Training Objectives

Dr. Lihini Aluwihare

SCRIPPS INSTITUTION OF OCEANOGRAPHY

UC San Diego

Who is ”here”

In person:

Lihini Aluwihare

Steven Diggs (arriving Wed)

Mattias Lankhorst

Stuart Sandin

Uwe Send

Remote (synchronous):

Chris Reddy – TUESDAY morning session

Mark Ohman – WEDNESDAY morning session.

Remote (asynchronous):

Richard Carson - TBD

Face to face and online training program suggestion:

- (i) Methods and parameters to be measured for assessing environmental consequences
- (ii) Sampling strategies and experimental design
- (iii) Sample collection, preservation and storage; laboratory analyses
- (iv) Data computation and management practices
- (v) Economic assessment/costing
- (vi) &(vii) Instrument purchase and training

Outputs/Tasks Assigned by ADB

- (i) review existing methods and monitoring plans, and research outputs
- (ii) provide expert review comments and guidance to NARA on recommended revisions to the research plan
- (iii) develop a training program and corresponding materials.
- (iv) implement training
- (v) conduct check-ins
- (vi)guide development of data organization, storage, and sharing methods

What are we in the best position to do

- Our goal with this project is to **build a long-term relationship** with relevant NARA scientists so that we can continue to be a resource for ocean related research.
- In addition to maritime disasters, **Sri Lanka hosts a significant amount of potential for blue carbon related endeavors** but also faces potential challenges **related to climate change (** including sea-level rise, increasing ocean temperatures and ocean acidification). **Our expertise and our network may be useful to NARA scientists going forward.**
- We are **best suited to discuss how to measure and monitor the ocean** so that we have good information on how the system is impacted during a disaster or in response to climate change.

Monday, June 19th 2023: INTRODUCTION

Welcome
ADB Perspective
Introduction of attendees
(Priorities for NARA)
Training objectives (Prof. L. Aluwihare)
Sampling and Modelling considerations (Prof. U. Send)
NARA Status and Needs on Disaster Preparedness, Monitoring (generic), Field Sampling (generic)
Interactive working session to discuss desired goals for future NARA disaster-elated sampling
-sampling
-modeling

OUTCOME: List of use cases and requirements that address these goals

Monday, June 19th 2023: DATA COLLECTION PRINCIPLES

- Spatial and temporal sampling considerations (where, what spacing, how often, etc), aliasing,
- bias, errors in mean, trends and de-trending, quantification of variability, diurnal and seasonal
- cycles, etc
- Accuracy, precision, resolution, drift over time, etc
- Estimating quality of observations
- Assuring quality of observations
- Interactive working session to discuss desired goals for observed quantities (means,
- variability, etc) and for data quality, and first steps NARA can take towards those
- Recap: Do these observations address the use cases and requirements from the morning
- session?

Tuesday, June 20h 2023: Responding during a disaster (Hybrid)

- Singularity and challenges of marine incidents (examples)
- Responding to and assessing a maritime disaster
- Discussion on plastics and oil analysis– from simple to more complex
- Sample documentation and preservation
- Discussion, including on baseline sampling and readiness; challenges from NARA perspective in terms of responding to crises.

- Simple lab methods (microscope methods and density measurements, standard reference materials for plastics etc).
- Sediment, water and biota sampling for contaminants

Tuesday, June 20th 2023: Data NetCDF (parallel afternoon)

- netCDF files as one tool for management of oceanographic data (for observations and models). History and use of netCDF files.
- Importance of metadata to annotate data.
- CF metadata conventions as a tool to describe oceanographic data (observations and
- models).
- Recap: Which use cases and requirements are addressed with these tools?

Wednesday, June 21st 2023: Water column ecosystem monitoring (hybrid)

- Sampling for base of the food web (water samples, net tows, CTD)
- Sample processing (labeling etc.) and sample preservation.

- Parameters monitored for long term observations and baseline data
- Use of stable isotope tools to establish biogeochemistry and trophic connections
- Harmful algal blooms and toxins

- Laboratory practices on methods covered (chlorophyll standards for fluorometer calibration, standard methods for seawater analyses etc) equipment permitting.

