Reef Check California: Providing scientifically sound data to support sustainable management.

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SUMMARY

Reef Check California trains experienced divers to collect scientifically sound data that can be used to improve marine management in California. Strict testing standards for surveyors and quality control/assurance procedures ensure the quality of the data provided to resource managers. During our first full year of operation in 2006, we trained 65 divers and completed surveys at 18 sites. For all sites combined, surveyors recorded 30 of the 35 indicator species of fishes, 20 of the 29 indicator species/groups of invertebrates, and 6 of the 9 indicator groups of seaweeds on 324 transects. In total, 5671 fishes and 8549 invertebrates were counted on survey transects. Preliminary analysis indicates the RCCA training methods and survey protocols allow surveyors to collect scientifically sound data.

INTRODUCTION

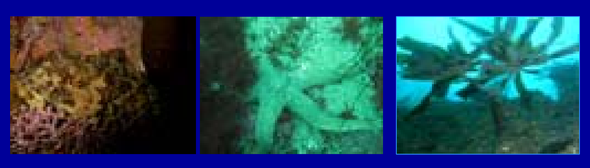
Reef Check is a non-profit organization who has been the world leader in community monitoring of tropical reefs worldwide since 1997. In 2005, Reef Check launched the Reef Check California (RCCA) program. The mission of RCCA is to educate, train, and engage all ocean users in the collection of scientifically sound data describing California's nearshore rocky reefs to help inform management decisions and create an informed constituency supportive of science-based management.

One of the main ways RCCA accomplishes this mission is by training experienced scuba divers to use the RCCA survey protocols. The RCCA survey protocols are subtidal scientific sampling techniques that are supported by academic scientists and consistent with the Department of Fish and Game (DFG) established subtidal protocols. RCCA divers are required to successfully pass testing standards in both the classroom and field before they are eligible to collect data to submit to the database. RCCA has worked closely with the DFG to ensure data collected by RCCA divers can be used to improve resource management and recently signed a Memorandum of Understanding formalizing the use of RCCA data by DFG to fill in data gaps in California's marine monitoring network.

MATERIALS AND METHODS

The RCCA protocol includes surveying for a select group of indicator species of fishes, invertebrates, seaweeds, and characterizing the substrate at a site. The criteria used to select the indicator species were ease of identification, commonly observed by divers, species of special interest or concern (*i.e.*, protected species, species known to be endangered, overfished and/or seriously depleted), species commonly targeted by recreational and commercial fishing activities, and ecologically important species.

- 35 fish species
- 28 invertebrate species and 1 order
- 8 seaweed species and 1 genus



Eighteen 30 x 2 m transects (30 x 2 x 2 m for fish transects) are completed at a site, which corresponds to 250 m of linear coastline.

- 6 core transects which include a fish, invertebrate, seaweed, and substrate surveys.
- 12 fish-only transects where only a fish survey is completed.
- Transects rules include: (1) no greater than 4 m change in depth on a single transect, (2) no more than 10 m of contiguous sand on one 30 m transect. If a surveyor encounters 10 m of contiguous sand they must void the transect, relocate, and start the transect survey over.

