Marine Ecoregional Planning Advice

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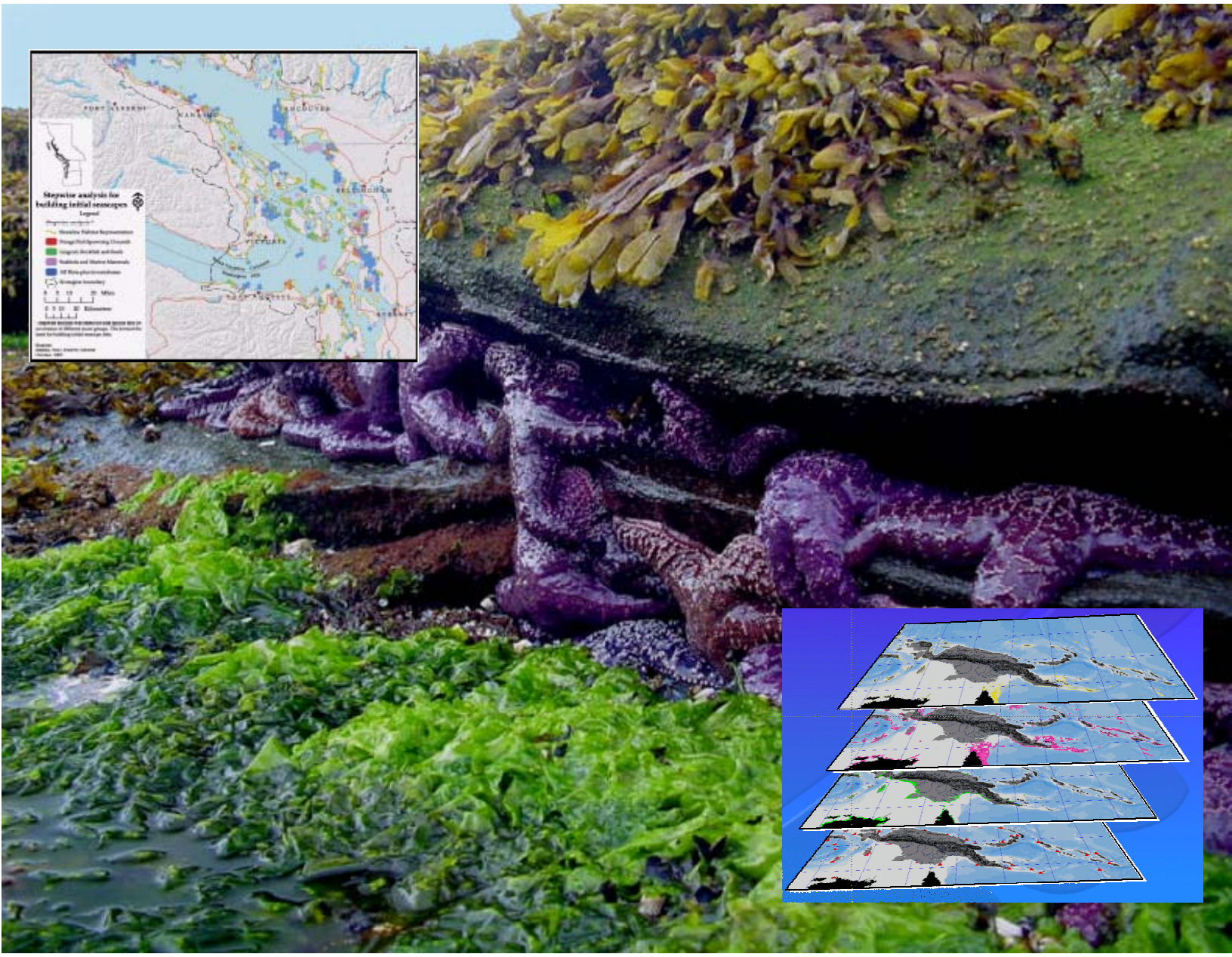


In this document, we summarize key advice in marine ecoregional planning. This document is intended to provide a resource to address the most frequently encountered problems and questions in marine ecoregional planning. This document is not meant to serve as a marine planning primer, i.e., to replace TNC's Geography of Hope and related literature as the primary planning guidance document. The advice suggested here is not meant as standards but we do expect that if followed the advice will help to improve the quality and consistency of our marine plans.