Wednesday, June 21st 2023: Assessing the status and trends of coral reefs

- Assessing the status and trends of coral reefs
- Summary of online course material for reef monitoring
- Interactive working session to develop reef approaches for Sri Lanka
- Data analysis methods

Thursday, June 22nd 2023: Modeling considerations

- Types of models (non-assimilating vs assimilating), forcing and boundary conditions,
- biogeochemical and ecosystem representations (U. Send)
- Current NARA modelling (unrelated to Xpress Pearl) efforts/capabilities (NARA)
- Applications of modeling studies (learning about processes, extending observations in space and time, forecasting, etc)
- Discussion about modelling needs

Thursday, June 22nd 2023: Modeling considerations

- Open Science
- Open Data
- o Open Data principles
- o Research Data Management Best Practices / FAIR
- Planning for Open Science / Open Data
- o FAIR Principles
- o Data Management Plans (DMP)
- o Persistent Identifiers - PIDs (Data, Software, DMPs and Physical Samples)
- o Data Licensing
- o Metadata and Documentation

Thursday, June 22nd 2023: Data Management (with instructional computers)

- Data Stewardship
- Data File Specifics
- Vocabularies and Ontologies
- Climate Forecast (CF)
- Data Formats (netCDF review)
- o Long Term Data Preservation / Repositories
- o Data accessibility for public dissemination
- Data Infrastructure
- o Hardware Platforms
- o Software
- Interactive practice session with provided Chromebooks
- The World Data System

ADB TA-9911 SUBPROJECT: DEVELOPMENT AND IMPLEMENTATION OF A TRAINING PROGRAM FOR TI NATIONLA AQUATIC RESOURCES RESEARCH

Methods and parameters to be measured for assessing environmental consequences resulting from any maritime disaster.

- Our training program was designed with this objective in mind and we had two major goals:

a). "assessing environmental consequences" – **this requires information on baseline conditions including "normal" pollution levels, ecosystem structure, vulnerability, natural temporal variability, prevailing physical oceanography etc** . This requires instrument parameters to be well known and calibrated, to have working instruments and methods ready and developed

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Methods and parameters to be measured for assessing environmental consequences resulting from any maritime disaster.

b). Designing a response– **we were hoping for an interactive discussion here to identify how the response from NARA would be different depending on where the maritime disasters occurred** , for example (in terms of ability to mobilize resources etc). Here, the knowledge from a) would help to inform the response. **Discuss frequency of sampling (which would be adaptive to the situation), discuss baseline measurements that are important for assessing ecosystem state, discuss responses to plastics and oil** (differences and similarities).

- Based on NARA response we will try to introduce a range of analytical approaches from simple to complex.

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Sampling strategies and preparing experimental designs

- Our training program was designed to address sampling strategies for assessing ecological impacts at the base of the food web (*our team does not have expertise in top marine predators - some turtle experience*), physical oceanographic parameters, and chemical measurements (including nutrients, (*we don't have expertise in metals but can get that information as necessary*) and industrial chemicals). We were planning to provide some input on designing a conceptual site model following a disaster..

- Based on NARA feedback case studies will be incorporated into the training.

Cont’d

Sampling strategies and preparing experimental designs

- Based on NARA response: There is interest in disaster mapping tools and we can **introduce NARA to the NOAA mapping resource** but our expertise is limited here since in the US this is handled by the federal response.

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Sample collection, preservation and storage techniques.

- We will provide guidance based on our expertise *but we can't cover all the areas that NARA has requested (e.g. ecotoxicological sampling).* We were planning to discuss both sample collection for assessing ecosystem impacts at the base of the food web and water, sediment, biota collection and storage for pollutants.

- We continue to assemble SOPs, literature on experimental design etc. to share

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Data computation and management techniques

- We were planning to cover ocean data storage and management.

Technical, operational, and management of laboratory equipment etc.

- We will have this information for the equipment that we are bringing but we won't be able to offer insight into other instruments until we visit.

