



Aerial Monitoring of Ocean Vessels in Southern California

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Project Overview

Objective long-term data on the type, extent and location of boating and boat-based fishing directly supports the success of marine spatial planning and resource management of coastal oceans. This project was initiated to generate an objective fishery-independent dataset to define the extent of boating activities in the state waters off the coast of mainland southern California. Now that a network of Marine Protected Areas (MPAs) has been established off this coast, these data allow in-depth descriptions and analyses of trends in fishing activities and compliance with the new regulations associated with this network. This information will be very useful in the adaptive management and enforcement of this network.

This project reflects the work of three partners; Santa Monica Bay Restoration Foundation, LightHawk, and Los Angeles Waterkeeper.

Pre-MPA

September 1, 2008 was the first of 41 flights that accurately mapped the type, location and activity of vessels (from oil tankers to kayaks) operating in state waters of the mainland coast of southern California from Point Conception, Santa Barbara County to the US / Mexican Border. 5,304 vessels were observed and recorded during a two and one half year effort, (9/1/2008 through 4/1/2011). This objective, fisheries-independent dataset was incorporated into the South Coast Marine Life Protection Act Initiative by providing spatially specific information on the extent and type of fishing occurring off the coast. These data helped the stakeholders and decision makers involved in this process determine the locations for a network of MPAs while allowing areas valuable to fishing to remain accessible.

Post-MPA

January 20, 2012 marked the first flight following the establishment of the south coast MPA network. The same method applied pre-MPA continues to be used to describe trends and responses to the MPA network, namely from the fishing communities that have been restricted due to the MPA network. The information from this effort will be useful to decision makers, enforcement agencies, stakeholders, scientists and resource managers charged with enforcing and adaptively managing the newly established network in two ways. Firstly, as the location, type and activity of vessels are observed and collected, noncompliance with the new regulations is accurately depicted by this dataset. Locations with high rates of noncompliance are identified, which enables the California Department of Fish and Wildlife and others to engage in strategic and highly effective enforcement efforts. In addition, sectors of the fishing community with high rates of noncompliance can be addressed in similarly targeted and effective way as a fishery, independent of location. Secondly, adaptive management of this network by the dataset generated during post-MPA (when compared with pre-MPA data) will provide objectivity to this public process by specifically elucidating trends in the amount, location and type of fishing occurring post-MPA. We can anticipate a highly charged politicized environment for this process, and this type of empirical information is especially effective in countering false or misguided claims by individuals or industries.

Methodology

These surveys collect spatially specific data regarding the distribution, type and activity of vessels operating in state waters following the implementation of MPAs in the south coast region. The Southern California Bight is divided into two transects; the southern transect begins south of LAX, ending at the Mexican Border and the northern transect begins north of LAX, ending at Point Conception. Small aircraft capable of high maneuverability and low speeds are used to fly directly over vessels while survey personnel accurately record location, vessel type, activity, and a photograph. Depending on weather conditions, aircraft fly at an altitude of 500 to 1000ft (average elevation for pre-MPA equaled approximately 650 feet) and travel at 100 to 120 knots. LightHawk coordinates volunteer pilots and their aircraft to complete the surveys. The collection of data from small fixed-wing aircraft allow for a transect to be completed in approximately two to two and one half hours depending on number of vessels encountered.



Survey team flying in a Piper Cherokee comprising; pilot (front left), spotter (front right), GPS technician (back right), Image collected courtesy of LightHawk.

The survey team consists of a pilot, spotter, GPS technician and photographer. Some of the planes are incapable of carrying a pilot plus three passengers; in this circumstance, the photographer role is adopted by the spotter. The spotter directs the pilots' flight path to intersect the vessels on the water, describes the type and activity of the vessel at time of contact and directs the GPS technician to enter a point and corresponding information into the computer. When possible, the photographer captures a photograph of the vessel(s) to aid in post flight QA/QC (Quality Assurance Quality Control), for transparency and for uploading to the project's online, interactive database. Due to the speed of the aircraft, rapid and accurate identification of vessels encountered on a transect is required. Therefore, the spotter, aided by binoculars or telephoto camera lens, must be familiar with the various boat types and activities boaters engage in, in the south coast region.

