Black Abalone Collection and Translocation Report
For take of black abalone authorized under Permit 26606
June 2023

Collection Donor Sites and Dates
Black abalone were collected from Fraser Cove on Santa Cruz Island (34.060477, -119.924457) on March 17, 2023. A pre-collection survey of the site was conducted on March 16, 2023.

Collection Participants
Nate Fletcher (UCSC) - collector
Melissa Miner (UCSC) - collector
Karah Ammann (UCSC) - collector
Laura Anderson (UCSC) - collector
Wendy Bragg (UCSC) - collector
Ian Taniguchi (CDFW) - data recorder
Melissa Neuman (NOAA) - data recorder
James Stilley (CDFW) - data recorder
Allyson Bailey (CDFW) - data recorder
Michael Ready - photographer

Pre-Collection Survey Results
We conducted a pre-collection survey at one large section of rocky intertidal reef at the west side of Fraser Cove (Figure 1) to ensure collections met collection criteria (see below). During the survey, we subsampled the survey area by counting black abalone within four, randomly placed swaths (Table 1). We then characterized habitat quality (% good, moderate, and poor habitat) within each swath and for the entire survey area. Mean densities (by habitat quality) from the swaths were used to extrapolate counts to the entire survey area, from which we estimated the population size and habitat based densities for the site (Table 2).

Collection Criteria:

- Maintain a density greater than the expected density for that site based on the habitat. This metric is consistent with the Habitat-based Density Recovery Criterion described in the Final Recovery Plan for Black Abalone (NMFS 2020).
- Maintain a minimum density of at least two black abalone per m^2 for good to moderate habitat. This minimum density is based on previous work that suggests that recruitment of juvenile black abalone can be compromised when adult density falls below one per square meter.
- Maintain the proportion of abalone within reproductive clusters. These “clusters” of black abalone are likely to contain a mixture of females and males in close proximity to one another (required for successful fertilization). Defined as groups of three or more abalone within one meter of one another.
- Collect no more than 10% of the black abalone from any one donor site. We expect that for most sites, this means we will not collect more than 50-60 abalone per site.

- Avoid areas where long-term monitoring or historic abalone surveys have been done.

Figure 1. Pre-collection survey area (blue polygon) at Fraser Cove on Santa Cruz Island.

Table 1. Results of swath surveys with habitat quality (proportion good, moderate, and poor) and habitat-based counts and densities. Mean habitat-based densities were used to extrapolate counts to the entire site (Table 2). SCFC= Santa Cruz Island, Fraser Cove.

Site	Swath	Length (m)	Width (m)	Area (m2)	Hab Good	Hab Mod	Qual Poor	Count Good	Count Mod	Count Poor	Density Good	Density Mod	Density Poor
SCFC	1.1	10	38	380	0.01	0.2	0.79	94	164	25	24.74	2.16	0.08
SCFC	1.2	10	15	150	0.01	0.15	0.84	40	106	5	26.67	4.71	0.04
SCFC	1.3	5	12	60	0.01	0.13	0.86	57	139	84	95.00	17.82	1.63
SCFC	1.4	10	11	110	0.01	0.1	0.89	76	176	34	69.09	16.00	0.35

Table 2. Site wide population and density estimates extrapolated from swaths (Table 1).

Seg.	Length (m)	Width (m)	Area (m2)	Hab Good	Hab Mod	Hab Poor	Est. Abundance	Est. Count Good	Est. Count Mod	Est. Count Poor	Est. Density Good	Est. Density Mod	Est. Density Poor
1	176	19	3344	0.01	0.2	0.79	**9991**	1802	6803	1386	53.87	10.17	0.52

Results from the pre-collection surveys showed that abalone at Fraser Cove are highly abundant. We estimate the population to be 9991 abalone with habitat-based densities well above expected densities (Expected density based on mean densities observed in populations unimpacted by withering syndrome; G = 1.58, M = 0.27, P = 0.0049). Based on these results we determined that we could collect our target of 120 abalone from the site while meeting all collection criteria.

