

# Geospatial Decision Support Tools for Planning of Marine Protected Areas in California



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**AAG ANNUAL MEETING, BOSTON, 2008**

**MARINE GEOMORPHOLOGY AS A DETERMINANT FOR ESSENTIAL LIFE HABITAT II: AN ECOSYSTEM  
MANAGEMENT APPROACH TO PLANNING FOR MARINE RESERVE NETWORKS**



# Outline



- **California Marine Life Protection Act (MLPA) Initiative**
  - Task at hand
  - Stakeholders, Science Advisory Team, Blue Ribbon Task Force
- **Current Decision Support System**
  - Geospatial Database
  - Internet Map Services
  - Doris (MPA Decision Support Tool)
  - Desktop GIS tools
- **Future Directions**
  - Open Source Database and Mapping Tools
  - Discussion Forums
  - Global Geography



# California Marine Life Protection Act Initiative

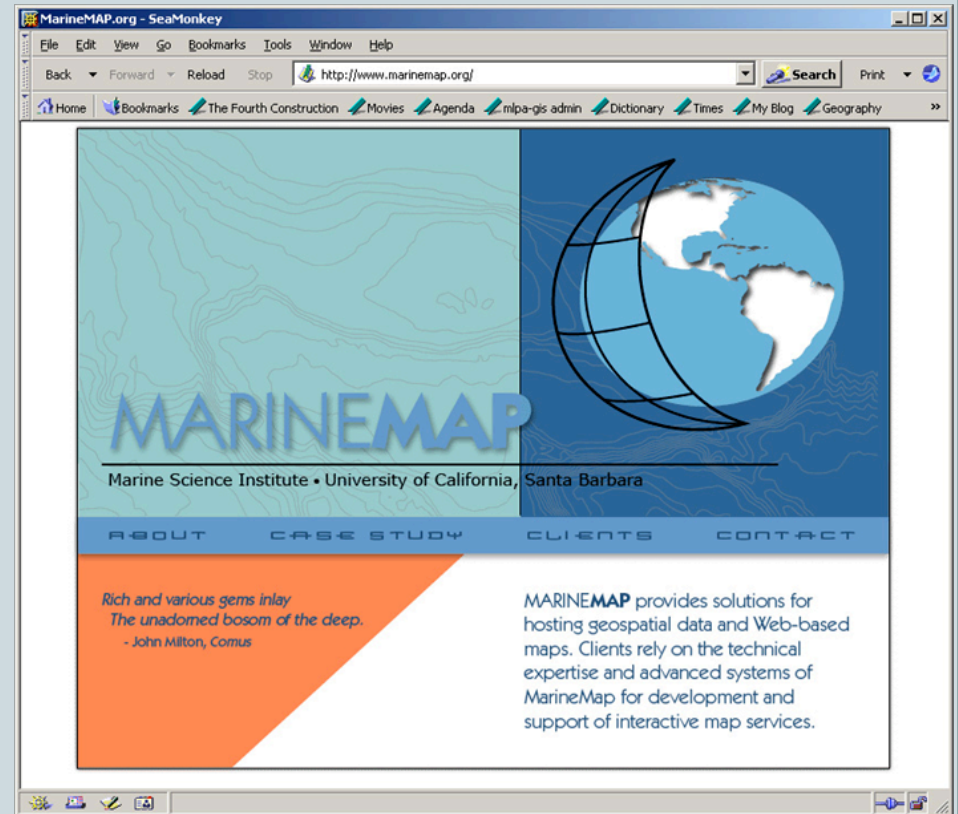


- **Marine Life Protection Act (1999)**
  - Mandates establishment of a managed network of MPAs to:
    - ✦ Protect marine life, habitat, ecosystems and natural heritage.
    - ✦ Improve recreational, educational and study opportunities provided by marine ecosystems.
  - Must use best, readily available science to guide decisions.
- **MLPA Initiative – a Public-Private Partnership (2003)**
  - Initiative Staff
  - Stakeholders (Commercial & Recreational Fishers, Scientists, Teachers, Conservationists, Artists, Policy Makers, etc.)
  - Science Advisory Team (Appointed by Dept. of Fish and Game)
  - Blue Ribbon Task Force (Appointed by the Governor)



# MarineMap.org

- Consortium of scientists and technologists
  - TNC
  - Ecotrust
  - UCSB
  - NOAA
- Contracted by Initiative to develop and host decision support system





