

Mooring Buoys as a Management Tool for Controlling Visitor Impacts: An Introduction

Boat anchors can cause significant damage to seafloor habitats. Whether from the dragging of a single anchor or anchor chain during a storm, or the repeated anchoring of boats at a popular dive spot, the damage can transform a picturesque, productive habitat to rubble. To counter this, many MPAs have installed mooring buoys. Consisting of a permanent fixture on the seafloor, a floating buoy on the surface, and a line or cable to attach the two, these systems enable boat users to tie off to an existing mooring rather than drop anchor, thus reducing the effect on the environment.

Installing and maintaining mooring buoys are not without challenges, however. This month, *MPA News* provides an introduction to this technology and examines how managers are using it to control visitor impacts.

What roles can mooring buoys play in MPAs?

Although all mooring buoy systems feature the same three general components described above, they otherwise come in a variety of designs. The different designs allow individual models to perform well in particular environments (solid bedrock, sand, mud, and so forth) and offer various other features, like self-cleaning buoy lines to reduce maintenance costs. A MPA considering installation of mooring buoys will want to match its environment, user needs, and technical and financial capabilities with the appropriate system. (An explanation of the types of mooring buoy systems available, as well as an overview of mooring buoys in general and tips on installing a system, is available in the *Mooring Buoy Planning Guide*, published by the Project AWARE Foundation and the PADI International Resort Association. It can be downloaded at <http://www.projectaware.org/americas/english/pdfs/moorbuoy.pdf>. In addition, a case study on installation of mooring buoys at Komodo National Park, Indonesia, is available at <http://www.komodonationalpark.org/downloads/mooring%20buoy%20report%20lowres.pdf>.)

Aside from helping prevent anchor damage, mooring buoys can aid MPAs in other ways. Billy Causey, superintendent of the Florida Keys National Marine Sanctuary in the US, says that while the sanctuary's deployment of hundreds of mooring buoys in high-use

areas has effectively eliminated anchor damage to the coral reefs and seagrass areas, it has also provided benefits such as demonstrating protective management action. "The installation of mooring buoys is a very visual sign to sanctuary visitors that management actions are being taken to protect the coral reefs," says Causey. In addition, he says, the mooring buoys provide convenience and peace of mind to resource users, who can tie off relatively easily and can rely on the moorings for a solid hold.

Craig Quirolo, founder and director of marine projects for Reef Relief (a US-based coral-protection NGO that installs mooring buoys as one of its programs), says the reef conservation effort symbolized by mooring buoys leads visitors to a discussion of anchoring impacts and introduces the concept of avoiding contact with fragile seafloor habitats. "This concept is easily extended to standing, touching, harvesting, etc., when diving or snorkeling," he says. Mooring buoys can also help reduce user conflicts, he says, by demarcating where particular uses — such as diving or snorkeling — are allowed or promoted. "The buoys provide a perfect opportunity to establish no-take areas — you do not want spearfishing to occur where people are snorkeling," he says.

What factors should managers consider when siting mooring buoys?

Mooring buoys are sited near sensitive seafloor habitat in need of protection, ideally in substrate appropriate for drilling and cementing. (In cases of "substrate failure", an entire cemented core can be pulled up and dragged across the bottom.) Also, managers should generally place mooring buoys where boat users already prefer to go. Dave Merrill, president of Boatmoorings.com, a private firm that has provided moorings and training to several marine parks worldwide, says, "When designing walkways, the saying goes, 'Put them where the people walk.' The dive vessel's captain is going to take his customers to where it's most attractive or of the most interest. To install a mooring where the parks people want the vessels to go, instead of where the users will go, is wasteful." Considering the financial investment necessary for installing and maintain-

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ing mooring buoys — US\$500+ per mooring buoy per year, according to the *Mooring Buoy Planning Guide* — siting moorings where they will be used is imperative.

