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

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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.

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

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

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

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.

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

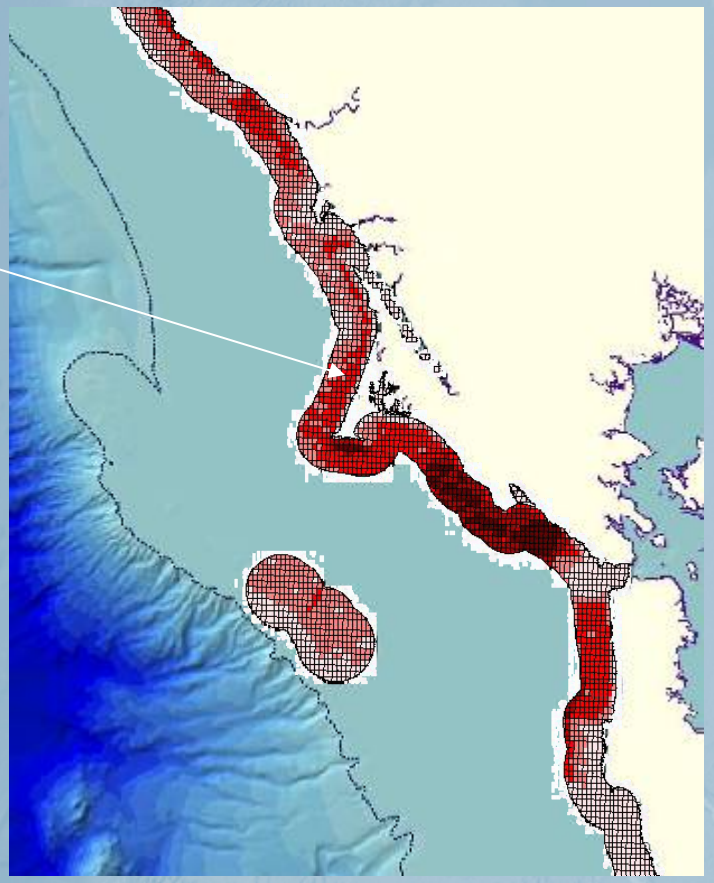
Use this cost surface in conjunction with costs associated with potential impacts to consumptive uses

MARXAN "costs"

Planning units: cost and status

Planning units = ½ minute

Use MARXAN to quantify costs

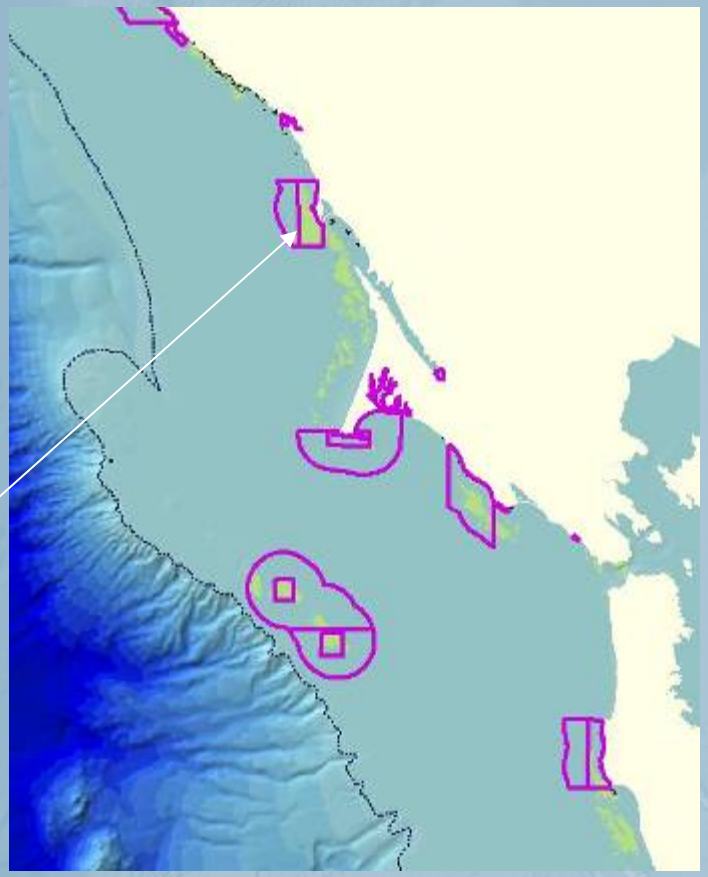


MARXAN "constraints"