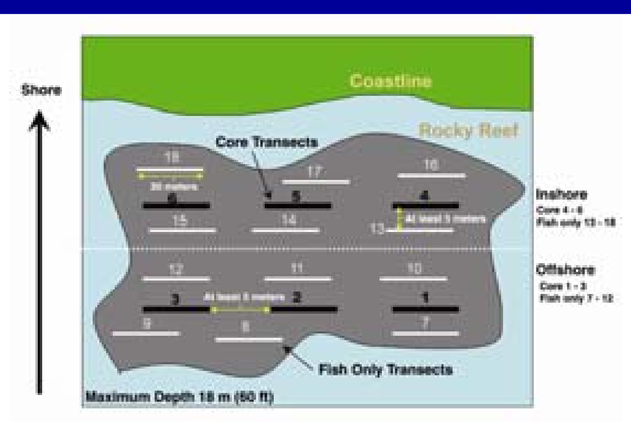


Figure 1. Layout of RCCA survey transects at a site. Transects 1 - 6 indicated by the dark bolded lines are core transects where a fish, invertebrate, seaweed, and substrate survey are conducted on each transect. The white lines, transects 7 - 18, indicate fish-only transects which have only a fish survey completed on each. Transects are allocated equally among an inshore and offshore zone. The inshore and offshore zones are not strictly associated with depth as some survey sites have a depth profile that does not increase rapidly as you move offshore. Inshore and offshore zones are delineated by distance from the shoreline and depth when appropriate. All transect start points are chosen randomly (i.e. haphazardly) to ensure a representative sample and all transects are at least 5 m apart to address independence issues.

RESULTS

In 2006, we trained 65 RCCA divers and completed surveys at 18 sites in California ranging from Gerstle Cove in Sonoma County to the Avalon Dive Park in Los Angeles County. For all sites combined, surveyors recorded 30 species of fishes, 20 species of invertebrates, and 6 species of seaweed on 324 transects. In total, 5671 fishes and 8549 invertebrates were counted on survey transects.

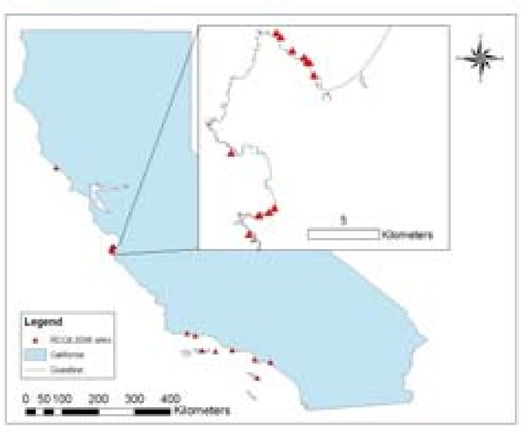


Figure 2. State of California with Reef Check California survey sites in 2006. Inset shows close-up of the Monterey peninsula.

RESULTS (continued)