Activities associated with anchored boats in MPAs — diving and snorkeling, for example — can also have impacts on the environment, such as from kicking, standing, or uncontrolled buoyancy. The potential for this damage should be considered when siting mooring buoys, as moorings tend to focus user activity around them. When Kalli De Meyer took over management of Bonaire National Marine Park in 1991, a system of moorings already existed. “It had been put in place by the dive industry, whose prime consideration was creating access to their favorite dive sites,” says De Meyer, who is now executive director of the Dutch Caribbean Nature Alliance, an NGO based on Bonaire. “Using moorings as a tool to manage visitation had not yet been considered.” This was evident, she says, in the distance between moorings. “In our inherited system, moorings were placed too close together: divers could swim from one to the next and back again in a dive,” she says. As a result, there was no protected zone between the dive sites that was free from visitor impacts — the entire area was essentially one big dive site. “We have learned a lot since then,” she says.

Artie Jacobson, district manager for the Whitsunday region of the Great Barrier Reef for the Queensland Parks and Wildlife Service (Australia), says it is essential to involve the community and industry in choosing mooring buoy sites, particularly where use levels are high. The Whitsunday region, although comprising just 1% of the area of the Great Barrier Reef Marine Park, accounts for 60% of the park’s tourism activity.

“Each site within a park can be assessed in consultation with interest groups to determine how best it could be used and subsequently protected, assuming that conservation/protection is the bottom line,” says Jacobson. He instituted a program more than 10 years ago for the Whitsunday region that involved installation of mooring buoys to help manage visitors. “Rather than implement a ‘moorings program’, per se, we adopted the theme or project title of ‘reef appreciation and protection program,’” he says. “This broader approach allowed us to consider a number of options that would mitigate physical impact to the specific area (usually a bay or reef that was protected from the prevailing south easterly wind), and think about how best to provide for ongoing access and reef appreciation. It also allowed us to think about the cost of doing this — a key consideration.” Ultimately, the approach resulted in a tiered system that demarcated where anchoring and/or tying to a mooring buoy was allowed or not.

“When we commenced our program, we worked with the community to establish a volunteer dive group,” says Jacobson. “These teams went out into the park —

through their own means — and surveyed the edge of the reef for where good coral-growing substrate existed, marking these sites with small temporary buoys.” Jacobson’s team followed, made any necessary adjustments, then installed markers and moorings to indicate the area’s management scheme. “Actively engaging the community in such schemes — these guys were generally employed by the dive industry — gave them a true sense of ownership in protecting these reef systems,” he says. “Consultation is good, but to engage the community and industry actively in the ‘doing’ side of business is even better.”

Jacobson says some sectors of the tourism industry would be happy to see moorings within every bay as it is convenient and cost-effective for them to pick up a mooring rather than lay and weigh anchor. “I don’t think we want to see every destination within the park ‘industrialized’ through the installation of infrastructure, though,” he says, adding that it would be too costly as well to implement.

What are the main challenges of operating mooring buoys?

As mentioned above, mooring buoys can serve as magnets for use, leading to seafloor impacts associated with visitor activity. The related degradation that can occur is another reason why mooring buoys are often not placed in pristine, unvisited areas [see following article]. To mitigate the impacts of this magnet effect, experts on mooring buoy installation suggest combining mooring buoys with other management actions, including reef closures, limited entry schemes, and rotation of buoys. The Florida Keys National Marine Sanctuary, for example, has installed 36 mooring pins in its Dry Tortugas Ecological Reserve, but puts only 12 buoys out at a time. “This is proving to be a good management tool,” says sanctuary Superintendent Causey. “We can manage the user activity by rotating the mooring buoys and requiring their use in the reserve.”

Dave Merrill of Boatmoorings.com says, however, that the main challenge of mooring buoy systems is “money, money, money”. Namely, it costs to install the moorings and maintain them. Moorings wear out due to environmental factors and usage, and need to be replaced. Sometimes they are stolen or cut. The investment does not end with the initial installation.