Targets:

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

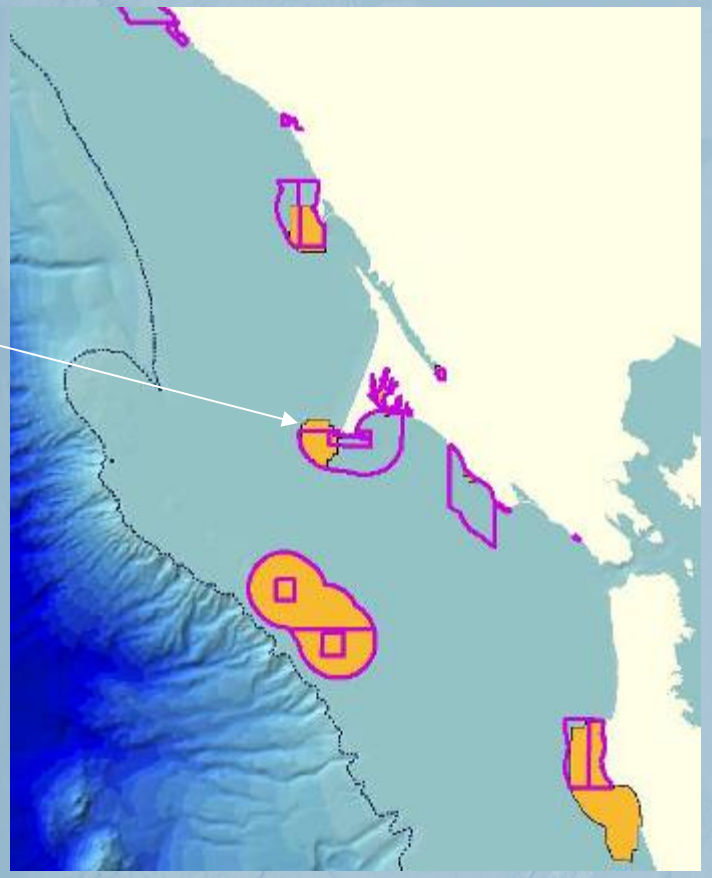
Use proposals to define targets by adding up amount of features in MPAs.



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.



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.

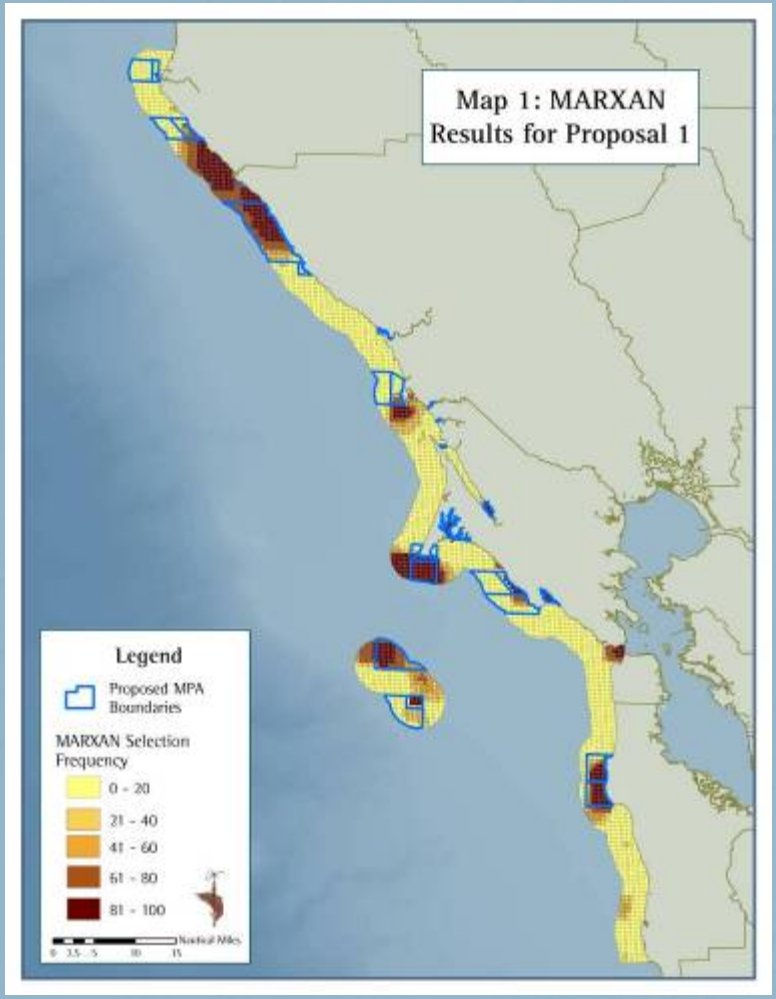
Significant Spatial variation in some areas in terms of MARXAN outputs compared to proposals

