Conceptualizing A System of Marine Protected Area Networks for North America

Tundi Agardy, Sound Seas, 6620 Broad Street, Bethesda, MD USA, phone 301.229.9105, fax301.2294914, tundiagardy@earthlink.net

Tara Wilkinson, Commission for Environmental Cooperation, 393, rue St-Jacques Ouest, bureau 200, Montréal, Québec, Canada, phone 514.350.4309, fax 514.350.4314, twilkins@ccemtl.org

SUMMARY

Marine protected area networks are relatively new tools used to promote conservation at geographically large scales, by maintaining ecosystem integrity and at the same time safeguarding sustainable use of marine resources. In the North American context, the Commission for Environmental Cooperation (CEC) and its partners have spearheaded an initiative to explore how a network or system of networks could be used to conserve important marine habitat and species, using trilateral cooperation among Canada, Mexico, and the United States to maximize conservation impact. This paper describes one possible approach to developing such networks in North America—one that attempts to coordinate various possible goals through a framework consisting of complementary conservation areas, and tools to help protect these areas. Identification of conservation areas that could serve as nodes within marine protected area networks is proposed at four complementary scales: 1) marine ecoregions , 2) priority conservation areas within ecoregions, 3) ecologically critical areas that could serve as actual protected areas or zones within protected areas, and 4) key areas for migratory and transboundary species. The first three scales are hierarchical or nested, while the fourth scale transcends the other three and serves as a

kind of proxy for comprehensive transboundary marine conservation. Paralleling this building of networks based on existing and new marine protected areas is the development of human or institutional networks to make coordination and cooperation possible at the continental scale.

1. Introduction

The health of marine ecosystems in North American is in decline—a decline that has largely been "out of sight" for many people. However, with growing awareness of collapsing fish stocks, endangered marine species, outbreaks of disease, increase in degradation of areas, and other high visibility environmental issues, North Americans are beginning to demand greater efforts for marine and coastal conservation—and marine protected areas (MPA) have been recognized as useful conservation tools for combating many of these issues.

In recent years, all three countries in North America have taken significant steps in developing federal legislation to protect the marine environment, and have supported efforts at the international, state or provincial government, and community levels to work synergistically to protect and restore North America's marine environment. Part of this work has been to establish various types of MPAs—from strictly protected fisheries reserves or no-take areas to multiple use areas. However, even the best MPAs, on their own, have not been shown to adequately protect marine ecosystems and the ecological processes they support beyond the local scale. For this reason, North Americans need networks of MPAs that distribute conservation

attention and resources to key areas and that therefore work to conserve a greater whole.

Because ecosystems know no boundaries, Canada, Mexico, and the United States have cooperated with the support of the Commission for Environmental Cooperation (CEC) to explore the idea of developing a system of continental networks of MPAs. These networks can be conceived as both ecological networks of sites and institutional systems that link people and organizations for cooperation in conservation activities (1).

1.1 Creation of the North American MPA Network (NAMPAN): a collaborative effort

Recognizing the need for cooperation, the Commission for Environmental Cooperation (CEC) has moved to explore options for Canada, Mexico and the US in developing networks of MPAs that span these jurisdictions and make it possible for North American countries to coordinate their marine conservation activities. To implement these goals, the CEC convened and coordinates the North American MPA Network (NAMPAN). The *human* component of this network is a tri-national partnership of Americans, Canadians, and Mexicans comprising over 250 stakeholders from all levels of government, indigenous organizations, local communities, non-government organizations, the private sector, and academia. Their aim is to enhance and strengthen the conservation of marine biodiversity in critical marine habitats throughout North America by creating a functional system of *ecologically* based MPA networks that span political borders and depend on broad

cooperation. The network thus commits to "doing together what cannot be done alone."

Development of a system of North American Marine Protected Areas Networks will be no small endeavor. It will require major efforts by people, organizations, and governments. It will require creative ideas, volunteerism, cooperation, authority, money, information, and other assets of the three partnering countries. Yet, for those who depend on these resources for their livelihood, enjoyment, and intrinsic satisfaction, there is no doubt that the investment of time and energy is worthwhile.

