Using InVEST for Marine Spatial Planning

Marine InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) is a tool being developed by the Natural Capital Project – a partnership of Stanford University, The Nature Conservancy (TNC) and World Wildlife Fund (WWF). It is being tested in a pilot site on the West Coast of Vancouver Island and is due for release in 2010. Marine InVEST models the ecosystem services of food from fisheries and aquaculture, recreation, coastal protection and energy from waves. It can be a useful tool for implementing an ecosystem-based management approach to marine spatial planning. This document provides guidance on how the current 'Tier 1' version of Marine InVEST can be used at each typical step of a marine spatial planning process.

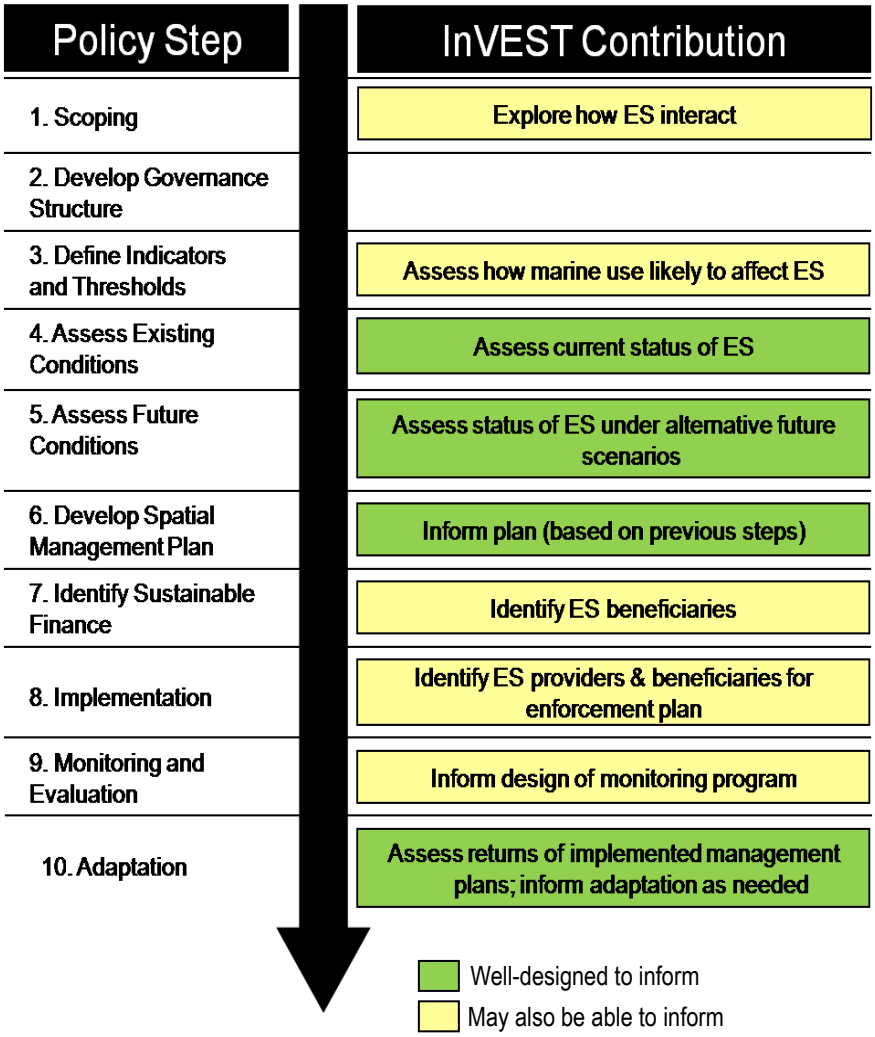
Marine spatial planning is a process for analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives (UNESCO, 2009). An ecosystem-based management (EBM) approach to marine spatial planning should balance the interests of diverse stakeholder groups, consider the status of both target and non-target species, incorporate networks of marine protected areas to protect habitats and their associated biota, and adopt an overarching system of marine spatial planning to coordinate regulation of human activities in particular areas at particular times (Ruckelshaus et. al., 2008).