Merrill says that because mooring buoys offer convenience to users, it may be feasible to pass along at least some of the expense to them. “Most mariners understand there is an expense to installing and maintaining moorings,” he says. “To have moorings for the boaters to utilize certainly helps rationalize the necessity of a user fee.”

David Rowat, chairman of the Marine Conservation Society Seychelles (MCSS), an NGO, says that the high cost of fuel and labor in the Seychelles is partly to blame

for why many of the country's 80-plus installed mooring buoys have fallen into disrepair. Maintenance of the moorings is the responsibility of the national marine parks authority and several local conservation organizations (not including MCSS), but these institutions are short of funds to carry out the task, says Rowat. The poor condition of the moorings has led boaters to avoid them and drop anchor elsewhere. A new funding system is needed, he says. (Rowat estimates that the annualized cost of installation, monthly cleaning, and bi-annual replacement of components could add up to as much as US\$1850 per mooring per year if performed by an outside contractor. If performed "in-house" by the marine parks authority and responsible NGOs, he says, the cost would be lower, assuming the expenses of staff time and vessel operations are internalized.)

MCSS is working to create a national mooring fee system in association with charter yacht operators, an expanding and profitable sector of the Seychelles tourism industry with more than 120 boats. (The dive sector, in contrast, has fewer than 25 boats.) Under the MCSS proposal, an additional 80 mooring buoys would be installed for charter boats' use. Installation and maintenance would be paid for through a weekly

mooring-use fee per boat, payable in advance by the charter companies and passed on to their clients. MCSS and the companies are in negotiations. "The fee would cover only the new mooring buoys," says Rowat. "The existing mooring buoys are already covered under the individual arrangements with management organizations. [Maintenance of the existing mooring buoys] could be included in the new system if their organizations were prepared to contribute."

Again, keeping the community and tourism sector involved is key to building support for a mooring buoy system and warding off opposition. Says Jacobson of Australia's Whitsunday region, "Rather than promoting conservation as the key outcome of what we are attempting to do, I have learned that when dealing with tourism operators and industry it is best to use the term 'tourism product'. This is not to downplay the value of conservation, but simply a way to highlight that what the industry is selling as a tourism product is all the things that nature provides. It then becomes easier to convince the industry that there is a range of 'tourism products' out there in the park available for presentation, and an ongoing need to work together to look after them. We are all in this together." 

"Sacrificial" Areas: An Appropriate Management Tool for MPAs?

In the course of researching the preceding article on mooring buoys, the subject of "sacrificial" areas arose: that is, the potential management strategy of directing visitors to areas that are already impacted (or even degraded) by visitation, thus leaving more-pristine areas untouched. *MPA News* asked several managers for their views on the concept of sacrificial areas, and their responses are below. Although the respondents are all from MPAs with coral reefs, their answers may also apply to MPAs with other sensitive habitats (seagrass, shipwrecks, etc.) and high visitation levels.

Athline Clark, Special Projects Program Manager, Hawaii Division of Aquatic Resources, USA

I do not think that designating an entire MPA as sacrificial is an appropriate management strategy. However, there are certain areas within a given MPA that — due to access, experience levels of the visitors, and water movement — are more likely to be impacted than others. It is important to recognize and manage this use so that these areas do not become completely degraded, as well as to manage overall activity in the MPA so that use does not impact the entire site.

The Hanauma Bay Nature Preserve [in Hawaii] is about 101 acres (0.4 km²) in size and in the past has had up to 3 million visitors a year. Only the inner reef area is heavily used. Even in this area, use is concentrated to

the eastern two-thirds of the inner reef. This means that well over 80 acres of the site are not heavily impacted, and have good coral growth and high fish biomass and diversity.