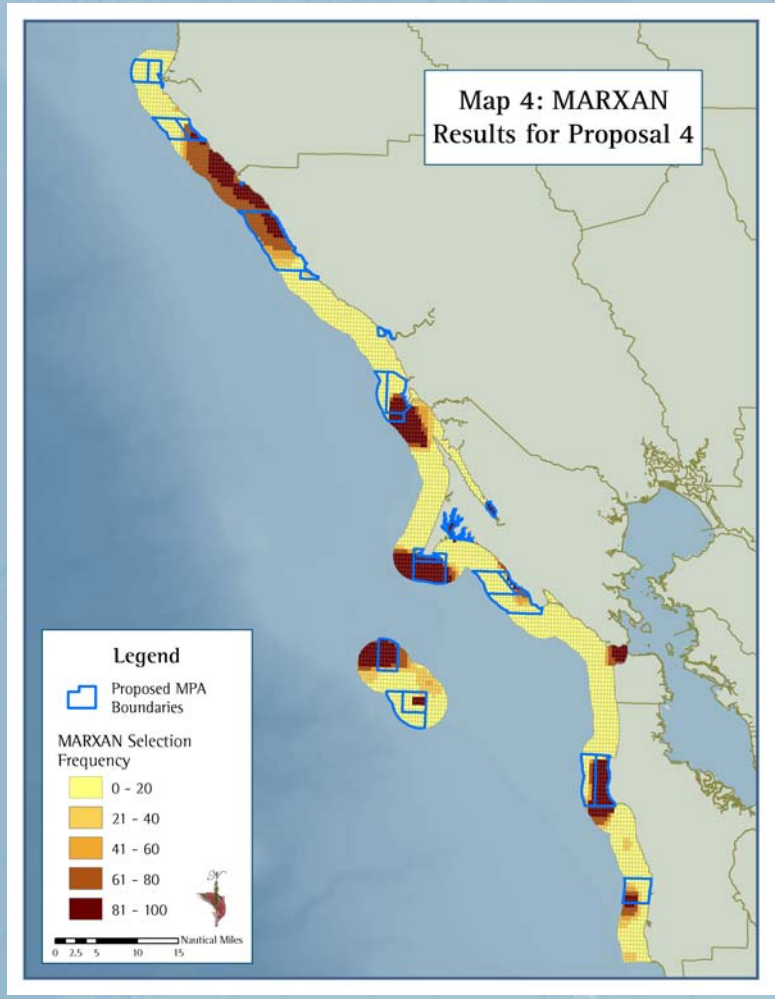
- •Non standard data used in decision process.

Package 4 – Socio-economic impacts compared to MARXAN outputs

			Package 4 - original	Pacakge 4 - MARXAN with spacing	Package 4 - MARXAN witout spacing
	FISHERY	**TOTAL VALUE 2000-06**	**Proportional impact**	**Proportional impact**	**Proportional impact**
NCC STUDY REGION	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%
	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%

Findings


Map 1: MARXAN
Results for Proposal 1
Legend
Proposed MPA Boundaries
MARXAN Selection Frequency
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
Nautical Miles


Map 4: MARXAN
Results for Proposal 4
Legend
Proposed MPA Boundaries
MARXAN Selection Frequency
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
Nautical Miles