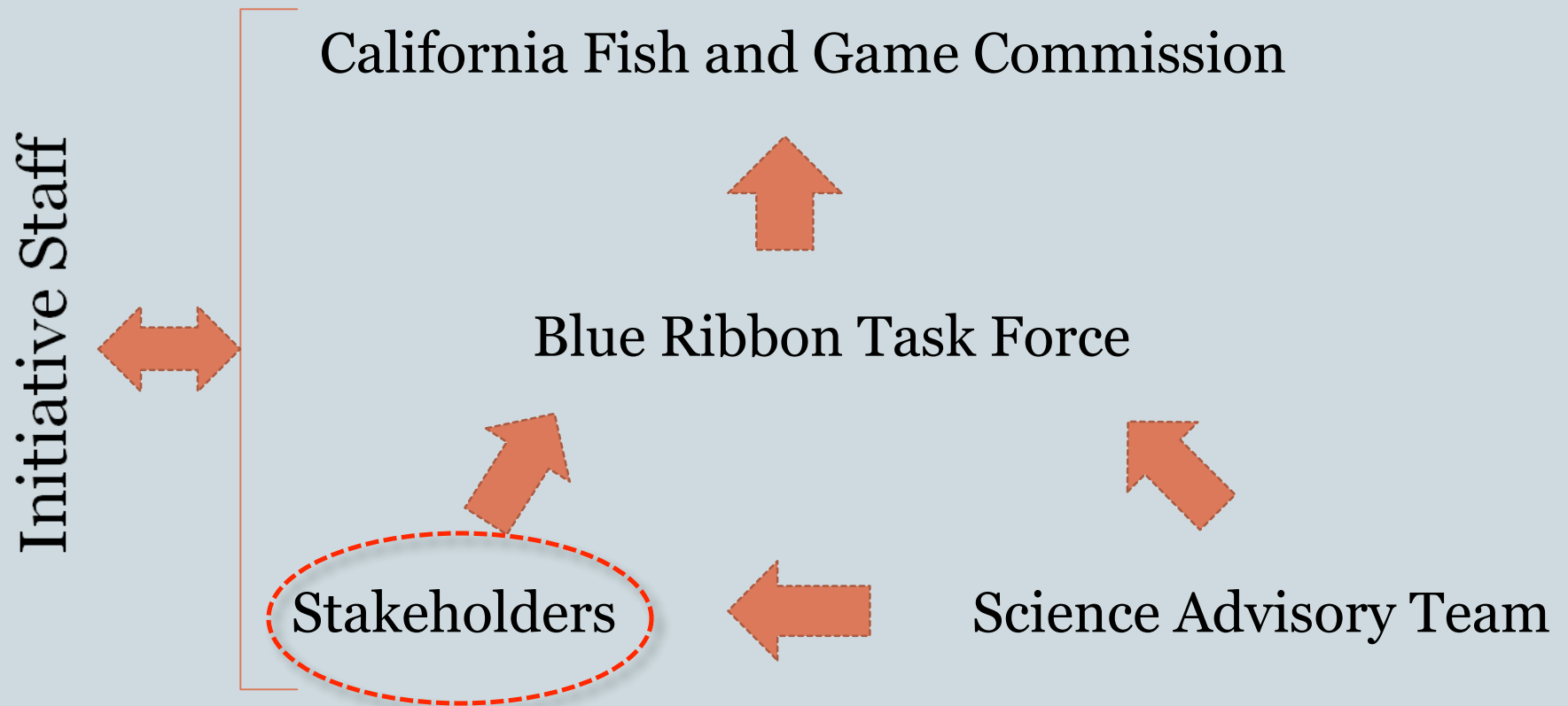
# MLPA Initiative Study Regions

- To be completed by 2011
  - Progressively working through six regional study areas that divide the California State waters.
  - Completed Phase I (29 new MPAs established for Central California in August, 2007)
  - Currently in Phase II (the North Central Coast Subregion)





# MLPA Initiative Structure





# Geospatial Information Used in Process

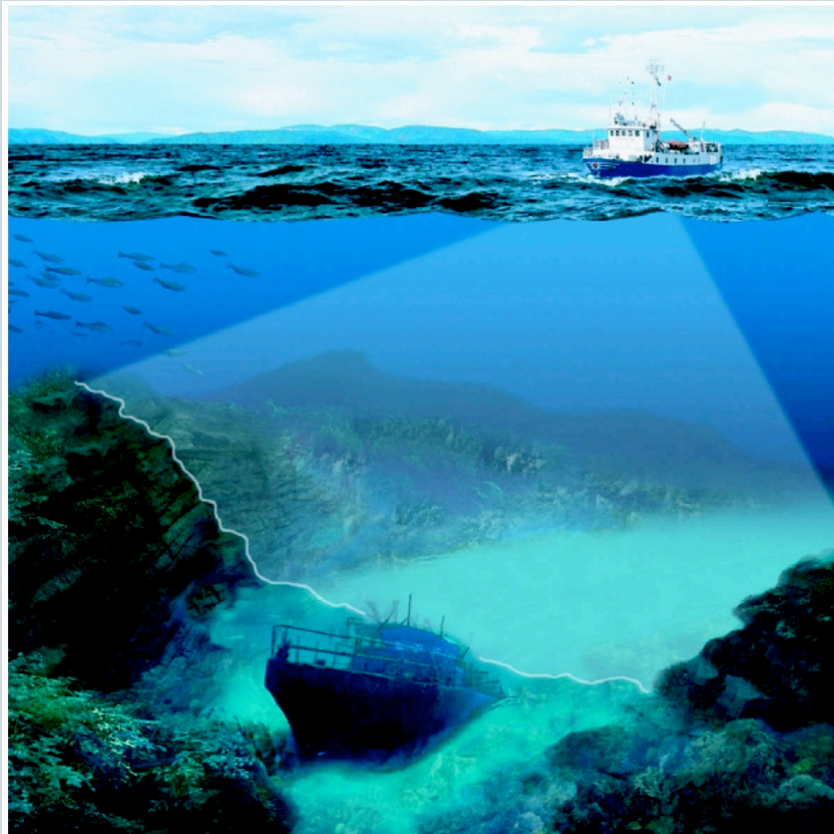


- **Habitat**
  - Distribution of kelp, seagrass, substrate types, bathymetry.
- **Biological**
  - Distribution of fish, birds, mammals, invertebrates, corals.
- **Physical**
  - Sea surface temperatures, upwelling, salinity, currents, impaired water bodies
- **Cultural**
  - Distribution of ports, coastal access points, cities
- **Socioeconomic Data**
  - Consumptive and non-consumptive activities (e.g., commercial and recreational fishing, recreational boating, diving, educational
- **Base (reference) Layers**
  - Existing MPAs, Study Area, Graticules, Nautical Charts

