



# Red Abalone Size Frequency Survey Protocol

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Reef Check California

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This is the official instruction manual for the Reef Check California Red Abalone Size Frequency Monitoring. If you have any questions about training procedures or about the protocol, please contact Reef Check at the contact numbers given below.

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## A Brief History on Abalone Fisheries and Regulations

Historically, Native Americans fished abalone along the entire coast of California. The first commercial fisheries were established in 1850 by Chinese Americans. The Chinese mainly targeted green (*Haliotis fulgens*) and black abalone (*Haliotis cracherodii*) and reported peak landings in 1879 with 4.1 million pounds of meat and shell. The Chinese worked in shallow water and by 1900 the first regulations were placed on abalone fishing and the shallow water fisheries were closed to commercial harvest [DFW, 2001]. Soon after the closure of the shallow water fisheries, Japanese divers started exploiting the subtidal abalone stocks; first by free diving and then by hard hat diving. In 1901, the first size limit of abalone was introduced, requiring all abalone to be 15 inches in circumference. In 1909, a commercial fishing license program was established and a variety of regulation efforts went into effect including landing requirements, size limits, gear restrictions and open/closed areas as well as open/closed seasons [DFW, 2003]. In 1913, the abalone fisheries in southern California were closed, thus forcing the fisheries northward. There was a steady increase in landings from 1916 to 1935 which peaked at 3.9 million pounds and then declined to 164,000 pounds in 1942 as fisherman with Japanese heritages were relocated during World War II [DFW, 2001]. In 1943, in order to boost wartime food productions, the southern California fishery was re-opened [DFW, 2001; DFW 2003]. In 1949, the northern California fisheries closed from Point Lobos (Monterey County) up to the California-Oregon border [DFW, 2003]. Landings experienced a second peak in 1957 with 5.4 million pounds, but by 1969, the fishery was in rapid decline [DFW, 2001]. In 1996 the commercial fisheries closed and landings had fallen to 229,500 pounds of meat and shell; roughly 4% of the peak landing of 5.4 million pounds [DFW, 2001].

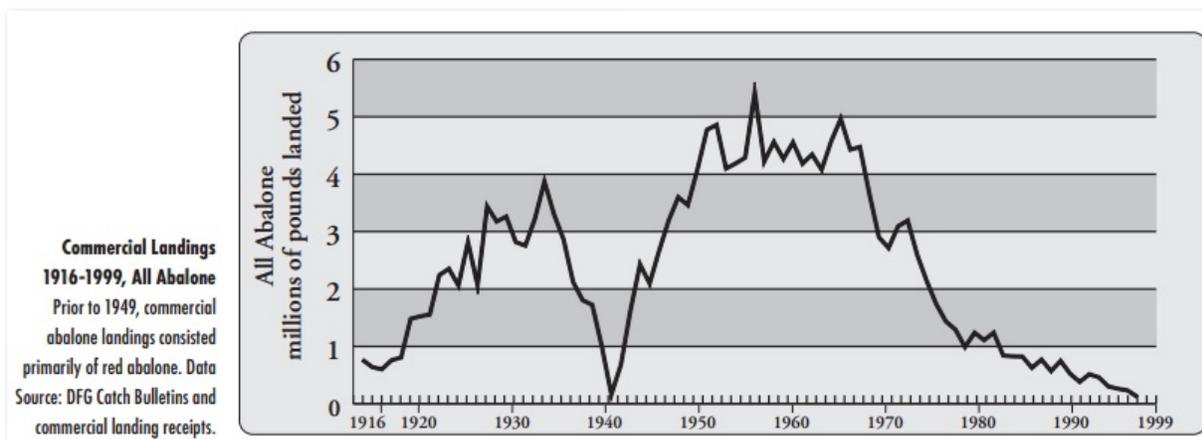


Figure 1: Commercial Landings of all Abalone 1916-1999 as reported by DFW.

