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## Paper Contrasts Coral Reef Conservation in Western, Pacific Island Nations

A recent paper in the journal *BioScience* argues that, because coral reefs and other coastal marine ecosystems effectively extend into adjacent watersheds, they should be managed as an integrated unit. Marine protected areas alone, the paper states, “will miss their targets of resource protection unless coupled terrestrial protected areas (TPAs) are established and enforced. Simply put, TPAs combined with MPAs create effective resource protection areas.”

The paper’s authors note that coral reefs worldwide are being degraded by human-induced disturbances, and that runoff and sedimentation are among the greatest threats to reefs surrounding high islands and adjacent to continental land masses. Existing scientific data, they continue, “identify the key stressors, synergisms, and outcomes at the coral reef ecosystem, community, and population levels. These data demonstrate that marine protected areas alone may be insufficient for coral reef protection; integrated watershed management practices are also needed.” However, despite the existence of such data, gaps in the effectiveness of environmental policy, legislation, and regulatory enforcement frequently prevent adequate protection of reefs in countries such as the United States and Australia.

In contrast, they assert, several Pacific Island nations, “with intact resource stewardship and traditional leadership

systems,” have been able to apply research findings to coral reef management policies “relatively quickly.”

The authors underscore that traditional systems of resource management are not always successful. However, they argue, citing case studies from Guam, Palau, and Pohnpei, that certain aspects of the traditional policies in Pacific island cultures “reflect an understanding that it is not the coral reefs and associated resources that can be managed, but rather the human activities affecting these ecosystems.”

They write:

“In some of these islands, there is still direct reef tenure or ownership, and hence individuals take responsibility for the state of their coral reefs and the fisheries they support. This is different from the “tragedy of the commons” observed in the United States, wherein all have shared ownership, but few take responsibility, and there is often a lack of concern among those living upstream regarding the impacts of their activities on individuals and ecosystems further downstream. In numerous Pacific islands, the same villages or clans own both the upland areas and the coastal reefs affected by land-use practices within these watersheds. In addition, many Pacific island cultures treat the land–sea interface as a continuum rather than a boundary, and this “ridge-to-reef” stewardship recognizes that upslope activities affect people and resources farther down a watershed and in the ocean. Pacific island communities with intact reef tenure systems often act to protect their assets through internal governance.

“Finally, traditional leadership, which still exists in many of these islands, is hereditary, with time horizons longer than the two- to four-year electoral cycles prevalent in Western democracies.”

Among their conclusions, the authors call for “a comprehensive review of U.S. federal legislation, regulatory agency jurisdiction, and human and financial resource allocation;” and urge that “government scientists be free of interference from their politically appointed supervisors and be allowed to express their true scientific opinions.” They also endorse formal training designed to improve communications among policymakers, social scientists, natural scientists, and policymakers, citing as examples programs run by the Aldo Leopold Leadership Program, COMPASS, and SeaWeb.

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**Source:** Richmond, R.H., *et al.* Watersheds and coral reefs: Conservation science, policy, and implementation. *BioScience* 57(7): 598-607.

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## More Bad News for Arctic Sea Ice, Polar Bears

Sea ice cover in the Arctic Ocean reached the lowest absolute minimum level ever recorded in September, according to the National Snow and Ice Data Center (NSIDC) in Boulder, Colorado. In a statement on September 10, NSIDC reported that sea ice extent “is now at 1.63 million square miles, falling yet further below the previous record absolute minimum of 2.05 million square miles that occurred on September 20-21, 2005.”

In an interview with CNN, NSIDC’s Mark Serreze called the decline “astounding.” It was, he said, “almost an exclamation point on the pronounced ice loss we’ve seen in the last 30 years.” Talking to the *Wall Street Journal*, Serreze noted that the fabled Northwest Passage was completely ice free and stated that, “What we’re seeing in 2007 appears to be unprecedented. This is the first time the passage has ever been completely ice-free.”

NSIDC released its data shortly after the publication of a paper in the journal *Geophysical Research Letters* which found “considerable evidence for loss of sea ice area of greater than 40 percent by 2050 in summer for the marginal areas of the Arctic basin.” The paper, by James Overland of the Pacific Marine Environmental Laboratory of the National Oceanic and Atmospheric Administration (NOAA), and Muyin Wang of the Joint Institute for the Study of Atmosphere and the Ocean at the University of Washington, also predicted, albeit “with less confidence,” a similar 40 percent sea ice loss by 2050 in winter in the Bering, Okhotsk, and Barents Seas.

Overland and Wang reached their conclusions after running a selection of models provided through the Fourth Assessment Report process of the Intergovernmental Panel on Climate Change (IPCC). The authors divided the Arctic into nine regions, and for each region compared up to 20 models, eliminating those “outlier” models which the authors felt less accurately reflected actual conditions at the end of the 20<sup>th</sup> century—by, for example, overstating the existing amount of sea ice. Using this method, only the Baffin Bay region showed no ice loss by 2050.