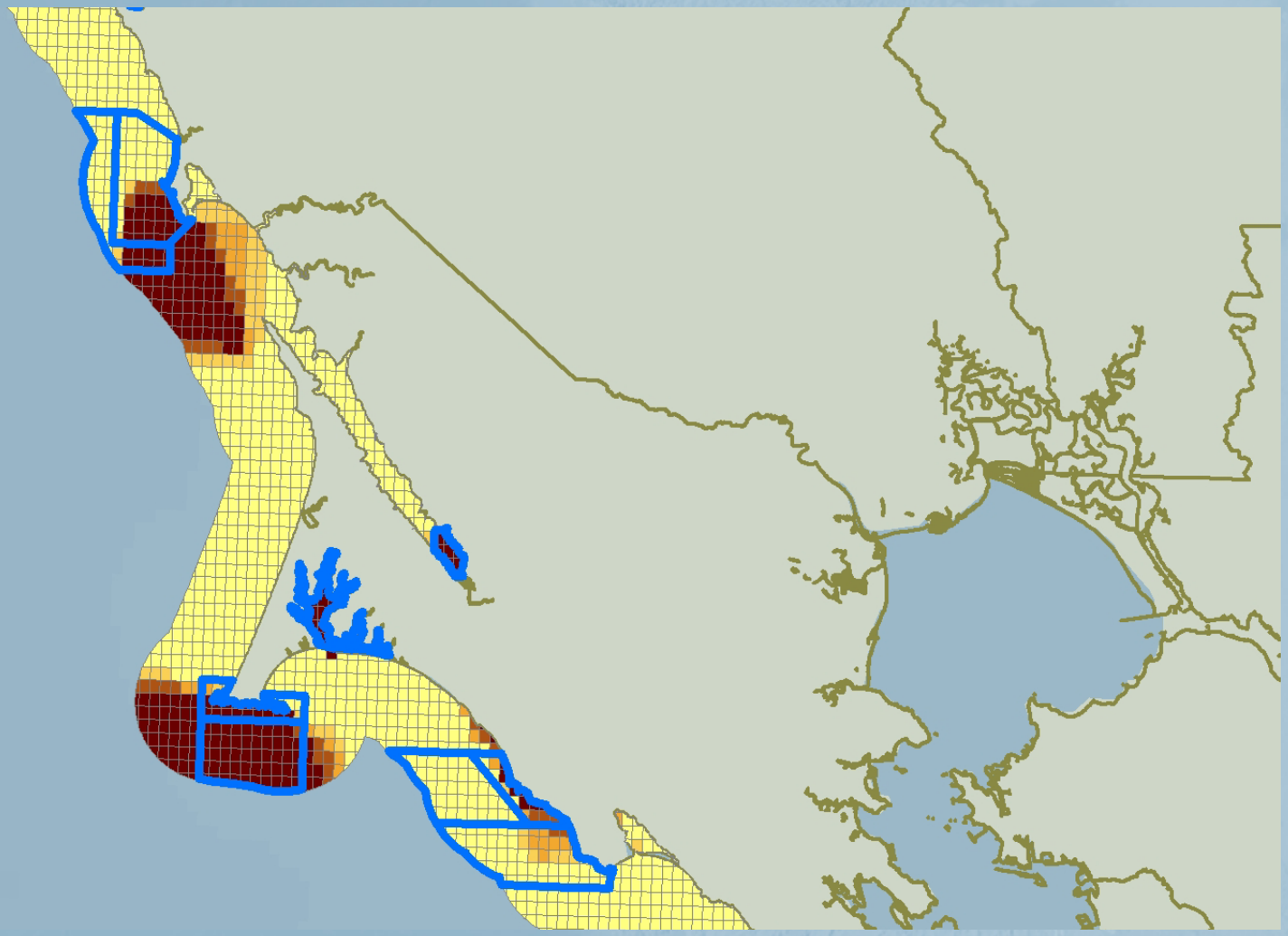
How is this useful?