Procurement and purchase of equipment

- This is underway and some of the equipment will travel with us.

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Economic assessment of environmental damage/costing

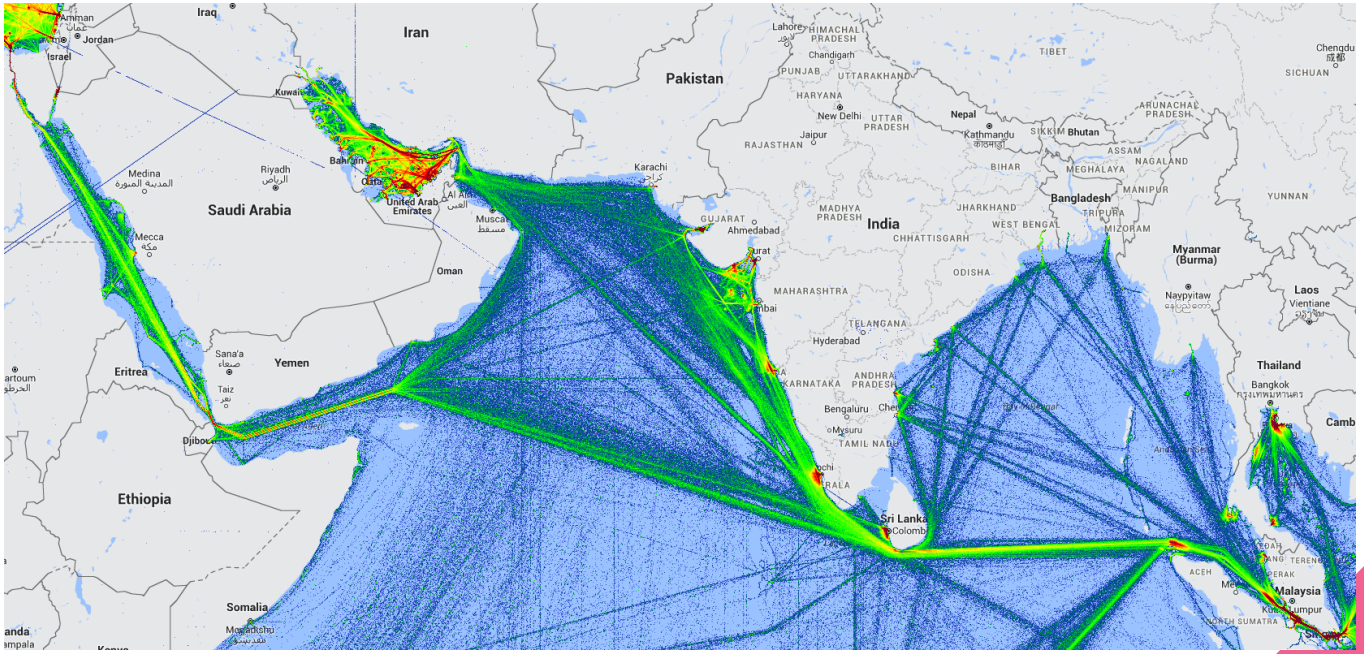
We envisioned two aspects to this training:

- We have an economic damage assessment expert who will discuss the mechanics of valuing different resources (asynchronous remote training; Carson).
- We have a tropical nearshore ecosystems expert (specifically reefs but also some broader expertise) who works in restoration and protection and we thought that the tools to monitor nearshore ecosystems could be useful for assessing the extent of ecosystem damage. This group uses a state of the art in-water monitoring approach but not remote sensing (NARA's preference is remote sensing).

