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Collaborative Monitoring of the Spiny Lobster in the Channel Islands Marine Protected Areas

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California's marine fisheries policies strive to encourage growth of commercial fisheries while protecting ecosystems. To further these policies, the California Fish and Game Commission implemented several no-take marine reserves (i.e., *marine protected areas* [MPAs]) within the Channel Island National Marine Sanctuary (CINMS) in April 2003 [1]. This region is a major fishing ground for California spiny lobster (*Panulirus interruptus*), and the lobster industry has shown considerable concern about how these MPAs may affect their fishery. In January 2004, we proposed to monitor these potential effects by measuring juvenile and adult spillover from the MPAs into the lobster fishery.

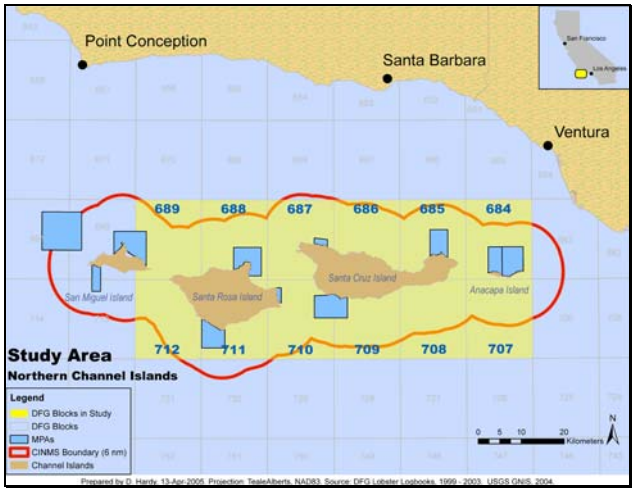

Figure 1: Our Study Area.

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Table 1: Our Project Focus

Collaboration (Chapter 2)	Collaboration between stakeholders, and its role in long-term monitoring.
Pilot Study (Chapter 3)	A detailed pilot study to assess lobster population demographics and behavior.
Logbooks (Chapter 4)	A historical baseline of catch data using landmarks (Figure 1) in our study area.
Recommendations (Chapter 5)	Policy and practical advice for resource managers and other stakeholders.

Our project's purpose is to measure juvenile and adult spillover from CINMS MPAs into lobster fishing grounds. Our main objective is to collaboratively develop methods to collect, organize, and analyze lobster fishery data both inside and outside the MPAs through a long-term monitoring plan. To achieve our objective, we select our study area (Figure 1), focus on three key aspects (Table 1) – collaboration, a pilot study, and logbooks – and give recommendations.

Marine Reserve Monitoring

At CINMS, current MPA monitoring programs focus on evaluating ecosystem impacts of MPAs [2]; however, they deal with few fishery objectives. For example, these programs do not study the effects of marine reserves on abundance, distribution and movement patterns – yet these effects are vital to fishery management.

Long-term monitoring provides quantitative information about population size, growth rates, fertility patterns, and juvenile and adult spillover between MPAs and fished areas. Resource managers can use these data to evaluate effects of MPAs on fisheries to achieve management goals.

Collaboration

Collaboration is vital to the success of most fishery research. It not only provides a forum to combine knowledge and experience from all parties involved, but it also yields results for each stakeholder. Thus, our project values cooperation between the lobster fishery, researchers, and government agencies.

Each party in our project brings unique skills and expertise to the collaborative (Figure 2). Agencies provide policy guidance and access to data and resources; lobster trappers provide local knowledge, technical fishing expertise, and socioeconomic and cultural realities; and researchers provide scientific guidance and field expertise. This alliance holds more promise for a comprehensive evaluation of the marine reserve impacts on the lobster fishery than factions. In turn, this partnership may prove useful for trappers and scientists as they strive towards other goals, such as creating a spiny lobster fishery management plan. Furthermore, combining skills and expertise help fill gaps in data and understanding that research projects face over time.