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

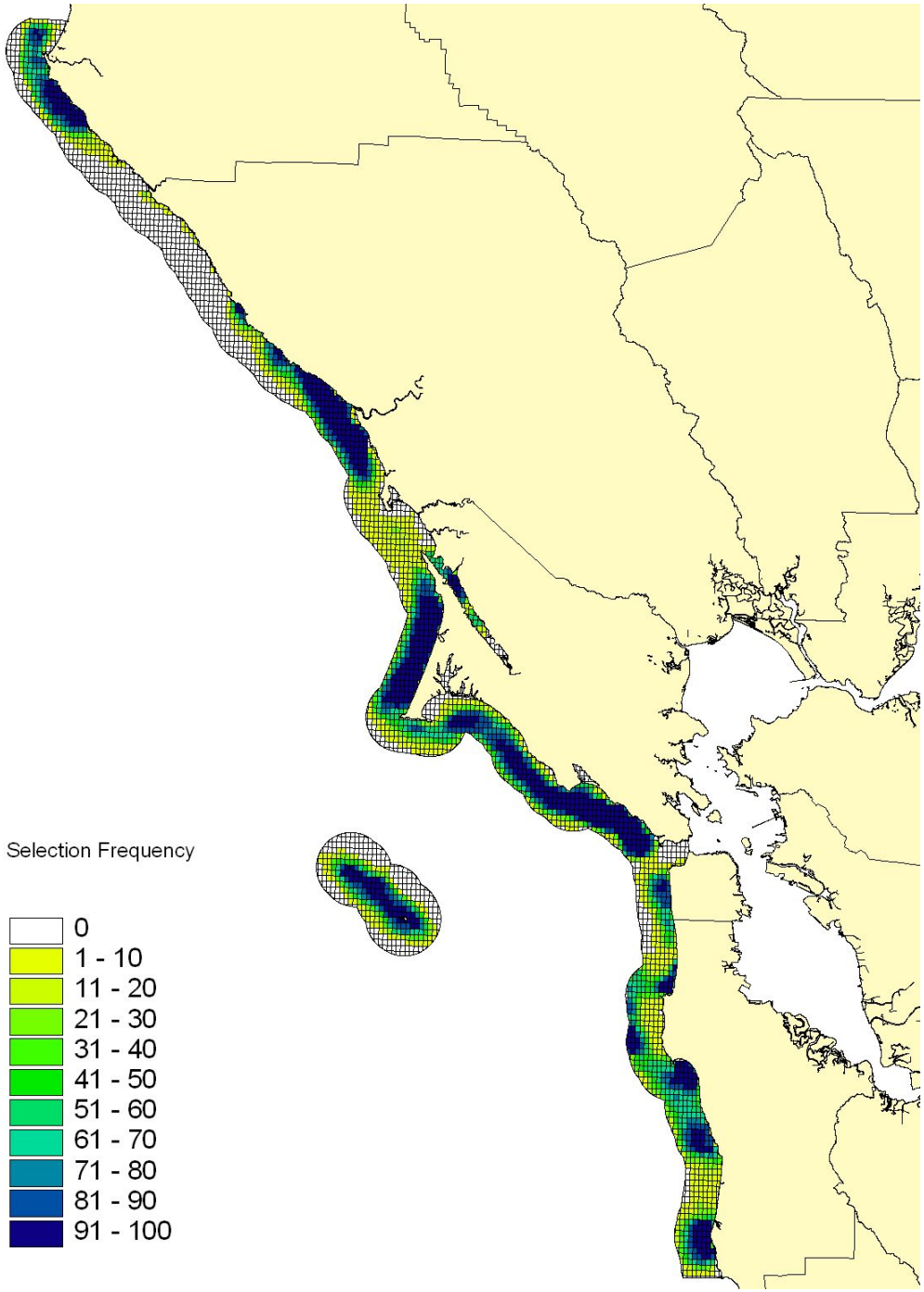
•Does this approach have merit from a scientific perspective for this process in this region or next

