ASSESSING THE CARRYING CAPACITY OF MPAS: HOW MANY VISITORS CAN YOUR MPA HOLD?

The benefits of tourism to Marine Protected Areas (MPA) can be significant, including the potential for generating revenue to support management (*MPA News* 2:8). Like other human activity in marine protected areas, though, tourism has environmental impacts. Damage to coral reefs from careless divers, as well as pollution and other ecosystem impacts from recreational vessels, are among the range of tourism effects documented in MPAs worldwide. Controlling these impacts can be as important an element of MPA management as any other. A potential key to such management lies in assessing the number of tourists that an MPA can support sustainably — its carrying capacity.

Assessing the carrying capacity of an MPA involves a number of factors, though some scientists suggest there may be general capacity limits for particular habitat types, like coral reefs. However, actual implementation of these hard limits on numbers of tourists can be politically difficult. For this reason, some experts suggest an alternative way to manage tourism impacts: estimating the "limits of acceptable change" for protected sites instead. This month, *MPA News* examines both methods, and how managers are incorporating them to ensure sustainable tourism for their MPAs.

Carrying capacity

The term *carrying capacity* derives from ecological science, where it indicates the number of organisms the resources of a given area can support over a given time period. Adapted to tourism management, it has a similar meaning: the number of people who can use a given area without an unacceptable alteration in the physical environment. In this case, the concept of an unacceptable alteration has ecological and social aspects. That is, under too much pressure from visitors, a site or ecosystem can degrade, thus making it less attractive as a tourism destination. Delegates to the 2003 World Parks Congress agreed that an action plan for the world's protected areas should include identification of "the limits of natural systems and their carrying capacity for different activities."

But how does a manager assess the carrying capacity of an MPA? It is rarely a straightforward process. Carrying capacity can differ from site to site, depending on habitat: a vertical wall of coral reef, in theory, may be able to sustain more divers than a flatter reef, prone to abrasion by divers with buoyancy problems. In addition, a site's carrying capacity can increase or decrease with visitors' level of experience and education. Again, the diver with buoyancy problems has a greater impact on habitat than the diver with good buoyancy control. If a park is able to educate visitors to have less impact per person, its carrying capacity increases accordingly.

From guidelines developed in 1992 by the World Tourism Organization and the UN Environment Programme, a basic equation for calculating visitor carrying capacity is:

Carrying capacity = Area used by tourists/Average individual standard

Here, the *average individual standard* (often measured in square metres per person) is the space a tourist requires for an acceptable experience in the protected area, which will vary depending on the area, activity, and management. Managers who seek to offer a pristine or wilderness-type environment for visitors, for example, would set a higher average individual standard than managers offering more high-traffic experiences. Despite the objective appearance of the square-metres-per-person figure, its calculation is based on subjective factors (*e.g.*, How many visitors in a given area cause a site to be less wilderness-like?).

Another way of setting carrying capacity limits is by examining in hindsight the impact of visitors on MPAs. In other words, when managers observe a level of use above which degradation ensued, that level becomes the carrying capacity. This was the basis for perhaps the most widely cited research on MPA carrying capacity to date. In 1996, biologists Julie Hawkins and Callum Roberts of the University of York (UK) set out to determine a safe level of carrying capacity for recreational diving. They compared damage levels of protected reefs in three regions (Bonaire in the southeastern Caribbean, Saba in the eastern Caribbean, and Egypt), with each reef subject to known levels of diving intensity. The sites were similar in coral cover and general topography.

Their conclusion: reefs could sustainably support roughly 5000–6000 dives per dive site per year, but greater levels of use caused a rapid rise in diver damage as measured in broken coral. An MPA with multiple dive sites could sustain many times that figure as a whole, as long as no site exceeded the 5000–6000 dive limit. (Incidentally, this figure was similar to

one found by a World Bank-funded research team that had studied the Bonaire site alone.) Hawkins and Roberts acknowledged that this was intended to be a general rule, adaptable to particular circumstances of individual MPAs. Such circumstances could include reef health, number of suitable moorings per site, level of diver experience, and enforcement of regula-tions, among other factors. (Their paper appears in the *Proceedings of the 8th International Coral Reef Symposium*, 1997, pp. 1923–1928.)

It is unclear how many MPAs have used the 5000–6000 dive figure in setting limits on visitation. In an informal search in July, *MPA News* found relatively few examples of MPAs that had set formal carrying capacity limits at all, whether for diving or other visitor activities. One of the reasons for this is political: it can be difficult for resource managers to limit the number of tourists allowed when local businesses depend on those tourists and, understandably, want to maximise their revenue. Inversely, many less-visited MPAs may not yet be experiencing negative impacts from tourism, so their management is not yet occupied with carrying capacity concerns. Of course, proactive planning can ease management later in cases of growing tourism pressure.

