Summary

The aim of this case study was to examine approaches and methods for linking biodiversity conservation and fishery production objectives within one spatial planning framework. This was conducted in the U.S. portion of the Pacific Northwest Coast ecoregion. By combining information on species, habitats, ecosystems and threats to the marine environment with marine fish targets and fishing effort, it has been illustrated that biodiversity and fishery objectives can be quantitatively and jointly accounted for within a single decision support system.

Changes in the identification of priority conservation areas were significant when fishery data is included in site selection analyses (case 1). These site selection scenarios (with and without the inclusion of fishery data) were then input into a fisheries-based ecosystem modeling approach (case 2). Results from case 2 illustrated how abundant (amount of biomass) a fish species was both inside and outside of various-sized priority conservation areas. Both of these cases have led to several implications for both biodiversity and fishery objectives.

Cape Flattery, Washington. Photo © Susan Bernstein

Implications

Case 1

The inclusion of fish targets and fishing effort with biodiversity data had two major effects on site selection. First, the inclusion of fish targets increased the likelihood that areas with higher fish diversity overall would be included in sets of priority areas. Second, the inclusion of information on fishing effort as a human use factor in the suitability index steered the selection of priority areas away from important fishing areas. This joint consideration of fishery and biodiversity information should help reduce conflict by avoiding areas with the highest human use where the fish and other species are also likely to be in overall lower condition. This represents a preferable scenario where joint goals can be met at the lowest cost and conflict.

In this case there was a significant shift in the placement of priority areas in the Olympic Coast National Marine Sanctuary (OCNMS) just south of Cape Flattery. With the inclusion of marine fish and fishing effort data the Sanctuary was highlighted relative to when these factors were not included. The Olympic peninsula contains high levels of biodiversity in both terrestrial and marine environments, and the Sanctuary itself contains relatively high amounts of marine fish diversity; it is also a place where fishing effort is lower than other areas in the ecoregion. This result reinforces the importance of continued sound management within OCNMS.

Case 2

This case illustrated that Ecospace and Marxan tools can be linked to inform decision making across biodiversity conservation and fishery production objectives. It is extremely important for planners and managers to understand how the selection of priority conservation areas may affect total fishery production inside and outside of these areas.

The linkages illustrated here are just a base, and there are further implications that can be explored. It is highly likely that the placement of priority areas, not just the total area, has strong effects on total biomass just as they do on the likelihood of conservation. By importing Marxan solutions that have been informed by biodiversity conservation, marine fish and fishing effort data, there is an implied spatial efficiency in representing marine ecosystems within the fisheries-based, Ecospace model. This work needs to be further tested, but has laid the groundwork for future effort in advancing joint objectives.

The case illustrated that there was more biomass inside priority conservation areas than outside for Dover Sole and Lingcod. This is perhaps a verification of the literature stating the benefits of no-take reserves for marine fish production. But why did biomass for English Sole decline above 25{2a5d6d1706341671d74cd9e261e7084f344be5d0ac8e3cb469aaa53c623578a6} total conservation area in the Cape Blanco subregion? Perhaps the amount of preferred habitat for English Sole was reached around 25{2a5d6d1706341671d74cd9e261e7084f344be5d0ac8e3cb469aaa53c623578a6}, after which the production dropped because larger areas were not able to capture more preferred and/or higher quality habitat. This could also imply that fishing effort outside that 25{2a5d6d1706341671d74cd9e261e7084f344be5d0ac8e3cb469aaa53c623578a6} area had degraded their preferred habitat. To advance this case more work needs to be done to examine the spatial relationships between marine fish distributions and their habitat preferences.

Next Steps

Ecosystem-based management calls for an integrated approach to management that considers the entire ecosystem, including humans. By understanding the complex ecological relationships within which exploited fishes exist, researchers can better anticipate the effects of the ecosystem on fishery production and the effects of fishing on the ecosystem. This case study provides an

approach to decision support that advances ecosystem management by accounting for multiple objectives through a credible, transparent, and efficient process.

There are many opportunities to enhance this case study by:

1. refining methods for processing fishery-independent and dependent information
2. associating spatially-explicit marine fish distributions with habitat types
3. improving the functionality and exchange of spatial information from site selection to fisheries-based ecosystem modeling tools
4. interpreting the results of site selection and ecosystem modeling that lead towards better biodiversity and fishery management

This approach can ultimately assist in the design configurations (arrangement and size) of managed areas needed to consider the assemblage of life stage requirements between and among individual target species, and the ecosystem in total across biodiversity and fishery objectives. This work can also lead to important precedents for regional zoning, suggesting that strategic, large scale planning does hold promise for more effective marine conservation.