Proceedings of the Regional Ocean Model System Overview Workshop

August 10-11, 2017

Long Marine Lab, UC Santa Cruz

Hosted by California Department of Fish and Wildlife
Marine Region

Table of Contents

Proceedings of the Regional Ocean Model System Overview Workshop

Workshop Participants

University of California, Santa Cruz (UCSC)

Mark Carr and Pete Raimondi

California Department of Fish and Wildlife (Department)

Becky Ota, Steve Wertz, Adam Frimodig, Sara Worden, Paulo Serpa, Amanda Van Diggelen, Mike Prall, and Leandra Lopez

University of California, Davis/Department Post Docs

Lauren Yamane, Nick Perkins, and Katie Kaplan

Acknowledgements

We extend a special thank you to UCSC, Long Marine Lab for allowing us to use their facility to host the workshop. We also thank Department staff Leandra Lopez for recording detailed notes of the discussions at the workshop.

Executive Summary

Pursuant to the Marine Life Protection Act (MLPA),[1] significant steps were taken to ensure California's marine protected areas (MPAs) were designed as an ecologically connected network. The California Department of Fish and Wildlife (Department) is developing priorities for designing a Statewide MPA Monitoring Program in coordination with the Ocean Protection Council and Ocean Science Trust. A Statewide MPA Monitoring Action Plan (Action Plan) will synthesize quantitative and expert informed approaches to long-term monitoring, and identify a priority list of indicators and sites for long-term monitoring to evaluate the performance of the network at meeting the goals of the MLPA.

The Department convened a workshop titled "Regional Ocean Modeling for Site Selection" in Santa Cruz, California, on August 10-11, 2017. The purpose of this two-day workshop was to facilitate the Regional Ocean Modeling System (ROMS) effort in progress by Dr. Pete Raimondi and Dr. Mark Carr of UC Santa Cruz, and develop a shared understanding for how the Department may utilize their ROMS connectivity modeling results to inform long-term MPA monitoring site selection.

On the first day of the workshop, discussions among the participants centered around 1) understanding how the ROMS model works; 2) reviewing the model results for a subset of priority habitats and indicator species; and 3) discussing the model accuracy and the process for fine-tuning the model to include specific physical and biological parameters. On the second day, UC Davis/Department post-doctoral researchers shared their progress on 1) analyzing and integrating extensive remotely operated vehicle (ROV) data, along with other visual data, to gain insights on MPA performance; and 2) developing effective methods to integrate MPAs with fisheries management. The focus of this proceedings document is to highlight key outcomes and next steps facilitated primarily during the first day of the workshop.

The workshop participants identified core priorities for moving forward on the ROMS connectivity model and eventual long-term monitoring site selection criteria. Next steps include:
1) Focusing on modeling planktonic larval duration (PLD) for species that are data-rich and recognized as species likely to benefit from MPAs, focusing on PLDs between 30-60 days
2) Fine-tuning the model by integrating specific physical and biological parameters
3) Modeling network connectivity both between and within rocky reef habitat types
4) Integrating the ROMS modeling results with the state-space integral projection models

[1] FGC §2850-2863.

Overview

California has adopted a two-phase approach to MPA monitoring to track the ecological and socioeconomic conditions in and around the network of MPAs, including Phase 1 regional baseline monitoring, and Phase 2 statewide long-term monitoring. A key priority for the Department for Phase 2 is to develop practical, cost-efficient standardized metrics that can be gathered consistently over time. Gathering consistent ecological and socioeconomic information over sufficient time and geographic scales is necessary to evaluate MPA network performance, inform adaptive management decisions, and ensure that the statewide network of MPAs is meeting the goals of the MLPA.

One component of long-term monitoring design is MPA and reference site selection. Establishing long-term data collection efforts at a select set of sites to better track MPA network performance over time will help inform adaptive management in a manner that is scientifically rigorous, cost-effective, and consistent with MLPA goals.[2] By leveraging existing partnerships and capacity of academic partners, this project will lower costs and ensure a scientifically robust product that meets or exceeds the scientific standards established by the state in order to effectively evaluate the performance of the MPA network.