Collection Plots

We identified 3 locations within the site with very high densities of black abalone to establish collection plots. These plots were smaller areas(<100m^2) than the surveyed swaths and were marked with marine epoxy and photographed so they could be relocated for future monitoring. We counted and sized all abalone, characterized the habitat, and determined the proportion of abalone within reproductive clusters (RC; 3 or more abalone within 1m^2) within the collection plots (Table 3).

Table 3. Results from collection plot surveys with habitat quality (proportion good, moderate, and poor), habitat-based counts and densities, and % of abalone within reproductive clusters (% RC).

Plot	Length (m)	Width (m)	Area (m2)	Hab Good	Hab Mod	Hab Poor	Total Count	Count Good	Count Mod	Count Poor	Density Good	Density Mod	Density Poor	% RC
C1	6	12	66	0.01	0.40	0.59	619	206	343	70	312.12	12.99	1.80	99.52
C2	7	7	42	0.01	0.15	0.84	194	43	109	42	101.78	17.20	1.18	100
C3	5	5	23	0.01	0.12	0.87	261	29	167	65	128.89	61.85	3.32	100

Results of Collection Activities

We collected 114 black abalone from the donor site (Fraser Cove). Collections were made from the three collection plots: 51 abalone from Plot 1, 38 abalone from Plot 2, and 25 abalone from Plot 3. All abalone were collected from moderate and poor habitat. Following collections, density in good to moderate habitat was maintained well above 2/m^2, densities remained well above expected densities, and all abalone remained in reproductive clusters (Table 4). We collected an estimated 1.14% of the population at the site.

Table 4. Plot counts and densities following collections.

Plot	Length (m)	Width (m)	Area (m2)	Hab Good	Hab Mod	Hab Poor	Total Count	Count Good	Count Mod	Count Poor	Density Poor	Density Good	Density Mod	% RC
C1	6	12	66	0.01	0.40	0.59	568	206	309	53	1.36	312.12	11.70	100
C2	7	7	42	0.01	0.15	0.84	156	43	81	32	0.90	101.78	12.78	100
C3	5	5	23	0.01	0.12	0.87	236	29	155	52	2.66	128.89	57.41	100

Summary of Collected Abalone
The 114 collected abalone ranged in size from 50-130mm (Figure 2).

