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The three screen doors: *Can* marine "protected" areas be effective?

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Abstract

The great majority of marine protected areas (MPAs) fail to meet their management objectives. So MPAs *can* be effective conservation tools, we recommend two paradigm shifts, the first related to how they are located and the second related to how they are managed. MPAs are unlikely to be effective if they are located in areas that are subject to numerous, and often uncontrollable, external stressors from atmospheric, terrestrial, and oceanic sources, all of which can degrade the environment and compromise protection. MPA effectiveness is also limited by low institutional and community capacity for management and inappropriate size with respect to ecological needs. In particular, the check list approach to management does not ensure that key threats are dealt with, or that management expenditures provide a quantifiable return. We recommend a business planning approach to MPA management, in which managers focus on the viability of the management system, i.e. the ability of the MPA to provide ecological goods and services to its target users over the long term.

Keywords: marine protected area, management effectiveness, community capacity, institutional capacity, business planning, index of biotic integrity.

The general who wins a battle makes many calculations in his temple before the battle is fought. It is by attention to this point that I can foresee who is likely to win or lose.
Sun Tzu, The Art of War, 500 B. C.

1. The 3 screen doors: a management perspective

The lack of effectiveness in marine protected areas (MPAs) is no mystery to MPA managers in the field and is highlighted by several authors (Kelleher *et al.* 1995; Alder 1996; McClanahan 1999). Of the 1,306 MPAs surveyed world-wide by Kelleher *et al.* (1995) only 31% of the areas thought they were achieving their management objectives. Several efforts are now underway to determine *if* MPA management is effective (Hockings *et al.* 2000; Ehler *et al.* 2002; MBRS 2002, CSC 2002).In this exercise of "thinking outside the box", we contend that the critical question that needs prompt consideration, and much more rigorous evaluation (both for existing and future MPAs), is not *if* MPAs are effective but *can* MPAs be effective.American naval personnel have long described tools or methods that did not work with the old saw "as useless as a screen door in a submarine". Unless MPA managers have control over stressors entering from atmospheric, terrestrial and oceanic sources, they are trying to manage the proverbial "submarine with 3 screen doors". They might have some success on the terestrial side (Causey 2002), but the atmospheric and oceanic sides are usually international, as well as large-scale national problems, and not easily mitigated.

To illustrate the point we only have to look at the premier coral reef MPA in the United States — the Florida Keys National Marine Sanctuary (FKNMS). From 1996 to 1999:

• coral cover has decreased 38%;

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• the average rate of coral loss is 13% per year and is unsustainable;
• the number of monitoring stations where disease occurred increased, as has the number of coral species affected; and
• there was significant loss of species richness (Porter et al. 2002).

Can the FKNMS be effective? Let's briefly look at the potent mixture of stressors coming in through *The 3 Screen Doors* (Table 1).
• *Can* the impacts from these stressors be effectively mitigated – *before* the coral reef completely dies?
• Should money be spent on sanctuary restoration efforts in a polluted environment?
• How many *more* millions of dollars should United States taxpayers spend on "management" — or should they cut losses now?
• How will the government explain the loss of this national treasure, and the social and economic benefits derived from it, to the public who trusted them to "protect" it?
• How will this loss affect the potential designation of future MPAs and their use as a conservation tool within the United States and globally?

These are all tough questions that will probably have to be faced, not only by the FKNMS, but by many MPAs (some more than others) — depending on their ability to manage *the three screen doors* and their designated purposes (i.e. MPAs with a strictly fisheries focus may be less affected by uncontrollable sources of stress than general biodiversity type MPAs with sensitive sessile organisms, such as corals, which cannot leave the area.