Dr. Raimondi and Dr. Carr (PIs) of University of California, Santa Cruz (UCSC) have been tasked with developing long-term monitoring site recommendations inside and outside MPAs statewide to most efficiently support MPA network evaluation. These recommendations include:

1. Minimum number of sites that will support an assessment of condition and trends to evaluate the progress of the statewide network at meeting MLPA goals within the ten year management review time frame;
2. Siting recommendations that will support a more robust assessment of condition and trends to evaluate the progress of the statewide network at meeting MLPA goals within the same time frame;
3. Siting recommendations that will support a comprehensive assessment of condition, trends to evaluate the progress of the statewide network at meeting MLPA goals, and explicitly links to other state priorities.

The PIs have opted to use the Regional Ocean Modeling System (ROMS) as one tool to evaluate connectivity of California's rocky intertidal habitats, shallow rocky-reef/kelp forest habitats (0-30m), and deep rock habitats (30-100 m) as driven by oceanographic currents. The proceedings from this workshop are summarized below.

[2] FGC §2853(c)(3)

Day 1: Developing an Understanding for MPA Site Selection Criteria

1. ROMS based connectivity matrix overview: Network analytical approach to spatial sampling design

The ROMS framework is a free-surface, terrain-following, primitive equations ocean model widely used by the scientific community for a diverse range of applications. The PIs are using the ROMS model to evaluate connectivity of rocky intertidal habitats, shallow rocky-reef/kelp forest habitats (0-30m), and deep rock (30-100 m) habitats driven by oceanographic conditions. In simplest terms, the ROMS model allows users to make the basic assumption that larvae particles are moved around by oceanographic currents, and then track where those larvae particles are moving over a set period of time.

Detailed ROMS model approach:

1. The eastern Pacific coast is divided into eight regions ranging from Canada south to Mexico.
    a. Each region is divided into a number of 5km cells along its coast. There are 557 cells in total. (Figure 1)
    b. Mexico and Canada are included in the model because particles are subject to ocean currents and are not constrained to state/country borders.
2. The ROMS model simulates the release and movement of planktonic larvae from each cell under different temporal scenarios with respect to dispersal times (planktonic larval durations [PLD]) and oceanographic conditions.
    a. Particles can move in any direction (3-Dimensional movement)
    b. Oceanographic conditions are average annual conditions over 15-years (1999-2013)
        i. Current time period to model oceanographic conditions avoids major El Niño events, but these can be added to the model, or run separately, to simulate planktonic movement during anomalous years
    c. Over the 15 year period approximately 88000 larvae particles were released from each cell, within each bioregion
        i. Settlement of larvae depends on the PLD; PLD's can last from 5, 10, 15, 20, 30, 45, 60, 90, 120, 150, or 180 days
            1. ROMS model can used to model PLD for indicator species to track possible movement into and out of MPAs (Table 1)
        ii. Larvae particles either settle (larvae end up in an appropriate habitat) or die
3. The ROMS model currently assumes that habitat is proportional to amount of larvae production for species from that habitat (e.g. more kelp forest = more production of blue rockfish larvae)
    a. Estimates could (and should) be improved in the future through incorporation of:
        i. Site specific geomorphological, and physical attributes such as geology, rugosity, relief, sand scour, wave climate
        ii. MPA effect–over time protection should lead to increased propagule production for certain species

2. What is an appropriate geographic scale for network connectivity evaluation?

Three primary considerations and needed to determine an appropriate geographic scale for long-term site selection 1) oceanographic drivers (biogeographic scale), 2) the demographic life history traits of nearshore species, and 3) overlay of logistical constraints (access to sites, white sharks, etc.) While the current ROMS model has eight regions, the model shows large regional differences. Participants thought it best to discuss the current boundaries and adjust them based on our current understanding of biogeographic regions.

At or near the time of MPA implementation, baseline monitoring data was collected in each of four coastal regions: the north coast (OR-CA border to Alder Creek, 2013-2016), north central coast (Alder Creek to Pigeon Point, 2010-2012), central coast (Pigeon Point to Point Conception, 2007-2011), and south coast (Point Conception to the US-MEX border, 2011-2013). However, these divisions were selected during the MPA planning period in order to divide the California coast into reasonable geographies from a planning logistics viewpoint, not a biogeographical one. In order to better define bioregions informed by clusters of similar biota, workshop participants selected new bioregions for consideration in connectivity modeling. These new regions are the north coast (OR-CA border to Cape Mendocino), north-central coast (Cape Mendocino to San Francisco Bay), south-central coast (San Francisco Bay to Point Conception), and south coast (Point Conception to the US-MEX border.)

