Sand Beach and Coastal Lagoon Monitoring
Santa Rosa Island

2004 Annual Report


Staphylinid beetle


China Camp


Soledad West


Old Ranch House
Canyon Lagoon

CHANNEL ISLANDS NATIONAL PARK

Cover photos by Dan Richards from 2004 surveys of Staphylinid beetle from Soledad Beach, the beach at China Camp looking east, the beach at Soledad (Canyon) West looking west, and the lagoon at Old Ranch House Canyon

National Park Service
Channel Islands National Park

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Santa Rosa Island
2004 Annual Report

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ABSTRACT

Sand beach monitoring was conducted at five beaches on Santa Rosa Island between July 28 and Aug 2, 2004. This project is part of the Ecological long-term monitoring program at Channel Islands National Park and was implemented in 1994 following the design protocol of Dugan *et al*. 1990. Methods included bird censuses, physical measurements of beaches and coastal lagoons, clam gun (core) transects of upper beach and washzone habitats, and point contact transects to determine macrophyte wrack cover. Five beaches were monitored (Abalone Rocks, Becher's Pier, China Camp, Sandy Point, and Soledad West). Sand crab, *Emerita analoga*, mean abundances ranged from 1,837-9,152 crabs per meter (/m)^{2} of beach with the lowest abundance at Abalone Rocks and the highest at Sandy Point. Between 8 and 31% of the females were ovigerous (carrying eggs). Sandy Point also had the highest abundance of beachhopper amphipods (*Megalorchestia* spp.) with a mean abundance of 54,047/m, the highest we have recorded in this program. Bechers Pier had the lowest abundance of amphipods with only 338/m. Macrophyte wrack cover was lowest at Abalone Rocks (8%) and highest at Soledad West (45%). The coastal lagoons were all hypersaline and had low water levels.

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EXECUTIVE SUMMARY

Previous Sand Beach and Lagoon Monitoring by National Park Service staff was performed in 1994 (Richards 1996), 1995 (Richards and Lerma 1996), 1997 (Lerma and Richards 2000), 1999 (Lerma et al. 2001), and 2000 (Lerma and Richards 2002). In 2004, a minimal effort was made to conduct monitoring on five representative beaches because timing and logistics prevented the full range of sampling.

Beach sampling was conducted between July 28 and August 2, 2004 at Becher's Pier, Abalone Rocks, China Camp, Sandy Point, and Soledad West on Santa Rosa Island. Sampling followed standard methods (Dugan *et al.,* 1990) including: (i) five upper beach core transects to estimate the abundance of beachhopper amphipods, *Megalorchestia* spp., isopods *Alloniscus* sp. and associated species; (ii) five wash zone core transects to estimate abundance of sand crabs (*Emerita analoga*) and isopods (including *Excirolana chiltoni,* and associated species); (iii) three point contact transects were used to determine percent cover and composition of macrophyte wrack; (iv) size frequencies of sand crabs; (v) measurements of beach slope and sea surface temperature; and (vi) bird census.

Sand crab, *Emerita analoga,* densities from washzone transects ranged from 1,837 per meter of beach (/m) at Abalone Rocks to 9,152/m at Sandy Point (Table 1). *Excirolana chiltoni,* found at all five beaches, ranged in density from 94/m to 6,939/m. On the whole, both *Emerita analoga* and *Excirolana chiltoni* numbers were typical for these beaches.

Bloodworms, *Euzonus mucronata*, were present at all five beaches. Becher's Pier had the most blood worms at 4,348/m (table 1). *Euzonus mucronata* were also abundant at Soledad West. China Camp and Sandy Point had low numbers while Abalone Rocks had none in the washzone transects. Bloodworms were also abundant in the upper beach transects at Bechers Pier and Soledad West beaches, common at China Camp, and present at Sandy Point and Abalone Rocks. Becher's Pier is the only beach where they have been common in the past. The numbers found far exceed those recorded in 1999 or 2000.

Emerita analoga megalopa (larval stage at settlement) were present at all beaches. Ovigerous (egg bearing) crab densities ranged from only 20/m at Abalone Rocks to 478/m at Soledad West. China Camp however, had the greatest proportion of ovigerous females in the population with 31% compared to only 20% at Soledad West (table 2).

Beachhopper amphipods, *Megalorchestia* spp. varied greatly in abundance among the five beaches. Sandy Point and Soledad West had the highest densities (54,046/m and 37,594/m respectively) with the record numbers for both beaches in this monitoring program. Orders of magnitude lower, Abalone Rocks and Bechers Pier had just 711 and 358 amphipods/m respectively.