From the start abalone has been managed as a single fishery and this made it difficult to address the collapse of a single species despite stable landing records [DFW, 2001; DFW, 2003]. This process is known as serial depletion and can only be seen when landings are divided by species. From 1952 to 1968 in southern California, the decline in pink abalone (*Haliotis corrugata*) landings was offset by an increase in red abalone landings and in 1971 size regulations were placed on the pink abalone to protect the remaining stocks. The new regulations on pink abalone brought an abrupt decline to the landings of pinks; however, this drop was masked in overall catch data by an increase in green abalone landings. The red

abalone (*Haliotis rufescens*) landings began to decline in 1968; yet the decline was again masked by an increase in green, black and white abalone landings [DFW, 2003; DFW, 2010].

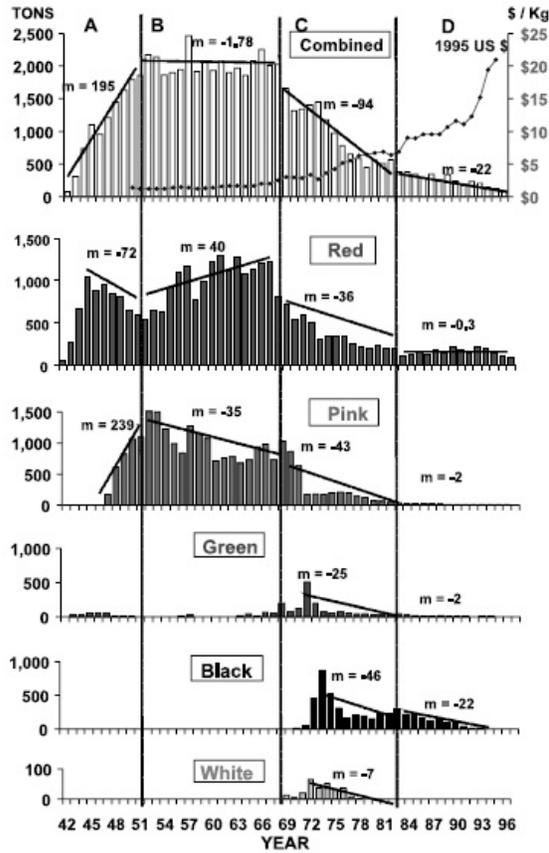


Figure 2: Top graph shows the combined catch in metric tons of abalone from 1942-1996. The following graphs show catch in metric tons for red, pink, green, black and white abalone. Overall, illustrating the serial depletion that was occurring as a result of managing the fishery as a whole. Figure from: Karpov, K., Haaker, P., Taniguchi, I., Rogers-Bennett, L.. 2000. Serial depletion and the collapse of the California abalone (*Haliotis* spp.) fishery. Canadian Special Publication Fisheries and Aquatic Sciences 130:11-24.

The recreational take of abalone first became regulated in 1911 when fishing seasons were established. A bag limit of 10 abalone was established in southern California in 1913 and a recreational license was required by 1931 for all species. In 1953, the northern California recreational red abalone fishery became limited to breath-hold diving only, in hopes of protecting deeper stocks of abalone free divers cannot reach. By 1993, the recreational fishing of black abalone closed and in 1996, recreational fisheries for green, pink and white abalone (*Haliotis sorenseni*) were also closed. In the following year, the abalone fisheries along the entire California coast south of San Francisco were closed. Northern California remained open for recreational fisheries and an abalone stamp was introduced in 1998 to generate revenue for population assessments, management and enforcement efforts. The stamp was replaced by the abalone report card in 2000. The abalone report card became mandatory for all abalone divers and helped control illegal take as well as document catch and effort [DFW, 2003]. In 2005, the Abalone Recovery and Management Plan was adopted by the California Fish and Game Commission to manage the red abalone stocks in California [DFW, 2010]. Current abalone regulations, which went into effect April 2014, permit divers to take 3 abalone per day with a yearly limit of 18 abalone. Of the 18 abalone taken, only 9 may be taken from Marin and Sonoma Counties. The Fort Ross area in Sonoma is completely closed to abalone fishing [DFW, 2014].