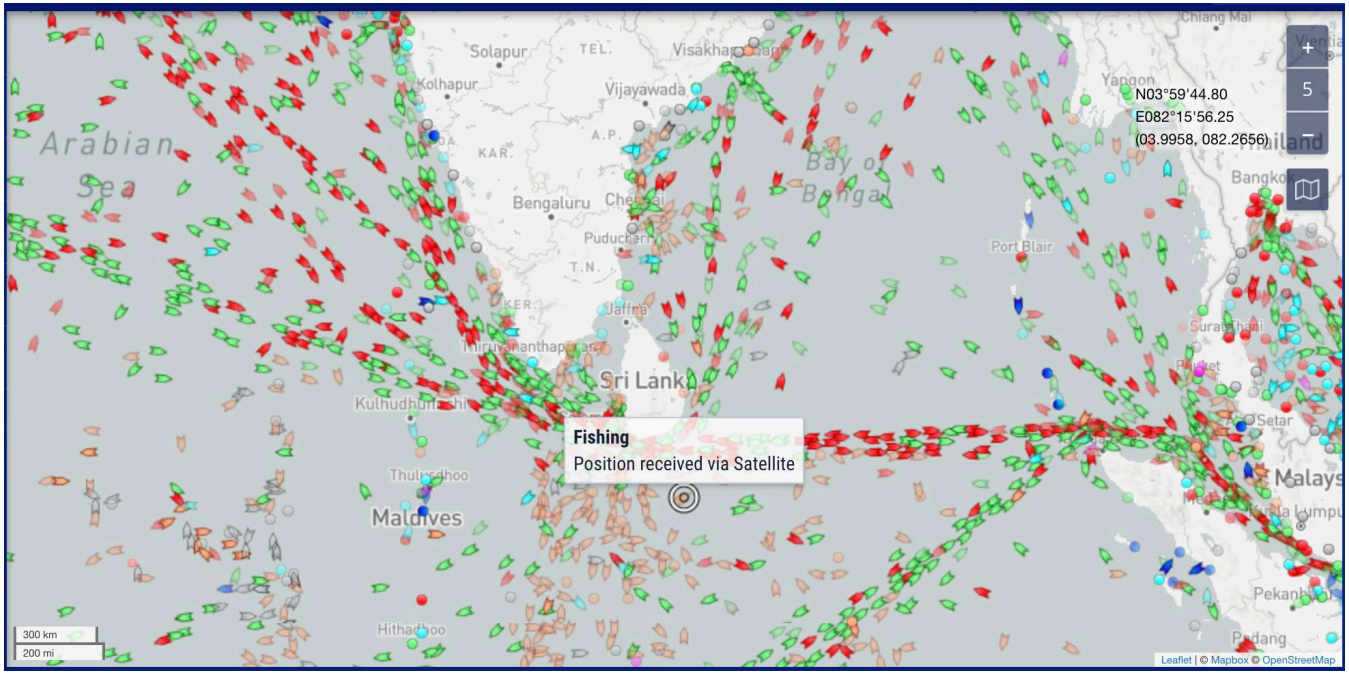
Guide development of data organization, storage and sharing methods

- We are offering this.

Potential for maritime disasters



Marine traffic snapshot



Cargo ships (green)
Tankers (red)
Fishing vessels (light red)
Unknown vessel (white)
Dark blue (passenger)

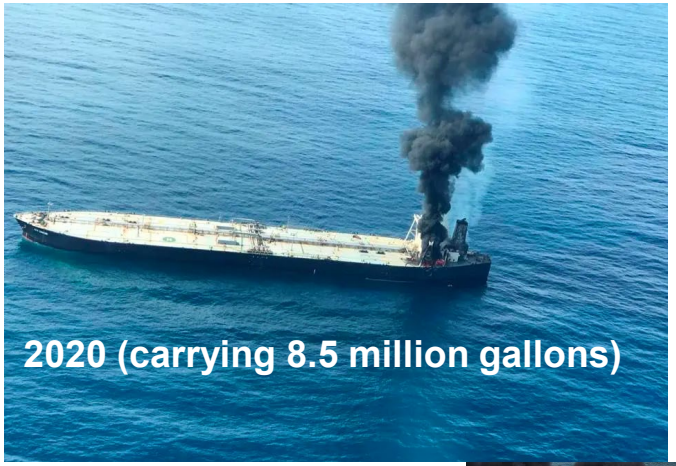
Fuel capacity of different vessels

- Cargo ships: 1.5-2million gallons of oil (as much as 4.5 million gallons)