Abalone Rocks and China Camp both had a high fraction of shell fragments in the sand matrix. Gravel was common in the Becher's pier sand on the lower beach. Wrack was uncommon on all three of those beaches.

The isopod *Alloniscus* sp. was present on all the beaches except Bechers Bay (table 4). Soledad West was the only site with *Alloniscus* found on all transects. Both Soledad West and Sandy Point had higher numbers of beetles in general and Staphylinid beetles in particular than in 2000.

Total macrophyte wrack coverage was highest on Sandy Point and Soledad West with 40% and 45% cover (Table 5). The other three beaches had less than 20% cover. The wrack was composed primarily of giant kelp, *Macrocystis pyrifera,* and dried surfgrass, *Phyllospadix* sp., blades. Average wrack height ranged from 1.3 cm at China Camp to 3.4 cm at Sandy Point.

Shorebird counts were made on each of the beaches. Birds in general were relatively uncommon on the beaches and lagoons. We only recorded seven species during the monitoring on beaches. Western Snowy Plovers were observed only between Oat Point and Abalone Rocks beach (table 6).

All three lagoons were at low water levels. The high salinities indicate that freshwater flow to the lagoons was very low (table 7).

No monitoring for Pismo clams (*Tivela stultorum*), mole crabs (*Blepharipoda occidentalis*), or olive snails (*Olivella biplicata*) was performed in the 2004 sampling effort. Pismo clam populations have not been surveyed since 1999.

The typical high depositional beaches (Sandy Point, Soledad West) are those that face northwest into the prevailing winds and swell. These beaches receive the most input of kelp as well as carcasses and marine debris and are generally the most productive beaches. Because these are depositional beaches, they are also the most likely to be impacted by oil spills.

There is a direct relationship between amphipod abundance and macrophyte wrack cover, something we have observed in the past (Lerma and Richards 2000, Dugan et al. 2000) (figure 3). The depth of the wrack at Soledad West was not as deep as the wrack at Sandy Point and that may be an indication of the total amount of wrack available to the amphipods. Also Sandy Point is broken into smaller pieces of beach by small rocky points which could concentrate the amphipods into higher numbers. There was a high degree of variability in the numbers of amphipods among the beaches as well as among transects as there was with macrophyte wrack cover. It is important to keep in mind however that the abundance of amphipods on both beaches was higher than we have found in the past at these sites. The offshore *Macrocystis* canopy the last few years has been much higher along the north side of Santa Rosa Island than it has been since the early 1980's.

INTRODUCTION

Sandy beaches are a major component of the intertidal region of the northern Channel Islands. On Santa Rosa Island, sandy beaches make up approximately 30 km of shoreline, encompassing a wide variety of exposures and beach types. Approximately 20 percent of the shoreline of the California Channel Islands are sandy beach, in comparison to 80 percent of the shoreline of the southern California mainland coast. Though often overlooked, sandy beach communities offer a dynamic arena for the interaction of marine and terrestrial ecosystems. Sandy beaches harbor high densities of detritus, infauna, and macro-invertebrates that supply food and habitat for both marine and terrestrial organisms (Dugan *et al*. 2000). Many bird species utilize sand beaches as nesting and foraging habitat. Terrestrial mammals and birds prey and scavenge on sand beach organisms. All these organisms in turn play a vital role in the functioning ecosystem we classify as sandy beaches.

A design study for sand beach monitoring on Santa Rosa Island was completed in 1990 (Dugan *et al*. 1990). A draft report summarizing the inventory and design study was completed in February 1993 (Dugan *et al*. 1993). Monitoring by National Park Service staff was performed in 1994 (Richards 1996), 1995 (Richards and Lerma 1996), 1997 (Lerma and Richards 2000), 1999 (Lerma et al. 2001), and 2000 (Lerma and Richards 2002).

In 2004, a minimal effort was made to conduct monitoring on five representative beaches because timing and logistics prevented the full range of sampling. This report presents the data collected in 2004, including summaries of *Emerita analoga*, isopods, and worms sampled in the wash zone transects; beachhopper amphipods, beetles, and isopods sampled in upper beach transects, macrophyte wrack cover, shorebird numbers, and lagoon physical observations. Detailed transect data are presented in the attached appendices.