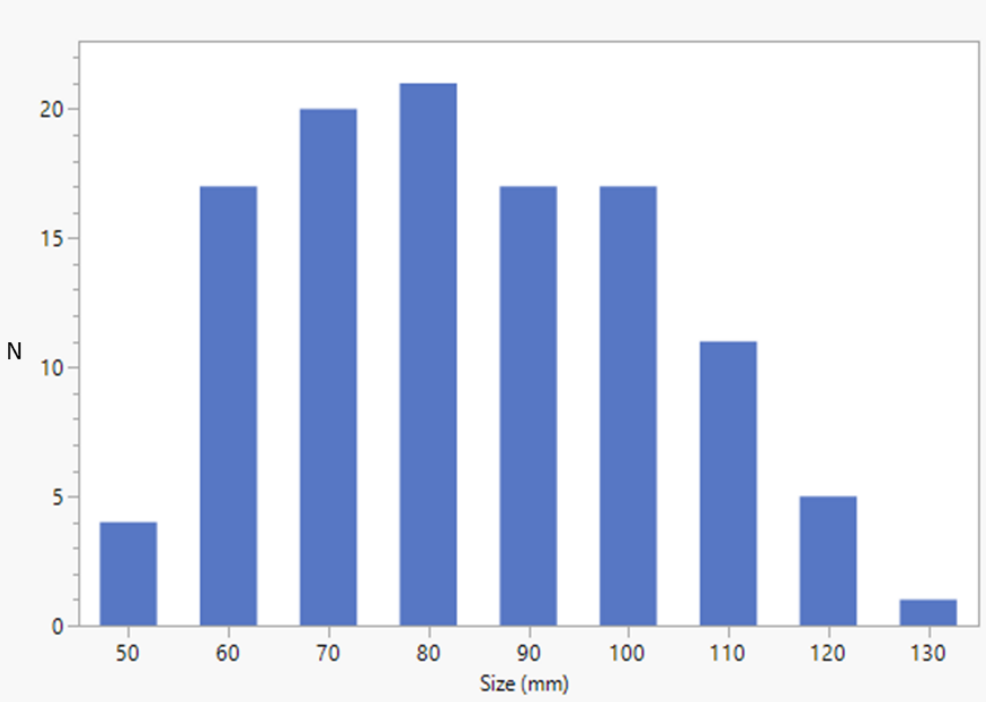

Figure 2. Size distribution of collected black abalone from Fraser Cove on Santa Cruz Island.

Collected abalone were placed in individual mesh bags on top of a piece of thin plastic for them to attach to. They were transported from shore to boat (CDFW's vessel The Garibaldi) in soft sided coolers. Once onboard, the abalone were placed in large hard-sided coolers containing newspaper wrapped ice packs and damp towels for transport to the mainland (Santa Barbara Harbor). Abalone were driven from the Santa Barbara Harbor to UC Santa Barbara where they were temporarily held. Total transport time was 6 hours.

Abalone were held in a 5' diameter, free-flowing, seawater tank at UC Santa Barbara. Abalone were kept in individual mesh bags during holding. Abalone were held at this facility for a total of 38 hours.

On March 18, 2023 the abalone were processed for outplanting at the restoration site. Processing consisted of sizing and weighing, tagging, photographing, collecting tissue samples for genetic analyses, and ultrasounding the abalone to assess gonad condition. Abalone were tagged with two small, numbered Floy tags adhered to the shell with Corafix. Floy tags were placed at the anterior and posterior ends of the shell. Two small blobs of colored two- part epoxy were also placed on the sides of the shell. Injuries were also assessed during processing (see summary of injuries). Quickly and efficiently processing the abalone was a collaborative effort involving UCSC, UCSB, CDFW, NOAA, Tenera, NPS, UC Davis, The Nature Conservancy, and the Paua Marine Research Group.

Summary of Injuries and Mortalities

During processing we assessed injuries and determined that 38% of the collected abalone had some form of injury, ranging from mild scapes to deep cuts/gouges. We determined that 15% had moderate to severe injuries (cuts and gouges). Of these, we determined that 9 abalone were severely injured to the extent that they should not be outplanted immediately. These abalone were transported to UC Santa Cruz to allow the abalone to heal prior to outplanting. The abalone were held in a free-flowing, seawater tank at CDFW's Marine Wildlife Veterinary Care and Research Center (MWVCRC) in Santa Cruz for 26 days. They were provided fresh kelp (*Macrocystis* and *Egregia*) during this period. One abalone died on March 29, 2023 (Table 1), but after two weeks, 8 of the 9 abalone were alive and it was determined that the best course of action was to outplant the abalone at the restoration site after a month of recovery time. These abalone were transported to and outlanted at Government Point on April 14, 2023. Injuries were not fully healed but were improving (Figure 3). During monitoring on May 20, 2023, we relocated 7 of the 8 abalone.

Figure 3. Recovery of injury to the foot of abalone #216 between March 18 (left) and April 14 (right).

There were three confirmed mortalities during the translocations (Table 5). Following the translocations, no unhealthy/dying abalone have been observed and no empty shells have been found at the restoration site.

Table 5. Summary of confirmed mortalities.

Date	Location	Abalone ID	Abalone Size (mm)	Location of Tissue Samples	Notes on Mortality
3/17/2023	Fraser Cove, SCI	N/A	80	N/A - animal left of site	Shell detached from foot muscle during collection.
3/19/2023	Government Point	133	110	UC Santa Cruz	Deceased on arrival at Government Point. No cuts or injuries to foot but upon inspection the foot muscle was found to be partially torn away from the shell. Dissected for tissue collection for genetic analysis.
3/29/2023	CDFW MWVCRC, Santa Cruz	138	80	UC Santa Cruz	Died while being held for injury recovery. Found detached at bottom of tank. Dissected for tissue collection for genetic analysis.

