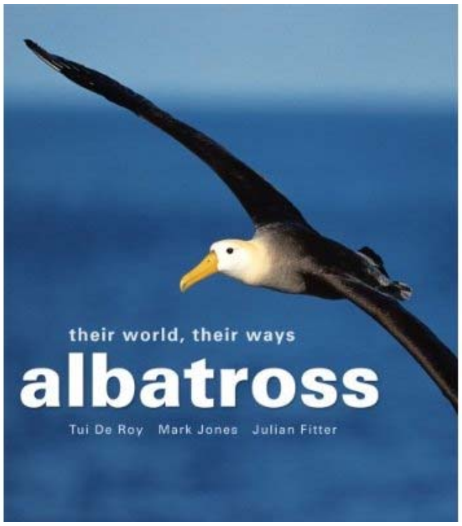
Applying Spatially-explicit Measures for Albatross Conservation

K. David Hyrenbach

Synopsis: A technical overview promoting integrated and wide-ranging management tools, including marine protected areas and other regulations, to achieve optimum albatross protection across entire ocean basins.



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Recent technological and conceptual advances, including the advent of satellite remote sensing of ocean habitats, the design of electronic tags to track the movements of marine organisms, and the development of Geographic Information System (G.I.S.) visualisation and analysis tools, are helping researchers to study the habits and habitats of far-ranging albatrosses. The resulting improved understanding of albatross distributions has important conservation implications, by helping to identify the locations and time periods when these species overlap with potential threats.

This enhanced ability to map the movements and habitats of protected species is at the centre of a growing "spatially-explicit" approach to marine conservation. In this essay, I explore the potential application of this novel approach, based on the mapping and regulation of human activities in time and space, to advance albatross conservation. I advocate an integrated strategy, whereby focused and diffuse management measures are used in conjunction throughout entire ocean basins.

Marine Protected Areas (MPAs) networks are increasingly being used to manage fisheries, and to protect threatened species and marine habitats around the globe. Although most MPAs have focused on sessile and sedentary organisms (e.g., coral reefs, mangroves, reef fishes), there is growing interest in extending their application to the conservation of highly-mobile species (e.g., marine mammals, birds, turtles). Increasingly, there are calls for the creation of large-scale oceanic reserves, akin to the parks established to protect large terrestrial vertebrates and their habitats (Norse et al. 2005).

In principle, MPAs may afford protected species with protection from some anthropogenic (man-induced) impacts, during certain periods of their life cycle. However, MPAs will not provide far-ranging albatrosses with comprehensive protection, since they routinely cover thousands of kilometres of open ocean in search of food for their chicks, and engage in vast post-breeding migrations. Thus, the implementation and enforcement of large-scale reserves capable of encompassing the entire marine ranges of albatrosses is logistically and politically unattainable. Nevertheless, MPAs may prove feasible during certain critical periods of the albatross life cycle, particularly in those instances when these species aggregate at specific habitats defined by bathymetric (e.g., continental shelf-breaks and slopes) and hydrographic (e.g., frontal systems) features to forage (Hyrenbach et al. 2000). Several studies have quantified the overlap of satellite-tracked albatrosses with management jurisdictions, like Exclusive Economic Zones (EEZs) and MPAs. These data provide valuable lessons about the potential use of marine zoning to protect these far-ranging species during different parts of their life cycle (Table 1). First, albatross species breeding concurrently at the same location may use marine reserves differently, if they forage in different oceanic habitats. For instance, during their incubation and brooding period two sympatrically-breeding albatrosses spent approximately 31% (Black-browed) and 15% (Grey-headed) of their at-sea time within the Macquarie Island Marine Park, a 16 million hectare protected area within the Australian E.E.Z. (Terauds et al. 2006). Telemetry studies have also documented substantial variability in MPA use within a given species, as trip durations and foraging ranges expand and contract during the breeding season. For instance, foraging Waved albatross from Isla Española spend over two thirds their time within the Galápagos Marine Reserve (GMR) during the brooding period, but the use of the reserve was reduced significantly during the incubation (15%) and chick-rearing

(10%) periods. Finally, some species, like the Black-footed albatross, may forage within MPAs located very far from their breeding colonies. Chick-rearing birds from Tern Island, NW Hawaiian Islands, commuted 4,500 km to forage within National Marine Sanctuaries located in the California Current. Yet, when post-breeding birds were subsequently tagged within these sanctuaries, they spent a small amount of time within these protected waters and ranged widely across the North Pacific. These studies underscore the need for detailed data on albatross distributions, as the foundation for an integrated and comprehensive approach to the conservation of their populations and oceanic habitats (Hyrenbach et al. 2000, Gilman 2001).