1.2 The Status of North American Marine Ecosystems

The marine and coastal regions of the North American continent are unsurpassed in ecological richness and biological diversity. While the "hotspot" for species diversity rests squarely in the IndoPacific, a great wealth of coastal and marine life is within the mainland jurisdictions of Canada, Mexico, and the United States. From the tropical coral reefs of Mexico's Yucatan Peninsula and the Florida Keys, to some of the world's most productive estuaries such as Chesapeake Bay and the Upper Gulf of California, and on to the cold, teeming waters of the greater Gulf of Maine, the Grand Banks, the Georgia Basin-Puget Sound, the Bering Sea and Alaskan Shelf, the continent can claim virtually every type of marine habitat existing worldwide (2). Contained within these habitats is a profusion of marine species, some of which are recognized as highly valuable commodities for exploitation, others of which have non-extractive value.

It is thus paradoxical that we have not done more to conserve this great natural heritage—signs of ecological imbalance and biodiversity loss are everywhere. The

formerly rich, and for humans highly enriching, fish stocks of the Northeast US—Atlantic Canada have collapsed and their habitats have been degraded, changing the very nature of our communities along the shore. In the Bay of Fundy, Long Island Sound, Narragansett Bay, the Chesapeake, and throughout the inlets of coastal North Carolina, toxic blooms of algae disrupt the food chain and impact human health. Both the Mesoamerican Reef of Mexico and coral reefs in Florida are suffering from coral bleaching, emergent coral diseases, and algal overgrowth. Just inland, fixing the ecological damage we wrought to the great Everglades with canals, agricultural waste, and zealous urbanization is expected to cost over one hundred billion dollars. The Gulf of Mexico fares even worse, with an expanding "dead zone" of oxygen-deprived and lifeless water caused in part by river-borne pollutants. In California, rampant overfishing has depleted stocks of abalone and other organisms of the kelp forests, spelling potential doom for our beloved sea otter in the process. At the same time, the state's most valued symbol—its golden beaches—are periodically closed to swimming as bacterial levels exceed health standards. Along the Pacific coast of Canada and the US Northwest, several runs of salmon are endangered and coastal waters suffer from land-based sources of pollution exacerbated by massive logging operations. And in Alaska and the Canadian Arctic, global climate change, bioaccumulation of toxins like PCBs and DDT, and radical shifts of the food web in response to stock collapses and cutting edge fisheries technologies have caused dramatic declines in seabird, Steller sea lion, and otter populations. All this taking place in the world's wealthiest continent—among nations that pride themselves on commitment to the environment (3 Agardy, 1999).

Worse than the cataloguing of our failures in marine conservation is the fact that many would consider these ominous signs the droplets of water that presage the bursting of a dam. While we scramble to identify problems, assess the damages, and fix past mistakes, we seem stuck in the reactive mode (1).

However, with the increasing recognition of threats to the marine and coastal environment there has come a plethora of goals for and types of MPAs and policy frameworks, which, once coordinated into a coherent and coordinated system, can be better used for a big picture view and proactive stance. Roberts and others, for example, lists the following as possible goals MPAs can address in terms of conservation: "1) biodiversity conservation, 2) conservation of rare and restricted-range species, 3) maintenance of genetic diversity, 4) maintenance and or restoration of natural ecosystem functioning at local and regional scales, 5) conservation of areas vital for vulnerable life stage" and in terms of human uses (sustainable use): "1) managing fisheries (using reserves to sustain or enhance yields, restore or rebuild stocks of overexploited species, and provide insurance against management failures), 2) recreation, 3) education, 4) research, and 5) fulfilling aesthetic needs"(4). A big picture view for MPAs of the continent needs to go beyond the more or less ad hoc and opportunistic manner various agencies and institutions have been following for MPA identification and establishment. It needs to seize the increasing trend towards a systems approach to MPA planning. It also needs to see how MPAs fit and contribute to into the picture beyond their regional, sectoral and agency boundaries. An integrated, systematic and hierarchical approach to conservation and sustainable use via MPAs is needed to allow North American nations to address various