The advice is aimed first and foremost at marine planners and practitioners but we believe that it also can be useful to terrestrial and freshwater planners. This document is also relevant to senior managers, because it helps to answer questions commonly raised by them.

The advice comes from working with over a dozen different planning teams over the course of 5 years. Much of this information was coalesced most recently from a marine ecoregional planning workshop in Santa Cruz, California June 18 – 19, 2003. Planners and practitioners from 12 different plans across The Conservancy were represented at this meeting.

We envision this to be a living document to be updated regularly with our lessons learned. Please let us know of advice and issues from your experience.

Advice on Aims

- Be clear on aims at all times. These are not marine protected area (MPA) plans[1]—repeat early and often, because most partners and stakeholders assume that any marine plan is intended to identify MPAs and in particular marine preserves (sometimes called no-take areas)[2].
- The Conservancy identifies minimum areas for biodiversity representation & preservation. We identify important sites for the conservation of biodiversity. The identification of these priority sites makes no presumption about the best strategies for conservation at individual sites. We identify the present and likely future threats to marine diversity at these sites before identifying appropriate strategies for conservation.
- At over a hundred marine sites around the world, The Nature Conservancy has used a variety of strategies for marine conservation including habitat restoration of important nursery and spawning areas, removal of invasive species, coastal land acquisition, private acquisition of submerged lands, elimination of destructive practices, management of extractive marine resources activities, reduction of nutrient and pollutant inflow to estuaries and marine protected areas. No single strategy works everywhere, and at every specific site, multiple strategies are needed. The selection of appropriate strategies depends on biological, socioeconomic and political circumstances at each site.
- These are not plans for sustainable fisheries. Plans for sustainable fisheries will have different aims, targets, goals, and the sites selected will differ in size, shape, and number as compared to a plan for biodiversity representation and preservation (see targets section for advice on when to choose fished species as targets).
- While biodiversity conservation is the aim, after a plan is complete and sites are identified there are situations in which cooperation towards sustainable fisheries could be one of the strategies. Note however that most fisheries would go to economic extinction long before their ecological extinction becomes an issue.

[1] Throughout this document we refer to these priority setting exercises by TNC and others as "plans". Similar terms include regional plans, ecoregional plans, and ecoregional assessments. We make no assumptions about which term is best for you and generally assume that they can be used interchangeably throughout the document.

[2] The Conservancy is developing a draft policy on MPAs; this should be available soon.

Advice on Ecoregional Standards

- Most of the standards should not be viewed as onerous. The standards largely say identify targets, goals, viability/cost factors, and sites as systematically as possible with the best available data.
- The real mechanism for evaluation of plans and their adherence to standards is in the peer review. The better portion of these peers should for every region know the constraints in information availability and judge the credibility of our efforts accordingly. We cannot ask more than to do the best job that we can with reasonably available information.
- The information from prior planning efforts should be included as much as possible.
- When are partner plans most useful? To be useful, all planning efforts (by The Conservancy or others) must have clear targets and quantitative data (at least presence/absence data) collected on targets. Without this minimum information, these efforts provide little basis for any future efforts.