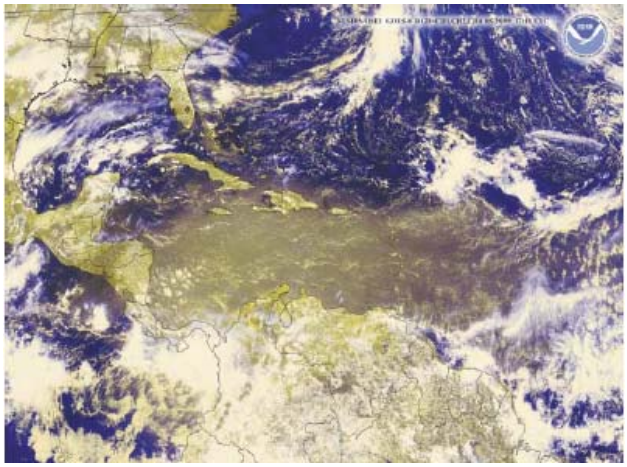

Figure 1: Airborne African dust (brown haze) over the Caribbean Sea and western Atlantic Ocean. Dust originated in the Sahara Desert of western Africa where it was lifted and carried off the coast by strong winds. Prevailing winds carry African dust into the FKNMS primarily during June - October. Since the late 1960s, droughts and agricultural practices have increased the size of arid lands in North Africa and fueled the problem (from Griffin et al., 2002).
Satellite image courtesy of NOAA

In summary, MPAs are unlikely to be effective if they are located in areas that are subject to numerous, and often uncontrollable, external stressors from atmospheric, terrestrial, and oceanic sources, all of which can degrade the environment and compromise protection. These critical calculations should be made before designation and periodically re-evaluated after designation. Top priority should be given to designating MPAs in minimally impaired locations that can act as reference sites for monitoring and assessment programs (Jameson et al. 1998, Jameson et al subm.).

Table 1
Stressors entering the Florida Keys National Marine Sanctuary (FKNMS) through *The 3 Screen Doors*. The overall toxicity created by the synergism of this mixture and the long-term cumulative effects (lethal and sub-lethal) on the coral reef system are not understood. African dust information from Griffin *et al.* (2002), global climate change information from (USEPA 2001) and all other information from Porter and Porter (2002).

Atmospheric
African dust: herbicides, pesticides, bacteria, viruses, fungi, nutrients, polyaromatic hydrocarbons, carcinogens (dioxin and radioactive isotopes), and heavy metals (Fig. 1).
Advective and atmospheric deposition: have not been quantified for the FKNMS but could be greater than land-based anthropogenic loadings.
Global climate change factors: warmer average sea surface temperature, higher sea level, increased carbon dioxide absorption by the ocean impacting coral calcification, more severe weather events increasing sediments, nutrients, and storm damage, changes in ocean circulation affecting dispersal and transport of larvae and nutrients.

Terrestrial
Stormwater runoff: organic debris, silt, nutrients (Fig.2), metals, oils, and fine sediment resuspended by boat traffic
Mosquito control programs: pesticides
Residential wastewater: nutrients, fecal coliform bacteria, fungus spores, and viruses via cesspits, septic tanks, injection wells, live-aboard vessels.
Marina operations: boat scrapings, paints, engine fuel and lubricants.
Natural sources: animal wastes, runoff from natural environments and weed wrack.

Oceanic
Tidal exchange with Florida Bay and Biscayne Bay: nutrients and turbid water.
Gulf of Mexico and west coast of Florida: pollutants (mainly nutrients and herbicides) from the Mississippi River watershed and west coast Florida rivers and farm lands are carried into the FKNMS via the Loop Current and Florida Current, or they can take a more complex route through Florida Bay and the tidal channels(Fig. 3). These events also can decrease salinity and increase turbidity.
Oceanic upwelling: nutrient loading via oceanic upwelling has not been quantified and needs study.
Cuba and the Caribbean: south Florida coastal waters are also linked via currents to waters of the north coast of Cuba and the Caribbean but the potential impact of pollution from these areas needs study.