geographic scopes and scales of continental marine conservation problems simultaneously in a more holistic manner. Through such an integrated system, goals such as biodiversity conservation, conservation of rare and threatened species, maintenance of natural ecosystem functioning at a regional scale, conserving areas vital for vulnerable life stages, managing fisheries, recreation, education, research and aesthetic needs could all be addressed in a more coordinated and complementary fashion. Moreover, objectives, such as the conservation of areas representative of marine ecosystems, areas rich is species diversity, unique areas, and areas important for migratory species could all be addressed through such a holistic system. The integrated approach is a natural response to a complex set of ecological processes and environmental problems and is an efficient way to allocate scarce time and resources to combating critical issues. The remainder of this paper presents work in progress on the framework development of an integrated system of MPAs within North America. It outlines how the various stakeholders from the three countries can work together, drill down in a systematic and integrated manner, and address the various goals for conservation and sustainable use at different scales with the various MPA-related tools available.

2. A System of MPA Networks

Recognizing that all North American marine ecosystems, species, and coastal communities are inexorably linked, and that piecemeal efforts to protect the marine environment have been largely unsuccessful, there is an obvious need for a strategically developed system of marine protected area networks spanning the

critically important coastal waters of Canada, Mexico and the US.[i] The linkages in these systems of networks have a dual nature: they connect physical sites deemed ecologically critical (the system of *ecological* networks), and they link people and institutions in order to make effective conservation possible (the *human* networks)(1). Because marine protected areas and networks of areas can target a wide range of objectives and vary greatly in scope (4,5), we envision a system of networks that is essentially a hierarchy. At each level within this hierarchy, both humans and marine ecosystems are drawn into networks, making coordinated, effective, and efficient management possible.

Development of a system of North American Marine Protected Areas Networks—both in ecological and human/institutional aspects—will be no small endeavor. It will require major efforts by people, organizations, and governments (1). It will require creative ideas, volunteerism, cooperation, authority, money, information, and other assets of the three partnering countries. Yet, for those who depend on these resources for their livelihood, enjoyment, and intrinsic satisfaction, there is no doubt that the investment of time and energy is certainly worthwhile.

2.1 Systems Hierarchy

A hierarchical approach would allow North American nations to address various geographic scales and scopes of continental marine conservation problems simultaneously. The hierarchy is not an artificial construct, rather it is borne out of the fact that because marine conservation issues vary in scale, marine protected area goals must likewise vary. Thus the hierarchical approach is a natural response to a

complex set of problems, and is likely to be the most efficient way to allocate scarce time and resources to combating the issues.

2.1.1 Ecoregional Scale

At the very grandest scale—that being the continental scale—a system of marine protected areas might consist of networks of representative samples of marine biodiversity at the *ecological region* (or *ecoregional*) level. At this scale the system attempts to capture the differences in biodiversity values in the horizontal and vertical planes of the ocean, as well as the neritic realm, with assemblages of species being distinct in each ecoregion, I to III (6,7,8). Habitat representivity should be incorporated within this level of the system as well, with eventually at least one example of every marine and coastal habitat type within all the defined ecoregions of the continent represented. To decrease the probability of catastrophic events (both human and natural) wiping out entire protected systems, replication or redundancy should also be built into the system. In terms of identifying location for MPA development, areas that incorporate many habitats should be favoured. Here habitat heterogeneity serves as a proxy for species richness in the absence of detailed species data available (6,9).

Developing such a representative system would require a clear, consistent, and mutually acceptable system of classification of marine ecological regions and habitat types within them.[ii] At the same time, one would have to also know what elements were already being protected in various sorts of protected areas.[iii]

- At this top level of the hierarchy, the linkages between ecological regions exist because the sites share the same continent; linkages within ecological regions but between habitats exist to help maintain an intact functional ecosystem at the regional level (4). For examples of existing MPA tools for networks and systems at this scale, see table 1.

