3:3) — “EBM in a Changing World: Strategies for Proactive Management...”**

<http://depts.washington.edu/meam/MEAM10.html>

## Management of ecosystems as carbon sinks

- **Management of Natural Coastal Carbon Sinks (2009, IUCN)**

[http://cmsdata.iucn.org/downloads/carbon\\_management\\_report\\_final\\_printed\\_version\\_1.pdf](http://cmsdata.iucn.org/downloads/carbon_management_report_final_printed_version_1.pdf)

- **Blue Carbon Report: The Role of Healthy Oceans in Binding Carbon (2009, IUCN)**

[http://dev.grida.no/RRABluecarbon/pdfs/update/BlueCarbon\\_print12.10.09.pdf](http://dev.grida.no/RRABluecarbon/pdfs/update/BlueCarbon_print12.10.09.pdf)

## Ocean acidification

- **Ocean Acidification: The Facts (2009, IUCN)**

[http://cmsdata.iucn.org/downloads/ocean\\_acidification\\_guide.pdf](http://cmsdata.iucn.org/downloads/ocean_acidification_guide.pdf)

- **Website of the Ocean Acidification Network**

<http://www.ocean-acidification.net/>

- **Website of European Project on Ocean Acidification**

<http://www.epoca-project.eu/>

## Adaptation to climate change impacts

- **Natural Solutions: Protected Areas Helping People Cope with Climate Change (2009, IUCN)**

[http://cmsdata.iucn.org/downloads/natural\\_solutions.pdf](http://cmsdata.iucn.org/downloads/natural_solutions.pdf)

- **Ecosystem-based Adaptation: A Natural Response to Climate Change (2009, IUCN)**

[http://cmsdata.iucn.org/downloads/iucn\\_eba\\_brochure.pdf](http://cmsdata.iucn.org/downloads/iucn_eba_brochure.pdf)

- **Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change (2009, World Bank)**

[http://siteresources.worldbank.org/ENVIRONMENT/Resources/ESW\\_EcosystemBasedApp.pdf](http://siteresources.worldbank.org/ENVIRONMENT/Resources/ESW_EcosystemBasedApp.pdf)

## Sea level rise

- **Planning for Climate Change: Leading Practice Principles and Models for Sea Change Communities in Coastal Australia (2008, National Sea Change Taskforce)**

<http://www.seachangetaskforce.org.au/Publications/PlanningforClimateChange.pdf>

- **Working Together with Water: A Living Land Builds for Its Future (2008, Delta Commission [Netherlands])**

[http://www.deltacommissie.com/doc/deltareport\\_full.pdf](http://www.deltacommissie.com/doc/deltareport_full.pdf)

## Coral bleaching

- **A Reef Manager's Guide to Coral Bleaching (2006, Great Barrier Reef Marine Park Authority)**

[http://coris.noaa.gov/activities/reef\\_managers\\_guide/reef\\_managers\\_guide.pdf](http://coris.noaa.gov/activities/reef_managers_guide/reef_managers_guide.pdf)

- **Coral Reef Resilience and Resistance to Bleaching (2006, IUCN)**

<http://www.iucn.org/dbtw-wpd/edocs/2006-042.pdf>

- **“Climate Shifts” blog on climate change and coral reefs**

<http://www.climateshifts.org>

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[www.mpanews.org](http://www.mpanews.org)

searchable back issues, MPA-related conference calendar, and more



## Notes & News

### Correction

Due to an editorial error, the name of the Swiss watch manufacturer Jaeger-LeCoultre was misspelled in our November-December 2009 issue. As mentioned in the article “New Coordinator of World Heritage Marine Programme Describes Plan Forward”, Jaeger-LeCoultre is providing financial support to the UNESCO World Heritage Marine Programme.

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### Available for public comment: second round of MPAs nominated to US national system

The US National Marine Protected Areas Center has received the second round of nominations for existing MPAs to join the national system of MPAs. The list of 32 nominated sites is open for public comment through 22 February 2010.

Following review of public comments, the final nominations will be formally accepted as members of the national system in March 2010. Details on the nominated sites, as well as on the national system in general, are available at [www.mpa.gov](http://www.mpa.gov).