Kalli De Meyer, Executive Director, Dutch Caribbean Nature Alliance, Bonaire (and former director of Bonaire National Marine Park)

On Bonaire, we have had a decade-long discussion comparing our reefs to a piano keyboard — the choices being to wear out a very few keys by playing them all the time or to use all of them a little every day. Where there is evidence that areas are suffering degradation due to over-visitation, I find it entirely appropriate to consider clustering moorings to create what I call "honeypots". These might be over-visited sacrificial areas. But they might also be areas where there are fewer vulnerable species (such as around sandy beaches in coral reef areas); areas that have already been disturbed and may be dominated by more robust species; or areas where the topography tends to limit visitor impacts (such as walls). I also find it entirely appropriate that a percentage of the protected area remains pristine as this is the only way to ensure a full suite of species and a good gene pool. There should be no access allowed to these pristine areas.

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I don't believe we should be looking at this issue from a "sacrificial sites" perspective. Rather, we should consider the need to better manage a broad range of diver opportunity that is site-specific. At the top end of the spectrum, we would ideally have "prime sites" where we want not only to manage damage (diver and anchor), but also protect the specific natural attributes *and* offer a high-order dive experience. We should not be "training divers" within prime dive sites. Many dive sites would be better sustained if we were more selective as to who uses them: trainees or novices fumbling around with buoyancy or needing time to acclimatize to the underwater world have tremendous potential to cause physical damage to coral. If we want to protect some of the more delicate dive sites in perpetuity, we should not promote/permit trainee or novice divers to use these sites until they qualify as competent to do so. They should be first exposed to more diver-hardy sites. We need to explore this as a future management tool, particularly where new parks are being planned and established.


I'm not sure if I like the term "sacrificial areas". It doesn't help us focus on what we are really about: good

management — getting the right balance between appropriate use and resource tolerance. If we are sacrificing a place then I don't believe we are doing our job well.

Billy Causey, Superintendent, Florida Keys National Marine Sanctuary, USA

I would never identify sacrificial areas, and I do not think the use of mooring buoys should be in conjunction with identifying sacrificial areas. That would be contrary to what our job [of conservation] is intended to be.

We install mooring buoys in traditionally high-use areas, with the goal of mitigating damage to the corals and other resources. The most heavily used reefs in the Keys are the shallow reef areas, and they are not only under threat from over-use but are also the areas most impacted by coral bleaching and other perturbations such as hurricanes. By default, some of our shallow reefs are beginning to look like "sacrificial areas" — not just due to snorkeler-diver use, but also due to the other factors.

We do make it a practice to not put buoys on some of the best remaining coral reefs, unless these are areas of increasing use due to the public discovering them. The mooring buoys have a tendency to serve as a magnet for dive activity. 

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Notes & News

Funding available for coral reef projects

Applications are due 15 November 2005 for the Coral Reef Conservation Grant Program, operated by the (US) National Oceanic and Atmospheric Administration. The program provides grants to international, governmental (except federal US agencies), and non-governmental entities working to protect coral reefs. Grants for Fiscal Year 2006 are available in four categories, including "Regional Enhancement of Marine Protected Area Management Effectiveness" and "Development of National Systems of Marine Protected Areas in the Wider Caribbean, Bermuda, Brazil, and Southeast Asia". Proposed work must be conducted at non-US sites, and country eligibility varies by grant category. For details on categories and eligibility, go to <http://ipo.nos.noaa.gov/coralgrants.html>.

IMPAC1 update

Organizers of the First International Marine Protected Areas Congress (IMPAC1) — to be held 23-28 October 2005 in Geelong, Australia — expect more than 600 delegates from 66 countries to attend. In response to requests for financial assistance, the IMPAC1 organizing committee has provided support to more than 65 delegates from developing nations or

with indigenous backgrounds. The conference program and other details on the event are available at <http://www.impactcongress.org>.