Observed and projected declines in thickness and extent of Arctic sea ice have prompted concerns over the survivability of some of the region’s key species, particularly polar bears. A separate study, by the United States Geological Survey (USGS), has added to those concerns.

In January 2007, the U.S. Fish & Wildlife Service proposed listing the polar bear as a threatened species under the Endangered Species Act. To assist in the final decision on the listing, the Secretary of the Interior directed USGS to “generate new scientific data, models, and interpretations on polar bears and their sea ice habitats.” The USGS research was of two basic types: new observational data on polar bears; and projections or forecasts of future distribution and abundance of polar bears in the rest of the 21<sup>st</sup> century, given changes expected in future sea ice conditions.

The study then divided the species’ range into four “ecoregions,” based on “major differences in current and projected sea ice conditions:”

- *Seasonal Ice Ecoregion*, which includes Hudson Bay, and occurs mainly at the southern extreme of the polar bear range;
- *Archipelagic Ecoregion* of the Canadian Arctic;
- *Polar Basin Divergent Ecoregion*, where ice is formed and then drawn away from near-shore areas, especially during the summer minimum ice season;
- *Polar Basin Convergent Ecoregion* where sea ice formed elsewhere tends to collect against the shore.

The study projected a 42 percent loss of optimal polar bear sea ice habitat during the summer by the year 2050, and forecast that polar bears could be extirpated within the seasonal sea ice and polar basin divergent ecoregions within 45 years from the present. It also forecast extirpation of the species from the polar basin convergent ecoregion within 75 years. It concluded that polar bears would remain in the archipelagic ecoregion, but at reduced numbers.

Overall, the USGS concluded that: “Projected changes in future sea ice conditions, if realized, will result in loss of approximately 2/3 of the world’s current polar bear population by the mid 21<sup>st</sup> century. Because the observed trajectory of Arctic sea ice decline appears to be underestimated by currently available models, this assessment of future polar bear status may be conservative.”

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**Source:** Overland, J.E., and M. Wang. 2007. Future regional Arctic sea ice declines. *Geophysical Research Letters* **34**: L17705. doi:10.1029/2007GL030808.

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**For Further Information:** The National Snow and Ice Data Center posts regular updates and information on sea ice conditions at its website, [www.nsidc.org](http://www.nsidc.org). The full USGS polar bear report, with executive summary and press advisory is available at [http://www.usgs.gov/newsroom/special/polar\\_bears/](http://www.usgs.gov/newsroom/special/polar_bears/)

## Studies Show Warming in Northern European Seas, Impact on Fisheries

Two papers in the journal *Global Change Biology* show, first, record warming in northern European seas; and second, the projected impact of 21<sup>st</sup> century climate change on Baltic Sea fisheries and fish communities.

The first paper, by Brian Mackenzie of the Technical University of Denmark and Doris Schiedek of the Baltic Sea

Research Institute, investigates long-term variations in sea surface temperatures in the North and Baltic Seas by taking advantage of daily direct temperature measurements since the 1860s. Although the readings reveal a warm period in the mid-late 1800s and again in the mid-1900s, the more recent warming period (i.e. over the past 15 years) is, write the authors, “unprecedented.” The probability of extremely warm winters, summers and years has increased by two- to fourfold in the 1990s and 2000s relative to the probability in nearly all previous decades; this change in frequency of extreme events, say the authors, is “statistically highly significant.” Since 1990, they write, there has been an approximately 50 percent chance that any given winter or summer has had a temperature in the warmest 10 percent of all measurements since at least 1880. Similarly, the probability of having extremely cold winters, summers and years has decreased to 10 percent over the same period.

Mackenzie and Schiedek conclude by noting that the “recent warming event is exceeding the ability of local species to adapt and is consequently leading to major changes in the structure, function and services of these ecosystems.”

The second paper, by Mackenzie and three colleagues, focuses on the impact of present and future climate change on fish communities and fisheries in the Baltic Sea region. Using regional climate models, they predict that “climate changes in northern Europe will likely affect both the temperature and salinity of the Baltic, causing it to become warmer and fresher. As an estuarine ecosystem with large horizontal and vertical salinity gradients, biodiversity will be particularly sensitive to changes in salinity which can be expected as a consequence of altered precipitation patterns. Marine-tolerant species will be disadvantaged and their distributions will partially contract from the Baltic Sea; habitats of freshwater species will likely expand ... Fishing fleets which presently target marine species (e.g. cod, herring, sprat, plaice, sole) in the Baltic will likely have to relocate to more marine areas or switch to other species which tolerate decreasing salinities.”

The authors note that longer-term predictions of fish stock development are uncertain because of the counteracting effects of sea surface temperature rise and decreased salinity, and the fact that other impacts, such as fishing pressure and introduction of non-native species, will also affect the ecosystem. In the shorter term, however, they predict that, in tandem with existing levels of fishing, environmental conditions seem likely to prompt a collapse in the eastern Baltic cod population, and that recovery from such a collapse “would be very slow or perhaps impossible even under very low or zero fishing mortality.”