3. How will long-term monitoring sites be selected?

With long-term monitoring regions established, the PIs will use the ROMS model to determine how cells connect to all other cells using source-sink dynamics. A source cell is considered a cell where larval particle distribution has a higher rate of connectivity with all other cells, essentially larvae distributed from this cell disperse and settle to a disproportionate number of other cells (Figure 2). A sink cell exhibits the reverse trend, where larval particle distribution is low, but larval particle settlement from other cells is high. To determine if the network displays true connectivity, a mixture of both source and sink locations is recommended for site selection.

The PIs will use the ROMS model to determine which cells are contributing significantly as source locations both within their respective region as well as statewide. This includes running the ROMS model for PLDs, which primarily fall within the 30-60 day larval duration period; how larvae connect within the same habitats (i.e. cell connectivity from one rocky intertidal habitat to another rocky intertidal habitat); as well as between habitats (i.e. cell connectivity from rocky intertidal habitat to shallow rocky-reef habitat.)

MPAs and reference sites that have the following criteria are likely to be good indicators of MPA network connectivity and should be considered for long-term monitoring sites:

- High degree of connectivity with other cells prioritizing statewide connectivity over regional connectivity
    - Source locations will be prioritized for cells south of Cape Mendocino, as these are the locations that will be connecting the network through propagule distribution

    - Sink locations will be prioritized north of Cape Mendocino, any source cells north of Cape Mendocino will be contributing more to Oregon and Washington waters and are outside the evaluation of California's MPA network connectivity
- Multiple habitats represented within their boundaries
    - MPAs with multiple habitat types allow for cross collaboration on monitoring projects, and can help determine how marine ecosystems and species move across different depths and habitat types
- Historic monitoring data are available
    - MPAs and reference sites with historic data available will allow for data sets to be expanded temporally increasing the available information to help determine network performance for meeting the goals of the MLPA
- Sites are accessible for long-term monitoring (i.e. the site safe to monitor)
    - If other criteria are met, but researchers cannot physically get to the location there will be little utility in selecting that MPA or reference site as a long-term monitoring location

Figure 1. Eight regions assigned for the ROMS MPA network connectivity model

Table 1. Planktonic larval duration (PLD) of potential indicator species for network evaluation

PLD	Potential Indicator Species
10 DAYS	Red and black abalone
20 DAYS	Barnacles
30 DAYS	California mussel, basses
45 DAYS	California sheephead
60 DAYS	Nearshore rockfish, red and purple sea urhcins
90 DAYS	Yellowtail rockfish, rock crab, lingcod
120 DAYS	Blue rockfish