Huge Aleutian MPA approved

An area of nearly one million square kilometers in the Aleutian Islands of Alaska (US) is now off-limits to bottom trawling in an effort to minimize the effects of fishing on sensitive coral and sponge habitat, following a decision by the US federal fisheries agency (NOAA Fisheries) on 8 August. The permanent closure of 950,000 km² — larger than France, Germany, and the Netherlands combined — is consistent with a February 2005 recommendation from the North Pacific Fishery Management Council (*MPA News* 6:8). The management action leaves 4%, or 43,000 km², of the Aleutian Islands management area open to bottom-trawl gear; most current and historic trawling activity has occurred in this 4% area. Concurrently, NOAA Fisheries approved closure of six areas with especially high-density coral and sponge habitat to all bottom-contact fishing gear, including longlines and pots. An announcement of the Aleutian management actions is at <http://www.fakr.noaa.gov/newsreleases/efhrod080805.htm>.

Report available on enforcement in US MPAs

A new report from the US National Marine Protected Areas Center compiles a range of information on MPA enforcement in the nation, including insights on challenges faced by resource managers and perspectives on how to optimize enforcement. Although aimed at officials working to coordinate and enhance MPAs in the US, the report may prove useful to practitioners elsewhere as well: it reviews various theories on enforcement and compliance, and offers three detailed case studies on how particular MPAs are handling enforcement (Florida Keys National Marine Sanctuary,

Channel Islands National Marine Sanctuary, and a federal fishery management area [Oculina Bank in eastern Florida]).

Enforcing US Marine Protected Areas: Synthesis Report is intended to provide a snapshot of current perspectives on MPA enforcement/compliance issues, and lay a foundation for improvements in MPA implementation. Authored by Braxton Davis and Greg Moretti, the 67-page report is available in PDF format at http://mpa.gov/virtual_library/Publications/enforcement.pdf.

Conference Calendar — October '05

2-5 October — **3rd Global Summit on Peace through Tourism**. Pattaya, Thailand. Web: www.iipt.org/3rdglobalsummit/

2-7 October — **Third Symposium on Harmful Algae in the US**. Monterey, California, USA. Web: www.who.edu/redtide/3rdsymposium/

5-8 October — **Third Congress of Planning and Management of Coastal Zones in Portuguese-speaking Countries**. Maputo, Mozambique. Web: www.fe.up.pt/%7Efipinto/IIICongress

10-11 October — **Seminar on Environmental Services and Financing for the Protection and Sustainable Use of Ecosystems**. Geneva, Switzerland. Web: www.unece.org/env/water/meetings/payment_ecosystems/seminar.htm

10-12 October — **Marine Scientific Research and the Law of the Sea: the Balance Between Coastal State and International Rights**. Monaco. Web: www.gmat.unsw.edu.au/ablos/#ABLOS'05

10-14 October — **TOPS 2005: The Ocean Policy Summit**. Lisbon, Portugal. Web: www.globaloceans.org/tops2005/index.html

12-14 October — **Innovative Governance, Regional Development & Economic Growth: Strategic Lessons from/for Island Territories and Rural Regions**. Twillingate, Newfoundland, Canada. Web: www.crrf.ca/about/call05.shtml

16-21 October — **18th Biennial Conference of the Estuarine Research Foundation**. Norfolk, Virginia. Web: www.sgmeet.com/erf2005/

16-21 October — **24th International Submerged Lands Management Conference**. St. John, US Virgin Islands. Web: www.islc2005.org/

23-27 October — **First International Marine Protected Areas Congress (IMPAC 1)**. Melbourne, Australia. Web: www.impaccongress.org

24-27 October — **History of Marine Animal Populations (HMAP) Conference**. Kolding, Denmark. Web: www.hmapcoml.org/Default.asp?ID=248

25-29 October — **MEDCOAST 2005: Seventh International Conference on the Mediterranean Coastal Environment**. Kusadasi, Turkey. Web: www.metu.edu.tr/home/wwwmdcst/MC05/index.htm

31 October - 3 November — **Pacem in Maribus XXXI 2005**. Townsville, Queensland, Australia. Web: www.imarest.org/events/pim/

For an updated calendar of MPA-related conferences worldwide, visit <http://www.mpanews.org>.

