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Commentary

Cetaceans and MPAs should go hand in hand: A case study in Santa Monica Bay, California

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Cetaceans are iconic animals often referred to as keystone and umbrella species. They are keystone creatures because their disappearance may lead to the disappearance of other species (Paine, 1969, 1995), and umbrella because conservation actions that mitigate threats to them are likely to improve the prospects for the protection of other organisms, as well as the ecosystem itself (Mann et al., 2000; Prideaux, 2003; Roberge and Angelstam, 2004). In several areas worldwide, the significance of cetaceans as keystone and umbrella species is increasingly well recognized, as is the need to protect charismatic megafauna (Garibaldi and Turner, 2004; Roberge and Angelstam, 2004; Hoyt, 2005). In recent years, there have been a growing number of monitoring investigations on dolphins and whales that have contributed to the identification of key areas for cetaceans and helped in the creation or expansion of Marine Protected Areas (MPAs; Dawson and Slooten, 1993; Hooker et al., 1999; Gregr and Trites, 2001; Hooker and Gerber, 2004; Fury and Harrison, 2008; Hoyt, 2011). A few MPAs have also facilitated the protection of cetaceans, the species they feed upon, and their habitats (Hooker and Gerber, 2004).

Creating MPAs for cetaceans is a complex process[2] which involves a variety of stakeholders, but MPAs – when properly enforced and implemented - can play a crucial role in protecting dolphins and whales. Defining critical habitats[3] for these animals is the first step toward an effective management of MPAs (Hoyt, 2005). Considering that critical habitats for cetaceans and many other marine creatures are usually less fixed than critical habitats for terrestrial species (e.g., foraging areas at sea depending on highly variable oceanographic conditions), the definition of MPAs must be flexible (Agardy, 1994, 1997; Hoyt, 2005), thereby facilitating the changes necessary to protect cetaceans and their prey species. For instance, depending on a specific region, appropriate "zoned protection" should be established and/or re-sized to reflect seasonal changes in prey occurrence and abundance for cetaceans. This requires a fine-grained understanding of a study area, achieved through ongoing research and monitoring, and the application of ecosystem-based management. The goal of this type of management is to maintain a healthy marine ecosystem by taking into account all the linkages within the ecosystem itself as well as the anthropogenic activities (fishing, chemical and noise pollution, vessel traffic, etc; Hoyt, 2005).

Many existing MPAs with cetaceans, however, still lack basic monitoring and research to identify critical marine mammal habitats and only a few of them have developed adequate policy recommendations and adaptive ecosystem-based management guidance to guarantee effective cetacean habitat protection (Hoyt, 2011). There are instances in which cetaceans have been overlooked or dismissed in the monitoring efforts and decision-making process regarding the establishment and management of MPAs. The rationale for not considering cetaceans stems from their highly mobile nature with dynamic movement patterns (the MPA size is not large enough to guarantee protection to them) to the difficulty of defining their habitat needs due to lack of knowledge (Hoyt, 2005). There are many reasons, however, why even small MPAs should include regular fine-scale monitoring of wild cetaceans within and outside their boundaries.

Santa Monica Bay (SMB) and its adjacent areas in Southern California, where several small MPAs have been recently established[4] (Box 1), is an example of a region in which cetaceans have

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[2] For better understanding the creation of MPAs for cetaceans and the selection of criteria see: Evans (2008).

[3] Cetacean critical habitats are defined as the areas where these animals can hunt, feed, court, play, and reproduce. These critical habitats are usually more dynamic than critical habitats on land, and they can change seasonally (for a detailed discussion of critical habitats see Hoyt, 2011).

[4] Coastal MPAs in SMB: Point Dume State Marine Reserve, Point Dume State Marine Conservation Area, Point Vicente State Marine Conservation Area, Abalone Cove State Marine Conservation Area (for a complete list of recently established coastal and offshore MPAs in the region and more information, see:http://www.dfg.ca.gov/mlpa/pdfs/scmpas121510.pdf http://www.dfg.ca.gov/mlpa/southcoast.asp).

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been overlooked in the creation of MPAs and, until now, no monitoring of these species has been included in MPA planning. SMB has a diverse and rich cetacean fauna (Bearzi, 2003; Bearzi et al., 2005a,b; 2009a), including threatened and endangered species such as gray whales *Eschrichtius robustus* and blue whales *Balaenoptera musculus*, which have been recorded traveling and foraging in the Bay and within the local coastal MPAs (Bearzi and Saylan, 2011). Further, upwelling areas near submarine canyons and escarpments in SMB are regular feeding hotspots for a diversity of cetaceans as well as other species (Bearzi, 2005b; Bearzi et al., 2008, 2009c), and they can represent critical habitats for dolphins and other charismatic marine megafauna (Hooker and Gerber, 2004). For instance, the endangered blue whales were recently recorded in high number foraging both, within and outside the boundaries of the coastal MPAs and along the escarpment, as well as nearby the shipping lanes in SMB (Bearzi and Saylan, 2011; Berman-Kowalewski et al., 2010). Harassment of this species by recreational boaters has increased near the whales' feeding grounds, due to press coverage, absence of enforcement and lack of public knowledge on distance regulations concerning these whales. Further, associations between blue whale mortality and ship strikes along this stretch of California coast have been recorded, including near the coastal MPAs of SMB (Berman-Kowaleswki et al., 2010).