This information is recorded by the GPS technician into one of the predefined categories (Commercial Fishing, Commercial Non-fishing or Recreational) in a GPS data dictionary along with observed vessel type and activity (underway, fishing or anchored/not fishing). Ideally, vessel positions are not logged until survey planes are directly overhead for highest spatial accuracy. In areas with high vessel density or restricted airspace, where logging vessels individually is infeasible, multiple boats may be logged to a single representative point and later extracted using GIS. After completion of the aerial survey, the GPS data are downloaded to Pathfinder Office, then exported into ArcGIS for analysis. Any photos taken of the vessels are linked to the corresponding data points collected and used for post-flight QA/QC and training purposes. Once these data have been verified as accurate through QA/QC processes, the information is updated to the entire dataset from which maps and summary statistics are derived.

Summary and Conclusions

The summaries below are drawn from data collected by this effort. Data collected between 2009 and 2011 were consolidated as a pre-MPA assessment and compared to the full year of surveys conducted in 2012 and January through June of 2013 as the post-MPA assessment. Seasonality and access to different fish or fisheries vary throughout the year and affect the type, location, activity and number of boats operating off the coast of southern California.

Summary Statistics

Time Interval	Boats logged	# of flights
Pre-MPA	5304	41
Jan - Jun 2012	1619	15
Jul - Dec 2012	2645	14
Jan - Jun 2013	1314	11
Post-MPA Total	5578	40

Initial results identified the following trends:

- The density-number of boats operating on the south transect from Los Angeles to the US Mexican Border is significantly greater than the density on the north transect from Los Angeles to Point Conception
- The majority of fishing on rocky reefs (75% pre-MPA and 73.1% post-MPA) is concentrated on three reef complexes: Point Loma, La Jolla and Palos Verdes. These reef complexes represent 31% of the rocky reef along the mainland coast.
- The data suggest that boating offshore of mainland southern California is reduced in January through June 2012 compared to the same time frame (January through June) of 2009, 2010, 2011 from Los Angeles to the US Mexican Border
- The commercial fishing sectors that were observed displayed compliance with the new regulations with very few exceptions.
- Recreational fishing sectors are demonstrating greater non-compliance than commercial sectors, especially in San Diego and Orange Counties
- The highest incidents of non-compliance have occurred in a complex of MPAs off of La Jolla
- Fishing vessels are not displaying compaction due to displacement from MPA's.
- Commercial fishing vessels are not fishing the line. The data suggest that the opposite is the case; that commercial fishing has shifted away from the borders of the MPA's within the study area.

Presentations

- State Coastal Conservancy, Brown Bag Seminar
 - Attended by California Ocean Science Trust, MPA Monitoring Enterprise and members of the public
- Southern California Academy of Sciences
- Santa Monica Bay Restoration Commission Governing Board – quarterly updates
- Garibaldi Group
- Southern California Coastal Water Research Project

Maps and Graphs

The following series of maps and graphs are provided to illustrate the data collected by this effort presented in two-dimensional imagery. These data assembled in an online GIS interactive database can be queried by a number of factors including: date, place, boat type, fishery, etc.