Marine zoning, which seeks to manage the whole range of human activities (commercial and recreational fisheries, oil and gas exploration and drilling, maritime transportation, recreational activities, military exercises, ecotourism, aquaculture, and other extractive activities like sea mining) and the conservation of marine resources (including fisheries, protected species, and both benthic and pelagic habitats), provides a flexible framework for integrated albatross conservation.

The key to effective marine zoning lies on the ability to mitigate detrimental impacts on the natural resources, by segregating non-compatible uses in time or in space. Zoning concepts are not new, having been used in terrestrial systems for decades. The segregation of commercial and residential areas within cities, the design of highway and railway transportation corridors, and the establishment of national parks are classic examples of land use planning. Similar large-scale zoning approaches are being advocated for the management of marine systems (Norse et al. 2005).

The marine zoning "tool kit" includes a wide array of protective measures, with varying degrees of spatial coverage and design flexibility. Fishery monitoring (e.g., observer programmes) and bycatch mitigation measures (e.g., seabird scaring lines or "tori-lines") can be applied in a diffuse fashion (e.g., across entire fishing fleets), or can be focused on priority times and areas of highest potential threat to protected species. Information on albatross movements and fishing effort distributions are being used to identify "high risk" times and areas of high albatross overlap with fisheries (BirdLife 2004). Marine reserves and temporary fishery closures are best suited for instances when albatrosses forage within fairly restricted areas around their colonies or commute to specific foraging grounds. Yet, effective reserve designs will require an understanding of the dynamics (spatial and temporal predictability) of the oceanographic habitats exploited by albatrosses (Hyrenbach et al. 2000; 2006).

The vision and political will to develop an integrated albatross conservation plan are coming together, spurred by the development of marine zoning. A particularly novel conceptual development entails the private leasing and ownership of submerged lands, which offers many exciting possibilities for the conservation and management of marine resources, including the establishment of MPAs for the protection of marine resources and habitat restoration. Currently, local communities own and lease submerged lands for commercial fishing and pearl harvesting, national governments grant marine concessions to support growing aquaculture and wind-power industries, and private organisations own and manage islands and reefs for conservation and ecotourism. These examples illustrate the potential application of this approach to the "grass-root" advancement of a marine zoning.

Marine reserves designed to manage longlining and trawling on continental shelf-slope regions around albatross colonies, coupled with reductions of fishing effort through license buy-back programmes, could protect those critical habitats where breeding albatrosses concentrate to forage (Figure 1). Albatross conservation during other periods of their life cycle, when they disperse widely, would require the use of the diffuse management approaches described above (Figure 2). Thus, the utility of marine reserves for albatross conservation should be addressed on a case-by-case basis, bearing in mind the life-history of the species and the local oceanographic conditions in the study area (Table 1).

Different threats have characteristic “footprints”, which directly influence the ability of MPAs to mitigate their impacts. In fact, certain threats have such large-scale impacts, that MPAs are ineffective conservation measures. For instance, whereas the main line of a pelagic longline is up to 100 km long, oil may extend many hundreds of kilometres downstream from the site of a spill before it dissipates. Therefore, MPAs should include buffers designed to displace the “footprint” of potential threats away from critical albatross habitats. For instance, while the classic core and buffer MPA illustrated in figure 1 would exclude fisheries bycatch impacts, it would not protect the core albatross habitat from an oil spill. This inability of MPAs to mitigate large-scale anthropogenic impacts with basin-wide “footprints”, such as climate change and plastic pollution, emphasises the need for a comprehensive approach to albatross conservation over entire ocean basins.