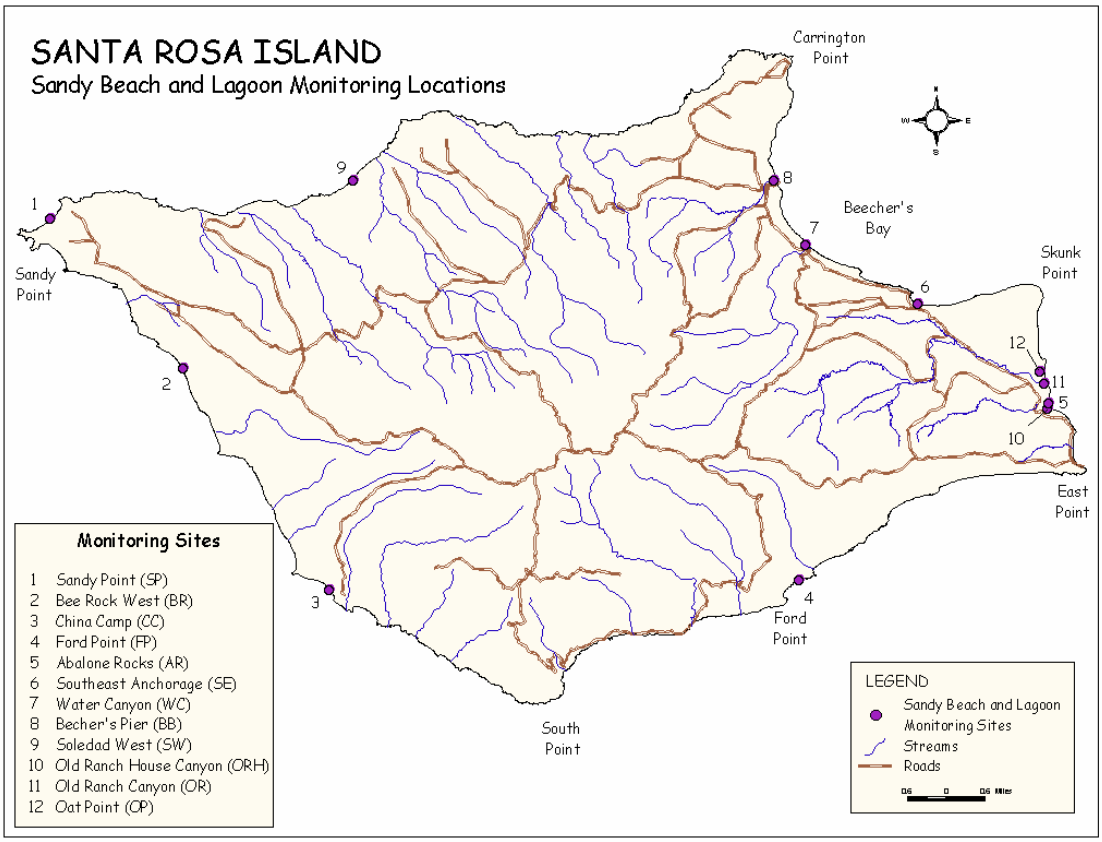
The 2004 field work was conducted by Dan Richards (Marine Biologist, Channel Islands National Park) and Bill Strojny (park volunteer). A big thanks to Bill for help in carrying equipment, recording data, and sampling beach wrack in blowing sands

METHODS

Study Area

The California Channel Islands are comprised of eight islands in the Southern California Bight, of which five are included in the Channel Islands National Park. Santa Rosa Island (21,854 hectares (ha)) is the second largest island in the group and has the most extensive beaches of the park Islands.

Our nine study beaches on Santa Rosa Island encompass a wave energy gradient influenced by storm activity and aspect. These differences influence the physical properties of beaches including slope, grain size, permeability, cusping, and stability. The physical properties in turn affect the beach fauna. Sampling sites were established by Dugan *et al* (1990) to represent the range of exposures and beach types found on Santa Rosa Island (Figure1).



Sand Beach and Lagoon Monitoring Methods

Sampling techniques used are described in the monitoring handbook for sand beaches and coastal lagoons (Dugan *et al*. 1990). Lagoon temperatures and salinities were measured at each sampling station using a handheld thermometer and a refractometer. Samples were obtained just below the surface and at 10-centimeter (cm) depth.