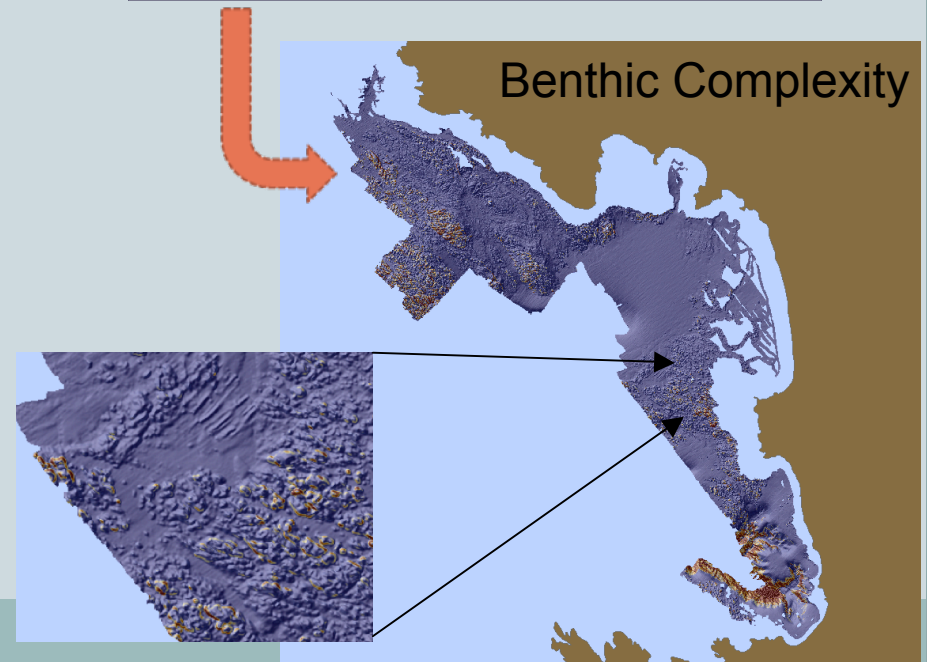
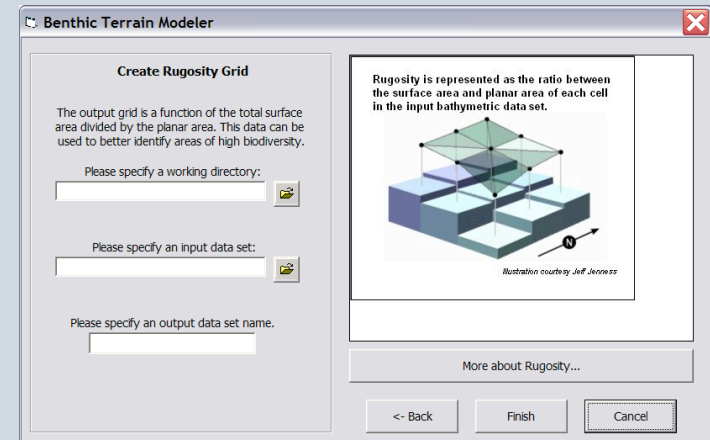


# Key Data: Benthic Habitat

## Side-scan / multi-beam mapping



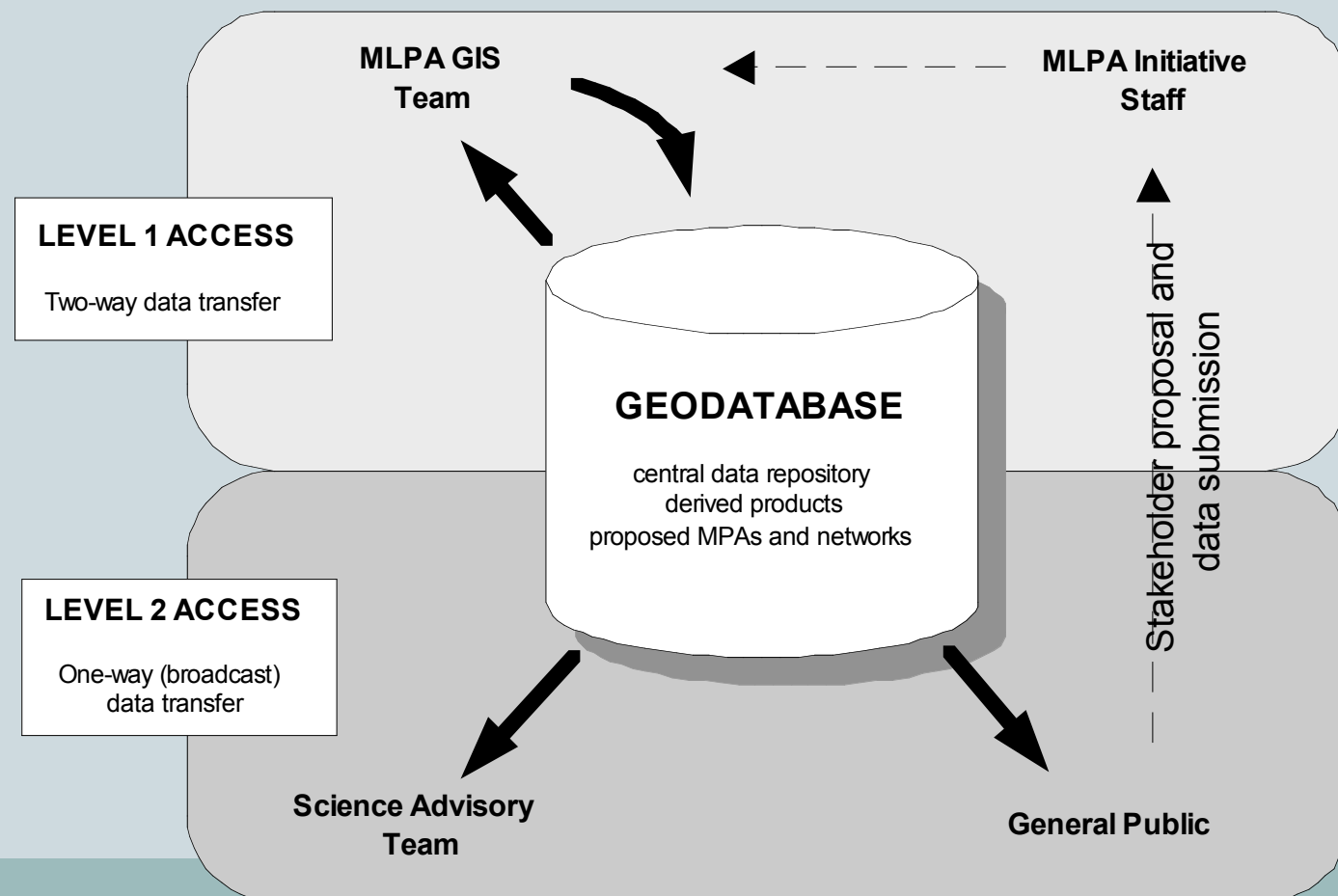
Source: NAP 2003. A Geospatial Framework for the Coastal Zone  
National Needs for Coastal Mapping and Charting