(Plus cargo: e.g., nurdles)

- Oil tankers: 3.2-14.5 million gallons of oil

With 200-300 ships passing a day there is a risk

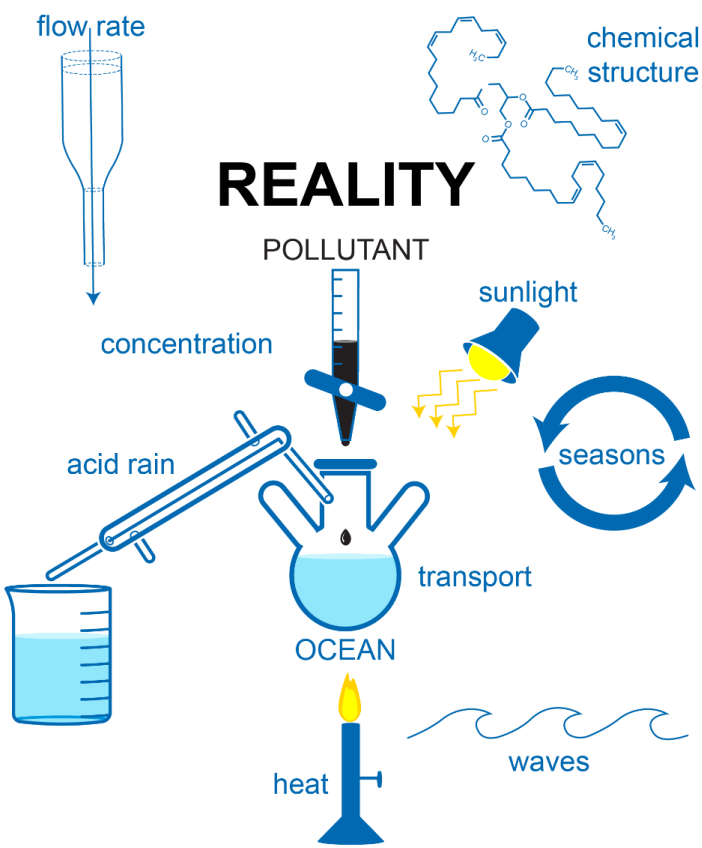


Authorities say the incident is an "eye-opener" that highlights the need to improve preparedness to quickly respond to spills off Sri Lanka, whose waters are heavily traversed by ships carrying oil from the Persian Gulf to East Asia

Fuels are not all the same: (https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/adios.html

PERCEPTION

REALITY



Chris Reddy, WHOI

Factors that NOAA considers when determining spill complexity
(Michel et al., 2011)

- Spill volume
- Product released (especially if unusual or dangerous)
- Spatial extent of oiling (e.g., number of miles or acres affected)
- **Number and complexity of shoreline types potentially affected**
- **Sensitivity of oiled shoreline types**
- Uniformity/complexity of oiling
- Multiple zones of oiling within segments prevalent vs. one continuous band
- "3-dimensional" oiling (e.g., oiling on stems or branches of marsh/mangrove)
- Spill conditions (e.g., buried or sunken, oil (evaporation, transport) or ocean conditions changing rapidly?)
- Sources changing (fuel oil versus plastics?)
- **Logistical constraints to shoreline access**
- Resource concerns that need to be specifically confirmed in the field
- **Recreational or industrial use of the oiled shorelines, seasonal use factors**
- **Commercial, recreational, and/or subsistence consumption of resources**
- Aesthetic requirements (which might require use of chemical agents or other means to reach endpoints)
- Degree of cooperation among the Responsible Party (RP) and Natural Resource Trustee agencies (Trustees)