Figure 1. Diagram illustrating Marine Protected Area designs for core albatross habitats (A) and the "footprint" of different potential threats (B). The conceptual match / mis-match between the protective "buffers" and the "footprints" allows managers to evaluate whether specific MPA design will offer albatrosses protection from a given threat.

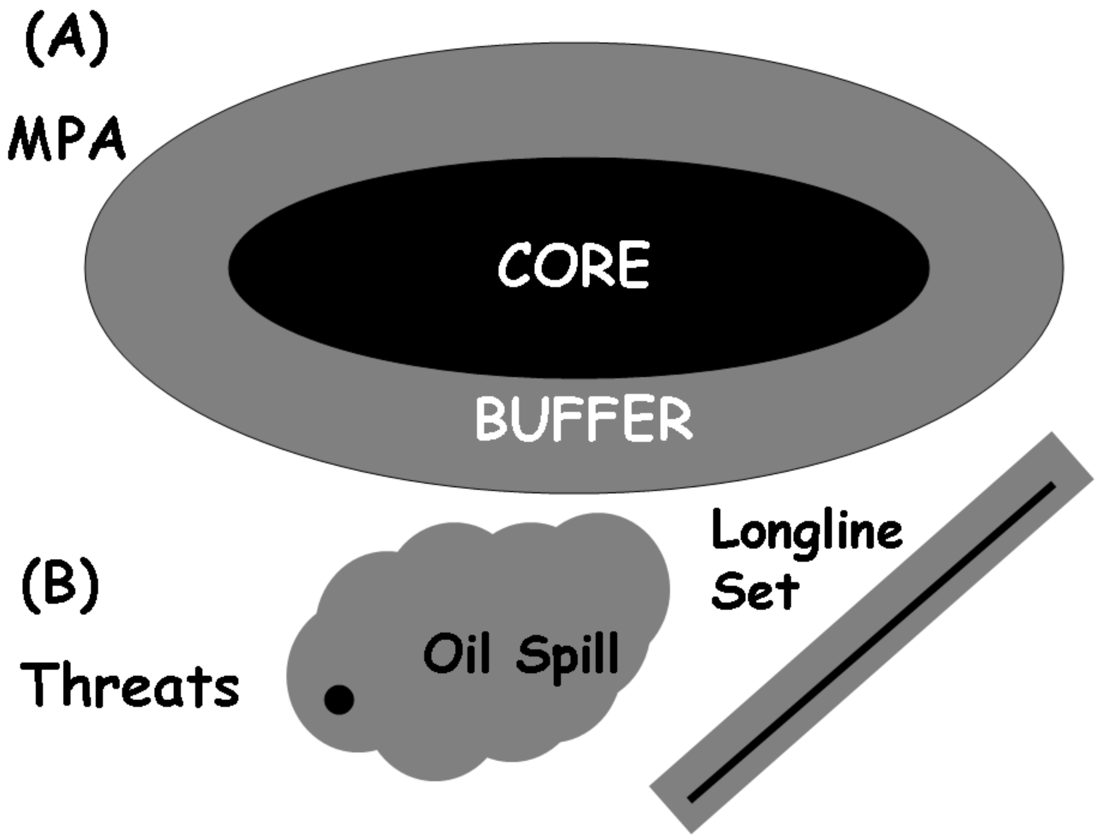

Figure 2. Post-breeding movements of 18 satellite-tracked Black-footed Albatross tagged in the Cordell Bank National Marine Sanctuary, within the U.S. West Coast Exclusive Economic Zone (E.E.Z.) in summer (July – August). Figure modified from Hyrenbach et al. 2006b.