Figure 2: The "Black Water Event" (February, 2002 satellite image) off the west coast of Florida showing the effects of land-based sources of pollution moving into the FKNMS (Naples Daily News, 2002; SWFDOG, 2002). The Mississippi and Atchafalaya Rivers drain 40% of the United States and parts of Canada (USEPA, 1994) providing 79% of the Gulf of Mexico freshwater inflow. Nutrient loadings in the Gulf of Mexico have risen dramatically over the last 30 years due to increasing agricultural, commercial, and residential development and are causing growing eutrophication problems (Day et al., 1995) and an ever increasing Gulf of Mexico dead zone (MPB News, 2001). The largest continuous input of nutrients to south Florida coastal waters comes from the west Florida shelf and its adjacent rivers (Lee et al., 2002). Orb View-2 imagery provided by Drs. Chuanmin Hu and Frank Muller-Karger, Institute for Marine Remote Sensing at the University of South Florida, St. Petersburg, FL, with permission from ORBIMAGE and the NASA Sea WiFS Project.

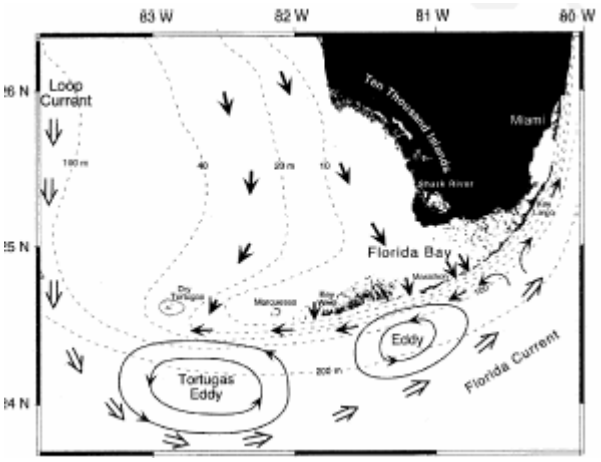

Figure 3: The Florida Keys National Marine Sanctuary recirculation system. It takes Mississippi River water 3 weeks to reach the Florida Keys and it remains about 3 months due to recirculating currents (from Lee et al. 2002).

2. Other Major Obstacles to Management Success

Whether or not an MPA *can* achieve its management objectives also depends greatly on the level of compliance by local resource users, who bear most of the costs of an MPA (Rudd *et al.* 2001). The probability of compliance will increase if local resource users derive direct benefits from the MPA (Ostrom 1990). For example, in MPAs with a fisheries focus, for such benefits to occur they must export sufficient biomass to mitigate for the loss of fishing grounds within the MPA boundaries. To date, many studies have found substantial increases in biomass within MPAs (e.g. Russ and Alcala 1989, 1996; Polunin and Roberts 1993; Johnson *et al.* 1999; Roberts *et al.* 2001), and several studies have shown an increase in catch-per-unit-effort (CPUE) in fishing grounds adjacent to MPAs (e.g., McClanahan & Kaunda-Arara 1996; McClanahan & Mangi 2000; Roberts *et al.* 2001; Kelly *et al.* 2002). These ecological studies are cited repeatedly as evidence for the success of MPAs in fisheries and ecosystem management.

In contrast, large-scale surveys of MPA users, managers and researchers paint a different picture of MPA success. It is estimated that about 35% of Caribbean MPAs and only 10-15% of Indo-Pacific MPAs are meeting their stated management objectives (Alder 1996; McClanahan 1999). Most MPAs are “paper parks” which lack compliance on the part of resource users and monitoring or enforcement on the part of management agencies. Why do such a high proportion of MPAs fail to meet their objectives? Recent research points to the level of community and institutional capacity as important determinants of MPA success (Rudd *et al.* 2001). Community capacity refers to the rules, procedures and values that people hold, which predispose them to work collectively for mutual benefit (Rudd 2000). Institutional capacity is the ability of government agencies to provide public goods and services and ensure that laws and regulations will be enforced.