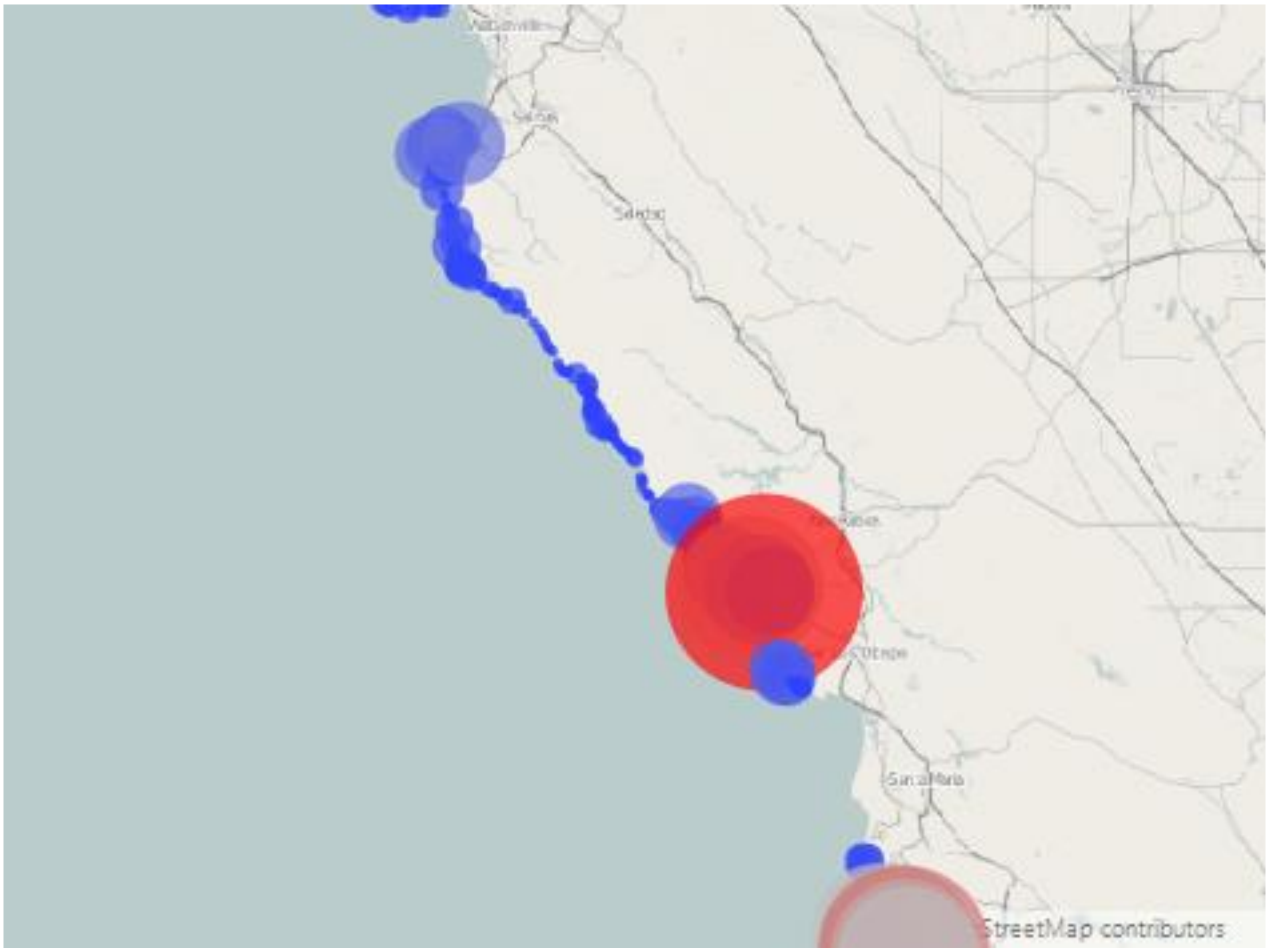

Figure 2. Effect of planktonic larval duration (PLD) on network connectivity; shallow rocky-reef habitat with a PLD of 60 days. Bubble size indicates the degree of connectivity with other cells, with larger bubbles indicating areas of greater connectivity (source populations).

Day 2: Integration Projects Update

MPA managers and partners are interested in learning from regional baseline monitoring efforts, and seeking resolution from a statewide network perspective, to discuss the best approach for arriving at a select set of MPAs throughout the network. Three, one-year contracts for post-doctoral fellows with a background in MPA data synthesis and integration began in early 2017, to aid in statewide, long-term monitoring planning. The three projects focus on:

1. Analyzing and integrating extensive remotely operated vehicle (ROV) data to gain insights on MPA performance;
2. Develop effective methods to integrate MPAs with fisheries management; and
3. Helping to develop the Action Plan to inform long-term statewide MPA monitoring.

Two of the three post-doctoral fellows were able to attend the workshop and provide an update on their progress to help inform the evaluation of the MPA network at meeting the goals of the MLPA.

1. Deep-water habitat surveys with ROVs: Spatial point process models for benthic visual survey and sampling design

This project focuses on the analysis and integration of an extensive ROV data set collected by CDFW and Marine Applied Research and Exploration to gain insights on MPA performance to date and inform the creation of the Statewide MPA Monitoring Action Plan.

ROV data needed to be conditioned for ongoing development of spatial analyses to examine species density at hard bottom index sites inside and outside of MPAs. Now that data conditioning is complete, spatial point process models can model ROV transect data and bathymetric layers. A model simulation was presented for rockfish in the Bodega Bay area. The simulation informs understanding of ROV transect precision, number of transects needed to achieve similar results between ROVs and video landers, and number of transects necessary to achieve a statistical power that will show significant results over time. While a scarcity of data associated with some species can lead to high model uncertainty, spatial point process models may be useful as a power analysis to decide final sampling design for the deep water MPA monitoring program.