Table 1 (see *Table 1 MPA tools.doc*)

[SEE TABLE DOCUMENT]

2.1.2 Priority Conservation Areas Within Ecoregions

At the next level of organization, one or more MPA networks and related conservation tools could target ecologically critical areas within each ecological region (*Priority Conservation Areas*). These units of interest would be inherently larger than most MPAs and are essentially habitat complexes that are identified as ecologically critical due to the large number of services they provide—such as areas that are rich in benthic and/or pelagic features, areas of high beta diversity, sea life aggregations, areas of high biomass/highly productive areas. They could also encompass complexes that are particularly vulnerable and/or unique to the whole region—such as sites of deep sea corals or areas of continental endemism. These areas, rich in regionally significant species, features, and processes, would also be identified by the fact that they are threatened and vulnerable to disturbance or change from human induced or natural causes but still hold an opportunity for conservation. They would serve as nodes for conservation that benefit the greater region; they would also serve as flags to focus regional attention, as well as linkages for conservation between the regional and local levels (9). Conservation efforts within

these PCAs would include a variety of mechanisms including both regulations and voluntary incentives. For examples of existing tools that identify priority areas, see table 1.

2.1.3 Ecologically Critical Areas Within Priority Conservation Areas

Next in the hierarchical arrangement of a system of ecological networks would be identification of specific sites within critical ecosystem complexes/priority conservation areas. Such sites might serve as the actual basis of an MPA or reserve designation, and could be thought of as "vital organs" of the continental marine system—areas that are crucial to the functioning of the region on the whole, as well as areas that are unique to the region. Here the system would seek to protect areas that are critical to many species (such as spawning aggregation areas, breeding or feeding grounds) as well as areas that support the functioning of other habitats (such as coral reefs or kelp forests that help protect adjacent sandy beaches or rocky coasts from wave action, or estuaries that provide nutrients to more offshore sites and marshes that help to purify water from land-based sources). At this level, the system would also serve to protect areas or species that are unique to the entire region (such as Hecate Strait sea sponge reefs or the endangered vaquita of the Upper Gulf of California). For existing tools for MPA Networks and Systems at this scale, see table 1.

2.1.4 Critical Areas for Migratory and Transboundary Species

A parallel system could see the creation of networks of MPAs to conserve key species of concern for North America—species of rare, endangered, endemic species, particularly those that are transboundary, migratory or found in one country, but

affected by actions in another, such as *Marine Species of Common Conservation Concern (MSCCC)*(26). The CEC has already convened a multilateral Advisory Group to identify the first list of MSCCC; the sixteen species selected are listed in Table 2.

Table 2. Marine Species of Common Conservation Concern List

Common Name	**Scientific Name**
Leatherback	*Dermochelys coriacea*
Hawksbill Turtle	*Eretmochelys imbricata*
Kemp's Ridley Turtle	*Lepidochelys kempii*
East Pacific Green Turtle	*Chelonia mydas agassizii*
Loggerhead Turtle	*Caretta caretta*
Right Whale	*Eubalaena glacialis* and *E. japonica*
Gray Whale	*Eschrichtius robustus*
Humpback Whale	*Megaptera novaeangliae*
Killer Whale	*Orcinus orca*
Blue Whale	*Balaenoptera musculus*
Guadalupe Fur Seal	*Arctocephalus townsendi*
Sea Otter	*Enhydra lutris*
Vaquita	*Phocoena sinus*
Pink-footed Shearwater	*Puffinus creatopus*
Short-tailed Albatross	*Phoebastria albatrus*
Xantus' Murrelet	*Synthlibiramphus hypoleucus*

Here the system is attempting to conserve key species and the transbondary connections that are needed to support them. A system of MPA networks at this scale of organization would seek to protect the critical habitats of these species through linked protected areas designed to address the specific threats affecting theses species in each specific locale. While some scientists have questioned the utility of using single species as the conservation hook for planning strategies, umbrella species like those on the MSCCC list can be used to capture what is important from a target species point of view and from the overall ecosystem perspective. These critical elements (such as upwelling areas and other feeding zones, shallow water banks, and points of migration bottlenecks) must be maximally protected; whereas links between these areas can be protected by a “virtual

corridor" of targeted policy reform that would ensure that the connectivity is preserved and that these most vital parts are not degraded by direct and indirect impacts of human activity. At this level of organization, it is species and their movements that provide the linkages within the system. For existing tools for MPA Networks and Systems at this scale, see table 1.

