Use of Marxan in evaluation of stakeholder proposals for the North Central Coast Study Region: MLPA

SAT meeting, 8 January 2008
Mike Mertens, Ecotrust

ecotrust | KNOWLEDGE SYSTEMS

Introduction

Explore the use of MARXAN for optimizing the placement of MPAs based on multiple objectives

- Habitat conservation objectives
- Spacing constraints
- Impacts to commercial and recreational fisheries

Fundamentally different than other models presented by the PPG.

Developed to aid in MPA network design process.
Inform stakeholders how they can reduce costs while maintaining similar habitat protections.

ecotrust | KNOWLEDGE SYSTEMS

Brief Overview of MARXAN

Spatially explicit model that optimizes the placement of MPAs based on multiple objectives

Objective – minimize cost and boundary length subject to the constraint that targets are met.

Spatial design constraints and objectives – Boundary Length / Spacing

Simulated annealing

ecotrust | KNOWLEDGE SYSTEMS

Marxan Lingo

Planning units – unit of analysis

Targets – A specified amount of the features of which the user is interested in protecting
    Model is "constrained" by meeting all targets

Costs – Penalty related to any negative consequence for placement of a reserve
    •Do NOT represent economic costs
    •Impacts to fisheries
    •Failure to meet spacing guidelines

ecotrust | KNOWLEDGE SYSTEMS

MARXAN "Costs"

Two types of costs in our model
  •Costs associated with consumptive uses
  •Costs associated with not meeting spacing guidelines

Value of any given location to commercial and recreational
Fisheries in terms of relative importance and associated
Penalty for closing the area to fishing
  8 commercial fisheries fishing from 5 ports
  4 recreational fisheries represented by 4 sectors from 3 regions

ecotrust | KNOWLEDGE SYSTEMS

Consumptive uses

•Relative importance: Relative to what?

•Multiplicative in nature
    •(8 x 5) + (4 x 4 x 3) = 76
    •Multiple objectives

•Set relative importance of any given fishery and any given
port or region as a target.

•Run MARXAN using those targets to quantify planning
units in terms of relative importance at every level.

ecotrust | KNOWLEDGE SYSTEMS

Spacing guidlines

Run MARXAN without spacing objectives to determine areas that are guaranteed to be in the final configuration – "seed" units

Run spacing model to assign cost surface associated with distances to "seed" units

Use this cost surface in conjunction with costs associated with potential impacts to consumptive uses
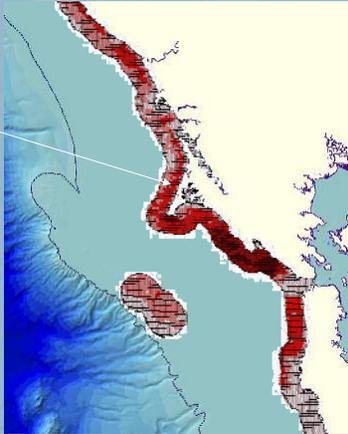
ecotrust | KNOWLEDGE SYSTEMS

MARXAN "costs"

Planning units: cost and status

Planning units = ½ minute

Use MARXAN to quantify costs

ecotrust | KNOWLEDGE SYSTEMS
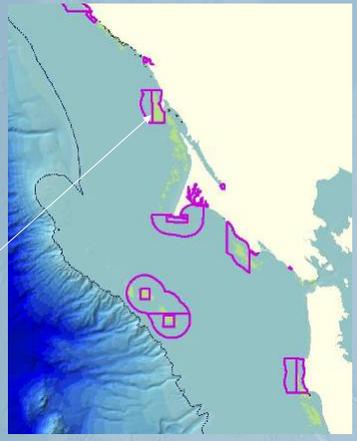
MARXAN "constraints"

Targets:
•Inform stakeholders how they can reduce costs while maintaining similar habitat protections.