Workshop participants recommended:

- ROVs be used over video landers due to the amount of data that can be collected within the same period of time;
- The model be expanded to simulate/test other areas; and
- Incorporate information such as fishing effort to project changing abundances

2. Integrate MPAs with Fisheries Management: Assessing MPA effectiveness and integrating MLMA-MLPA

This project focuses on the development of effective methods for the integration of MPAs with fisheries management. The development of quantitative approaches to integrate the ocean health goals of the

MLPA with ecosystem-based fisheries management requirements of the Marine Life Management Act in fishery management plans is the goal.

In order to assess MPA effectiveness local fish mortality rates are being modeled. Local mortality rates can be estimated by looking at fish species size distributions over time and modeling size structure changes by taking into account both natural mortality (i.e. disease, old age, predation) and fishing mortality (removal of fish from a stock by fishing.) High fishing mortality will be apparent in areas where fewer large, old fish are present. By modeling mortality rates, pre-MPA annual recruitment rate can be estimated to help establish transient population dynamics.

Workshop participants recommended:

- Looking to regulations for particular minimum sizes of indicator species;
- Choosing species that have strong data sets, and avoid certain species with missing size distributions based on cryptic size classes
    - Red abalone, blue rockfish, and scorpionfish were identified as species with strong data sets
- Considering the need to model recruitment data

3. Develop the Action Plan to inform long-term, statewide MPA monitoring

The third project will focus on the development of the Action Plan that will inform the approach to long-term monitoring of the statewide MPA network. The creation of the Action Plan, which will identify the sites and temporal frequency of sampling and metrics, needed to evaluate network performance and inform the adaptive management of California's MPA network.

Next Steps

The immediate primary purpose of the workshop and ROMS connectivity model, along with post-doctoral contracts, is to assist the state in identifying priority monitoring parameters and sites to include in the Action Plan, which is anticipated to be released in 2018. MPAs and reference sites should also be selected to represent and span important biogeographic features along the coast. Because there are many definitions of biogeographic regions and the MLPA planning regions are not based strictly on biogeography, the group suggested that selection of MPAs to be monitored should not be constrained by the MLPA planning regions, but rather using newly drawn borders, or a statewide focus as required by the MLPA. The PIs should also work to incorporate potential MPA effects into the ROMS model (increase production in any given cell), and look both within and between the three types of habitats. At least one other workshop, if not more, will likely be needed to continue fine-tuning the model to display MPA network connectivity statewide.

Appendix A: Workshop Agenda

ROMs Model Workshop Agenda

Long Marine Lab, UC Santa Cruz
115 McAllister Way, Santa Cruz CA 95060
August 10-11, 2017

Participants

UCSC: Mark Carr and Pete Raimondi
CDFW: Becky Ota, Steve Wertz, Adam Frimodig, Sara Worden, Paulo Serpa, Amanda Van Diggelen, Mike Prall, Leandra Lopez
UCD/CDFW Post Docs: Lauren Yamane, Nick Perkins, and Katie Kaplan (she will try to join us for some of the time via phone)

Workshop Objectives

Day One:

- Gain understanding of how the ROMs model works
- Review model results for a subset of priority habitats, indicator species (PLDs), and sources/sinks for indicator species
- Discuss model accuracy and parameters, the process for fine-tuning the model to include specific physical and biological parameters, and integrating the model with other work (i.e. post-docs' projects, CDFW MPA habitat spreadsheet)
- Identify next steps for how to best use the model to inform the Statewide MPA Monitoring Action Plan

Day Two:

- Presentations by post-docs on MPA Monitoring Action Plan, MLMA, and ROV projects
- Discuss post-doc projects, alignment with state priorities, and integration with ROMs model

August 10: ROMs Model Overview and Brainstorm Session

10:00-5:00: Center for Ocean Health Library, room 201 (upstairs to the left)

10:00-10:10	Introductions and logistics for the day
10:10-11:10	Presentation: ROMs model overview and question/answer session
11:10-11:25	BREAK
11:25-12:30	Presentation: Model results for priority habitats, indicator species, sources, sinks with time for questions
12:30-1:00	LUNCH