Beach sampling was conducted between July 28 and August 2, 2004 at Becher's Pier, Abalone Rocks, China Camp, Sandy Point, and Soledad West. Sampling followed standard methods (Dugan *et al.,* 1990) including: (i) five upper beach core transects to estimate the abundance of beachhopper amphipods, *Megalorchestia* spp., isopods, *Alloniscus* sp., and associated species; (ii) five wash zone core transects to estimate abundance of sand crabs (*Emerita analoga*) and isopods (including *Excirolana chiltoni* and associated species); (iii) three point contact transects were used to determine percent cover and composition of macrophyte wrack; (iv) size frequencies of sand crabs; (v) measurements of beach slope and sea surface temperature; and (vi) bird census. Both upper beach and wash zone core transects utilized a clam gun with a 10 cm diameter core, to a 10 cm depth in the sand. Core samples were uniformly spaced based on the beach/habitat width and the vertical transect length, ensuring sampling through the prime habitat for the target species. Cores were pooled from all transects for overall abundance per meter of beach (a vertical meter-wide strip of intertidal beach). Abalone Rocks and Becher's Bay had the narrowest beaches and therefore the shortest transect and sampling intervals. Beach slope was calculated from the rise over run measured by metal ruler and carpenter level. Figure 1 shows all the beach and lagoon sampling locations on Santa Rosa Island with site codes. The wash zone is the wet sand portion of beach between the waves. The organisms here cannot dry out completely and typically migrate with the tide level. The upper beach is typically dry sand with plant material deposited by the high tide and winds.

RESULTS

Wash-zone Transects

Sand crab, *Emerita analoga,* densities from washzone transects ranged from 1,837/m at Abalone Rocks to 9,152/mat Sandy Point (Table 1). *Excirolana chiltoni,* found at all five beaches, ranged in density from 94/m to 6939/m. The polychaete, *Nephtys californiensis*, was present at Becher's Pier (19/m) and Abalone Rocks (24/m).

The standard measure of reporting beach animals is number per meter of beach which reflects the length of the swash zone (or the upper beach). While this may seem strange to those not used to it, it is a better representation of the overall beach than a square meter since populations are highly mobile with the tide and wave swash, and may be compressed or stretched out depending on the beach slope and wave strength.

Table 1. Washzone transect species abundance summary. Mean number per meter of beach.

SiteCode	*Emerita/m*	*Excirolana/m*	*Euzonus/m*	*Nephtys/m*	*Blepharipoda/m*
AR	1837	94	0	24	0
BB	4770	907	4348	19	0
CC	2802	214	111	0	0
SP	9152	6939	49	0	0
SW	3021	435	2184	0	0

Bloodworms, *Euzonus mucronata*, were present in all wash zone transects except Abalone Rocks. Becher's Pier had the most blood worms with 4,348/m (table 1). *Euzonus mucronata* were also abundant at Soledad West. China Camp and Sandy Point had low numbers while Abalone Rocks had none in the washzone transects.

Emerita analoga megalopa (recently settled from the plankton) were present at all beaches (Table 2). Ovigerous (egg bearing) sand crab densities ranged from only 20/m at Abalone rocks to 478/m at Soledad West. China Camp however, had the greatest proportion of ovigerous females in the population with 31% compared to only 20% at Soledad West with similar abundance.

Table 2. Female *Emerita analoga*, numbers of individuals and reproductive population percentage. Totals and mean/m from five transects per beach.

SiteCode	*Ovigerous*	*Non-Ovigerous*	*Total crabs*	*%Ovigerous in population*	*Total Ovigerous Emerita/m beach*
AR	20	1	266	8%	105
BB	188	8	713	26%	1777
CC	327	36	1044	31%	955
SP	444	76	1852	24%	1290
SW	478	84	2332	20%	133

Size frequencies were conducted by sorting *Emerita analoga* through a series of buckets with graduated holes corresponding to carapace lengths. Supplemental samples (in addition to the washzone transects) were collected at all beaches except Bechers Pier to provide a larger sample. Crabs less than sieve #12 (7.72 mm carapace) were not sexed due to the difficulty of seeing genital characters on these small animals, the abundance of the crabs in these size

categories, and the lack of females in the small size categories. Only sub-samples were sexed when crabs were abundant in the larger categories (Dugan *et al*. 1990). Males were generally rare above sieve size 20 (11.8 mm), though Bechers and Abalone Rocks both had some larger males. Two *Blepharipoda occidentalis* were collected in the supplemental sample at Sandy Point. Bechers was the first site sampled, and my ability to sex the crabs may be suspect as I was getting acquainted with what to look for. Blowing sand also made for difficult working conditions. Ovigerous females were not found in sieves smaller than size 22 (12.8 mm) and were rare below size 26 (14.7 mm). Complete size distribution and reproductive status tables and graphical representation are presented in Appendix A.