Use proposals to define targets by adding up amount of features in MPAs.

ecotrust | KNOWLEDGE SYSTEMS

MARXAN evaluating results

Run MARXAN using targets parameterized by proposals and costs as represented by the results of the MARXAN analysis of perceived relative importance of fishing grounds and spacing model

Best solution is determined (optimum objective function) and used to inform stakeholders where minimal boundary adjustments can result in either increased protection or decreased costs.

ecotrust | KNOWLEDGE SYSTEMS
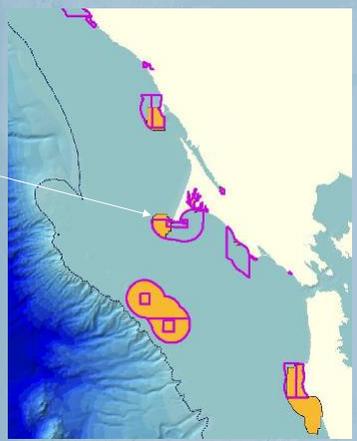
Findings

Proposals perform fairly well when it comes to minimizing impacts to commercial fisheries (given specified habitat protections)
- Only marginal differences when run through socio-economic impact analysis.
- Some fisheries are impacted more when spacing is considered.

Significant Spatial variation in some areas in terms of MARXAN outputs compared to proposals
- Non standard data used in decision process.

ecotrust | KNOWLEDGE SYSTEMS

Package 4 – Socio-economic impacts compared to MARXAN outputs

	FISHERY	TOTAL VALUE 2000-06	Package 4 - original Proportional impact	Pacakge 4 - MARXAN with spacing Proportional impact	Package 4 - MARXAN witout spacing Proportional impact
	California Halibut	$1,801,923.52	5.5%	2.4%	4.5%
	Coastal Pelagics	$188,700.47	0.0%	0.0%	0.0%
	Market Squid	$1,927,057.32	18.2%	31.1%	16.6%
NCC STUDY REGION	Rockfish - Deeper Nearshore	$683,177.98	15.9%	15.6%	12.1%
	Rockfish - Nearshore	$987,204.08	11.7%	9.0%	10.6%
	Urchin	$5,397,586.60	18.0%	16.7%	20.2%
	Dungeness Crab	$54,704,366.74	3.8%	4.0%	3.0%
	Salmon	$37,135,127.38	3.6%	3.5%	2.9%

ecotrust | KNOWLEDGE SYSTEMS
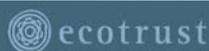
Findings
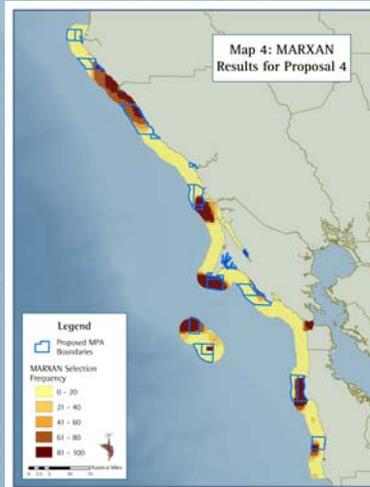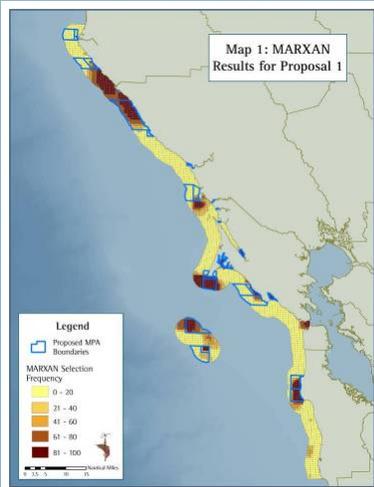
How is this useful?

Provide evaluation of performance of individual proposals in meeting objectives – Can they improve objectives under the same constraints?

Provide visual representation of where "optimized" perceived fishing grounds for all fisheries at all scales.

Provide spatially explicit data (GIS data sets) as a visual aid in the design and refinement phases of MPA design.

Proposal 4 – Bodega Bay area

Next steps / recommendations

- Does this approach have merit from a scientific perspective for this process in this region or next

This region:
- Uses costs from all fisheries
- Need to break out costs associated with different zones
- Run once for reserves and once for conservation areas
- Doesn't consider "tacit" knowledge used in stakeholder decision process

Next region
- Most appropriate if used up front.
- Can be integrated with population viability models