1:00-2:45	Group Discussion and Brainstorm: Preliminary results, model accuracy, fine tuning the model, action plan integration
2:45-3:00	BREAK
3:00-4:30	Continue Group Discussion and Brainstorm
4:30-5:00	Next steps
5:00-???	Optional team activity

August 11: CDFW/UCD Post-docs Project Presentations and Discussion

8:30-11:30, Center for Ocean Health Library, room 201

8:30-8:35	Welcome
8:35-9:30	Presentation (Nick and Mike): ROV work, workshop overview and group questions
9:30-9:40	BREAK
9:40-10:30	Presentation (Lauren): MLMA/Action Plan and group questions
10:30-11:30	Group Discussion: Project alignment with state priorities and ROMs model

Appendix B: Workshop Detailed Notes

Regional Ocean Model Workshop Notes

Long Marine Lab, UC Santa Cruz

August 10-11, 2017

Participants

UCSC: Mark Carr and Pete Raimondi

CDFW: Becky Ota, Steve Wertz, Adam Frimodig, Sara Worden, Paulo Serpa, Amanda Van Diggelen, Mike Prall, and Leandra Lopez

UCD/CDFW Post Docs: Lauren Yamane, Nick Perkins, and Katie Kaplan (telephoned in)

Note Taker: Leandra Lopez

Workshop Outcomes

Day One:

1. Gained a deeper understanding of how the ROMs model works through a presentation about and live example outputs produced from the model.
2. Developed a list of key priorities for the Action Plan:
   - Identify the MPAs that are the largest sources
   - Model a range of PLDs that produce the most accurate results across the three priority habitats
   - Examine MPAs regional vs. statewide contributions
   - Model connectivity by decided upon bioregions
   - Recommend run ROMS statewide as tier 1 and regional as tier 2 to validate statewide outcomes
   - Important to fine tune model by integrating specific physical and biological parameters, and other work (i.e. post-docs' projects, CDFW MPA habitat spreadsheet)

Day Two:

1. Gained a deeper understanding of post-doc projects through presentations and discussions of preliminary simulation results.
2. Developed a list of suggested changes to strengthen the projects (see UCD/CDFW Post-Doc action items)

Action Items

UCSC:

1. Produce model outputs for tier I priorities (listed under Day 1 workshop outcomes) agreed upon by the group to present at the next modeling/siting workshop.
2. Refine/integrate south coast habitat mapping data into ROMS (requires input from #5 CDFW below)
3. Incorporate MPA effect into the model (increase production in any given cell)
4. Make reference site selections

5. Overlay criteria on CA map
    a. Determine if source/priority MPAs are distributed statewide
    b. How source/priority MPAs align with other design criteria (i.e. ASBSs)

CDFW:

1. Provide new list of practical de facto SMR specifically for the habitat UCSC is looking for
2. Request habitat mapping data from ODFW
3. Ground truth MPAs that rise to the top of the models using MPA criteria spreadsheet
    a. Determine how feasible it is to monitor multiple habitats at the MPAs identified as priority/source locations
4. Examine overlap with historical data
5. Send Post-docs nearshore finfish life history information from Greg Cailliet work (CDFW) Reanalyze habitat mapping data within ROMs cells with WZ updates and additional Point St. George. (First step requires pending updates from UCSC)

UCD/CDFW Post Docs:

ROV Project:

1. Link the temporal variance structure between the MPA and reference site transect simulation

MLMA/MLPA Integration

1. Examine and choose more appropriate fish data for minimum catch and recruitment sizes
2. Create model outputs using other data rich focal species like abalone
3. Consider modeling recruitment data

Critical Dates

Next Workshop tentatively planned for January 2018

Meeting Summary

Presentation by Pete Raimondi: *Network analytical approach to spatial sampling design*

Presentation Overview

- Walked through the Regional Ocean Modeling System (ROMS) and habitat based modeling system that will inform network-based evaluation of California's MPAs
- Provided background on the "construction" and function of the model
- Demonstrated some initial outputs from the model including levels of raw connectivity and contribution ("source") vs settlement ("sink") based connectivity (connectivity index) based on 11 planktonic larval durations (PLDs). The PLDs range from 5 to 180 days.
- Demonstrated model output for PRIORITY MPAs identified by CDFW. These demonstrations offered insight into the importance of time and spatial scales.
    - Model biases exist on the north and south borders due to a lack of data from Mexico and Oregon.
    - The northern most cells mainly contribute to Oregon but not California
    - Statewide vs Regional PLD contribution outputs for some Priority MPAs were drastic (Point Arena as an example), highlighting the significance of looking at the model on a regional scale.