2.2 Systems Integration and Coordination

Since some of the most important areas in the marine and coastal realm of the continent are already protected through various types of MPA designations, establishing such a system of networks may not entail the development of many new MPAs—rather it would require that MPAs be systematically linked to other areas, and assessed in terms of the degree of protection afforded as compared to the fragility, resilience, threats facing the vital area they are helping to conserve.

This system of networks of MPAs, both human and ecological, should be linked and evolve just as ecosystems evolve. A network will have many niches with some network activities growing stronger in some regions than in others. Some networks will be ephemeral, while others will be permanent. The dynamic nature of these hierarchical networks should guarantee that the countries of North America can be responsive yet proactive, and rigorous yet flexible in approaching marine conservation (27).

Finally, there are networks within these networks as well. For each site, effective protection requires coordination of efforts at the national, state or provincial, and local level, as well as a coming together of many different disciplines. Differences in ecology, as well as social and political systems, will determine what a MPA network

can accomplish in different regions. In certain urbanized coastal regions such as southern California, the Gulf of Mexico, the US east coast, and Puget Sound/Georgia Basin region, large multi-agency initiatives have taken the lead. In all regions, it is unthinkable to organize an MPA network without partnership or co-management with indigenous groups and local communities (1). The unique socio-political situation of each region will influence how marine ecosystems can be conserved, and how MPAs will be used in these efforts. The dynamic nature of these hierarchical networks should guarantee that the countries of North America can be responsive yet proactive, and rigorous yet flexible in approaching marine conservation.

This vision for a North American system of MPA networks is an ambitious one, yet one that is eminently feasible. What is needed to get there is not implementing endless new protected areas, but rather assessing what we already have, improving existing protected areas, filling the gaps where appropriate, and—most important of all—finding the connections that will make functioning networks a reality.

References

1. Agardy, T. and L. Wolfe. 2002. Institutional Options for Integrated Management of a North American Marine Protected Areas Network: a CEC Report. CEC, Montreal.

2. Hanson, A.J., T. Agardy, and R. Perez Gil Salcido. 2000. *Securing the Continent's Biological Wealth: Toward Effective Biodiversity Conservation in North America*. A working draft. CEC, Montreal.

3. Agardy, T. 1999. Creating havens for marine life. *Issues in Science and Technology Online* 16(1): 37-44 http://www.nap.edu/issues/16.1/agardy.htm

4. Roberts, C.M., G. Branch, R.H. Bustamante, J.C. Castilla, J. Dugan, B.S. Halpern, K.D. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, M. Ruckelshaus, R.R. Warner 2003. Application of Ecological Criteria in Selecting Marine Reserves and Developing Reserve Networks. *Ecological Applications 13(1) Supplement: S215-S228.*

5. Roberts, C.M., B. Halpern, S.R. Palumbi, and R. R. Warner. 2001. Designing marine reserve networks: Why small, isolated protected areas are not enough. *Conservation Biology In Practice* 2(3):12-19.

6. Roberts, C.M., S. Andelman, G. Branch, R.H. Bustamante, J.C. Castilla, J. Dugan, B.S. Halpern, K.D. Laferty, H. Leslie, J. Lubchenco, D. McArdle, H.P. Possingham, M. Ruckelshaus, R.R. Warner. 2003. Ecological Criteria for Evaluating Candidate Sites for Marine Reserves. *Ecological Applications* 13(1) Supplement: *S199-S214*

7. CEC. in review. *Marine Ecological Regions of North America.* CEC, Montreal.

8. Wilkinson, T., E. Wiken, C. Madden, T. Hourigan, J. Bezaury, M. Padilla, L. Janishevski, C. Valdes, H. Herrmann, F. Gutierrez. This edition. Mapping Marine Ecological Regions of North America: Laying the Foundation for Cooperative Ecosystem-based Conservation in North America. *Making Ecosystem-based Management Work, Proceedings of the Fifth International Conference on Science and Management of Protected Areas. May 11-16, 2003.* SAMPAA.