The coastal areas of Southern California and SMB also serve as a regular transit corridor for dolphins moving between foraging hotspots (Defran et al., 1999; Bearzi et al., 2005a). Coastal bottlenose dolphins (*Tursiops truncatus*) are known to move from Northern Baja California, Mexico, to Northern California. They display long shore movement reversals among different study areas and travel extensively in search of optimal feeding locations (Hwang, 2010). During their long-range inshore movements, these dolphins are regularly subject to human impacts (e.g., runoff and noise pollution, vessel traffic, etc.), which expose them to direct and indirect threats (Hwang, 2010). Long-term monitoring research along corridors – collecting data ranging from ecological information to pollutant loads – can help to identify any change in their occurrence and behavior as well as detect potential stressors to the dolphin population. This information is also important to determine the overall health of the marine ecosystem in which this and other species live.

Such corridors, often ignored in the design of MPAs and MPA networks (including those in SMB), are critically important to the long-term population viability of cetaceans (Reeves, 2000). Protecting migratory and movement corridors, and incorporating them in the design, implementation and expansion of MPA networks, is essential to ensure that the connections among critical habitats remain unbroken (Vasarhelyi and Vernon, 2008).

Further, top predators such as bottlenose dolphins, which are regular visitors of SMB and use this area as a regular foraging hotspot (Bearzi, 2005a), are now considered in many locations worldwide to be indicators and sentinels of the status and health of coastal habitats (Simberloff, 1998; Wells et al., 2004; Bossart, 2011; Hart, 2011; Reif, 2011). Systematic near shore monitoring of these free-ranging animals can provide key data for understanding their habitat use as well as tracking the progression of poorly known diseases in addition of emerging and re-emerging pathogens that may impact both dolphins and human health (Simmonds and Hutchinson, 1996; Hart, 2011; Bossart, 2011). A recent study shows that bottlenose dolphins accumulate more chemical pollutants in their bodies when they move and forage in waters near urbanized areas (Kucklick et al., 2011). In the Southern California Bight, large amounts of pollution enter the coastal and offshore ocean environment (Shiff, 2000), and high levels of contaminants were recently found in high-order carnivores such as sea lions (Blasius and Goodmanlowe, 2008). Los Angeles represents the largest urbanized area bottlenose dolphins pass during their southward and northward near shore movements (Bearzi et al., 2009b). While human-induced effects on marine mammals are hard to assess, these animals accumulate contaminants and suffer immunological/reproductive disorders as a result (Bossart, 2007). In SMB, over 80% of the individually photo-identified bottlenose dolphins have skin diseases or body malformations (Bearzi et al., 2009b). Although these problems seem to be associated with poor water quality and presence of pollutants (Van Bressem, 2003; Van Bressem et al., 2009; Bossart, 2007), bottlenose dolphins have not yet been considered as environmental indicators within the SMB ecosystem.

Harmful algal blooms (HABs) have recently been linked to large-scale marine mammal mortalities along the Southern California coast, including SMB (Torres de la Riva et al., 2009). This data shows that stranding of bottlenose dolphins and common dolphins (*Delphinus* spp.) occurred at the same time of HABs, affecting both of these inshore and offshore animals. Monitoring wild cetaceans within the coastal and pelagic SMB ecosystem and the MPAs, and collecting regular data on their presence and activities during times of HABs, can help correlate seasonal blooms to cetacean occurrence, abnormal behaviors (neurological effects are observed in case of intoxication by marine mammals; Torres de la Riva et al., 2009) and potential die-offs.

Data on cetaceans recorded along coastal corridors as well as within and outside the boundaries of the local MPAs in SMB and adjacent areas, for instance, are extremely useful for policy recommendations regarding both newly established and future protected areas. Baseline information should include and combine data on the distribution, frequency, diversity and behavior of cetacean species, oceanographic data, as well as the type, intensity and potential impact of human activities on these animals (Evans, 2008; modified). These data, now collected with a variety of tools ranging from radio satellite telemetry to mark-recapture, will help to establish: a) critical habitats and hotspots for cetaceans, b) potential anthropogenic issues facing these species, and c) sizes of protected areas and their dynamic boundaries. Supplemental data might also include tools such as spatial modeling that incorporates a range of environmental and occurrence data for cetaceans to assess future habitat use by target species inside and outside the boundaries of the MPAs.