New eggs were the most common developmental stage for ovigerous females at all sites (Table 3). These are characterized by bright orange egg masses held under the abdomen of females. Later developmental stages were fairly common in each of the samples. Megalopa (the larval stage of *E. analoga* at settlement) were fairly common on all the beaches.

Table 3. *Emerita analoga* numbers by gender and egg developmental stage.

SiteCode	*NewEggs*	*EyespotEggs*	*GreyEggs*	*JustDropped*	*NonOvigerous*	*Male*	*Unsexed*	*Total crabs*	*Megalopa*
AR	9	6	5	0	1	74	171	266	11
BB	130	21	16	1	7	79	193	713	29
CC	95	32	10	2	28	45	119	1044	16
SP	89	19	7	2	40	65	586	1852	95
SW	24	4	0	0	8	33	405	2332	81

Upper-beach transects

Beachhopper amphipods, *Megalorchestia* spp. varied greatly in abundance among the five beaches. Sandy Point and Soledad West had the highest densities (54,046/m and 37,594/m respectively) with record numbers for both beaches in this monitoring program. Orders of magnitude lower, Abalone Rocks and Bechers Pier had just 711 and 358 amphipods/m repectively. Results are summarized in Table 4 and complete results are in Appendix B.

Table 4. Summarized results of Upper–beach transects. Numbers represent the mean abundance from five transects on each beach.

Sitecode	Amphipods/m	*Alloniscus*/m	Beetles/m	Staphylinids/m	*Thinopinus/m*	Excirolana*/m*
AR	712	19	19	0	0	7,691
BB	358	0	0	0	0	5,019
CC	1,459	150	0	30	0	1,944
SP	54,047	52	487	729	393	5,096
SW	37,594	557	718	979	52	2,211

At Becher's Bay, waves wash all the way to the cliff during high tide, though there was a small dune in the center of the beach at the time of the sampling. Small dunes and vegetation backed the beach at Soledad, and Abalone Rocks. The beaches at China Camp and Sandy Point gradually rise up to dry sand and low dunes not subject to normal inundation. The upper beach at both of these sites is dry, loose sand with very little vegetation.

The isopod *Alloniscus* sp. was present on all the beaches except Bechers Bay. Soledad West was the only site with *Alloniscus* found on all transects. Both Soledad West and Sandy Point had higher numbers of beetles in general and Staphylinid beetles in particular than in 2000. *Thinopinus pictus,* large predatory beetle larvae*,* were common at both of these sites but absent at China Camp where they were present in 2000. Isopods, *Excirolana chiltoni*, were common at

all beaches with the highest density at Abalone Rocks. Fewer organisms were captured at Soledad West than expected based on the amount of activity of beach hoppers and beetles around the upper beach wrack. Spiders were active on several beaches, especially Soledad West, but were never captured in the samples. Spiders, and to a certain extent the Staphylinid beetles, are rarely caught because they are so active and wary. Beachhoppers may have occupied a narrower band than was apparent, resulting in transects longer than necessary.

Bloodworms were also abundant in the upper beach transects at Bechers Pier and Soledad West beaches, common at China Camp, and present at Sandy Point and Abalone Rocks (Appendix B). Becher's Pier is the only beach where they have been common in the past. The numbers found far exceed those recorded in 1999 or 2000.

Macrophyte Wrack

Total wrack coverage was highest on Sandy Point and Soledad West with 40% and 45% cover (Table 5). The wrack was composed primarily of giant kelp, *Macrocystis pyrifera,* and dried surfgrass, *Phyllospadix* sp., blades. Surfgrass was generally composed of dried strands and rarely formed clumps, thus it did not likely contribute significantly to amphipod food sources or shelter for invertebrates. Average wrack height ranged from 1.3 cm at China Camp to 3.4 cm at Sandy Point. Average height is an overestimate due to trace amounts being entered as one cm in the database. Complete point transect data are presented in Appendix C.

Table 5. Macrophyte Wrack mean percent cover from three transects per site.