In the case of Cuba's national system of protected areas, such proactive planning is considered key. Located just 90 miles from the US, the nation is nonetheless largely shut off from US tourists by a trade embargo and travel restrictions the US government has applied to Cuba since the 1960s. Cuba's current tourism level of roughly 1.8 million foreign visitors per year consists largely of Europeans and Canadians. If the embargo and travel restrictions were lifted, Cuba would likely experience a boom in American tourism. Although estimates vary, the number of tourists in Cuba could increase as much as five-fold within a matter of years, according to some experts. This could place a substantial strain on the country's system of coastal and marine protected areas, with 18 sites currently designated and 12 more undergoing final government approval.

In the past decade, the National Center for Protected Areas (CNAP) in Cuba has had that scenario in mind. CNAP has already set general limits on visitor numbers for its "strictly protected" areas — those coastal and marine protected areas in which resource extraction is not allowed. The general limits apply to the number of bathers per beach (100 m^2/bather), maximum group size (10 individuals), and number of groups per day per trail or natural option (2 groups), among other factors. MPA managers can adapt these general limits as needed to their site-level management plans.

Reinaldo Estrada, director of CNAP, notes that current visitation levels to these protected areas are well below the general limits. But he is concerned that a future flood of tourists could overwhelm management. "The greater problem of the national protected areas system, and particularly of its MPAs, is that

Carrying capacity discussions

There are several examples of MPAs in which limits on tourism, though not set, have been discussed by managers or stakeholders:

Florida Keys National Marine Sanctuary (US): This MPA surrounds the Florida Keys, an archipelago that receives millions of tourists each year, including divers, anglers, and recreational boaters. The management plan for the sanctuary calls on managers to assess impacts of recreational activities and estimate user carrying capacities. Although the sanctuary has not yet conducted these assessments, it does have four research-only areas that were designated partly to serve as control sites for such studies. (Notably, a major inter-agency study in the late 1990s sought to measure carrying capacity for the entire Florida Keys ecosystem, both terrestrial and marine; the study is available online at http://www.sfrpc.com/gis/fkccs.htm. A critique of the study, provided by the National Research Council, is also online at http://www.nap.edu/catalog/10316.html.)

Stellwagen Bank National Marine Sanctuary (US): Off the coast of New England in the US, Stellwagen Bank is home to several species of large whales and a thriving whale watching industry. The sanctuary is now undergoing a management plan review process in which whale watching activity — both by commercial tour vessels and recreational boaters — will be one among many considerations. Federal guidelines for whale watch vessels in the region, including in the sanctuary, allow only one vessel at a time to be within 300 feet (90 metres) of a whale, and only two to be within 600 feet (180 metres).

Svalbard region (Norway): The arctic archipelago of Svalbard features several marine protected areas, totaling roughly 80,000 km^2. Cruise tourism has increased significantly around Svalbard in recent years. Although Norway has not yet crafted management plans for its Svalbard MPAs, it has restricted access to some landing sites due to impacts from overvisitation.

its limited development and capacity would prevent it from effectively and efficiently enforcing the regulations," says Estrada. The MPAs have practically no boats, land transport, communications technology, or buoy systems. "To face this problem, we are looking for external financing to allow us to strengthen these areas," he says. "For our MPAs, we have had some limited support for this, primarily from WWF-Canada." (The US embargo prevents US organisations from providing direct material assistance of this type.) CNAP is also looking to develop better tools for estimating carrying capacity, and is co-sponsoring a workshop with WWF-Canada and Environmental Defense (an international NGO) in November 2004 to address that issue.

Such pressures, still hypothetical in Cuba, are already real for Banco Chinchorro Biosphere Reserve, a coral reef MPA off the southeastern coast of Mexico. As set in the site's management plan, no more than 150 individuals are allowed to visit Banco Chinchorro each day, where there is a designated zone for diving and snorkeling. But in the past decade, coastal development along the nearby mainland has surged: vacation resorts and cruise tourism infrastructure — including a new cruise ship terminal in the town nearest to Banco Chinchorro — are changing the coastline from small fishing villages to a major international tourism destination. One tourism developer has reportedly purchased a large, high-speed catamaran to take visitors from the mainland to Banco Chinchorro, and is proposing to bring 400 individuals per day.

Tomás Camarena, a policy expert with Environmental Defense and former director of the Banco Chinchorro reserve, says that if that site and other MPAs in the region are to be protected — potentially through the court system — their defence may rely on their carrying capacity limits. "The carrying capacity component of the management plan is a key to protecting Banco Chinchorro," he says.

Limits of acceptable change

As already noted, setting limits on visitors while also satisfying tourism stakeholders can be a challenge. In the cases from Cuba and Mexico, the limits were instituted in the absence of an active private tourism sector to oppose them. (Banco Chinchorro's limit was set in 2000, before the nearby cruise terminal was completed.) Where tourism is already well-established, the suggestion of a carrying capacity is often interpreted by the private sector as a potential limit on business.