# The Geospatial Database

## Software Environment: ArcSDE and Microsoft SQL Server





[illegible][illegible]


## Connecting to ArcIMS Feature Service in ArcCatalog and ArcMap




# Metadata Services



## Complete metadata are online

 **metadata explorer**

Welcome, Guest



**Words:**

**Narrow search by:**

Content Types

- [Data](#)
- [Documents](#)
- [Resources](#)

Folders


- [MLPA](#)

Themes

- [Agriculture & Farming](#)
- [Biologic & Ecologic](#)
- [Admin & Political Bounds](#)
- [Atmospheric & Climatic](#)
- [Business & Economic](#)
- [Elevation & Derived Prods](#)
- [Environmental](#)
- [Geologic & Geophysical](#)

**Catalog Results** Details

: All Records on Map



### 2007 Rockfish Conservation Areas (RCA) - Recreational

A geodatabase polygon feature dataset depicting recreational fishing closures off the California coast as described here: [http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-Closed-Areas/Index.cfm#CP\\_JUMP\\_30272](http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-Closed-Areas/Index.cfm#CP_JUMP_30272).

**Document Links**

- [HTML](#)
- [XML](#)

**Content Citation**

**Title of Content:** 2007 Rockfish Conservation Areas (RCA) - Recreational

**Content Publisher:**

**Publication Place:**

**Publication Date:** Unpublished Material

**Content Summary:** A geodatabase polygon feature dataset depicting recreational fishing closures off the California coast as described here: [http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-Closed-Areas/Index.cfm#CP\\_JUMP\\_30272](http://www.nwr.noaa.gov/Groundfish-Halibut/Groundfish-Fishery-Management/Groundfish-Closed-Areas/Index.cfm#CP_JUMP_30272).

**Content Purpose:** Data container

**Supplemental Information:** Each polygon in this layer contains 12 fields labeled as "closed\_1", "closed\_2", "closed\_3", etc. These fields contain a 0 or a 1. If a polygon has a 1 in the closed\_2 field, that means that polygon represents an area that is closed in February. If closed\_6 contains a 1, then that polygon is closed in June. If you want to see which areas are close in December, for instance, you can use a definition query on this layer that looks like this: [closed\_12] = 1.

**Time Period of Content**

**Beginning Date:**

**Ending Date:**

**Content Status**

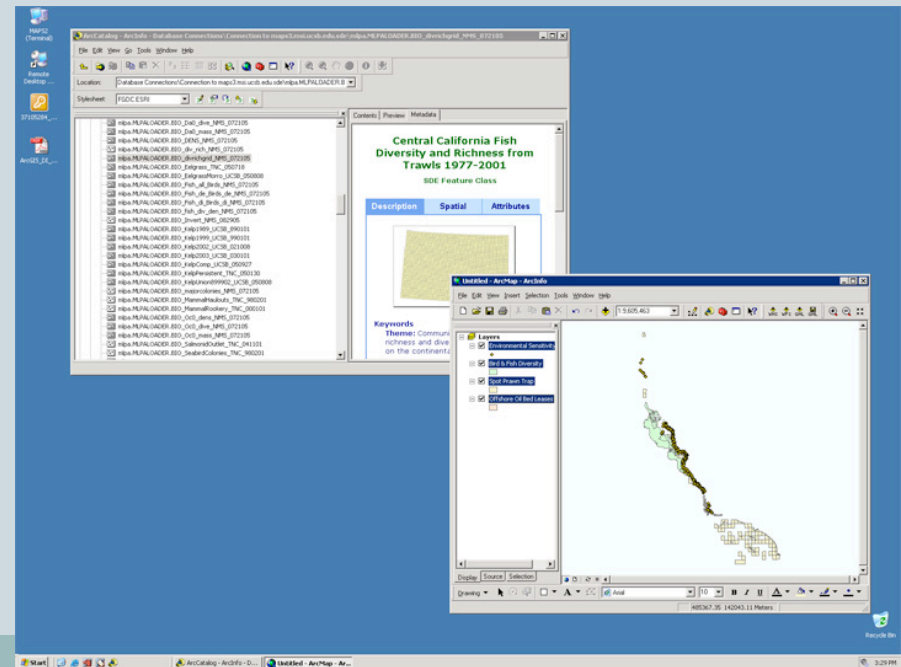
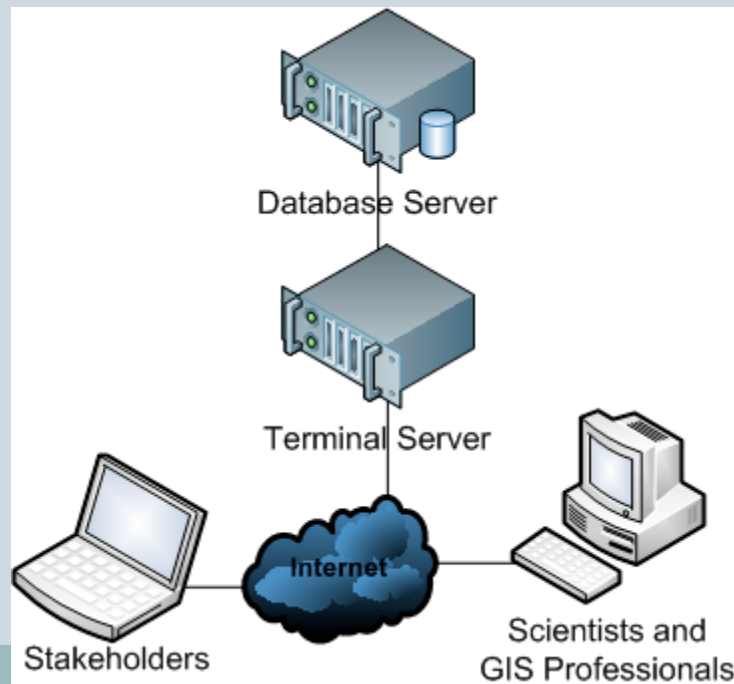
**Progress:** Complete