	Macrocystis	***Phyllospadix***	***Terrestrial***	***Egregia***	***Green algae***	***Red Algae***	***Brown algae***	***Tar***	***Total***
AR	2	8	4	0.67	0.67	0.67	0	0	16%
BB	0	11	0.3	0	0	0.67	0.3	0	12%
CC	11	5	1	0	0	0	0.67	0.3	18%
SP	29	9	0	1	0	0	1	0	40%
SW	23	22	0.3	0	0	0	0	0	45%

Bird Census

Shorebird counts were made on each of the beaches. Birds in general were relatively uncommon on the beaches and lagoons. We only recorded seven species during the monitoring on beaches (Table 6). We had blowing sand at Bechers Pier and China Camp but the other sites were mostly calm and nice. Two campers were at Becher's when we arrived on 7/28/2004 and no shorebirds were present that afternoon. Bird counts from Becher's (Table 6) are from 7/29/2004. No birds were seen at the lagoons during sampling though eight young Brown Pelicans landed on the Old Ranch House Lagoon when we were at Abalone Rocks and two unidentified sandpipers were observed upstream from the lagoon in Old Ranch Canyon Creek. Western Snowy Plovers were observed only between Oat Point and Abalone Rocks beach.

Table 6. Bird numbers at each beach on the sampling date.

Common Name	*Abalone Rocks*	*Bechers Pier*	*Sandy Point*	*Soledad West*
Black Oystercatcher			2	
Common Raven			8	4
Killdeer		4		
Snowy Plover	2			
Song Sparrow		4		10
Western Gull			22	17
Western Sandpiper	1	1		

Lagoon observations

All three lagoons were at low water levels. The high salinities indicate that freshwater flow to the lagoons was very low. The water in the lagoons may have been due to wave overwash or the salts in the sediments were dissolving into the runoff. Old Ranch House Lagoon had formed a small sandbar near the mouth splitting off a portion of the lagoon there. Water clarity was surprisingly low with most of the stations having very murky water. Small surface beetles and water boatmen, *Trichocorixa reticulata* were common at several of the stations. *Frankenia salina Distichlis spicata, Jaumea carnosa*, were common on the banks of the lagoons and *Ruppia maritima* was growing in the water at some sites (Table 7). Cincidella beetles were common around Old Ranch House Canyon Lagoon and between Old Ranch Canyon and Oat Point in the dunes.

Table 7. Physical data for lagoons and beaches in July 2004.

Location	*Date Sampled*	*Station #*	*Water Depth (cm)*	*Secchi Depth (cm)*	*Salinity at surface (ppt)*	*Salinity at 10 cm (ppt)*	*Water temperature (10 cm)*	*Slope (degrees)*	*Notes*
Old Ranch House Canyon Lagoon	7/29/2004	1	<10	Bottom	86	na	23		77ppt in second pool
Old Ranch House Canyon Lagoon	7/29/2004	2	25	10	86	96	23		*Ruppia,* brine flies, *Salicornia*
Old Ranch House Canyon Lagoon	7/29/2004	3	<10	Bottom	90	na	27		*Salicornia, Frankenia, Distichlis*, beetles, flies
Old Ranch House Canyon Lagoon	7/29/2004	5	28	6	83	85	19.5		*Ruppia,* Brine flies, *Salicornia*
Old Ranch Canyon Lagoon	7/29/2004	OR1	15	Bottom	46	46	19		worm holes in shore mud, *Ruppia* drift
Old Ranch Canyon Upstream	7/29/2004	OR2	24	11	28	30	19.5		*Trichocorixa, Jaumea, Salicornia, Distichlis*
Old Ranch Canyon Upstream	7/29/2004	10m above OR2		20	8		19		*Trichocorixa, Jaumea, Rupia, Salicornia, Distichlis*
Oat Point Wetland	7/29/2004		almost dry		>200	na	26		*Frankenia Distichlis, Salicornia*
Bechers Pier	7/28/2004						16	4.0	
Abalone Rocks	7/29/2004						17	3.7	
China Camp	8/1/2004						16	5.6	
Sandy Point	7/30/2004						18.5	5.6	
Soledad West	7/31/2004						18.5	1.5	typical flat
Soledad West	7/31/2004							6.1	near berm