Advice on Targets

- We spend too long on this stage of planning (probably because it is the first stage and we delve in to it too deeply).
- Identify targets quickly, focus on ecosystems; use fewer species.
- Generally include species if they are imperiled or keystone (for keystone species use the definition from Power et al. 1995—"keystone species have a disproportionate affect on ecosystems relative to their abundance".[3]).
- Early in the development of target lists we need to consider what data is available. We need to weigh developing exhaustive target lists with the recognition that the available data are sometimes quite limited.
- Lumping & Splitting-- When developing target lists it can be useful to identify many different categories (or communities) within ecosystems (e.g., high & low salt marsh)—i.e., splitting. We caution however that for many reasons (data availability chief among them) these categories will often have to be lumped (e.g., salt marsh). Having many (sub)categories at the beginning of target list development is ok, but don't spend too long splitting if the reality is that they will have to be lumped.
- Our targets are supposed to cover the full range of biodiversity (e.g., mangroves, seagrasses as coarse filter targets and imperiled/keystone species as fine filter targets). However it is entirely reasonable to weigh targets for which we have greatest reliability in the data. For some targets we are likely not to have good distributional data but will rely on more available biogeophysical data (see below).
- Some coarse filter Terminology: We make suggestions below although we are not hung up about terms.
  1. We suggest that most of our coarse filter types should be referred to as <u>ecosystems</u> (e.g., mangrove forest, seagrass meadows) instead of habitats or communities. Ecosystems encompass communities and their surrounding environments.
  2. Large sites with many different kinds of ecosystems are <u>seascapes</u> (to keep this generally consistent with the definition of "landscapes").
  3. The identification of surrogate coarse filter targets using biogeophysical data should be referred to as the development of <u>habitat models</u> and the units identified should be referred to as <u>habitat types</u> (not say Ecological Marine Units).[4]

<u>Coarse filter—(i) nearshore ecosystems</u>

It will help if we try to standardize our coarse filter targets. Lists and examples of targets (e.g., seagrass meadows, coral reefs, and kelp forests)

[3] This paper is on Marine Resources CD and Marine Ecoregional Resources Handbook from the Marine Initiative.

[4] For internal consistency sake, we would prefer to refer to these as <u>ecosystem models</u> and <u>ecosystem types</u> but most partners call these habitat models and habitat types

Table 1: Recommendations for Fine Filter Selection

(1) Develop a Secondary Target List first and put all potential fine filter targets on this list.
(2) Elevate fine filter targets to the Primary Target List when these will not be covered by representing the ecosystems in which they occur. i.e., species is imperiled or keystone, or otherwise has a major impact on the structure and function of communities.
(3) Be critical. Every fine filter target weights the plan towards a few species and away from most biodiversity. Each new target means more work in data collection, analysis, write-up & implementation.
(4) Do Not Add Species Targets just because they are Overfished. This is a biodiversity not a fisheries sustainability plan. Add a fished species if it is ecologically imperiled (this is rare) or its reduction in numbers critically degrades ecosystems.
(5) If you add a species because you think its loss alters community structure and function, be prepared with a clear argument/hypothesis of these likely effects. Hard evidence is not required, but it demands a defensible rationale beyond 'some fish feed on it and it feeds on other fish so its reduction must have food web repercussions' --these trophic interactions are notoriously difficult to document in marine systems .
(6) Targets that do not meet the above criteria may remain on (or be dropped from) Secondary Targets list. Site selection models/ workshops are initially 'run' on the primary targets only. After draft sites are selected based on primary targets, we then ask if the sites sufficiently cover the Secondary Targets. If not, then the sites may require some revision.

are available in the resources handbook. It will sometimes be necessary to make subdivisions in these broad categories when it is clear that there is strong community level differentiation.
- Shoreline classifications based on sediments and exposure (e.g., exposed rocky intertidal) have been developed by many entities often as Ecological Sensitivity Indices that identify shorelines at risk e.g., of oil spills.

Coarse filter—(ii) Habitat models for areas where nearshore classifications are not possible.