**For more information: Lauren Wenzel**, National System Coordinator. E-mail: [lauren.wenzel@noaa.gov](mailto:lauren.wenzel@noaa.gov)

### Western Australia designates marine park to benefit humpback whales

In October 2009, the government of the state of Western Australia designated an MPA in Camden Sound, an area of roughly 4000 km<sup>2</sup> that serves as a major breeding and calving ground for humpback whales. About 1000 humpbacks visit Camden Sound each year to give birth, making it the largest humpback nursery in the Southern Hemisphere. In turn, these calving individuals are part a greater population of 22,000 humpbacks that migrate each winter to Western Australia from Antarctica. It is the largest population of humpbacks in the world.

The regulations and boundaries of Camden Sound Marine Park have not yet been finalized, pending the development of a draft management plan that will undergo public consultation. It is the first marine park in the Kimberly region of Western Australia.

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### Tasmania designates new MPAs

In December 2009, the government of the Australian state of Tasmania designated 14 new MPAs and expanded the boundaries of two existing ones. The protected areas cover a total of 113 km<sup>2</sup>. Fishing will continue to be permitted in the 14 new protected areas. In the two expanded MPAs, no-take restrictions will apply.

“The reserves have been proclaimed as marine conservation areas under the Nature Conservation Act 2002 (Tasmanian State legislation),” says Fiona Rice, a marine reserves interpretation officer for the Tasmania Parks and Wildlife Service. “This legislation does not cover fish or fishing but provides some additional controls over other uses of the MPAs, including prohibition of interference with the seafloor and marine flora and the ability to control the use of vessels and commercial tourism operations.” A government press release on the new MPAs is at [www.media.tas.gov.au/release.php?id=28747](http://www.media.tas.gov.au/release.php?id=28747). **For more information: Fiona Rice**, Tasmania Parks and Wildlife Service, Hobart, Tasmania, Australia. E-mail: [fiona.rice@parks.tas.gov.au](mailto:fiona.rice@parks.tas.gov.au)

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### Publication available on governance of high seas biodiversity

A new publication offers a collection of more than two-dozen articles by authorities on high seas biodiversity and governance. Coordinated by France’s Institute for Sustainable Development and International Relations (IDDRI) and published by Institut Océanographique Éditeur, the book *Towards a New Governance of High Seas Biodiversity* aims to inform the study of high seas biodiversity, its potential management, and possibilities for ensuring its sustainable use. The articles were contributed by international experts who attended a 2007 Monaco seminar on high seas governance.

The publication’s table of contents, as well as a preface by Prince Albert II of Monaco and conclusion by Laurence Tubiana of IDDRI, are available for free at [www.ffem.fr/jahia/webdav/site/ffem/users/admiffem/public/Publications/OCEANIS\\_2009.pdf](http://www.ffem.fr/jahia/webdav/site/ffem/users/admiffem/public/Publications/OCEANIS_2009.pdf). The whole book costs 50€ (US \$72) and can be ordered at [www.oceano.org/io/spip.php?article424](http://www.oceano.org/io/spip.php?article424). For more information, contact the book’s editor, Julien Rochette of IDDRI, at [julien.rochette@iddri.org](mailto:julien.rochette@iddri.org).

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### Paper: Reserves could help coral reefs recover from climate change impacts

A new study in the free online journal *PLoS ONE* offers evidence that no-take marine reserves on coral reefs could help those reefs recover from the impacts of climate change, including bleaching events that cause sudden and extensive mortality. The study, by Peter Mumby and Alastair Harborne of the University of Exeter (UK), suggests that coral reef reserves allow for population growth of large herbivorous fish species that feed on macroalgae, a major competitor of corals. The resulting decline in macroalgae facilitates the recovery of coral populations after bleaching events. The authors based their conclusions on studies of ten sites inside and outside a Bahamian marine reserve over a 2.5-year period. The study is available at [www.plosone.org](http://www.plosone.org) (search word: Mumby.)

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### Recap: MPA News webinar on high seas MPAs

*MPA News* and the EBM Tools Network co-hosted a webinar on 16 December 2009 on strategies and technologies for developing MPAs and MPA networks in the open ocean and deep sea. A recording and transcript of the webinar, as well as recordings and transcripts of previous webinars on other aspects of MPAs and ecosystem-based management, are all available at [www.ebmtools.org/about\\_ebm/meam.html](http://www.ebmtools.org/about_ebm/meam.html).

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