## Reef Check California Abalone Size Frequency Survey Methods

### Sites

Eighteen sites will be targeted in an effort to collect red abalone size frequency data. Sites include, but are not limited to, Ten Mile, Westport, Glass Beach, Caspar Cove, Frolic Cove, Russian Gulch State Park, Mendocino Headlands, Portuguese Beach, Van Damme State Park, Stornetta, Point Arena MPA, Point Arena Reference, Gerstle Cove, Ocean Cove, Fort Ross, Stillwater Cove, Pebble Beach, Walk on Beach and Arch Rock Road. Additional sites may be added by divers trained in abalone protocols in coordination with Reef Check, but surveys at these sites may be conducted without the supervision of Reef Check staff.

### Data Collection

Abalone size data will be collected by scuba divers trained in Reef Check's abalone size survey protocol (see below). Divers will conduct roaming searches for abalone in a prescribed area of the reef at a given site and will measure all emergent abalone they find in their search area. This will ensure that they are not



Figure 3. Calipers will be used to measure the abalone at their longest length.

biasing their measurements to a certain size class of abalone. Once individuals are measured, they will be marked with chalk to avoid double measuring individuals by the diver or his/her buddy. During abalone size surveys, red abalone will be measured along the longest length of the shell, to the nearest millimeter, using calipers (Figure 3). Only emergent abalone will be measured and only if both tines of the caliper can be placed around the shell of the abalone. Red abalone of every size should be measured. Divers will attempt to measure at least 250-500 red abalone throughout the natural depth range of red abalone, but not deeper than 60 feet and not too shallow so

Site	Code	Lat (N)	Long (W)
<b>Ten Mile</b>	TM	39.579152	-123.778368
<b>Westport</b>	WP	39.666991	-123.793152
<b>Glass Beach</b>	GB	39.451645	-123.814728
<b>Caspar Cove</b>	CC	39.364429	-123.821327
<b>Frolic Cove</b>	FC	39.355026	-123.823868
<b>Russian Gulch</b>	RG	39.327984	-123.808800
<b>Mendocino Headlands</b>	MH	39.305283	-123.811218
<b>Portuguese Beach</b>	PO	39.303234	-123.803398
<b>Van Damme</b>	VD	39.271915	-123.795914
<b>Stornetta</b>	ST	38.937244	-123.731911
<b>Point Arena MPA</b>	PA	38.944801	-123.740501
<b>Point Arena Ref</b>	PF	38.908001	-123.719101
<b>Gerstle Cove</b>	GC	38.566460	-123.329964
<b>Ocean Cove</b>	OC	38.555119	-123.305664
<b>Fort Ross</b>	FR	38.5510601	-123.245064
<b>Stillwater Cove</b>	SC	38.540298	-123.288803
<b>Pebble Beach</b>	PB	38.691212	-123.441673
<b>Walk on Beach</b>	WB	38.706291	-123.45285
<b>Arch Rock</b>	AR	38.729988	-123.489508

length of the shell, to the nearest millimeter, using calipers (Figure 3). Only emergent abalone will be measured and only if both tines of the caliper can be placed around the shell of the abalone. Red abalone of every size should be measured. Divers will attempt to measure at least 250-500 red abalone throughout the natural depth range of red abalone, but not deeper than 60 feet and not too shallow so

that diving becomes unsafe (e.g., surf zone, breaking waves). If more individuals can be measured at a site, every effort will be made to measure up to 1000 individuals.