9. Morgan, L. P. Etnoyer, T. Wilkinson, H. Herrmann, F. Tsao. This issue. Identifying Priority Conservation Areas from Baja California to the Bering Sea. *Making Ecosystem-based Management Work, Proceedings of the Fifth International*

Conference on Science and Management of Protected Areas. May 11-16, 2003. SAMPAA.

10. http://www.parl.gc.ca/36/2/parlbus/chambus/house/bills/summaries/c8-e.htm

11. Ardron, J.A., J. Lash and D. Haggarty. 2002. *Modelling a Network of Marine Protected Areas for the Central Coast of British Columbia. Version 3.1*. Living Oceans Society, Sointula, BC, Canada.

12. http://www.dfo-mpo.gc.ca/canwaters-eauxcan/infocentre/publications/brochures/mpabrochure_e.asp)

13. http://www.cws-scf.ec.gc.ca/hww-fap/hww-fap.cfm?ID_species=87&lang=e

14. http://www.ine.gob.mx/lgeepa/art51.html

15. http://www.conabio.gob.mx/conocimiento/regionalizacion/doctos/marinas.html

16. http://www.ine.gob.mx/lgeepa/art48.html

17. http://www.ine.gob.mx/lgeepa/art54.html

18. http://www.nos.noaa.gov/topics/oceans/nms/welcome.html

19. US Federal Register. May 31, 2000. Presidential Documents, Executive Order 13158 of May 26, 2000. vol. 65, No. 105. US Government Printing Office, Washington, DC.

20. http://www.nos.noaa.gov/topics/coasts/reserves/welcome.html

21. http://www.worldwildlife.org/beringsea_erbc/main_book.pdf

22. http://galveston.ssp.nmfs.gov/efh/default.htm

23. http://galveston.ssp.nmfs.gov/efh/EFHprimer2.pdf

24. http://refuges.fws.gov/

25. http://policy.fws.gov/library/00fr33891.pdf

26. Wilkinson, T., T. Agardy, S. Perry, L. Rojas, D. Hyrenbach, K. Morgan, D. Fraser, L. Janishevski, H. Herrmann, H. De la Cueva. *this edition.* Marine Species of Common Conservation Concern: Protecting Species at Risk Across International Boundaries. *Making Ecosystem-based Management Work, Proceedings of the Fifth International Conference on Science and Management of Protected Areas. May 11-16, 2003.* SAMPAA.

27. Zacharias, M.A. and J.C. Roff. 2000. A hierarchical ecological approach to conserving marine biodiversity. Conservation Biology 14(5): 1327-1334.

[i] It may be germane to discussions of MPA networks to clearly define what we mean by "network" and "system". Though the two words are used interchangeably, herein we refer to networks of MPAs as grouping of protected areas that are physically linked, either through the movement of organisms and/or water/flow, or through common management institutions and personnel. System we use as a term to describe the conglomeration of networks under a strategically planned, and harmoniously operated, mutli-institutional framework.

[ii] The CEC and its partners are in the midst of defining a system of Marine Ecological Regions of North America, which identifies ecoregions in the pelagic, benthic and neritic realms (levels I-III).A more detailed habitat classification system would need to be developed at the next levels down. NOAA and Nature Serve are currently using the CEC North American system as a base upon which to define the following levels of habitat.

[iii] Such inventories do not yet exist for the continent. The 2000 Executive Order of the US recognized this shortcoming for the US and mandated that an inventory of MPA sites be immediately launched. Canada has embarked on a similar effort for its federal MPA sites. The CEC is building on these inventories, as well as those developed by the UNEP-WCMC and the North American Conservation Areas Database, to develop a North American inventory of MPAs.