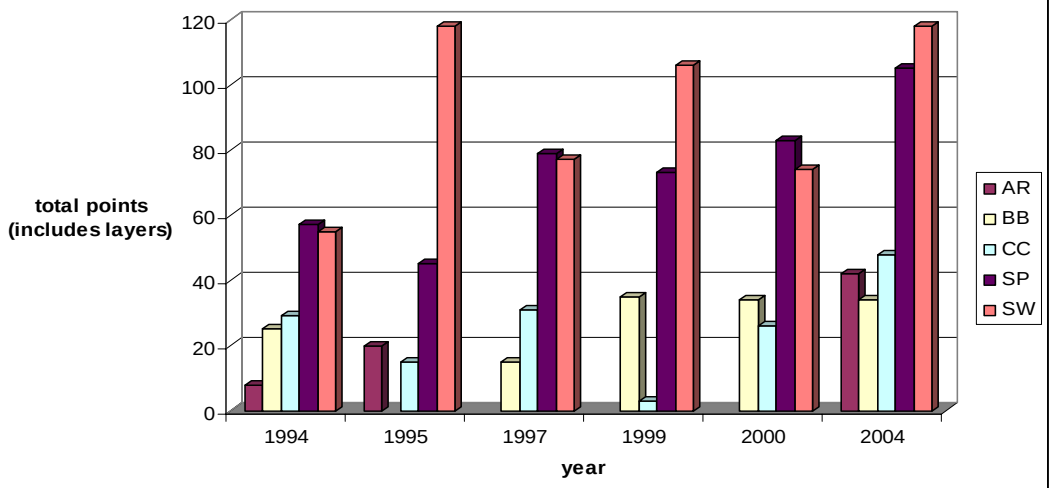
DISCUSSION

No monitoring for Pismo clams, *Tivela stultorum*; mole crabs, *Blepharipoda occidentalis*; or olive snails, *Olivella biplicata*, was performed in 2004. Pismo clam populations have not been surveyed since 1999. Time constraints and sea conditions prevented any of the surreptitious opportunities necessary to complete this part of the monitoring. However; beginning in November 2003, we started quarterly beach walk surveys of the major beaches on Santa Rosa Island, counting shorebirds and carcasses primarily. These surveys are part of the Montrose Restoration Program to identify the potential prey items that reintroduced bald eagles might be scavenging. Those data will be presented in a separate report for Beachwalk Monitoring (see Richards and Rich 2004; Rich and Richards *in prep*.).

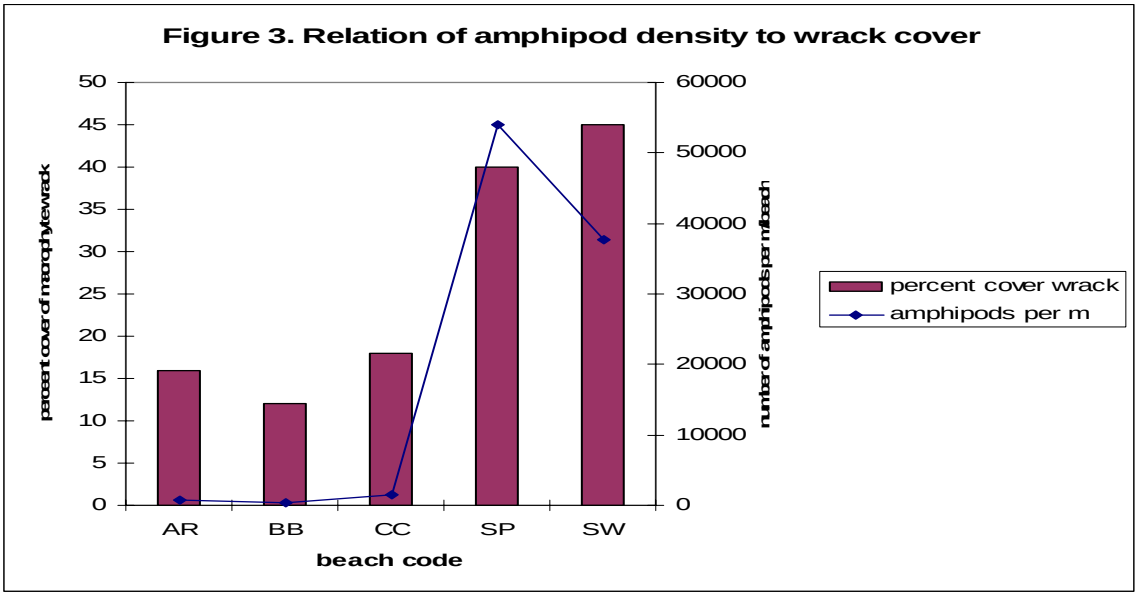
Emerita analoga abundance has been highly variable over the years. The abundance in 2004 was in general lower than the 10-year mean except at Bechers where it was just above. Mean abundance ranged from 2,174/m at Abalone Rocks to 12,365/m at Sandy Point. Bechers Pier (4,674/m), China Camp (5,345/m), and Soledad West (5476/m) had more moderate abundances. *Excirolana chiltoni* abundance somewhat tracks the *E. analoga* abundance, but at lower levels. The *E. analoga* size distribution is distinctly bimodal with mostly males below 15 mm carapace length and mostly females above that (Appx. A.). Bechers Pier and China Camp had the largest populations of ovigerous females, while Abalone Rocks and Soledad west had very few females.