**Update Frequency:** None planned



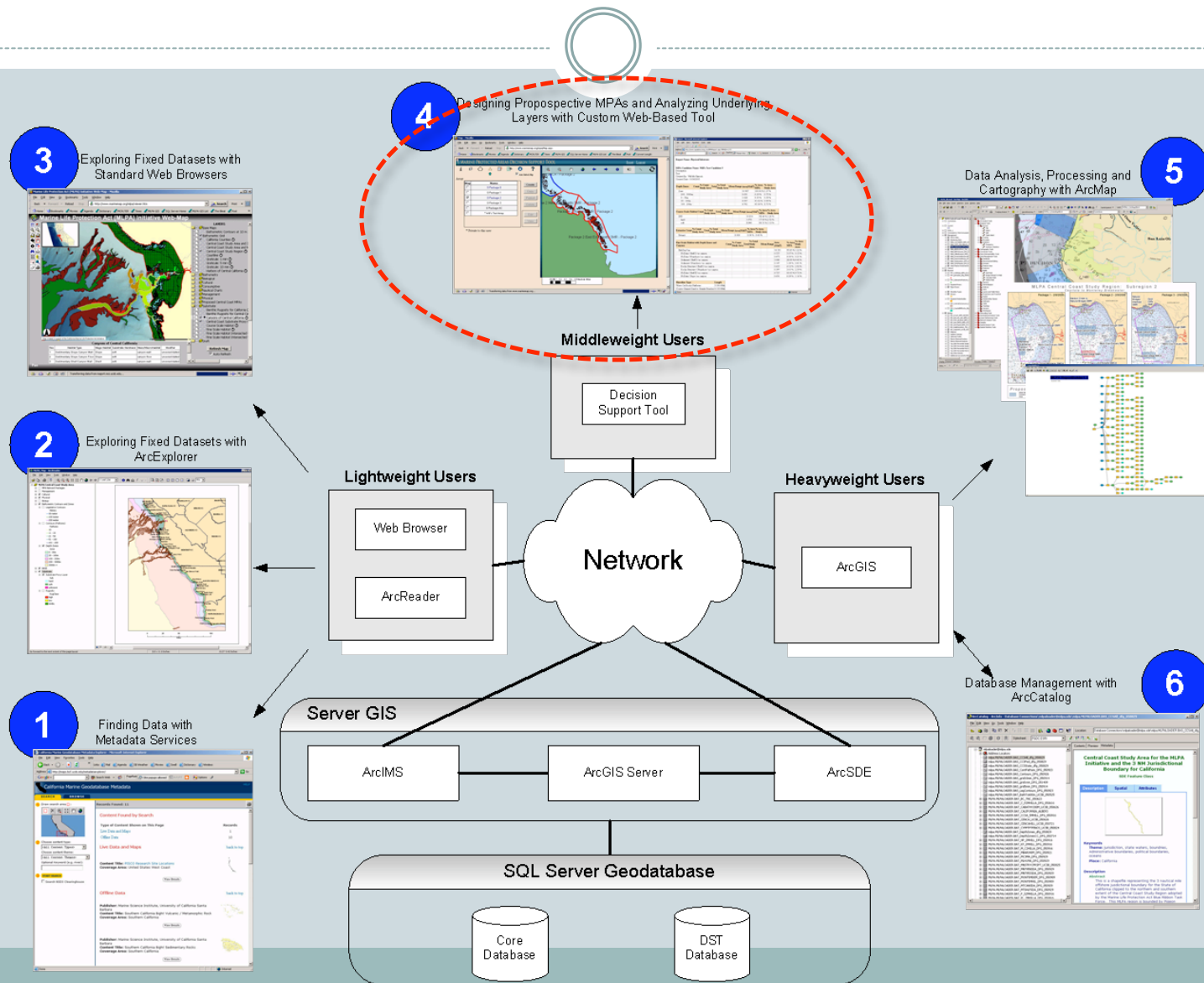
# Solutions for the GIS Savvy

- Distribute entire database as “file geodatabase”
  - 8 gigabytes total
- Provide access to a terminal server with direct access to central ArcSDE geodatabase.





# How it all fits together





# Doris: MPA Decision Support Tool



- Accessed using a standard web browser.
- Designed specifically for stakeholders to:
  - Draw prospective MPA boundaries
  - Calculate what they captured inside prospective MPAs
  - Share prospective MPAs with other users
- Based on ArcGIS Server 9.1 technology.

(Doris is a sea nymph)



# Doris: MPA Decision Support Tool



Password Protected (Private) Accounts for Stakeholders

## Doris

MARINE PROTECTED AREAS DECISION SUPPORT TOOL



Username:

Password: **Submit**

[Forgot password?](#)

[Change password](#)

## Welcome

The Doris Marine Protected Areas Decision support tool is a collaborative effort between Federal and California State Agencies, the Resources Legacy Fund Foundation (RLFF) and the Marine Sciences Institute located at the University of California in Santa Barbara.