InVEST and Marine Spatial Planning

In the past, marine management practices have often been ineffective because they optimize for a single target species and disregard habitat, non-target species, and how people interact with the environment. EBM attempts to address these weaknesses by considering multiple spatial and temporal scales, linking ecosystems and communities, connecting management efforts across air, land and sea boundaries, and engaging meaningfully with stakeholders (Leslie & McLeod, 2007). InVEST can inform an ecosystem-based approach to marine spatial planning processes by examining likely changes in a suite of ecosystem services provided by marine and coastal regions under different management alternatives.

Given the wide range of forms that marine spatial planning can take, the contributions Marine InVEST can make to the project will vary. Nevertheless, it is better suited to certain steps of marine spatial planning than others. Here, we provide initial guidance on how InVEST can be used at each typical step (Fig. 1). The aim is to give new users realistic expectations about when Marine InVEST is – and is not – likely to be appropriate and helpful.

Figure 1. InVEST Contributions to Marine Spatial Planning



Further Details on InVEST Contributions to Marine Spatial Planning

Step 1: Scoping objectives

In this initial step, goals are identified for the marine spatial plan, such as protection of species, habitats and ecosystem services, and improvements to human well-being. Ideally, goals and specific objectives are determined through a policy-directed process with stakeholder input. Scientifically, this step can be supported by a variety of analytical information from ecosystem simulation models, statistical analyses and conceptual models. These analyses help determine the most critical components to consider for ecosystem management. Marine InVEST can be used at this step to develop a plausible, effective set of objectives that account for interactions within the ecosystem. For example, an InVEST analysis of how marine management is likely to affect both coastal protection and fisheries could help define objectives for efficient service delivery that considers the effects of nearshore habitats on both services.

Step 2: Develop governance structure

For marine spatial planning to succeed, an implementing authority must be designated and a strong governing body established. This is largely a political and administrative process, although InVEST outputs can inform the governing body about various issues involved in marine spatial planning.

Step 3: Define indicators and thresholds

Indicators are selected to monitor the achievement of objectives and evaluate performance. Acceptable thresholds are determined, setting targets for each indicator. These indicators and thresholds are determined by stakeholders, but information from Marine InVEST can help identify them. For example, an InVEST analysis of how change in marine use is likely to affect fisheries could help set a target for efficient delivery of that service.

Step 4: Define and analyze existing conditions

This step involves mapping important biological and ecological areas, oceanographic and other physical features, and current human uses of the system. Marine InVEST can assess the levels and types of marine ecosystem services provided in specific locations, including food from fisheries and aquaculture, coastal protection, recreation and energy from waves. This provides an initial understanding of the current uses of marine ecosystems and their impacts on ecosystem services. It also helps identify possible conflicts and compatibilities among existing uses and environmental health.

Step 5: Define and analyze future conditions

This step involves developing alternative future marine use plans and assessing the potential impacts on biodiversity and ecosystem services. Alternative scenarios are generated that depict possible futures for the area, often based on alternative plans or zoning arrangements and potential influences of climate change. These scenarios are then analyzed to determine the ecosystem service tradeoffs incurred. These scenarios can reflect real alternatives being considered in policy and management contexts. They can also be heuristic scenarios used for illustrative purposes. InVEST does not generate these scenarios. But, when provided with spatially explicit scenarios, Marine InVEST can assess and compare the resulting supply and delivery of ecosystem services throughout the area.

Step 6: Select, prepare and approve the spatial management plan

This step involves assessing the effectiveness and impacts of possible management measures, such as marine protected areas, fishing gear regulations, and multi-use marine zones. Selection and approval of the preferred plan is based on an evaluation of how management measures and spatial plan alternatives meet objectives. Marine InVEST can assist in choosing an effective management plan by assessing how ecosystem services are likely to be affected by alternative plans or zoning arrangements, and clarifying the trade-offs incurred.

Step 7: Identify sustainable finance

Marine management requires a source of sustainable finance. Marine InVEST can assess where ecosystem services are delivered, which can help determine the location of stakeholders who benefit and therefore might have an interest in financing elements of marine management. Financing could come through a range of instruments, such as payments for ecosystem services, user fees or taxes and subsidies. InVEST outputs will need to be supplemented with additional social, economic and demographic information, and direct discussions with potential financiers to determine whether they are able and willing to providing funding.

Step 8: Implementation

The plan is now implemented, putting management measures into practice and enforcing rules and regulations. Marine InVEST provides information on where – and of whom – implementation and enforcement actions may be needed by locating areas of ecosystem service provision and delivery.