The success of MPAs as a management tool will be greatest when communities collectively support the MPA and government agencies (or in some cases, non-governmental organizations, Jameson and Williams 2000) provide the necessary financing, monitoring, enforcement, and technical expertise to ensure that MPAs reach their management objectives. For example, the Apo Island reserve in the Philippines, often considered a “poster child” for community-based MPAs, has been successful in enhancing reef fish populations and creating tourism revenue (Russ and Alcala 1996, 1999). The success of the Apo Island reserve stems from the level of community capacity, which prevented opportunistic poaching from negating MPA benefits.

Alternatively, if community capacity is low (e.g. in the Turks & Caicos Islands), illegal fishing is likely to occur (Rudd *et al.* 2001). If community capacity is high but institutional capacity is lacking (such as in Fiji, Cooke *et al.* 2000), communities may be unable to prevent outsiders from poaching in their MPAs. Improving MPA institutional capacity is a difficult task. Institutional capacity can be strengthened to some extent by influxes of funding from a higher governmental level (e.g., increased federal assistance to state or territorial resource management agencies). Community capacity, on the other hand, is a function of the community’s social and cultural

history, and it may be difficult to modify on time scales relevant to resource management — this is especially true in developed nations and their island territories/colonies that depend on their governments rather than their own communities for public goods and services.

Another obstacle to management success is the small size of most MPAs; only 16 km2 on average (McClanahan 1999). The smaller the MPA relative to the home range of the species within, the more time those species will spend outside the MPA and therefore unprotected (Kramer and Chapman 1999). However, resource users are unlikely to support MPAs large enough to effectively protect exploited species. Indeed, most MPAs are designed and located based on socioeconomic and political issues (McClanahan 1999) and rarely account for the ecology of organisms to be protected.

In summary, the usefulness of appropriately sized, well-managed MPAs is not in question. What requires closer scrutiny is the institutional and community capacity necessary for effective MPA management to occur.

3. Benefits of a Business Plan Approach

As pointed out by authors such as Kelleher (1999), finances available for MPA's internationally are extremely limited. Panayatou *et al.* (1995) further state that degradation of marine resources in one area will increase the economic value of less degraded marine resources elsewhere. We believe that MPA managers must recognize the competitive economic environment in which they operate and "must make a choice" (Porter 1985) as to how they will align their resources to compete effectively to obtain funding and achieve the multiple objectives of their MPAs.

We recommend a business planning approach towards establishing a new MPA and, like Sun Tzu in *The Art of War*, we recommend calculating very carefully the feasibility of succeeding over the long run. In business planning terms this amounts to evaluating the level of competition (i.e., the impacts of uncontrollable stressors entering the MPA through *The 3 Screen Doors*), our ability to compete (i.e., what control do we have over these stressors), the level of community and institutional capacity to manage MPAs, and MPA size considerations. Taking this approach would:

- help clarify the true extent of MPA resources that are manageable;
- make it harder for governments to use MPAs as under funded token conservation efforts and avoid mitigating more significant environmental threats (i.e., over fishing, global climate change, nutrification, and sedimentation);
- identify the linkages between economic and environmental processes which are capable of delivering value, but which must first be understood and managed in an integrated manner; and
- assist those battling for clean air, land and water worldwide by injecting a strong dose of reality into the development vs. conservation debate.

4. Why Business Planning?

One argument for implementing private sector management tools within the public and not-for-profit sectors is that, in the absence of the discipline of the 'bottom line' (Harvey and Snyder 1987) (i.e., the production of profit), managers often mistake being busy for being effective. Certainly MPA managers are encouraged to develop strategic 'pyramids' of Goals, Objectives and Activities, that multiply as the strategy is developed. They then set about their work armed with long lists of activities to undertake and motivated by a budget process that rewards only expenditure of the whole budget. Is it surprising then, if MPA managers are tempted to focus on picking off the most easily achieved Objectives and Activities while being more concerned about how quickly they spend their budget, rather than how well? This 'check list' management approach does not ensure that key threats to MPAs are dealt with first, nor that the most difficult stakeholder issues are addressed immediately, nor that annual expenditure provides a quantified return (to society). The check list approach does not ask, or answer the "bottom line" (Harvey and Snyder, 1987) question, is it going to improve the well-being of the protected resource? Furthermore the check list approach allows MPA management to be satisfied when it is merely "doing it's best" (Harvey and Snyder, 1987), even if the resources within the MPA continue to be rapidly degraded.