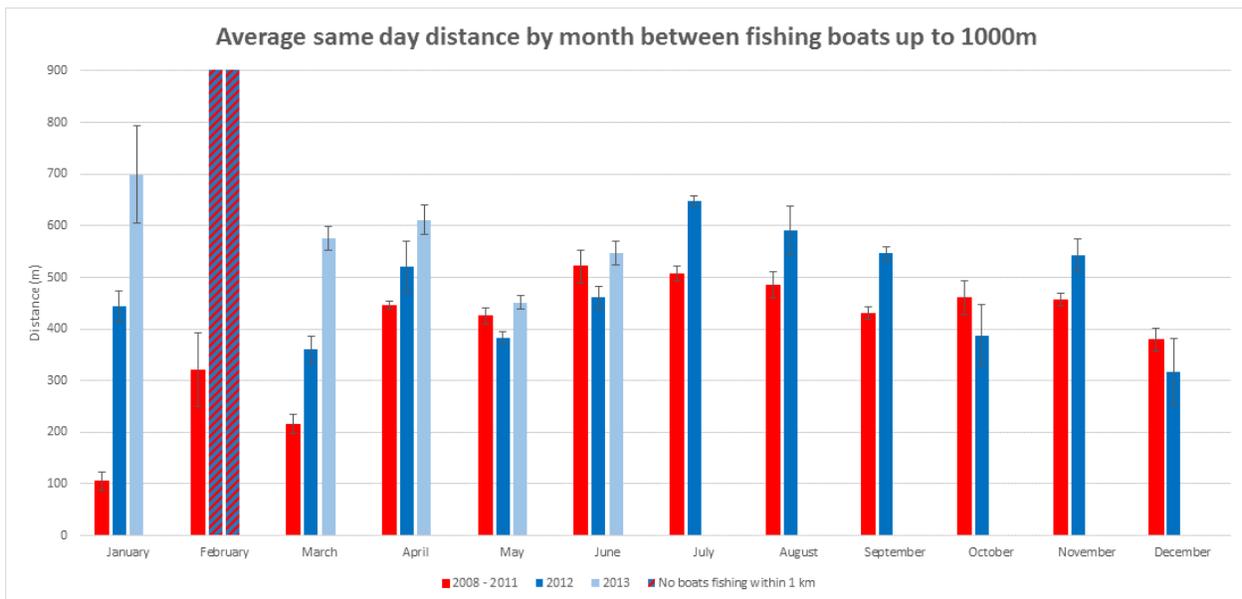


Figure 1. Spatial patterns of vessels on the water were compared between pre-MPA and post-MPA surveys. Compaction of fishing vessels was a concern due to displacement of vessels from MPA's but so far this has not been observed after implementation.

Table 1. This table illustrates the relationship between the data categories. The broad **Vessel Categories** are typically noted first, then the finer scale **Vessel Type**, lastly an **Activity** is assigned. This information is entered along with geographic coordinates to accurately characterize the location, type and activity of vessels operating in the 990 square miles of California State Waters off the mainland coast of Southern California.

Vessel Categories		Vessel Type
		Commercial Fishing
Lobster Boat		
Trap Boat		
Urchin Boat		
Other		
Recreational	Sport Fishing Boat	
	Power Boat	
	Sailboat	
	Dive Boat	
	Kayak	
	Jet Ski	
	Other (SUP, outrigger, row boat, etc.)	

Vessel Categories		Vessel Type (cont.)
		Commercial Non-Fishing
Tanker		
Cargo Ship (Barge, Container)		
Support Vessel (Tug, Tender)		
Res-Mil-Enf (All Science and Gov't Boats)		
Charter (Whale watching, Diving)		
Other (Dredge, parasail, etc.)		
Net Boat	Trawler	
	Purse Seiner	
	Light Boat	
	Gillnet	
	Other	