- In areas where ecosystem data is not available, we must develop habitat or ecosystem models based on combinations of biogeophysical data[5].
- The two most important and reasonably available datasets for habitat models are bathymetry and substrate type.
- Bathymetry data provide information on depth as well as /rugosity and/or slope.
- There is a tendency to identify too many habitat types by splitting the individual data in to too many classes. (e.g., 4 depth classes * 5 sediment type classes * 4 slope classes = 100 possible habitat types). You should consider if there are really likely to be this many (e.g., 100) different habitat types.

Fine Filter targets

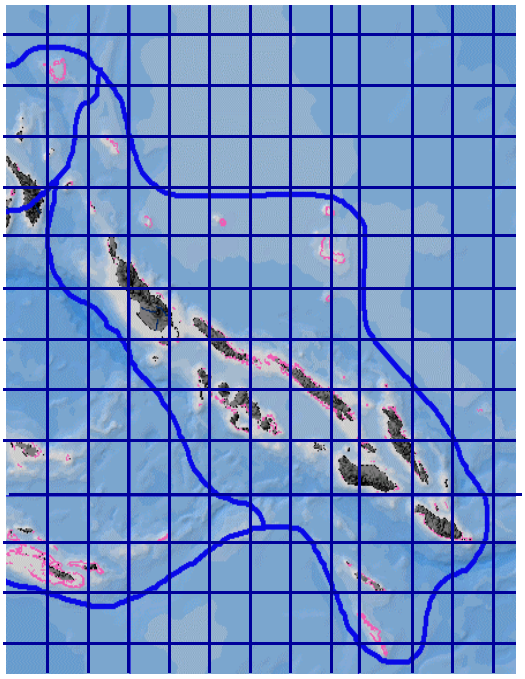
- Aggregations of species, convergences of water bodies, upwellings, areas of high productivity, and seamounts are useful fine filter targets.
- For wide ranging species -- distributional information on critical life history stages should take precedence over observation data for analysis and site selection. General 'sitings" of species (e.g., whales) are rarely useful in identifying the most important places for these species. Areas that are known to be critical foraging, nursery, haulout, breeding, or spawning grounds are usually much better as ecological targets. In many cases we may actually consider these aggregation sites as the targets for these particular species.
- We suggest a general mechanism for developing fine filter target lists to avoid having too many targets for the wrong reasons (see Table 1). (reminder: The fine filter list is only for species/types that can't get represented by coarse filter {ecosystem}

[5] Several examples of these habitat models are provided in Marine Ecoregional Resources Handbook and on the Marine Resources CD.

targets. We represent each ecosystem in the priority areas to ultimately represent the diversity that occurs within each ecosystem).

Advice on Data Collection

- Look for data that covers at least most of a subregion(s). It is tedious and often unproductive to spend time collecting very disparate small-scale data sets. Most of the time it is not possible to use these small-scale data sets in ecoregional analyses.
- An evaluation of data sets should be undertaken to decide whether they meet the requirements of regional analysis. Criteria may include how recently the habitat or species was surveyed and assembled into spatial format, its resolution or scale, and whether the data is empirical or modeled.
- Whenever possible - get historical data.
- When spatial data are not available and expert input is required then collect this information so that it can be quantitatively stored and analyzed. We suggest sending gridded maps to experts (grids at different scales may be required) and asking them to identify existence of targets (e.g., seagrass beds) just by simple noting presence (/absence) of the ecosystem within grids (e.g., see below). These presence/absence data can be analyzed in Sites, Marxan and other programs.



- British Admiralty Charts and other nautical charts often contain information that can be used to identify the locations of ecosystems (e.g., reefs, rocks, kelps).
- Data collection and analysis should focus on coarse filter ecosystems and primary fine filter targets.
- The main factors in constructing a coastal classification (and therefore coarse filter shoreline targets) should be bathymetry and substrate. It is possible to augment the substrate data with exposure by using a fetch model or other tools that calculate exposure classes.
- Data collection is often an important partner building exercise.
- Check out internet applications such are OBIS – SEAMAP (Ocean Biogeographic Information System - Spatial Ecological Analysis of Megavertebrate Animal Populations, http://obismap.env.duke.edu/) that contain centralized databases and links to taxonomic search engines.