Our project outlines a model for collaboration that lays the groundwork for a common mechanism to involve the fishing industry in future research. We provide this model because no institutional framework to involve members from the lobster industry in research and monitoring is readily available. For example, in the case of the Channel Islands, the relationship between agencies, scientists, and the fishing industry soured during the MPA design process [3]. Ineffective communication based on past experiences, societal roles, and cultural misunderstandings often exists between agencies, scientists, and fishermen. Throughout the CINMS MPA design process, these communication problems resulted in tension and distrust. Our project focuses on the dynamics of building trust and healthy relationships among stakeholders, as they are required to foster positive interactions.

Figure 2: Trapper Chris Miller and Researcher Sarah Abramson (left) discuss trapping sites at Santa Cruz Island, and Sea Grant Advisor John Richards and Chris Miller (right) measure lobster.

Pilot Study

Our pilot study was initially based on a monitoring framework developed by Stadler [4] for use within and outside of the Channel Island MPAs. We developed the pilot study into a detailed, step-by-step methodology based on collaboration and extensive feedback. When implemented, resource managers and lobster trappers can use pilot study data to better understand the impacts of these MPAs on local juvenile and adult lobster populations. Over the long-term, this information will help resource managers evaluate the effectiveness of MPAs as a lobster fishery management strategy.

Pilot study data will provide baseline data for estimating juvenile and adult size distribution and abundance, sex ratios, and reproductive characteristics. Lobster fishery assessment models will then have baseline demographic population data on which to run. We recommend analyzing these data through a nested 3-way ANOVA design to refine the necessary number of sample sites and replicates for long-term monitoring [5].

In addition to providing ecological refuges for many species, marine reserves represent the unfished areas required by fishery stock assessment models for the entire Santa Barbara Channel. Through MPAs, researchers are able to compare characteristics of specific populations over time between control sites (fished areas) and treatment sites within the MPAs. The sampling regime we propose is based upon a trap and tag, or *mark-recapture*, method that will allow for direct comparison of individual juvenile and adult lobster growth and movement over time.

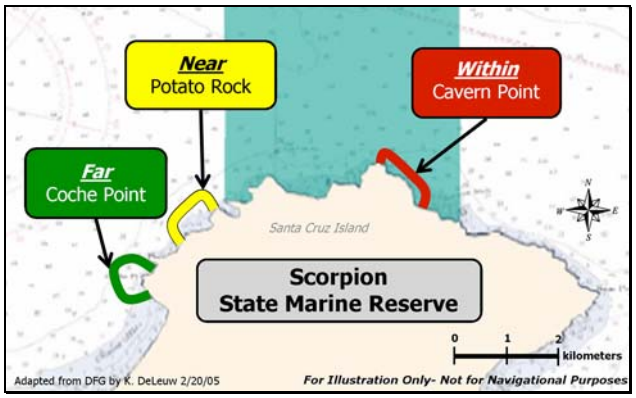

Figure 3: Study sites (within, near, and far) for the Scorpion MPA located off Santa Cruz Island.

We recommend standardized study sites located within, near and far from MPAs [6] at Santa Rosa, Santa Cruz (Figure 3), and Anacapa Islands. We ranked study sites based primarily upon local trapper knowledge of the most suitable lobster habitat. Specific trap locations within these sites would be according to a *stratified random sampling* design at each of three depths (e.g., shallow 3-7m, moderate 7-10m, deep 10-20m). We recommend two sampling periods during the lobster fishing off-season. The sampling would be in cooperation with local lobster trappers through paid charter using standard trapping equipment and bait techniques.

Analysis of Commercial Logbooks

Effective long-term monitoring requires a historical baseline to evaluate spatial and temporal variation. For the spiny lobster fishery, few information sources offer datasets that could serve as a historical baseline, and even fewer offer high spatial-resolution catch data. Spatial resolution is important for monitoring because it is the basis for comparison between reserves and fished areas. However, we found a latent source for historical catch data in the California Department of Fish & Game (DFG) commercial lobster logbooks. We revisited 5 seasons (1999-2003) of logbook paperwork and recorded trap locations for catch and *catch performance*. These trap locations identify *landmarks* (Figure 1) that we used to build an improved historical baseline.