By contrast, the business planning approach to MPA management asks managers to address the issue of viability as a primary activity.(i.e., balance consideration of what they hope to achieve, measured in terms of ecological and social objectives, with the reality of how they intend to do so, measured in terms of the resources required and available). It takes the approach that if an MPA management system is not viable then it is not worth implementing, and that it should be restructured or abandoned.

The business planning process "can be understood as two closely related processes: strategic planning and operational planning" (Sheldon and Waterfield, 1998) which asks managers to define the strategic goals of the MPA, to assess the MPA's performance to-date and to outline a wider strategy for achieving the MPA's goals. It also forces the managers to express in clear terms the "framework for implementing the strategy" (Sheldon and Waterfield, 1998) that explains exactly how the resources available (or required), will be utilized to meet the MPA's strategic objectives. This approach differs from traditional MPA planning, in that it requires managers to utilize "pricing, marketing, production, production planning and financial tools" (Alter, 1999) to clearly define "what" (Markides, 1999) they intend to achieve, "who"

(Markides, 1999) they must engage with, and "how" (Markides, 1999) they will align their resources. The "operational framework" (Sheldon and Waterfield, 1998) must then be refined in a marketing plan in which the MPA managers describe the product and services that the MPA will provide and, more importantly, how the target users (customers) of the MPA have been identified and their needs and wants defined. It may be difficult for MPA managers to think of themselves as providers of goods or services rather than as protectors or enforcers, yet this paradigm-shift necessarily addresses issues associated with the limited resources available to MPA managers. For example, whereas the direct cost of protection and enforcement activities is often high, managers are able to increase efficiency and effectiveness by developing partnerships with other sectors.

The key threat to the business planning approach to MPA management is the entrenched mindset of government and the other agencies within which many MPAs reside. Although there is general acceptance among these organizations that MPA managers must "see their job, in part, as running a business" (Thomas 2000), recent research by Ridley (in prep) shows that there is little understanding of what this means. The enduring traditional approach is to employ strategic tools such as log-frame analysis and cash accounting, that support the 'check-list' approach to MPA management. By contrast, the business planning approach measures the performance of MPA managers against their ability to focus their attention only on activities that will provide the returns required by the MPA's overarching strategy. The business planning approach forces MPA managers to:

- define how they will manage their resources in order to achieve measurable targets;
- to think laterally and to be nimble in the face of changing circumstances (including variations in funding); and
- seek out and discover the linkages between sectors and other actors in the MPA integrated value chain that (properly managed) will produce the ecological, economic and social returns envisioned in the MPA's strategy.

Given the urgency of these issues, we suggest that the debate should move on from whether MPA management is about business or conservation and accept that MPA management is in fact the business of conservation.

5. Calling It Something It Isn't

If MPA's aren't really "protected" from uncontrollable sources of pollutants entering *The 3 Screen Doors* then we shouldn't be calling them "marine protected areas" or "fully-protected areas" or any other form of "protected" area. If the term "MPA" or any of its derivations is continued to be used, it should be something that is earned or certified. Map-based indicators (Bryant et al. 1998) and indexes of biotic integrity (Jameson *et al.* 1998, 2001) which use the integration power of calibrated dose response biological metrics to detect the impacts of stressors, have the potential to aid in this certification function — and can be an invaluable tool for decision makers when deciding whether environmental conditions are healthy to proceed with a new MPA designation, continue with existing MPAs or engage in expensive restoration efforts.

In this day and age, with all the stresses imposed on coral reefs and other marine environments (Jameson *et al.* 1995, Bryant et al. 1998, Sheppard 2000), an area is not magically or instantaneously "protected" via an MPA designation process — protection must be fought for — and it may never be attained.

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