- While model output will be prioritized statewide, looking at a regional perspective will ensure site selected can provide good source populations both on a small and large scale.

Q& A, Group Discussion, and Brainstorm:

Main Discussion points

1. Initially questions were asked about overall goals of the use of the ROMS model and ways to best frame the assessment of the Network

   Questions raised:

   a. Is the network performing in some way?
   b. What are some of the ways to measure network performance?
   c. Does the network contribute to areas that have been overfished?
   d. In what ways does the network contribute to the sustainability of other MPAs?
   e. How important are the overall contributions relative to the regional contributions?

   Conclusions:

   a. Focus should begin from a broad perspective in order to address management goals.
   b. The conceptual design of the CA MPA Network called MPAs to be spaced such that the species within would replenish stocks inside of MPAs thus the assessment should be based on this assumption
   c. Target and monitor MPAs that the model identifies as important sources for replenishing other MPAs because these subsequently replenish non-MPA areas.
2. Importance of sink sites and their relevance to monitoring
   a. Sinks represent an important aspect of the resiliency of the network. Large sinks may offer protection to certain populations, promoting their persistence in times where source populations decline
   b. Monitoring sinks is going to depend on the stage for which monitoring is conducted
   c. Viewing which MPAs are important sinks may be useful criteria for determining Tier II sites
3. Importance of appropriate PLD lengths for use in assessing the network
   a. Example outputs shown the value of viewing the model at different spatial scales and PLD lengths and lead the group to discuss what spatial scales
   b. The group discussed the merits of different PLD lengths, noting that shorter PLD lengths, especially as short as 10 days don't have much of a network affect but do allow for self-recruitment
   c. Longer PLDs, especially as long as 120 day lengths highlight the network effect but dont capture
   d. Model outputs using PLDs from 30 to 60 days would offer insight appropriate to the needs
4. Reassigning regional biogeographic boundaries
   a. Example outputs on a regional scale used boundaries based on MLPAI distinctions and seeing the drastic differences Priority MPA sites had on a statewide vs regional scale lead the group to decide that regional boundaries should be reassigned based on stronger biogeographic qualities
   b. ***New*** Biogeographic regions

i. Oregon border to Cape Mendocino
ii. Cape Mendocino to SF
iii. SF to Point Conception
iv. Point Conception to Mexico

5. Direction of monitoring efforts if ROMS analyses shows particular sites to be of higher importance
    a. It was discussed that ROMs results alone would not drive a drastic change in current monitoring project site selection until a strategy was fully incorporated in the Action Plan.
6. Best ways to compare MPAs and how to choose reference sites
7. Habitat specifics and attributes
    a. Discussed the relevance of multi-beam data for 30 to 100m rock habitat

Example Outputs that we examined

1. Contribution (y-axis) vs SMR (x-axis)
2. Contribution (y-axis) vs No-Take SMCA (x-axis)
3. Mean Contribution (x-axis) vs All MPAs (x-axis) on the central coast
4. Mean contribution of ALL MPAs Statewide & regional contribution across the PLD range
5. Mean regional contribution & mean contribution vs protection

Possible Model Tweaks:

1. Site specific geomorphological attributes
2. MPA effect (even site specific factors)
3. Look at sink factors over source north of Mendocino in order to help decide appropriate monitoring sites.
4. Toggle feature (?) for comparing Network with and without MPA effect
5. How to factor in MPAs whose historical area was smaller but are now larger?