To record the size data, calipers designed by The Nature Conservancy (TNC) will be used. These calipers utilize a hole-punch system where a plastic data strip is inserted into the caliper and small buttons along the sliding tine punch a hole into the strip. Each hole punched represents one size measurement for one red abalone. When loading the plastic strip into the calipers, it is important that the strip has been pulled tight and both bolts have been tightened. After the strip has been loaded, it is important to “zero out” the caliper before data is collected. To do this, both tines will be tightly squeezed together and both, (top and bottom) buttons will be pushed. This will create two holes parallel to each other that will be used as the zero reference point for measuring the other holes. The surveyor should aim to take 40 measurements on each strip, ideally 20 on the bottom and 20 on the top. No more than 50 measurements should be taken with any one strip. Prior to entering the ocean, the surveyor will write their initials, the site code and the date on each strip (Figure 4). The surveyor will then write on the strip the depth and time when the first measurement was taken and the depth and time when the last measurement was taken during the dive. When the strip is full, it will be removed from the caliper and stored in a pocket, game bag or on a clip and a new strip will be inserted into the caliper, tightened, zeroed with the beginning depth and time noted before data collection begins again.

After the dive is finished, surveyors will use the datasheet to note where they collect data by drawing a polygon on the map indicating the area in which they dove (Figure 5). If two dives were conducted in different locations at the same site, two polygons should be drawn on the map and surveyors should write the corresponding strip numbers into each polygon. Surveyors will also conduct a general count of how many measurements were taken on each strip and note it on the datasheet next to their name and the strip number. Once data collection has been completed, surveyors will create a package that includes the datasheet and data strips. Each packet should only be comprised of one datasheet and the corresponding data strips. A large envelope or large Ziplock bags would make an ideal packet. The packet will then be given to Reef Check California staff members for data entry.

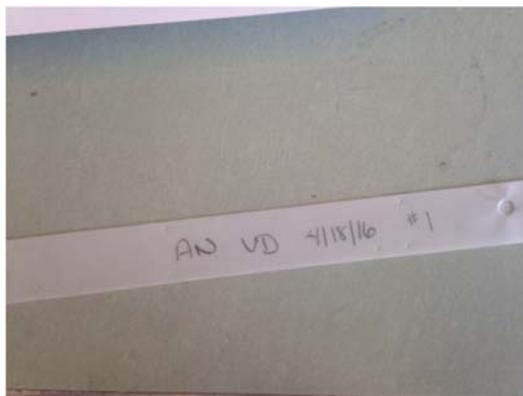


Figure 4: Sample data strip filled out with surveyor's initials, site code, data and strip number.

#### *Materials Needed*

- Calipers with pencils attached
- Data strips
- Datasheets
- Pen
- Large envelope

Date: 4/18/16 Weather Sunny  
 Suvyors: ANNA NEUMANN, FIN NEUMANN Swell 8ft @ 94s NW  
MAIA Grodin, SLOANE LOEY Visibility 8ft  
 Water Temp 48  
 Estimated Total 766

Stripe #	Name	Count Estimate	Stripe #	Name	Count Estimate
1	ANNA NEUMANN	42	15	MAIA Grodin	40
2	ANNA NEUMANN	38	16	SLOANE LOEY	40
3	ANNA NEUMANN	51	17	SLOANE LOEY	38
4	MAIA Grodin	48	18		
5	MAIA Grodin	39	19		
6	MAIA Grodin	38	20		
7	SLOANE LOEY	55	21		
8	SLOANE LOEY	60	22		
9	SLOANE LOEY	38	23		
10	ANNA NEUMANN	42	24		
11	SLOANE LOEY	48	25		
12	MAIA Grodin	47	26		
13	ANNA NEUMANN	50	27		
14	ANNA NEUMANN	50	28		