NOAA ORR participated in 2021 workshop

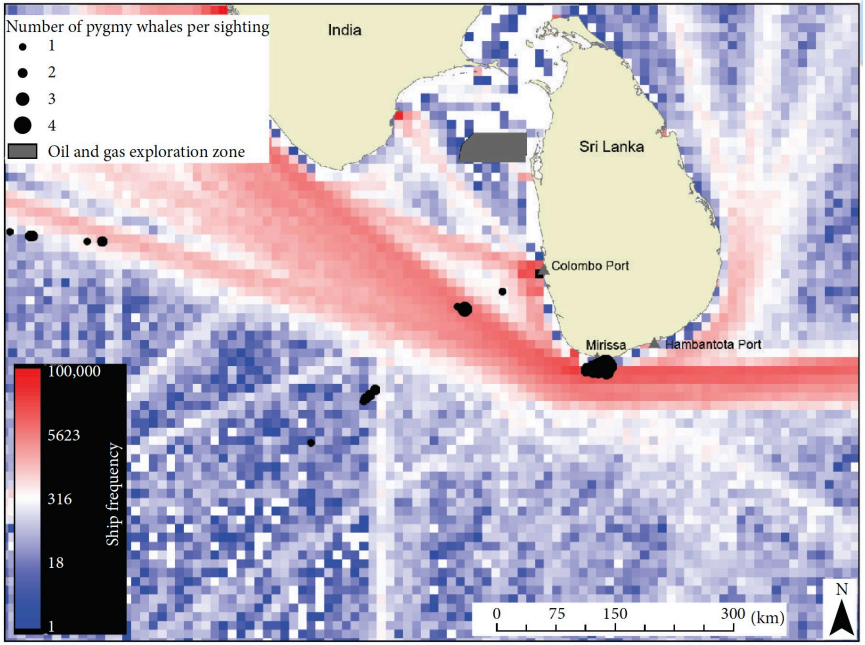
Participants in the Oil Spill Response Workshop held in Colombo, Sri Lanka from June 6-10, 2022. The workshop was sponsored by the U.S. Indo-Pacific Command (USINDOPACOM). Image credit: U.S. State Department

Conceptual Site Models

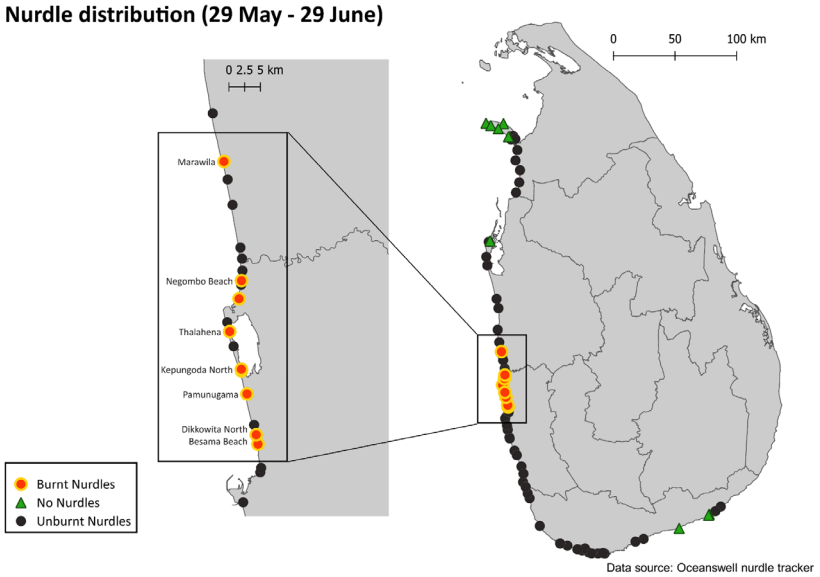
A conceptual site model is a useful tool for selecting sampling locations. It helps ensure that sources, migration pathways, and receptors throughout the site are considered before sampling locations are chosen.

- *Potential Sources*: Site (waste pile, lagoon); drum dump; sewage plant outfall; agricultural activities.
- *Potential Migration Pathway (Surface Water)*: Runoff from the waste pile, lagoon, drum dump, or agricultural activities; outfall from the lagoon or sewage plant.
- *Potential Migration Routes*: Ingestion or direct contact with water in the river, lake, or aquifer (e.g., ingestion of drinking water, direct contact with water at the public beach)
- *Potential Receptors of Concern*:
- Human Population (Residents/Workers/Trespassers): Ingestion or direct contact with contaminated water in the river, lake, or aquifer (e.g., swimming, drinking).
- Biota: Endangered/threatened species or human food chain organisms suspected of ingesting or being in direct contact with contaminated water.