Activity	Fishing
	Underway
	Not Fishing/Moored

Fishing breakdown by substrate and complex

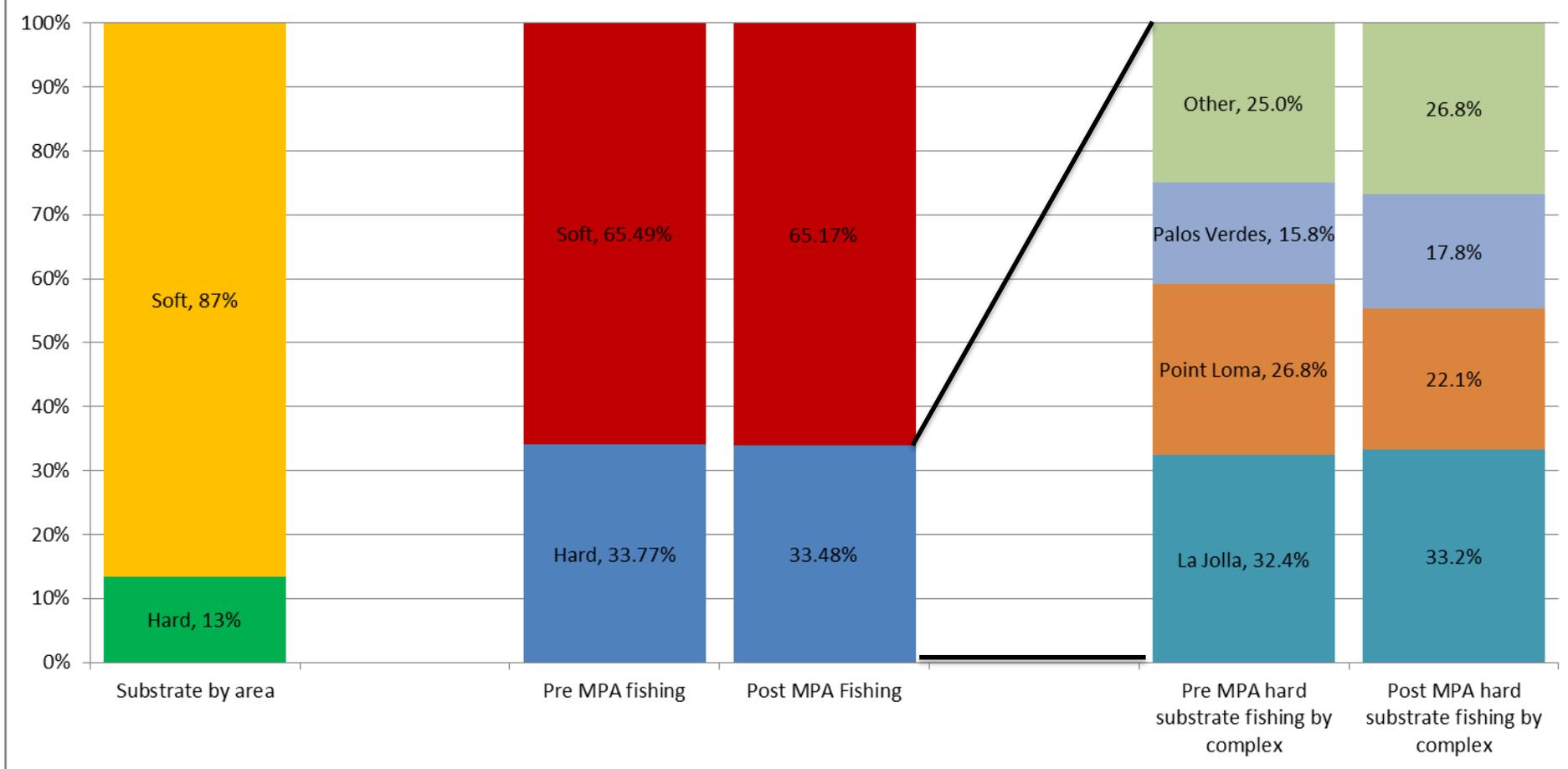


Figure 2. 13% of the mainland coast is rocky bottom, characterized collectively as hard substrate, 87% is sand, mud, thusly soft substrate. Approximately 33% of the total fishing effort pre and post MPA occurs on hard substrate. The preference for fishing on hard substrate by commercial and recreational fishers is, by this statistic, quantified. More narrowly the rocky reef complexes comprising the hard substrate off of three headlands, Palos Verdes, Point Loma and La Jolla supported 75% and 73% pre and post-MPA respectively of the 33% of all fishing occurring on hard substrate throughout the region. As the hard substrate surrounding these headlands represents only 31% of all of the hard substrate in the region yet supports roughly 75% of all the hard substrate fishing effort; they are presumably the most highly valued and impacted fishing grounds along the southern California mainland coast

Figures 3-5 display the change in fishing activity within MPA's located around Palos Verdes, La Jolla and Point Loma. As shown, fishing efforts are moving outside of the MPA boundaries since implementation in January 2012.