Steve McCool says there is a better way of addressing tourism impacts. A professor of wildland recreation management at the University of Montana (US), McCool says the concept of visitor carrying capacity impels managers to ask the wrong question: How many visitors is too many? He says this treats limits on visitor numbers as an end in themselves, whereas many problems of recreational use are a function not so much of numbers of people, but their behaviour. McCool suggests that managers should ask instead what resource and social conditions are acceptable, and how those conditions may be attained. In other words, management should be based on the limits of acceptable change (LAC) for a protected area.

"LAC is not a carrying capacity but a set of conditions — biophysical and social — that managers have deemed to be appropriate," says McCool. "The limits reflect values, preferences, science, policy, and public input, and can be maintained through a variety of policies, such as education. In the case of a marine protected area, concerns about damage to coral by divers could lead to a rule or guideline about ensuring proper buoyancy control."

An overview of the LAC framework, authored by McCool, is online at:

http://www.prm.nau.edu/prm300-old/ LAC_article.htm

In short, the framework involves four major components:

- Specification of acceptable and achievable resource and social conditions, defined by a series of measurable parameters;
- Analysis of the relationship between existing conditions and those judged to be acceptable;
- Identification of actions necessary to achieve these conditions; and
- A programme of monitoring and evaluation of management effectiveness.

Importantly, the process involves combining the technical expertise of planners and scientists with personal knowledge contributed by public stakeholders. Although the manager retains decisionmaking authority, the public consultation generally leads to greater buy-in from stakeholders and improved chances for successful implementation of management actions. (A carrying capacity approach, in contrast, prioritises science over public values and interests.) McCool acknowledges that as use increases, a manager may decide that the only option left is to implement a limit on visitor numbers. But he describes such a use limit as not a carrying capacity but a

decision that a limit is necessary to prevent any further change. "The strength of the LAC process is that it helps managers work through the process of making such decisions," he says.

The main criticism of the LAC process is that it can be costly in terms of time and staff, due to its requirement for monitoring. In contrast to a carrying capacity — which, once established, entails little monitoring apart from counting visitors — a LAC system requires regular measurements of changes in resource and social conditions. McCool says he has heard of terrestrial protected area managers choosing to implement carrying capacity limits instead of LAC in order to avoid monitoring — a misunderstanding, he says. "Manage-ment requires monitoring," he says. "To implement any management regime without monitoring implies that we know with certainty the outcomes of our decisions."

In 1999, McCool participated in developing the first LAC-based management plan for an MPA — the Saba National Marine Park in the eastern Caribbean. (This was the same site featured in the Hawkins/Roberts study mentioned earlier.) The management plan provides standards for multiple factors, including the proportion of damaged branching corals acceptable by zone and the minimum percentage of time that only one dive boat will be present at each dive site. The plan also requires standards for water quality, sedimentation, and fish stocks.

David Kooistra, manager of Saba National Marine Park, says the monitoring requirements, particularly for biophysical data, do pose a challenge for staff. "It is time-consuming," he says. To handle this, the park uses volunteers as much as possible for the collection of these data. Asked whether LAC has played a role in keeping the park's reefs "pristine", as they are described in the management plan, Kooistra says no — or, at least, not yet. "Low dive numbers, limited fishing activities, and no coastal development are more important contributors," he says. "We expect that LAC will play a more important role once dive numbers increase by at least 50%. With only 20,000 dives made in Saba each year, the highest number of visitors some of the dive sites receive annually is 2500."

In the Western Pacific, the LAC concept is emphasised as part of workshops for dive tourism operators, provided by the Coral Reef Alliance (or CORAL, a US-based NGO). The free-of-charge seminars, titled "Coral Reefs and Sustainable Dive Tourism: Protect Your Business By Protecting Your Reef", are provided upon the invitation of local dive operators, government agencies, or other stakeholders. Combining a general course on sustainable dive tourism with discussions of local issues, each workshop asks dive operators to identify stressors to local reefs (including diving-related stressors), and which of these the participants can address. Through 2003 and 2004, CORAL is conducting eight workshops, in Fiji, Indonesia, Palau, and Pohnpei. Each lasts two days.

Alex Brylske of Project AWARE Foundation — the educational and charitable arm of PADI, an international dive certification organization — has co-led three of these workshops for CORAL. "Dive operators are small-business folks operating on minimal margins," he says. "When they hear the term 'carrying capacity', they don't like it, even though they may never grow to a size where it would be a limitation on them." He says the buy-in of dive operators for management actions is essential to the success of virtually all MPAs in coral reef regions. "Once they understand that there are alternatives to the idea of 'no more than 6000 divers per reef', they look at the issue very differently. In fact, most become quite supportive of strong management practices once they see the big picture." A workshop in Palau in June 2004 focused significant attention on carrying capacity and LAC, as the Palauan government is encouraging the dive community to self-regulate visitor numbers at dive sites in lieu of government-imposed rules.

Brylske says education, though an important part of managing acceptable change, is not the solution in itself. In some cases, reefs may simply need some rest, he says, such as by moving mooring buoys or even closing sites down for a while. "Businesses are starting to recognise that some attention needs to be paid to the sheer numbers of people diving in some areas," he says. "After all, if the resource declines, divers will take their business elsewhere."

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