Our results include a historical baseline of catch and catch performance with improved spatial resolution, a landmark *gazetteer*, and an applied analysis of lobster catch value. Furthermore, our methodology (Table 2) is straightforward and applicable to other management situations that require improved spatial resolution.

Table 2: Methodology for Logbook Analysis

1.	Identify study area; obtain associated catch and catch performance data.
2.	Import those data into a new database for better support of research questions and data validation.
3.	Enter and associate trap locations with catch and catch performance data.
4.	Locate, characterize, and consolidate trap locations into gazetteer.
5.	Perform analyses to generate the historical baseline data.

The landmarks cover areas both inside and outside the MPAs for the northern Channel Islands. Although the size of the fishing areas identified by local landmark names is variable and unknown, they are considerably smaller than DFG blocks, the previous spatial unit used for catch data. In fact, by annotating our historical baseline with landmarks, we improved the spatial resolution of catch and catch performance by one order of magnitude – our landmarks represent a few to tens of square miles of fishing grounds.

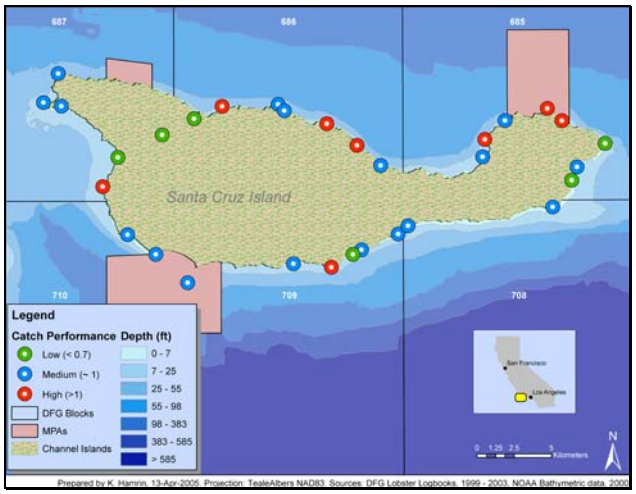

Figure 4: Mean Catch Performance for each Landmark at Santa Cruz Island, 1999 – 2003 seasons.

Conclusion

To measure juvenile and adult spillover from the MPAs into the lobster fishery, we introduce a pilot study methodology to monitor lobster population demographics and behavior, and provide a historical baseline of catch data based on landmarks. We also provide recommendations (Table 3) to our stakeholders.

We stress the importance for collaboration between the fishing community, agencies, and researchers. Our collaborative model provides a basis for collaborative fisheries research, which is not only important for monitoring but also essential for innovative approaches to fisheries management.

References

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Table 3: Key Recommendations

Collaboration
• Forming a Steering Committee with representatives from each participating stakeholder party. • Formalizing leadership roles and research agreements through written contracts to ensure responsibilities are clear to everyone involved.
Pilot Study
• Implementing the pilot study, prior to a long-term monitoring plan. • Ground-truthing proposed sample site to confirm presence of suitable lobster habitat and identify variability between sites.
Analysis of Commercial Logbooks
• Publish our historical baseline data and annual lobster logbook reports as public resources. • Adopt the landmark gazetteer to improve the spatial quality of catch data.

Glossary

Catch performance
Mean number of legal lobsters caught per trap.

Gazetteer
A catalog of names with geographic references.

Landmark
A conspicuous object, natural or man-made, located near or on land, which aids in fixing the position of an observer.

Mark-recapture
A method of estimating fish population size by marking a number of individuals then re-sampling the stock at a later date.

Marine protected area
Any coastal or open ocean area in which certain uses are regulated to protect natural resources, biodiversity, or human livelihoods.

Stratified random sampling
Random sampling within strata, or areas of known suitable habitat that share the same characteristics.