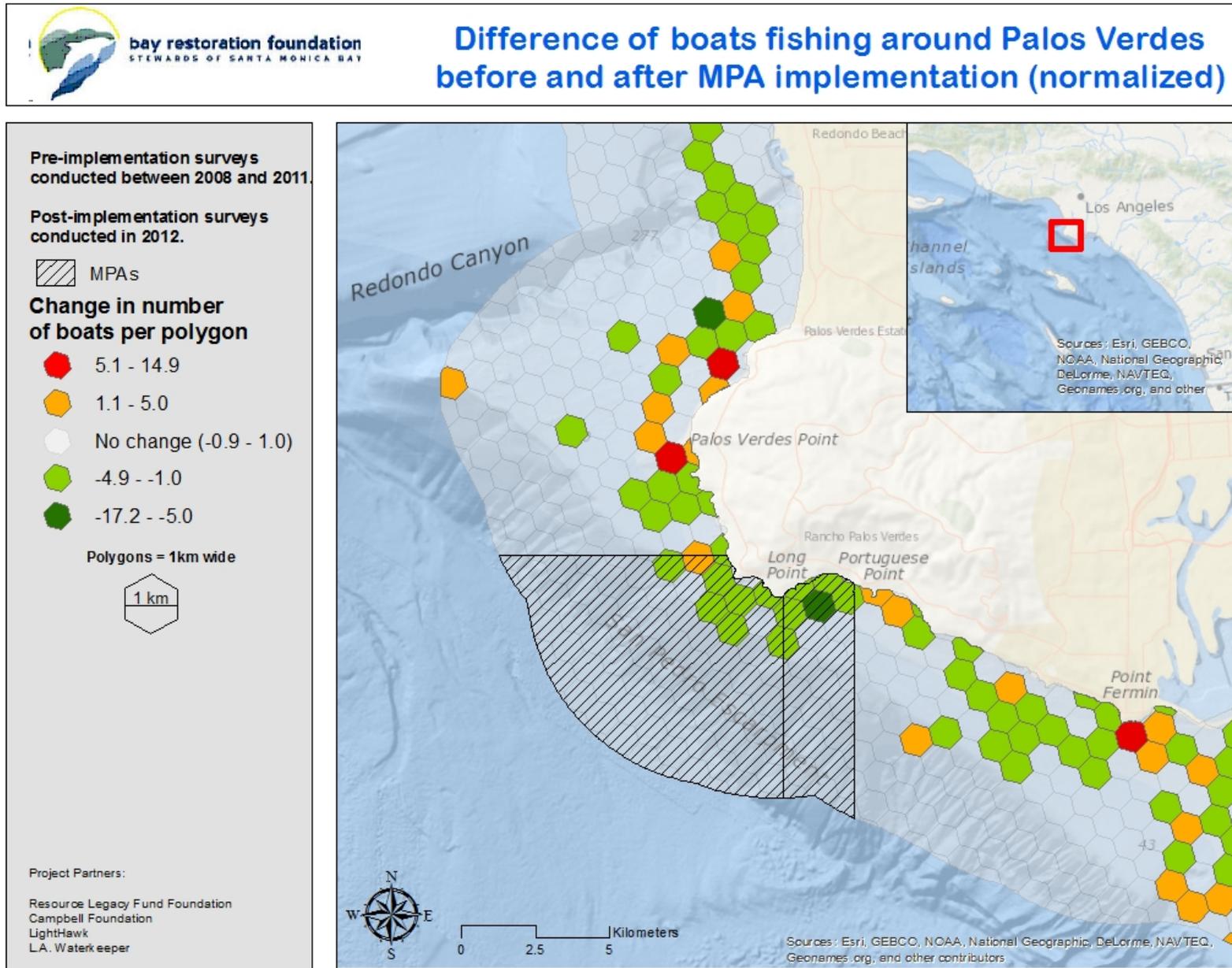


Figure 3.