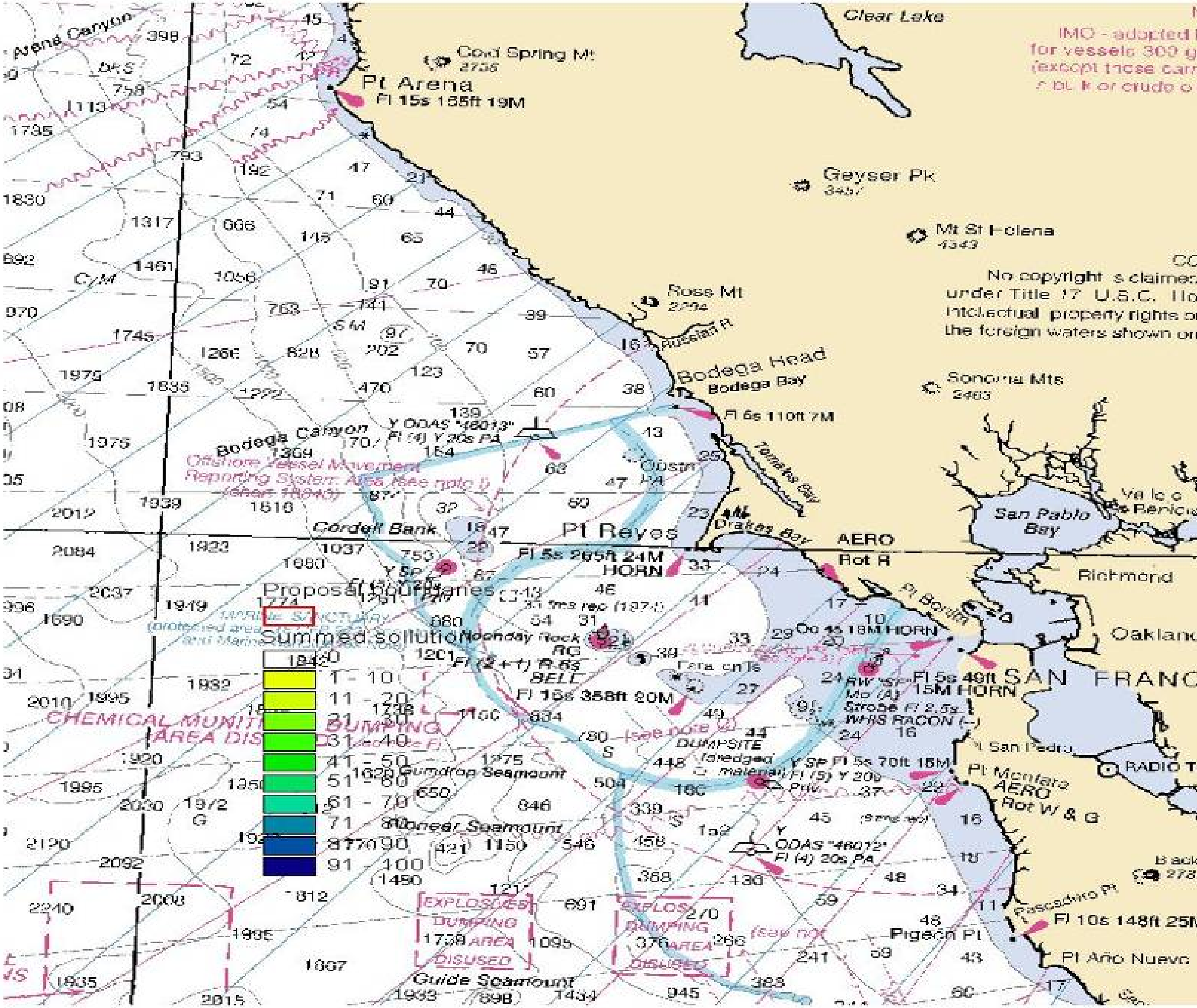
This region:

- •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


Selection Frequency
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100


Clear Lake
Cold Spring Mt
Pt Arena
Fl 15s 155ft 19M
IMO - adopted
Geyser Pk
Mt St Helena
No copyright is claimed
under Title 17 U.S.C.
Ross Mt
Russian R
Bodega Head
Bodega Bay
Fl 6s 110ft 7M
Sonoma Mts
Arena Canyon
Bodega Canyon
Offshore Vessel Movement
Reporting System Area (see note 5)
Cordell Bank
Pt Reyes
Fl 5s 265ft 24M
HORN
Tomales Bay
Drakes Bay
AERO
Rot R
San Pablo Bay
Richmond
Oakland
Pt Bonita
SAN FRANC
Noonday Rock
BELL
Fl 15s 358ft 20M
DUMPSITE
Pt San Pedro
Pt Montara
AERO
Rot W & G
RADIO TO
Gumdrop Seamount
Pioneer Seamount
Guide Seamount
CHEMICAL MUNITIONS DUMPING AREA
EXPLOSIVES DUMPING AREA DISUSED
Pigeon Pt
Pt Año Nuevo
Fl 10s 148ft 25M
Pescadero Pt
Proposal Routes
Summed sollution
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100