Advice on Marine Ecoregional Boundaries and Stratification[6]

- How far offshore do we go? Extent of coastal plans should be to continental shelf/slope or boundary currents (e.g., Gulf Stream, California Current, Humboldt Current). Within these areas there are strong connections between inshore and offshore populations and processes. Beyond these areas there is a substantial division into the 'deep blue sea'.
- We divide the marine environment into subunits -- ecoregions and subregions (stratifications) to be sure all diversity is represented across the plans.
- With stratification we are primarily trying to

  (1) Represent unknown biodiversity (e.g., possible genetic variation in species or community level variation in ecosystems) and
  (2) Distribute sites to spread risk (i.e., avoid having local catastrophes affect

[6] In the Resources handbook and on the CD, we have included some of the latest efforts on the development of ecoregional boundaries.

for example all representation of a particular target).

- Stratification also can help create manageable units for data analysis.
- Stratification can be based on
  1. Ecological criteria—e.g., depth, major currents, and salinity (e.g., estuarine/marine).
  2. Data quality and consistency. Where there are substantial differences in data quantity and quality (e.g., between states or countries), it is reasonable to stratify by these political boundaries or project regions (e.g. the same type of data collected using different methods from project to project) to be able to use as much data as possible throughout the entire planning region and at the same time reduce biases in the analysis.
- It can be useful to run analyses with and without stratification to understand how this affects site selection.
- Boundaries are less distinct in marine than terrestrial systems.
- Few marine scientists are passionate about particular boundaries because of the recognition that they can be quite variable and we have less information to identify them in marine than terrestrial systems. Even in the US where we have sometimes followed terrestrial boundaries even when good marine boundaries existed-- we have not gotten any grief from NOAA, EPA or marine researchers.
- Be reasonably rigorous in identifying boundaries but don't let this slow plans.
- Note that a particular set of boundaries becomes less important when we intend to eventually plan throughout the adjacent regions and connect the plans.

Advice on Viability, Costs, and Threats

- True viability will be difficult to assess.
- If Population Viability Analyses exist-- use them.
- Use cost factors in site selection programs (e.g., Sites or Marxan) as a screen for likely viability (this will meet standards).
- It can be helpful to examine results of analyses with/without costs to understand how these change results.
- The inclusion of cost factors in models is also a form of threats analysis, but this is a very limited threat analysis. Comprehensive multi-site threat analyses should be done after the final site selection.
- Do we consider existing "protected areas" in site selection? It can be useful to run models with and without existing protected areas to evaluate how well existing areas help meet biodiversity conservation goals. We have often found however that given high variability in the aims for establishing protected areas and the actual protection present that "locking in" protected sites in to final plans is not a recommended option.

Advice on Goals

- There is as yet no universal agreement on goals.[7]
- To the extent that we can best scientifically defend present goals we suggest (with some trepidation) that goals should be set around 20% of historical distributions of coarse filter targets (e.g., ecosystems), because we know from species areas curves that this is the point at which we see a steep increase in species lost. This goal is then increased for two reasons:
  1. It is defensible to raise goals based on presumed losses of targets. Even if we don't have absolute quantitative information on the area lost we can nonetheless factor loss estimates into the goals (e.g., if we think we have lost 50% of the distribution of an ecosystem then the goal should be to conserve 40% of the present distribution).
  2. Goals can be increased based on limitations in distribution data. If we suspect that there is good data on only 50% of the present distribution of a target then goals could be.
- Goals for fine filter targets and rare coarse filter targets need to be set individually;

[7] There are an increasing number of scientific papers; many of these are represented in the Resources Handbook and on the Marine Resources CD.

there is no consistent advice that can be given (except to consult with adjacent ecoregions and attempt to make these consistent).