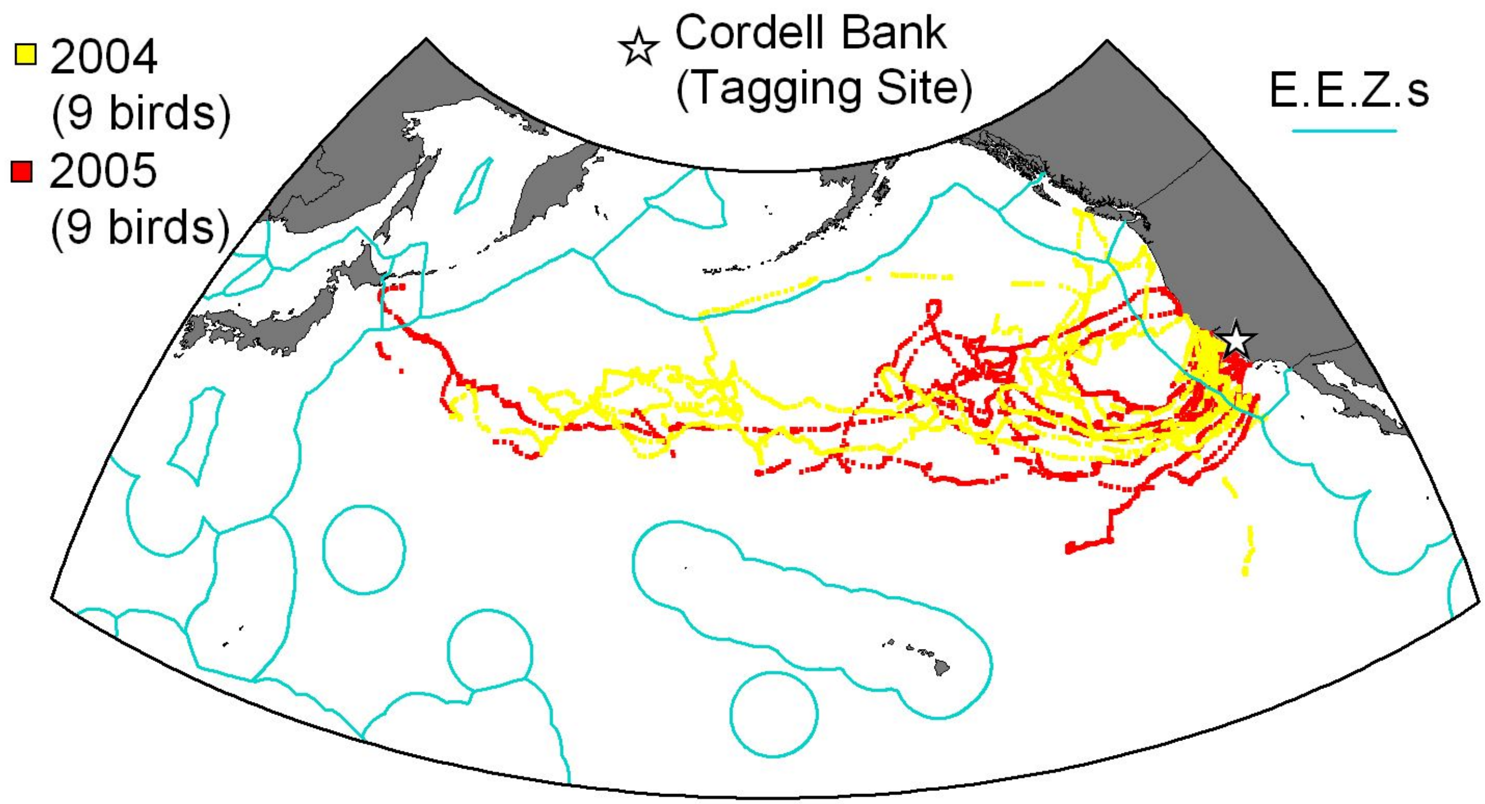

Figure courtesy of Oikonos and Duke University

Table 1. Studies of albatross use of Marine Protected Areas (MPAs).

Protected Area, Location	Albatross Species	Period of Life-cycle	Time in MPA (%)	Reference
Macquarie Island Marine Park (MIMP), Australia	Black-browed (*Thalassarche melanophrys*)	Incubation / Brooding	31	Terauds et al. 2006
	Grey-headed (*Thalassarche chrysostoma*)	Incubation / Brooding	15	
Galápagos Marine Reserve (GMR), Ecuador	Waved (*Phoebastria irrorata*)	Incubation	10	Anderson et al. 2003
		Brooding	68	
		Chick Rearing	15	
U.S. National Marine Sanctuaries (NMS), Central California, USA	Black-footed (*Phoebastria nigripes*)	Brooding	0	Hyrenbach et al. 2006a
		Chick Rearing	11	
		Post-breeding	19	Hyrenbach et al. 2006a

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