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The Role of MPAs in Protecting Against Coastal Disasters: Interview with Terry Hughes

Following the Indian Ocean tsunami in December 2004, experts analyzed how impacts of the disaster were influenced by coastal ecosystem alteration, including degradation of coral reefs and removal of mangrove forests. A primary conclusion was that more-natural coastal ecosystems were better able to dissipate the disaster forces, withstand stress, and recover from the event, as well as protect coastal communities. In general, natural systems were more resilient. For more on this, see the UN Environment Programme's *Rapid Environmental Assessment* report on the tsunami, available at http://www.unep.org/tsunami/tsunami_rpt.asp.

Coral biologist Terry Hughes of James Cook University (Australia) has co-authored recent papers in the journals *Science* and *Trends in Ecology and Evolution* on ways to support resilience of coastal and marine ecosystems to protect against disasters, including tsunamis and hurricanes [see box, lower right]. Hughes emphasizes that restoring and sustaining these ecosystems must be done in conjunction with social and governmental improvements so that human coastal communities are resilient as well. Diversity is essential for this, he says — both in ecology (diverse habitats, species, and spatial distribution) and in the surrounding human economy (diversified resource use and employment). Below, *MPA News* speaks with Hughes about the implications for MPAs from his research.

MPA News: Your papers do not specifically cite MPAs as a way of fostering resilience, although you stress the concepts of preserving natural ecosystem values and protecting against overfishing — common goals of MPAs. In the context of building ecological resilience, how would you rank the importance of, say, improving water quality versus establishing MPAs?

Hughes: Generalizing the relative importance of water quality and overfishing is difficult because they invariably go hand-in-hand, and often reinforce each other. No-take areas — one form of MPA — are a useful tool for reducing fishing pressure, but they are effective only in a larger setting. If regions surrounding no-take areas are drastically overfished or if the water is polluted, then their effectiveness is compromised. No-take areas need to be co-managed with surrounding areas that are often heavily used by people.

MPA News: With regard to resource users, you cite the importance of building social resilience as well as ecological, such as through reduction of coastal poverty and creation of long-term employment. Is it possible to

build lasting ecological resilience without also building social resilience?

Hughes: Sustaining and repairing ecosystems cannot be achieved in a social vacuum. Our recent papers highlight the emergence of an approach that links ecological resilience to governance structures, economics, and society. MPAs and no-take areas work only where there is local participation and support. A narrow focus on fisheries biology simply will not work unless the social costs and benefits of conservation efforts are addressed simultaneously.

MPA News: Your suggestions of ways to build ecological resilience to coastal disasters are similar to ones cited by other experts for building resilience to gradual climate change (*MPA News* 6:8, "Climate Change and Ocean Warming: Preparing MPAs for It"). That is, we need to restore natural ecosystem function, improve water quality, and decrease overfishing.

Hughes: The principles are the same: you must be proactive, anticipate gradual or sudden change, and build resilience beforehand. Of course, the immediate human consequences of sudden violent events (tsunamis, floods, hurricanes) makes them a priority for reducing their impact when they occur, and for bolstering the ability of societies and economies to adapt to and recover from them.

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Articles by Terry Hughes

TP Hughes, Bellwood, DR, Folke, C, Steneck, R, and Wilson, J. New paradigms for supporting the resilience of marine ecosystems, *Trends in Ecology and Evolution*, July 2005, pp. 380-386.

WN Adger, Hughes, TP, Folke, C, Carpenter, SR, and Rockström, J. Social-ecological resilience to coastal disasters, *Science*, 12 August 2005, pp. 1036-1039.

Note: Readers who do not have access to these journals may obtain copies of the papers by e-mailing their requests to Terry Hughes at terry.hughes@jcu.edu.au