- Remember in marine goal setting that the areas around many sites will still partly support some species and ecosystems (much more so in marine than terrestrial environments).
- It can be useful to run analyses with multiple goal levels for two reasons[8].
  1. Irreplaceability analyses—when programs like Sites and Marxan are run at high goals levels (i.e., higher than the ecological goals) it forces the programs to consider greater combinations of sites. Irreplaceability analyses are very informative at these high goals levels because they indicate which sites were consistently chosen. Planning units that get chosen the most often are the most "irreplaceable".
  2. Sensitivity analyses— Sometimes the area required to meet goals changes very little as we increase the goals; sometimes it increases drastically. It helps to know the shape of this curve.
- When multiple analyses are run, we should clearly document some of the main results.
- We should not set "poker" goals. We do not set higher goals on the assumption that these higher goals can be used as a bargaining chip in say political discussions. We set goals as ecologically reasonable as possible.
- Support research on goals. In the Galapagos, goals for sea cucumber harvest were initially set in joint conference between managers, conservationists and fisheries. Research was then done and it turned out that the goals needed to be higher (and harvest less) and the results were widely accepted across the groups.
- It may be necessary to increase goals when accounting for the likelihood of catastrophic impacts such as hurricanes and oils spills[9]. Increasing goals provide "insurance factors" that affect the size and distribution of individual sites.
- Part of the reason for not setting goals unrealistically high is that it would be useful for implementation to actually have overall goals that many partners and stakeholders could conceive of as attainable.
- When we are using surrogate targets—e.g., in our biogeophysical habitat models—we should be very cautious about setting goals too high, because we have less confidence that these habitat types actually represent the distributions of the real ecosystems.

Advice on Site Selection

- We strongly recommend using a site selection program (e.g., SITES or Marxan or SPOT) .
- There is no set planning unit size; it depends largely on the resolution of the data and the size of sites that will ultimately be ecologically meaningful in a given region. Smaller (and more) units are better when the data resolution will allow them. Hexagons are often useful because they have a consistent size and edge (boundary). Also consider the size of sites that are likely to be ecologically reasonable and ensure that at least several planning units fit inside these areas (e.g., we may not want a single planing unit to cover an entire estuary).
- Start with a simple modeling scenario and get more complex as far as the input parameters.
- Change results when credible ecological reasons can be recorded. The output of these site-selection programs provide a 'strawman' set of sites that must have expert review. We can change either the way analyses are run or make direct changes to the sites that are selected based on the review. If we manually change sites based on the review, we need to get a clear defense

[8] Both reasons are explained more fully in Beck, M. 2003. The sea around: marine regional planning. In Groves, C. R. Drafting a conservation blueprint: a practitioners' guide to planning for biodiversity. Island Press.

[9] See Allison, G. W., S. D. Gaines, J. Lubchenco, and H. P. Possingham. 2003. Taking the long view of marine reserves: catastrophes and an insurance factor. Ecological Applications 13: S8-S24. Paper is available on Marine Resources CD.

for these changes and this must recorded in the plan write-up to ensure defensibility.
- Look for low hanging fruit; i.e., sites where threats and the cost of conservation are lower. We have a tendency in the conservation community to pick the battle scenes.
- Site delineation at the ecoregional scale does not have to be highly detailed. We expect site boundaries to be considered and modified at the next stage of in depth planning (Conservation Area planning).
- Plans should be based more on the reliable data. It may be best to run analyses on the data in which we have the most confidence; for example the data on nearshore targets may be better and more reliable than offshore targets.
- The model outputs should be peer reviewed and adapted.