Step 9: Monitor and evaluate

This step involves monitoring whether an EBM approach to MSP is successfully meeting defined objectives. Marine InVEST is not a real-time monitoring device, and is therefore not a substitute for field measures of actual delivery towards objectives. Marine InVEST may, however, help design a monitoring program. For example, it can help determine the locations where monitoring is likely to provide the most effective assessment of processes that produce ecosystem service change. Outputs from Marine InVEST models can also be used to monitor supporting services (e.g., the contribution of nursery habitat and forage fish to the catch of target fish species) that cannot be measured directly in the field.

Step 10: Adapt the spatial management process

As marine spatial plans are monitored and evaluated, they can be adapted to improve performance and to fit changing economic and environmental conditions. Just as in Steps 5 and 6, InVEST can be used to evaluate alternative scenarios for adaptive management and inform the evolution of marine spatial plans.

Overarching Issues with Using InVEST for Marine Spatial Planning

Ecosystem services included: Currently, Marine InVEST can model food from fisheries and aquaculture, coastal protection, recreation and energy from waves.

Geographic Scale: The scale at which Marine InVEST can be applied is flexible and data-dependent, ranging from 10s to 1,000s of square kilometers of coastal or ocean areas.

Relative vs. absolute values: Without calibration, InVEST is most useful for identifying how the production of ecosystem services will change relative to current conditions, given specifications of where marine uses and activities will take place. However, if InVEST models are calibrated and there is good correlation between modeled results and observations, InVEST also can be used to estimate absolute values of changes in ecosystem services.

Biophysical vs. economic terms: Marine InVEST can quantify ecosystem services in biophysical terms (e.g. number of fish), which can be useful for targeting marine zones across seascapes, for example. It can also estimate economic values in monetary currency, using a range of techniques such as avoided damage or treatment costs and market valuation. Valuation can only be done once the biophysical parts of the models are calibrated to time series data. Given the simplifications in the biophysical and economic models, economic value estimates should be treated as first estimates only, for example, for gaining support for marine spatial plans.

Time and resources required: The skill and data requirements needed to apply InVEST are relatively light. The scale, scope, and availability of data all affect the amount of time and capacity required. In general, it will take 1-3 people two months to a year to compile data and run the InVEST models. A full application of InVEST results within the context of marine spatial planning will take longer. The team would need someone with basic GIS proficiency.

Further reading on InVEST and Marine Spatial Planning

The Natural Capital Project: www.naturalcapitalproject.org
InVEST (Terrestrial) User's Guide: http://www.naturalcapitalproject.org/InVEST.html
InVEST (Terrestrial) download: http://invest.ecoinformatics.org

Leslie, H.M., & McLeod, K.L. (2007). Confronting the challenges of implementing marine ecosystem-based management. *Frontiers in Ecology and Environment, 5*(10), 540 – 548.

Ruckelshaus, M., Klinger, T., Knowlton, N., & DeMaster, D. P. (2008). Marine ecosystem-based management in practice: Scientific and governance challenges. *BioScience, 58*(1), 53 – 63.

Tallis, H., Levin, P., Ruckelshaus, M., Lester, S. McLeod, K., Fluharty, D., & Halpern, B. (In press). The many faces of ecosystem-based management: Making the process work today in real places. *Marine Policy.*

UNESCO. (2009). Marine Spatial Planning at: http://www.unesco-ioc-marinesp.be/marine_spatial_planning_msp

InVEST in Practice is a series of short introductory materials to show potential InVEST users how the currently available Tier 1 version of the InVEST tool can be applied to existing policy and planning processes. The guidance for terrestrial InVEST is based on The Natural Capital Project's experiences developing and applying InVEST in more than ten places around the world. Each issue indicates how and when InVEST is likely to be helpful for each stage of a specific policy or planning context, and when it may be inappropriate. Our goal is to give users realistic expectations about the tool, based on the current understanding of its strengths and weaknesses. As more is learned about the tool through further testing, this guidance will be refined and updated. Every context is different. Experience thus far has shown that the applicability of InVEST to different decision contexts depends on the quality and availability of data and other ecosystem service tools, local modeling capacity, local institutional and governance structures and the policy time-frame. The guidance provided here should therefore be considered in light of the local context where InVEST may be applied. Additional tools and approaches will always be needed to complement InVEST when undertaking marine spatial planning.



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