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**Sources:** Mackenze, B.R., and D. Schiedek. 2007. Daily ocean monitoring since the 1860s shows record warming of northern European seas. *Global Change Biology* 13: 1335-1347; Mackenzie, B.R., *et al.* 2007. Impact of 21<sup>st</sup> century climate change on the Baltic Sea fish community and fisheries. *Global Change Biology* 13: 1348-1367.

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## Study Reveals Invasive Range Expansion by Humboldt Squid In Eastern North Pacific

The Humboldt squid, a native of tropical and subtropical waters of the eastern equatorial Pacific, has substantially expanded its perennial geographic range by invading the waters off central California, according to a paper published recently in the *Proceedings of the National Academy of Sciences*.

The paper, by Louis Zeidberg and Bruce Robison of the Monterey Bay Aquarium Research Institute, is based on discoveries made during a 16-year time series of deep video surveys using a Remote Operated Vehicle (ROV) in Monterey Bay. The authors write that, historically, Humboldt squid “has been only an occasional visitor to southern and central California, and we did not observe it in Monterey Bay until 1997, although our routine ROV surveys began in 1989.” The species first appeared during the onset of a strong El Nino in 1997-98, was seen occasionally in 1999, just once in 2000, and not at all in 2001. In 2002, however, it returned in abundance in association with a small El Nino event, and has been present year-round in Monterey Bay ever since.

Although the species’ arrival was preceded by increased sea-surface temperatures, the authors believe its presence to be at least partly also related to other factors, as evidenced by the squids’ vertical distribution in the water column and the fact that the species has remained in the region subsequent to a slight post-El Nino cooling period.

In particular, Zeidberg and Robison note that populations of species which prey on the squid, specifically tuna and billfish, have “experienced drastic depletions.” The range expansion of the Humboldt squid itself appears to be having ecological effects, namely on numbers of Pacific hake, on which the squid feed and which declined with the surge in squid numbers and have remained low ever since.

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**Source:** Zeidberg, L.D., and B.H. Robison. 2007. Invasive range expansion by the Humboldt squid, *Dosidicus gigas*, in the eastern North Pacific. *Proceedings of the National Academy of Sciences* 104 (31): 12948-12950.

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## Genetic Study Questions Past Numbers, Present Status of Eastern North Pacific Gray Whale Populations

The Eastern Pacific population of gray whales is frequently touted as a success story. Extensively hunted in the 19<sup>th</sup> century, recent census counts place the population at between 18,000 and 29,000, widely presumed to be its approximate pre-exploitation level. It is regularly cited as the only great whale population to have recovered fully from commercial whaling. Indeed, mortality spikes in the period from 1999 to 2001 were taken as evidence that the population had reached carrying capacity.

However, a recent study published in the *Proceedings of the National Academy of Sciences* questions that belief. While not disputing present population estimates, the paper's authors—Elizabeth Alter and Stephen Palumbi of Stanford University, and Eric Rynes of the University of Washington—question the conventional wisdom that such estimates are close to initial population levels.

According to Alter and colleagues, genetic analysis reveals DNA variability typical of a population of between approximately 76,000 and 118,000 animals, three-to-five times the average consensus estimate of the population today. They suggest that their average estimated initial population of 96,000 was probably divided between the eastern and western North Pacific stocks, the latter of which is presently highly endangered.

The authors acknowledge that it is possible the population declined from approximately 96,000 to roughly 22,000 over the past 1,000 to 1,600 years, and that if it did so before the commencement of whaling, then both the new and existing pre-exploitation estimates would be correct. It is also possible, they note, that carrying capacity for the population was greater in the past than it is at present, which could account for the 1999-2001 mortality spikes.

## About Ocean Update

*Ocean Update* is a free monthly electronic newsletter of SeaWeb, a communications-based non-profit organization that uses social marketing techniques to advance ocean conservation. The purpose of *Ocean Update* is to highlight the latest and most ground-breaking science and research related to the marine environment and conservation. *Ocean Update* reports with deliberate neutrality and does not editorialize nor advocate any of the positions or conclusions it publishes. It is intended to bring readers timely information they might otherwise not see.

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However, they also observe that "recent evidence suggests that gray whale feeding habitat may be declining as Arctic benthic prey populations are reduced because of changing climate in the Bering Sea. Although additional survey data will be critical to determining whether carrying capacity has been reached, our estimate of typical gray whale abundance suggests that recent problems in gray whale feeding, including reports of thin adults or high calf mortality, may result from changing conditions in northern feeding grounds."

**Source:** Alter, E., *et al.* 2007. DNA evidence for historic population size and past ecosystem impacts of gray whales. *Proceedings of the National Academy of Sciences* **104** (38): 15162-15167.

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