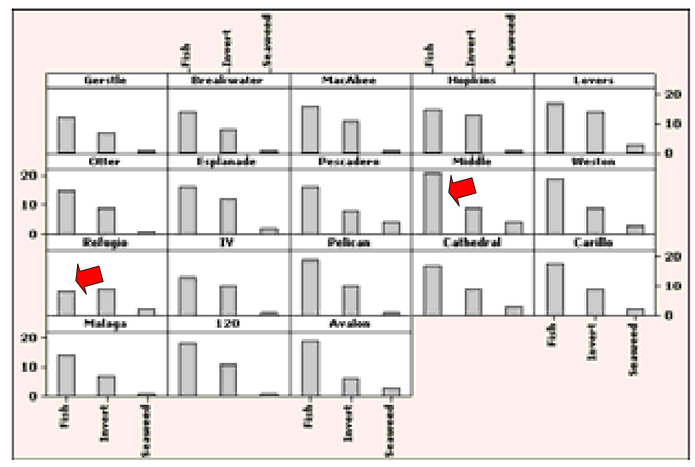
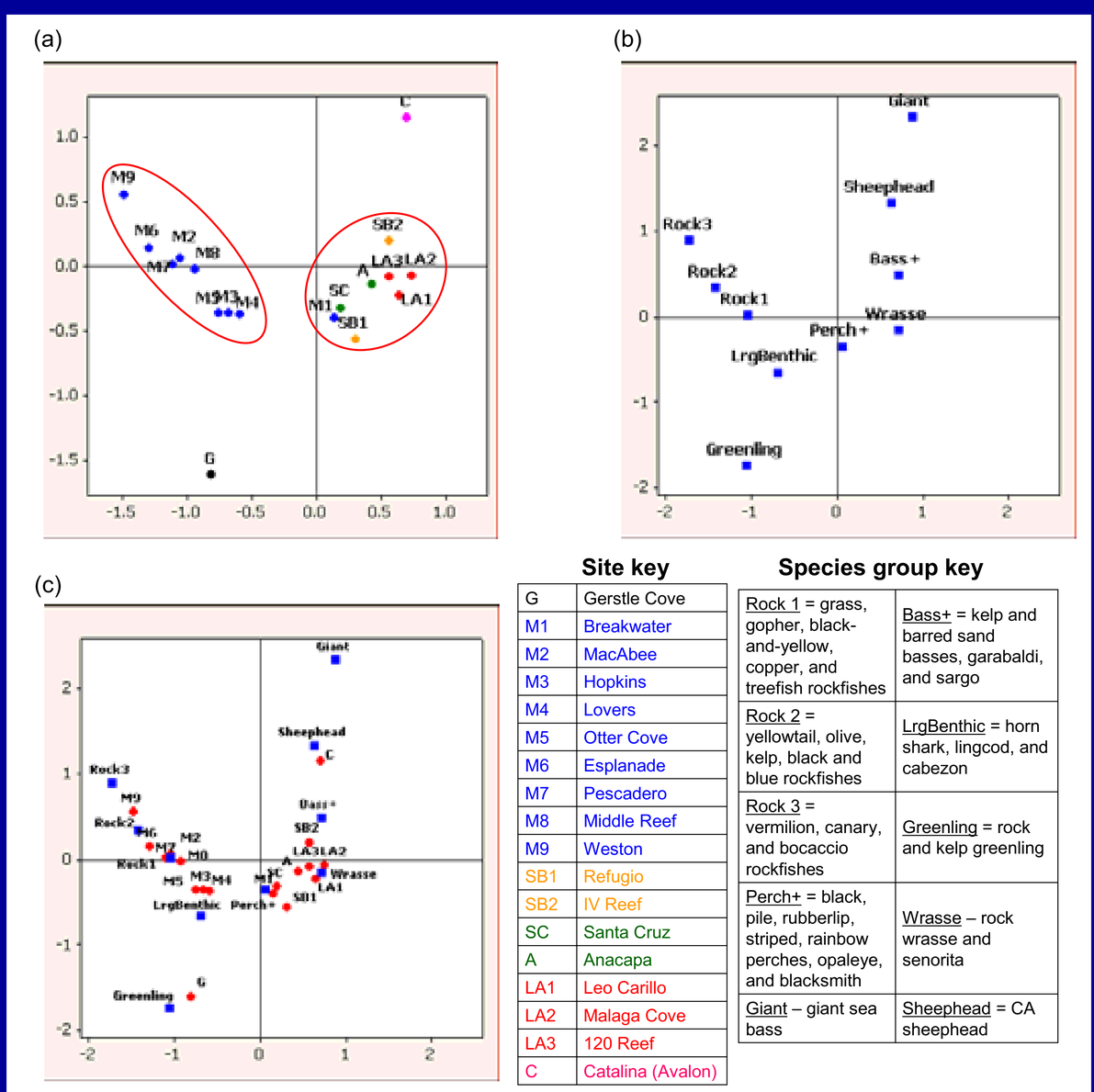


Figure 3. A key measure of the health and sustainability of an ecosystem is biodiversity or species richness, which is defined as the overall number of species at a site. Effectively surveying a rocky reef for every species that lives on it is clearly not possible. This is why RCCA surveys look for a select group of indicator species that gives an indication of the overall biological diversity at a given site. The graph above depicts the total number of species within each group (fishes, invertebrates, and seaweed) that were seen at each of the 18 RCCA survey sites in 2006. The maximum number of species/groups that could be seen was 35 for fishes, 29 for invertebrates, and 9 for seaweed. The data on the second row in the upper right indicated by a red arrow is from Middle Reef located in Pt. Lobos State Marine Reserve and shows the highest fish species richness. The plot on the third row on the lower left also indicated by a red arrow is from Refugio on the Santa Barbara coast and shows the lowest fish species richness of all sites surveyed in 2006. Long-term data is essential in properly interpreting whether the species richness at a site is changing rapidly which may indicate negative impacts or consistent overtime within the bounds of natural variability.