Advice on Integration
- Integrate with adjacent marine ecoregional plans by ensuring as much similarity and consistency in targets and goals as possible (this will also increase the implementation potential of the plans).
- Integrate with terrestrial and freshwater plans for ecological (connectivity) and economic (better to have one connected site than two sites in adjacent jurisdictions) reasons.
- Some targets such as anadromous species can assist in integration.
- Cost factors in particular can assist in integration – for example sewage outfalls and urban streams can be indicative of poor coastal water quality from upland sources. The % of impervious surfaces in coastal watersheds can also be indicative of poor water quality in coastal waters.
- It is not effective to simply lay a grid-based information system across all the terrestrial, freshwater, and marine environments of a region and run Sites or Marxan on all the data at once. The data are often quite different in structure and form in the three different environments. In addition, the areas selected will be overwhelmingly biased towards places on the coastline because these areas included targets from all three environments.
- We suggest running models on one environment (e.g., marine) and then "seeding" the selected coastal sites in to terrestrial runs (or vice versa). Seeding causes site selection algorithms to evaluate these seeded coastal sites first and biases the output towards integration without requiring that the same coastal sites are accepted in both terrestrial and marine results. Here again we suggest running models with and without seeding.
- The use of taking output from site selection algorithms and exporting them to more ecological "reporting out units" is becoming more widely accepted. An example in the terrestrial environment is to take the output of a hexagon analysis and report out the density of chosen hexes to a particular watershed class (e.g. HUC 6 or 7). An example in the nearshore is to take the output of a coastal analysis (e.g. shoreline units) and report them out to estuaries. This gives a density gradient of the amount of shoreline chosen within an estuary. Reporting out to ecological units from more abstract ones is a form of integration (e.g. matching selected watersheds and their adjacent estuaries).

Advice on Connectivity and Resilience

<u>Connectivity</u>
- Current research across many species points to bimodal distribution in dispersal at least on US west coast[10]. Short distance dispersers often go <1 km; and medium distance dispersers go most commonly around 20km. This research suggests that individual sites should be at least 1 km wide in size, and sites should generally not be more than 20km apart.

[10] see Kinlan and Gaines 2003. A copy is on the Marine Resources CD. Kinlan, B. P. and S. D. Gaines. 2003. Propagule dispersal in marine and terrestrial environments: a community perspective. Ecology 84(8):2007-2020.

- Different targets will have different scales of connectivity (e.g. tunas vs. gobies)—so there is rarely a single best configuration
- Connectivity should be considered after initial site selection runs by asking if any sites are too far apart and there needs to be a potential "stepping stone" site in between.
- Focus first on the best sites that contain the best examples of the targets—we don't want to have sites that are "appropriately spaced" but "poorly placed".
- Oceanographic currents are often poor predictors for dispersal; many species are affected most by local (nearshore) currents and these are highly variable and not well mapped or studied.
- Document connectivity considerations if you use them to alter selected sites.

<u>Resilience</u>

- Factor resilience into site selection
- Be aware that there is often a balance between selecting sites that are representative vs resilient. The more we focus on sites that are likely to be resilient or resistant to future catastrophes, the more difficult it is to be efficient in the representation of current diversity.
- The greater the likely near term impacts of threats (e.g., extensive coral bleaching in the near term) the more important it becomes to place weight on resiliency relative to representation.
- Consider what environments may look like under major oceanographic "regime shifts" (e.g., El Nino/La Nina).

Advice on Implementation

- Joint data collection and analysis is useful for partner-builder.
- Envision implementation early in the assessment process and engage the key players.
- Think of the key players as clients and consider their needs as well as your own.
- Be alert to new relationships that begin with the assessment process but may mature into implementation partnerships.
- Involve partners early—use ERP as a strategy.
- Plan to publish (now part of TNC standard).
- Make data available (within constraints).
- Bring on your 'lead implementer' before completion of plan.

Advice on Collaborative Tools for Planning

- ArcIMS and other internet map servers can help planning teams look interactively at data and portfolios.
- Consider using web software to document the planning process. For example open-Wiki Tiki software allows for interactive web-based establishment of targets lists, data inputs, draft maps. This software can capture screen shots (e.g., of a map of targets or sites) that can be automatically captured and sent in an email to team members and reviewers for analysis and comment. Data providers can also track where and how their data is being used.