bay restoration foundation
STEWARDS OF SANTA MONICA BAY

Difference of boats fishing around La Jolla before and after MPA implementation (normalized)

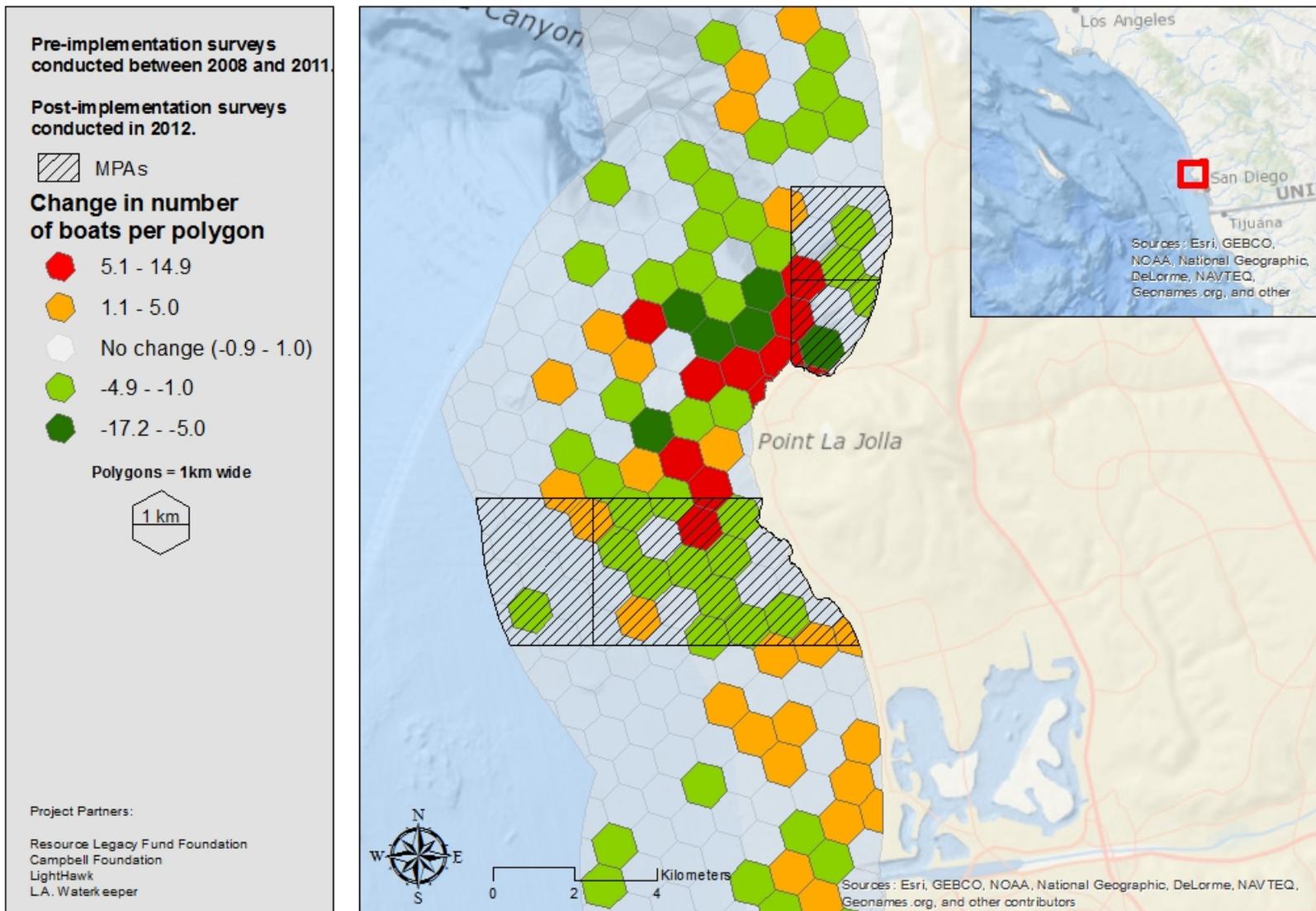


Figure 4.