The tool is named after Doris a Sea Nymph from Greek mythology who was associated with a "bountiful" ocean. Together with her husband the sea god Nereus, she was the mother to 50 beautiful nymphs known as the Nereids.

For problems accessing this site, please contact the [webmaster](#).

For best results, please use Internet Explorer 5+





# Doris: Instructions Page

## Doris

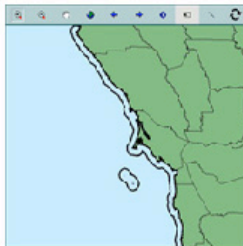
## MARINE PROTECTED AREAS DECISION SUPPORT TOOL

### Instructions

[log-out](#)[help](#)[Get Started](#)

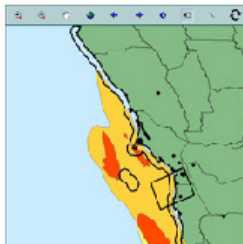
#### Step 1: Choose a Study Area

Select a study area. This will default the map to the area of interest.



#### Step 4: Create a system or array of MPAs

Create and name a new system of MPAs. Add new MPAs or existing MPAs to an array.



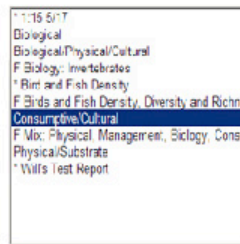
#### Step 2: Add Map Layers

Add the map layers that you are interested in capturing in a candidate Marine Protected Area (MPA).



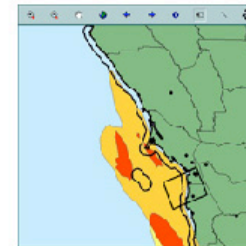
#### Step 5: Create or Load a Report

Select from existing reports or create a report based on layers that you selected.



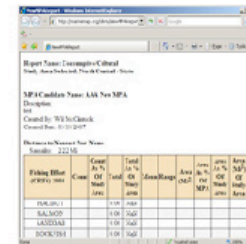
#### Step 3: Draw MPA

Draw a new MPA or add existing candidate MPAs.



#### Step 6: View Reports

View statistics and compare percentages to determine if candidate MPA(s) provided the desired outcome.





# Doris: Drawing Prospective MPA Boundaries

## Doris

### MARINE PROTECTED AREAS DECISION SUPPORT TOOL

[Study Area](#) | [Layers](#) | [MPAs](#) | [Arrays](#) | [Build Reports](#) | [View Report](#) | ☒ Auto Refresh Map | [reset](#) | [log-out](#) | [admin](#) | [help](#)

Click on 'Create' to draw an MPA - or select one from the list below by clicking on the checkbox at left.

MPA Candidate:

Map	Name
<input type="checkbox"/>	S Abalone Cove
<input type="checkbox"/>	S Agua Hedionda Lagoon
<input type="checkbox"/>	S Albany Mudflats
<input type="checkbox"/>	S Anacapa Island
<input type="checkbox"/>	S Anacapa Island
<input type="checkbox"/>	S Anacapa Island Special Closure
<input type="checkbox"/>	S Anacapa Island Special Closure

\* Private to this user

Create

Copy

Publish

Details

View

Edit

Zoom

Delete

Author: will  
Date: 08/31/2007  
Description:  
Type: Other

**DRAWING MPA**

Windows Internet Explorer

Press 'OK' to continue and SAVE MPA.  
Press 'Cancel' to EDIT MPA vertices and placement.

OK Cancel



# Doris: Prospective MPA Metadata



When saving new prospective MPA boundaries, users must enter information

## Dôris MARINE PROTECTED AREAS DECISION SUPPORT TOOL

### MPA Details

View or Edit information about the selected MPA. Click the "Save" button to save changes or click "Cancel" to close window without saving changes.

Name:

#### Designation of MPA:

- ☒ Marine Conservation Area
- ☐ Marine Reserve
- ☐ Marine Park
- ☐ Other
- ☐ New Designation

Description:

Boundaries:

Allowable Uses:

Save

Cancel



# Doris: MPA Arrays Page

Users may choose existing arrays or create new arrays

## Doris

MARINE PROTECTED AREAS DECISION SUPPORT TOOL

[Study Area](#) | [Layers](#) | [MPAs](#) | [Arrays](#) | [Build Reports](#) | [View Report](#)

☒ Auto Refresh Map [reset](#) | [log-out](#) | [admin](#) | [help](#)

Create a new array or select an existing one from list below.

Array:

Map	Name
<input checked="" type="checkbox"/>	* Demo
<input type="checkbox"/>	S Existing North Central Coast MPAs
<input type="checkbox"/>	S NCC Subregions
<input type="checkbox"/>	S New Central Coast MPAs

\* Private to this user

Author: will  
Date: 09/11/2007  
Description: Three demonstration MPAs for Symposium.