Sensitive habitats ?

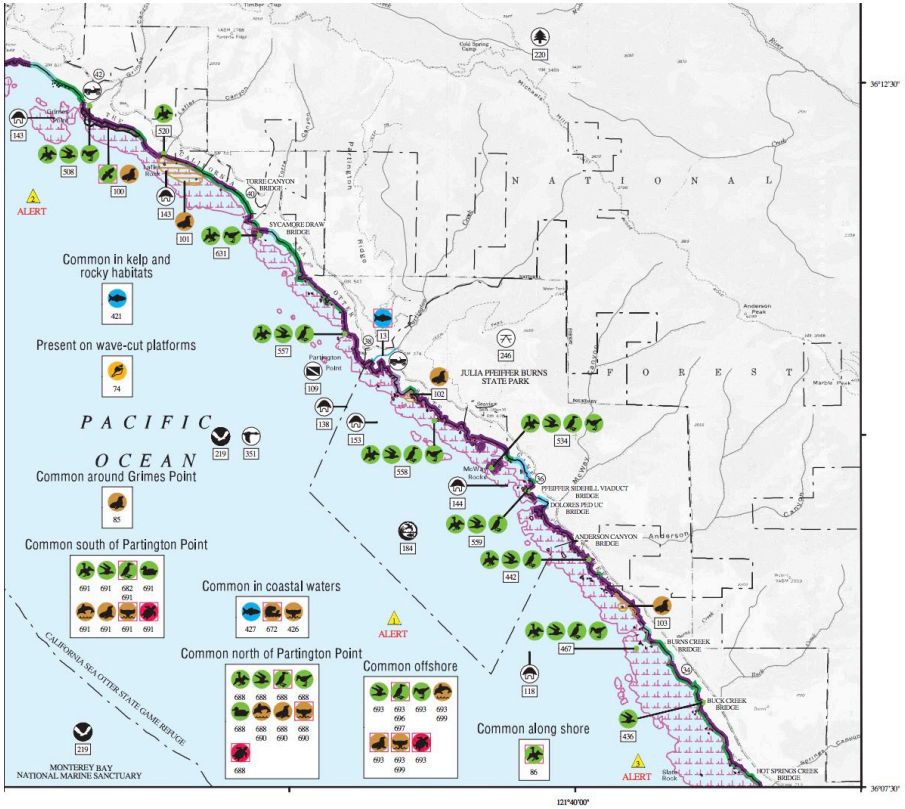


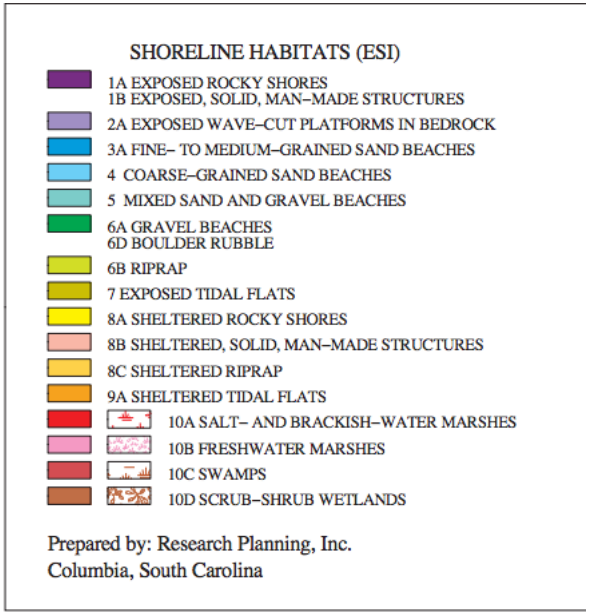
De Vos et al., 2016



De Vos et al., 2022

Environmental Sensitivity Indices?





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