Difference of boats fishing around Point Loma before and after MPA implementation (normalized)

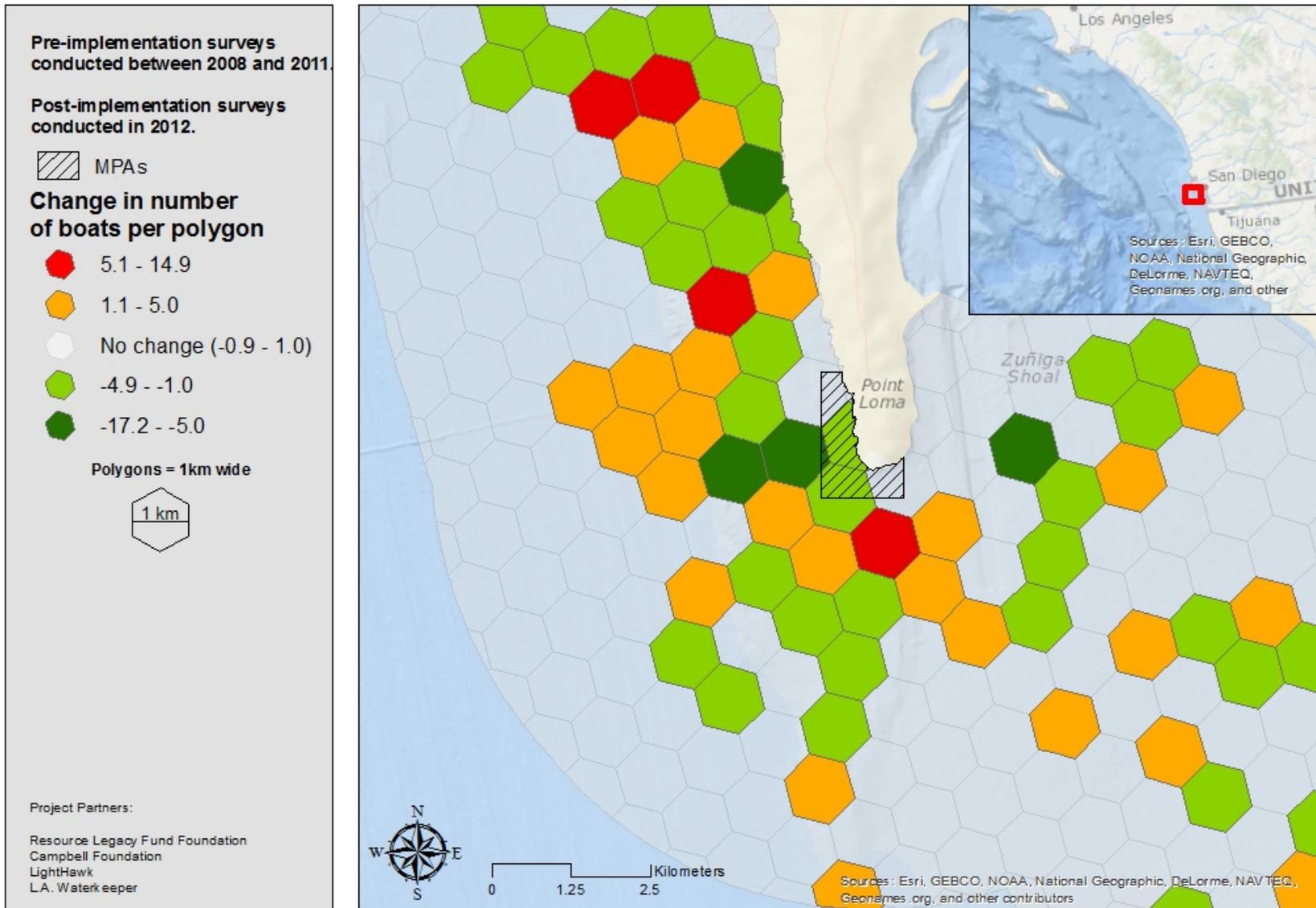


Figure 5.