Create

Copy

Publish

Details

Edit

View

Delete

Demo.Demonstration MPA for Symposium 3

Demo.Demonstration MPA for Symposium 2

Demo.Demonstration MPA for Symposium

0.5 1 2 3 4 5 Miles



# Doris: Report Results

- Report Results
  - MPA Area
  - Amount of area covered by any given data layer within MPA relative to entire study area
  - Distance between MPAs
  - Metadata
  - Key to results

NewMPAArrayReport - Windows Internet Explorer

http://maps4.msi.ucsb.edu/doris/NewMPAArrayReport.aspx?NetworkID=212

File Edit View Favorites Tools Help Links Agenda >> Contribute Edit in Contribute Post to Blog

NewMPAArrayReport

**Report Name: Habitat**  
**Study Area Selected: North Central - State**

**MPA Candidate Name: Demonstration MPA for Symposium**  
 Description:  
 Used for demonstration purposes.  
 Created By: Will McClintock  
 Created Date: 09/11/2007

Estuaries	Count	Count As % Of Study Area	Total	Total As % Of Study Area	Mean	Range	Area(Mi <sup>2</sup> )	Area As % Of MPA	Area As % Of Study Area	Area(Mi <sup>2</sup> ) Of Study Area
Estuary Area							0.000	0.00 %	0.00 %	19.474

Surf Grass	Length	Length As % Of Study Area	Length Of Study Area
Surf Grass	3.483 Mi	5.06 %	68.790 Mi

Depth Soundings	Count	Count As % Of Study Area	Total	Total As % Of Study Area	Mean	Range	Area(Mi <sup>2</sup> )	Area As % Of MPA	Area As % Of Study Area	Area(Mi <sup>2</sup> ) Of Study Area
Min-Max Depth						-150 - 0				

Eelgrass	Count	Count As % Of Study Area	Total	Total As % Of Study Area	Mean	Range	Area(Mi <sup>2</sup> )	Area As % Of MPA	Area As % Of Study Area	Area(Mi <sup>2</sup> ) Of Study Area
Eelgrass							0.000	0.00 %	0.00 %	6.051

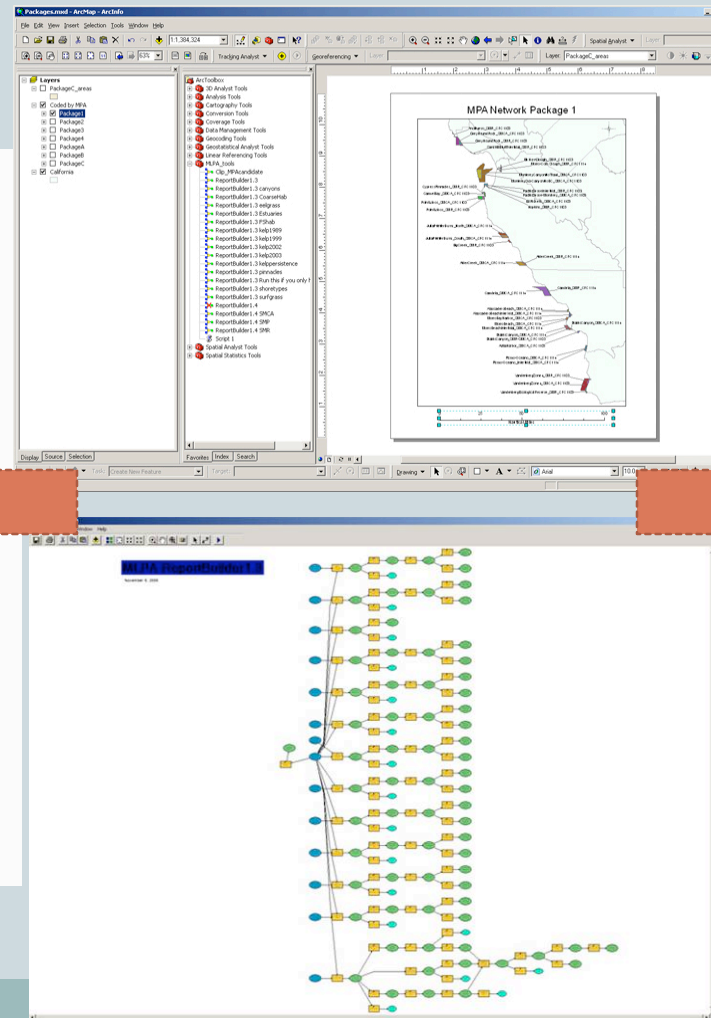
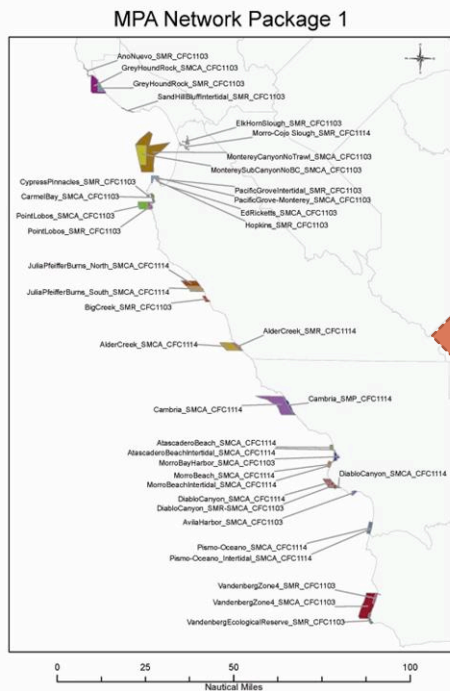
Shoreline Type	Length	Length As % Of Study Area	Length Of Study Area
Course-Grained Sand to Granule Beaches	3.100 Mi	12.84 %	24.135 Mi
Exposed Rocky Cliffs	0.335 Mi	0.82 %	40.945 Mi
Mixed Sand and Gravel Beaches	0.516 Mi	1.06 %	48.856 Mi