Recipient Site and Translocation Date

On March 19, 2023, we transported 104 abalone from UC Santa Barbara to the restoration site at Government Point (34.443211, -120.456039) on The Nature Conservancy's Dangermond Preserve. Total time between collection and outplanting was about 48 hours.

Translocation Participants

Nate Fletcher (UCSC) - outplanted abalone
Melissa Miner (UCSC) - outplanted abalone
Karah Ammann (UCSC) - outplanted abalone
Laura Anderson (UCSC) - outplanted abalone
Wendy Bragg (UCSC) - outplanted abalone
Ian Taniguchi (CDFW) - data recorder/outplanted abalone
Walter Heady (TNC) - data recorder/outplanted abalone
John Steinbeck (Tenera) - data recorder
Keith Lombardo (NPS) - data recorder
Avrey Parsons-Field (UCSB) - data recorder/outplanted abalone
Michael Ready - photographer

Summary of Translocations

Abalone were outplanted into five translocation plots at the West Block at Government Point (see Table 6). These plots had been previously marked and cleared of fouling organisms. Within

translocation and control plots at the site, there were 15 resident abalone prior to outplanting. All resident abalone except for one (in plot 2T) were observed during monitoring to date.

Post-translocation Monitoring

We conducted monitoring of the translocated abalone at Government Point the day following outplanting, two weeks following outplanting, and then monthly in April and May. Monthly monitoring will continue through July or August. In addition, we plan to monitor the collection plots at Fraser Cove in July and October.

Monitoring results are shown in Table 6. These results show the number of black abalone translocated into each of the five Translocation Plots (T plots), the number of resident black abalone within each plot at the time of translocations, the number of translocated abalone found within each plot (this includes non-resident individuals where the tags were either not visible or missing but are within the size range of translocated abalone), the number of resident black abalone found within each plot (these were sized and documented at the time of translocations), and the number of translocated abalone resighted including those within plots and tagged individuals outside of plots.

Table 6. Translocation monitoring results by plot (T = translocation plot, C = control plot). "# In Plot" includes all non-resident abalone including individuals where a tag was not visible or present. "# Resighted" includes # In Plot and tagged individuals found outside of the Translocation Plots during more extensive searches of the surrounding area or within Control Plots. * The 8 abalone held in Santa Cruz were outplanted on April 14 into plots 4T (4 abs) and 6T (4 abs) bringing the total number of translocated abalone to 112. **These abalone were translocated abalone from Plot 3T that moved into Plot 3C.

			March 20, 2023			March 31, 2023			April 14, 2023			May 20, 2023		
Plot	# Abalone Outplanted	# Resident Abalone	# Resighted	# In Plot	Residents in Plot	# Resighted	# In Plot	Residents in Plot	# Resighted	# In Plot	Residents in Plot	# Resighted	# In Plot	Residents in Plot
2T	17	4	17	12	4	13	9	3	10	7	3	10	9	3
3T	34	1	21	15	1	18	10	1	16	10	1	10	7	1
4T*	20 (4)	0	19	17	0	18	16	0	16	16	0	16	15	0
5T	12	2	9	8	2	10	6	2	7	5	2	9	5	2
6T*	21 (4)	2	21	20	2	20	19	2	19	18	2	19	18	2
2C	0	1	.	0	1	.	0	1	.	0	1	.	0	1
3C	0	3	.	1**	3	.	1**	3	.	1**	3	.	2**	3
4C	0	0	.	0	0	.	0	0	.	0	0	.	0	0
5C	0	2	.	0	2	.	0	2	.	0	2	.	0	2
6C	0	0	.	0	0	.	0	0	.	0	0	.	0	0
Total	104 (112)	15	87	73	15	79	61	14	68	57	14	64	56	14