All this information can be used for determining accurate levels of protection and zoning so that MPAs can be adapted and/or extended to guard "predictable" concentrations of cetaceans (Box 2; Hoyt, 2005). MPAs must have boundaries that have an "ecological" meaning, and fine-scale monitoring of cetacean movements and behavior – within and outside the existing MPAs – can help in better defining such boundaries. Further, developing networks of MPAs with an appropriate ecosystem-based management will assure better protection for populations such as the California coastal bottlenose dolphins which travel from one foraging spot to the next, and consequently, move between the postage-stamp MPAs located along shore (see also Box 2).

In conclusion, including cetaceans in regular and fine-scale monitoring efforts – even in small MPAs like those established in SMB and adjacent areas - and using an adaptive ecosystem-based management approach (Cortner and Moote, 1999; Hoyt, 2005) that can help promote MPA interconnectivity, are keys for the future preservation of these iconic species. This is particularly important today, in a world where MPAs cover just over one percent of the oceans (Hinrichsen, 2011), and in the face of climate change and other environmental issues.

Box 1.

The Marine Life Protection Act (MLPA) was passed in 1999 as part of the California Fish & Game Code to reevaluate all existing MPAs, possibly design new ones and decide methods and objectives to establish a MPA network along the entire California coastline. Because of the tradeoff among a variety of stakeholders' interests, the MLPA overall goals, and the wrong perception about cetaceans' protection and needs, whale and dolphin conservation has not been a priority or an objective for the creation of MPAs and the network. Based on the MLPA goals, however, a few cetacean species might indirectly benefit from the establishment of this network under the umbrella of "protection of natural biodiversity and abundance of marine life" and future efforts may take into account these marine mammals.

The California Fish and Game Commission recently adopted regulations to create 36 new MPAs in Southern California (http://www.dfg.ca.gov/news/news10/2010121501-Commission-Approves-SCMPA.html). These protected areas encompass roughly 187 square miles (8 percent) of state waters in the south region, with approximately 5% designated as fully protected no-take areas (the other zones are open to fishing). The Department of Fish & Game's future plan is to incorporate the south coast network of MPAs into a larger national network of MPAs (which now includes central coast, north central coast, and northern Channel Islands) after the south coast MPAs will go into effect on January 1, 2012. There are four US national marine sanctuaries extending into California's offshore waters, which have programs already in place to protect marine mammals (Hoyt, 2011). These are the Channel Islands, Monterey Bay, Gulf of the Farallones, and Cordell Bank national marine sanctuaries.

Considering the already established presence of cetaceans in Santa Monica Bay and adjacent areas – including species that can be used as indicators (Bearzi and Saylan, 2011) – the hope is that managers, policy-makers, etc. will recognize the significance of these keystone animals in ongoing monitoring efforts and future decision-making process regarding MPAs in the region.

Box 2.

Cetacean monitoring data (e.g., diversity, distribution, occurrence, seasonal frequency and behavior of different species) as well as data collection on anthropogenic activities within and outside the boundaries of small MPAs in areas such as SMB where human activities and marine life overlap, can help to:

- identify and define dolphin and whale aggregations, hotspots and/or critical habitats;
- create a better understanding of spatial relationships among species, ecological processes, and human activities;
- provide data for implementation of an overall adaptive ecosystem-based management approach to ensure that critical habitats will remain healthy while supporting of marine life;
- establish priorities for protection for cetaceans;
- identify and help control human threats to cetaceans (e.g., noise and chemical pollution, marine traffic, fishing, etc);
- track the progression of poorly understood new diseases relevant to both human and dolphin health;
- produce peer-reviewed publications that have strong conservation and policy applications;
- help raise public support for better protection of cetaceans and the possible expansion of local MPAs using dolphins and whales as symbolic species (MPA managers can "use the human-dolphin connection" to pursue the conservation of other marine species and environmental features for which such a connection is lacking or is less direct);
- provide guidance on enforcing, managing and evaluating the expansion of existing MPAs and help identify areas outside the current MPAs that may deserve consideration;
- use cetaceans as iconic species to develop public awareness and as a vehicle for the establishment of new MPAs and expansion of existing ones, as well as species conservation;
- facilitate stronger collaborations with other members of the MPA network (well-designed and strategically planned networks can help to connect the dots among spatially separate MPAs, thus improving the lack of protection to mobile animals like cetaceans, as discussed at the first International Committee on Marine Mammal Protected Areas Conference in 2009 (http://icmmpa.org/).

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