Done Internet 100%



# ArcGIS Desktop Tools for Maps and Analysis

## Creating Maps



## Creating Reports

### MLPA DATA Report

Area in Statute Miles:	13.96	Name of First Area		
ShoreType:		SS_PurisimaPRBO_SMR		
		Length:	Total:	% of Total:
Sandy or	3.522		223.66	1.57%
Rocky intertidal	2.409		209.21	1.15%
Coastal marsh			36.53	
Tidal flats			23.48	
Surfgrass:		Length:	Total:	% of Total:
Eelgrass:		Area:	Total:	% of Total:
			1.07	
Estuary Habitat:		Area:	Total:	% of Total:
			4.410	
Distribution of data resolution				
High:	Low:	Total Area:	%High	% Low:
5.63	8.33	13.95	40.32%	59.68%
Fine Scale Habitat:		Area:	Total:	% of Total:
0 - 30m Sediment		0.101	24.21	0.42%
30 - 100m Sediment		0.692	93.72	0.74%
100 - 200m Sediment			1.93	
200 - 3000m Sediment			0.29	
0 - 30m Rocky Structure		3.594	20.16	17.78%
30 - 100m Rocky Structure		1.248	20.59	6.06%
100 - 200m Rocky Structure			0.4	
200 - 3000m Rocky Structure			0.01	
0 - 30m NoData		1.964		
30 - 100m NoData		6.464		
100 - 200m NoData				
200 - 3000m NoData				
Coarse Scale Habitat:		Area:	Total:	% of Total:
Rocky 0 - 30		5.427	46.66	11.63%
Rocky 30 - 100		1.248	26.78	4.66%
Rocky 100 - 200			13.91	
Rocky 200 - 3000+			16.16	
Soft 0 - 30		0.110	294.14	0.04%
Soft 30 - 100		7.155	575.78	1.24%
Soft 100 - 200			58.46	
Soft 200 - 3000+			105.52	
unknown		0.034		



# Summary of Existing Support Tools



- **What we have:**
  - Large database of geospatial information
  - Web-accessible, interactive map of all data
  - Doris: MPA design and analysis tool
  - ArcGIS Desktop-based analytical and cartographic tools



# Summary of Existing Support Tools



- **What we have:**
  - Large database of geospatial information
  - Web-accessible, interactive map of all data
  - Doris: MPA design and analysis tool
  - ArcGIS Desktop-based analytical and cartographic tools
- **However....**
  - Kludgy interface
  - Reports are ugly and hard to interpret
  - Can't save and share map views or reports
  - No direct means to share and discuss results online

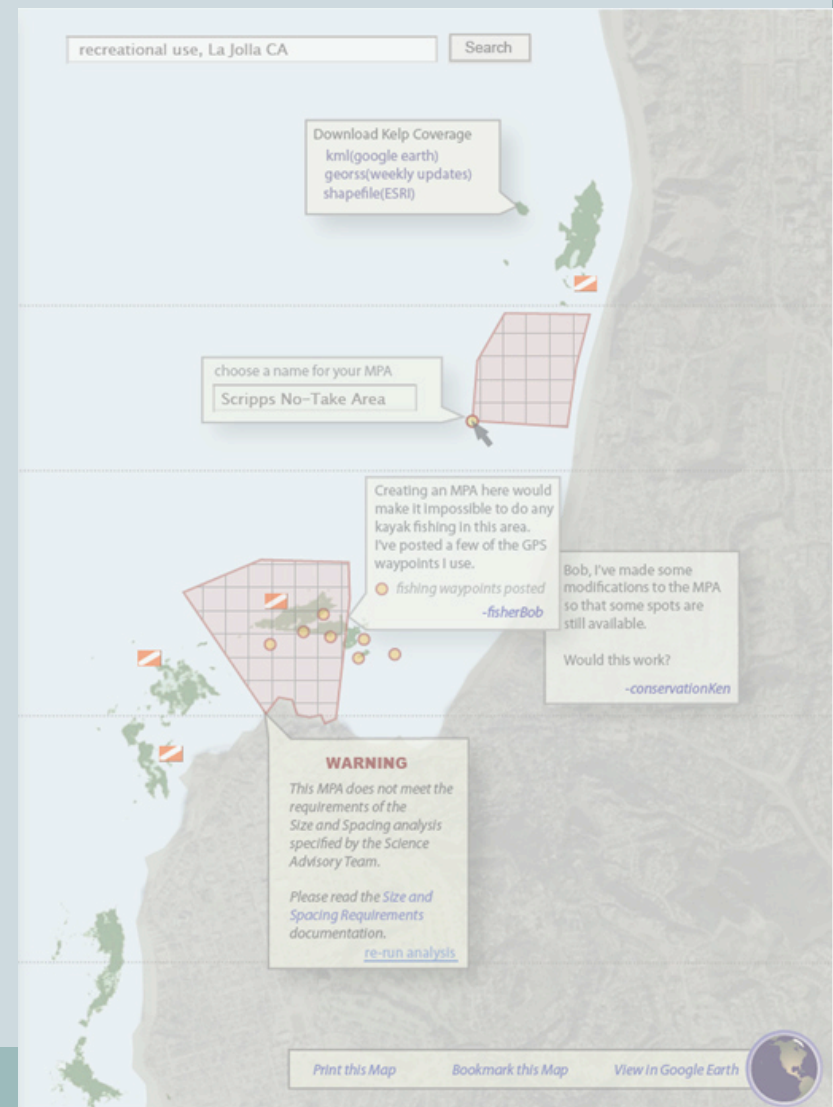






# New Directions for September, 2008

- Spatially enabled discussion forums
- Sharing dynamic map views
- Sharing reports (with graphics)
- Wiki for collaborative proposals
- Instant feedback re: meeting SAT guidelines (i.e., validation rules)
- Enhanced metadata viewing
- Enhanced mechanisms for integrating offline work (e.g., in ArcMap, Excel)
  - Importing / exporting shapefiles, KML
  - Using ODBC applications (e.g., Excel) to edit attributes if needed.
- Extensible for inclusion of additional models (e.g., Economic, Marzone)





# MarineMap for World-Wide Protected Area Design



- **Framework for global extent**
  - User defined study areas
  - User provided content
- **Open source software**
  - Low cost
  - Modifiable





# Acknowledgments



- Resources Legacy Fund Foundation
- Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)
- California Department of Fish and Game
- The Nature Conservancy
- Ecotrust
- National Oceanic and Atmospheric Association (NOAA)
- IM Systems Group, Inc.

For more information: <http://marinemap.org/mlpa>