Presentation by Mike Prall: *ROV work and workshop overview*

Presentation Overview:

- Using CIAP ROV data (2014-2016). Looking at biogeographic analyses
    - Looking at 6 fish sp. (gopher, brown, canary, lingcod, quillback, yelloweye) latitudinal breaks
- 2nd Deep Water Monitoring Workshop – June 2017
    - Provided the state with tool & MPA recommendations for long-term monitoring of deep-water habitats
    - Discuss various tool and analytical technique combinations for conducting deep-water MPA monitoring
        - ROV, manned sub, video lander, video sled
    - Articulated the tradeoffs between different approaches
    - Made recommendations for site selection

Q& A, Group Discussion, and Brainstorm:

Main Discussion points

1. ROV Methodologies and ROV video review

2. How much do we need to sample?
    a. Statistical power – effect size –
3. How do we calculate a mean density for a given site or MPA?
4. How do we model spatially specific data to reduce underlying variability?
    a. ROV in situ data
    b. Bathy survey data

Presentation by Nick Perkins: *Spatial point process models for benthic visual survey and sampling design*

Presentation Overview

- Nick provides overview of spatial point process models and their relevance to long term MPA monitoring, sampling design, and tool comparison
- Model uses ROV transect data and bathymetric layers
- Demonstrates model simulation using brown rockfish. The simulation informs understanding of ROV transect precision, number of transects needed to achieve similar results between ROVs and video landers, and number of transects necessary to achieve a statistical power that will show significant results over time

Q& A, Group Discussion, and Brainstorm:

Main Discussion Points

1. Comparing Lander drops to ROVs including number of transects,
2. Difficulty of realizing a network effect
    a. Thinking of more maybe you have a specific bioregion
    b. **Decades to detect statistical power from sampling**
    c. Issues with comparing sites. Spatial vs treatment level
3. Rugosity and relief and its effect on sampling efforts
4. Effect of ROMS model on spatial point process model – possibly providing more predictable trends

Model Tweaks

1. link the temporal variance structure between the MPA and reference site transect simulation

---

Presentation by Lauren Yamane: *Assessing MPA effectiveness and integrating MLMA-MLPA*

Presentation Overview

- Provided an overview of their project's work to assess MPA effectiveness while also addressing goals of the MLMA; to shape upcoming MPA monitoring in a manner that ensures the collection of relevant fisheries management information
- Gave an overview of the rationale behind their approach which focuses on finding local fishing mortality rates
    - Can look at size distributions over time and estimate fish mortality rate (size structure changes)

- Stock Assessments traditionally have fishing mortality rates for much larger areas
    - It can help determine the rate at which the population is expected to replenish itself
    - This model can help estimate the pre-MPA recruitment annual rate – necessary for establishing the transient population dynamics
- Gave an overview of the State Space Integral Projection Model (SSIPM) and its two main components- the Process model (IPM) and the observation model and the work of Kerry Nichols that describes the expected timelines for populations to "fill in"
- Katie conveys the impacts of her work on measuring sample size and the effect on the model's performance- for some species the model fits very well, others not so well
    - Maybe there are a handful of "indicator" species that could act as good indicators of local mortality
- Examining simulations from different species (blues, blacks, yellow)
    - For F=0.05 its never a very good fit (likely variability in recruitment is swamping out recruitment in the size structure)
    - Need to figure out why certain simulations aren't fitting very well
    - Why is it fitting better at higher f?

Q& A, Group Discussion, and Brainstorm:

Main Discussion Points

1. Minimum catch size for fish, what data to reference, and the many considerations that may have to be taken into account when choosing a size
    a. Data and things to consider included CRFS, landing data, stock assessments, fishing style changes, release mortality, high grading, live fish fishery and gear types,
    b. Recommended to look to regulations for particular minimum sizes
    c. Does the model need a hard number for this parameter or could a Bayesian input be considered?
2. More on accuracy of given parameters and choosing species that have strong data sets. Missing size distributions based on cryptic size classes for certain species
    a. Greg Caillet has a worksheet about species life histories
    b. Red abalone recommended as focal species
    c. How much info is needed to know about YOYs?
    d. Scorpion fish recruitment data is available to a very fine scale (to the cm)
3. Recruitment data, what data to reference, what other parameters should be considered when choosing recruitment size
    a. Certain species recruitment is episodic leading to gaps and absence of fill-in rates
    b. Careful of recruit sizes because it is dependent on time of year.
4. Modeling recruitment: Is there a feedback based upon the other MPAs that are in the vicinity? Is it all driven by death or input? Are there two ends to the MPA effect or is it all driven by recruitment?

Model Tweaks

1. Consider limitations of fish data for minimum catch size, recruitment size
2. Consider using data rich focal species like abalone
3. Consider modeling recruitment data
4. Determine why certain simulations aren't fitting well