RCCA surveys are a long-term monitoring project which provides yearly data to resource managers on survey sites and will continue to expand coverage as funding becomes available. We plan to complete at least 40 sites statewide in 2007. A major goal of the first year of RCCA surveys was to ensure the protocol and training procedures produced quality data to provide to resource managers. We took the fish transect data and conducted a statistical analysis that allowed us to assess whether RCCA surveys were generally reflecting the well-known biogeographical breaks along the coast of California. Fish were grouped into broad guilds based on general behavioral characteristics. Additional comparative analysis with other research groups is on-going which will further address the quality of RCCA data.



Site key

G	Gerstle Cove
M1	Breakwater
M2	MacAbee
M3	Hopkins
M4	Lovers
M5	Otter Cove
M6	Esplanade
M7	Pescadero
M8	Middle Reef
M9	Weston
SB1	Refugio
SB2	IV Reef
SC	Santa Cruz
A	Anacapa
LA1	Leo Carillo
LA2	Malaga Cove
LA3	120 Reef
C	Catalina (Avalon)

Species group key

Rock 1 = grass, gopher, black-and-yellow, copper, and treefish rockfishes	Bass+ = kelp and barred sand basses, garabaldi, and sargo
Rock 2 = yellowtail, olive, kelp, black and blue rockfishes	LrgBenthic = horn shark, lingcod, and cabezon
Rock 3 = vermilion, canary, and bocaccio rockfishes	Greenling = rock and kelp greenling
Perch+ = black, pile, rubberlip, striped, rainbow perches, opaleye, and blacksmith	Wrasse – rock wrasse and senorita
Giant – giant sea bass	Sheephead = CA sheephead

Figure 4. Correspondence analysis plots of the 18 sites and 10 fish groups formed from the 35 RCCA fish indicator species. (a) Correspondence analysis row plot of RCCA survey sites in 2006. (b) Correspondence analysis column plot of RCCA fish species groups. (c) Correspondence analysis biplot of RCCA survey sites and fish species groups overlaid. Correspondence analysis projects both sites and species groups on new axes calculated from eigenanalysis of the contingency table. The first axis covers 50 % and the second axis 20% of the variability, a total of 70% variability is depicted on the plots. Distances between sites on the plots reflect levels of similarity between sites in terms of species abundance. Similarly, closeness between species groups indicate similar distribution at various sites. The biplot overlaying both sites and species groups tells us which fish group dominates which site. The horizontal axis separates the northern sites (on the left) from the southern ones (on the right). This axis is dominated by the rockfish and greenling groups that have much higher counts at the northern sites. The second axis separates Gerstle Cove (G) from the Monterey sites (M1-M9) mainly based on its high greenling count. Geographically Gerstle Cove is 250 km from the nearest survey site to the south and it is north of a well known biogeographical break along the coast. As expected, a unique species group dominates the counts at Gerstle Cove because it is a geographically unique site compared to others surveyed in 2006. The second axis also separates Catalina (C) from the other southern California sites due to its high count of sheephead as well as a single sighting of a giant sea bass.

DISCUSSION

Correspondence analysis of the 2006 fish survey data reflects the latitudinal gradient present along California's coast and provides evidence that RCCA survey protocols and training resulted in the collection of scientifically sound data. In general, the Monterey area sites, the single northern California site, Catalina Island, and the southern California sites form distinct groups. These groupings are associated with predictable species groups. The southern sites are dominated by more southerly distributed fish such as CA sheephead, wrasses and basses while the northern sites are more closely associated with northern species such as greenling and rockfishes. One Monterey site (M1) grouped with the southern sites and this can be explained by an unusually high count of senorita when compared other Monterey sites. M1 had a higher amount of sandy substrate than the other Monterey sites surveyed which could explain the high counts of senorita.