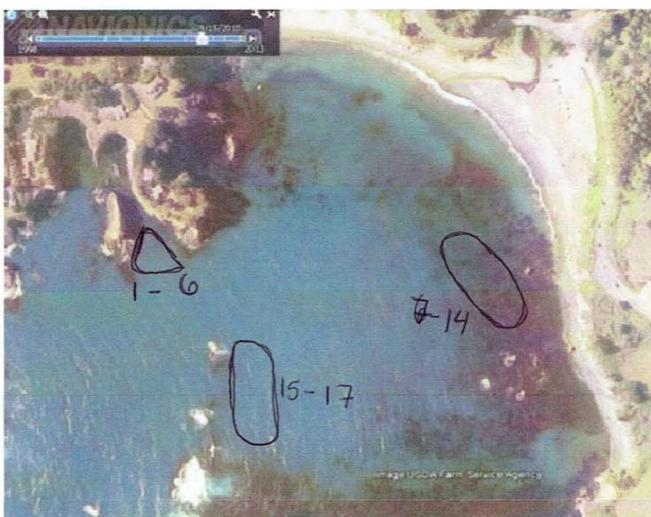


Figure 5: Sample Data Sheet  
 Information includes site name, date, surveyor names, swell, weather, visibility, water temperature and estimated total of abalone measured. Polygons indicate where each dive occurred and the data strips that correspond with that location.

### *Reef Check Forum*

To coordinate survey efforts over multiple days or weeks and to ensure enough data points will be collected from each sites, we will use the Reef Check Online Forum so that divers can communicate about what has been done at a given site. Once data has been collected, surveyors will be responsible for logging onto the Reef Check Online Forum and reporting the approximate number of data points that were collected. The forum can then be used by divers to determine which of the sites need to be targeted in future dives. A Reef Check staff member will post on the forum once enough data points have been collected from a site.

### *Data Reading and Reporting*

Data entry will require two people - one person will read the measurements from the data strip while the other enters the data into the database. A ruler will be placed so the zero mark lines up perfectly with the zero hole punches on the data strip. All of the data points will be read to the nearest millimeter and recorded in millimeters. A pencil will be used to mark the hole above each punch so the same hole is not read twice. If the hole has been punched twice, or two holes are extremely close making an elongated hole, two tags will be marked above the holes to indicate two data points were recorded. After the first person is done reading the data from the strip, the team will switch roles. The person who entered the data will then read the data points to the nearest millimeter and the other person will double check that the correct number was entered into the database. This will allow for data entry and Quality Assurance/Quality Control to occur at once and the data to become available in a timely fashion through the Reef Check Global Reef Tracker ([data.reefcheck.org](http://data.reefcheck.org)). Additional data such as site, depth and time will be entered along the measurements. Data strips and associated site information will be archived to keep a physical record of the data.

### *Training*

All divers participating in data collection will be required to participate in either a full Reef Check California training or a Reef Check Abalone training. During both trainings, participants will learn how to correctly identify abalone species, survey methods and how use the calipers designed by The Nature Conservancy. The Abalone Training will consist of a two-day training with 8 hours spent in the classroom and pool and one dive in the ocean to test the divers' skills. In the classroom, divers will be introduced to abalone biology, ecology their management and learn how to identify abalone species, the roaming diver protocol and the use of the calipers. In the pool, divers will practice survey methods and measurement and these skills will then be tested during an ocean dive. In the ocean, divers' skills will be evaluated using abalone shells of known size. Marked abalone shells will be measured by the trainee and their measurements will be compared to the actual size of the shells. Divers will be observed by the trainer and their search methods will be evaluated to ensure divers measure all individuals in their search area. Only if they pass with an acceptable margin of error will divers be allowed to collect abalone size data.

Both, the full Reef Check California training and the Reef Check Abalone Training have the following prerequisites

- ✓ 30 lifetime dives
- ✓ 15 cold water dives
- ✓ 8 dives within the last year

### *Buddy Awareness*

Buddy diving is not only a standard in recreational diving but also in researching diving. All divers will dive with a buddy and buddies will stay together for the entire dive. Buddy awareness while collecting data takes an extra effort in consciousness of your buddy's location and your own movements. Teams will make a dive plan before entering the water about how they want to conduct the dive as buddies and dive the plan established on the beach. If a buddy is lost on a dive, then both buddies should follow the lost buddy procedure and not continue data collection until the buddy is found.

### **Literature cited:**

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