It is worth noting that the typical high depositional beaches (Sandy Point and Soledad West) have been identified time and again as receiving large quantities of marine debris, carcasses, and macrophyte wrack, primarily *Macrocystis pyrifera* (Richards 1994, Dugan *et al.* 1993, Lerma and Richards 2002, Richards and Rich 2004) (fig.2). These beaches both face northwest into the prevailing winds and swell. As a result of this allochthonous input, these tend to be the most productive beaches; however, they are also the most vulnerable to an oil spill for the same reason.

Figure 2. Macrophyte Wrack Cover for all years sampled

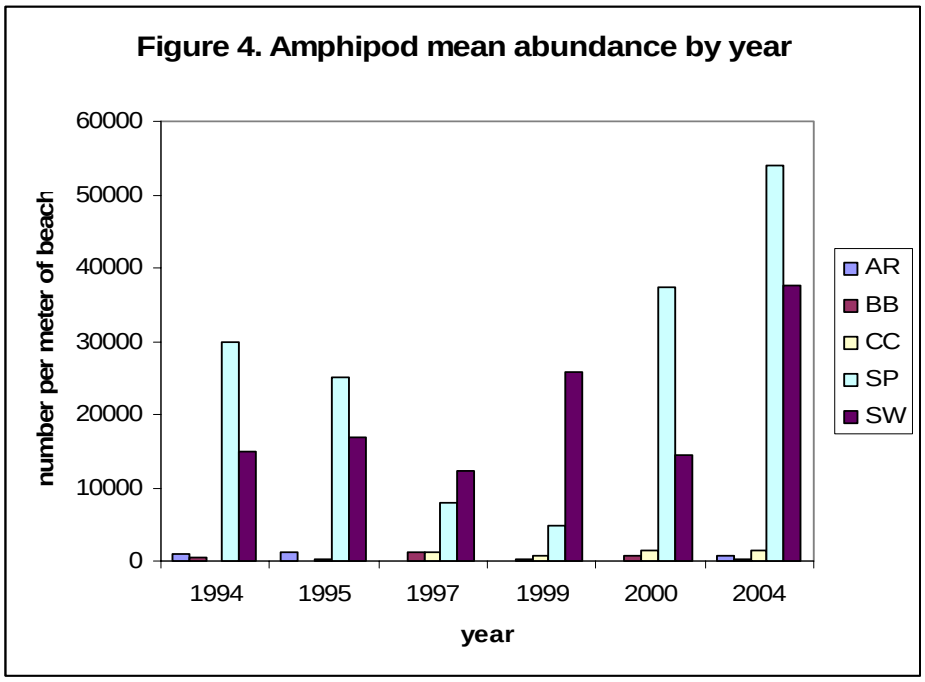


There is a direct relationship between amphipod abundance and macrophyte wrack cover, something we have observed in the past (Lerma and Richards 2000, Dugan et al. 2000) (figure 3). The depth of the wrack at Soledad West was not as deep as the wrack at Sandy Point and that may be an indication of the total amount of wrack available to the amphipods. Also Sandy Point is broken into smaller pieces of beach by small rocky points which could concentrate the amphipods into higher numbers. There was a high degree of variability in the numbers of amphipods among the beaches as well as among transects. Macrophyte wrack cover was also highly variable. It is important to keep in mind however that the abundance of amphipods on both beaches was higher than we have found in the past at these sites. The offshore *Macrocystis* canopy the last few years has been much higher along the north side of Santa Rosa Island than it has been since the early 1980's.



The cover of macrophyte wrack on the beaches has increased at all beaches in the last decade (figure 2). Kelp wrack was abundant at Sandy Point and Soledad West beaches in early July and during earlier quarterly Beachwalk surveys (Rich and Richards in prep). Shorebird numbers were low at the beach monitoring sites during the Beachwalk surveys, similar to numbers found during this beach monitoring. During the beachwalk surveys in mid-July 2004, Western Snowy Plovers were seen only on Bee Rock West and Skunk Point beaches.

Shore bird numbers seem like they should be higher based on the productivity of sand crabs and amphipods present. Gulls and ravens were most common where there were carcasses on the beach. Song Sparrows and Black Phoebes were often present at the back beach where they were seen catching flies. True shorebirds were actually uncommon during these surveys. Mid-summer is probably not an optimal time to be looking for shorebirds, however. Shorebirds are counted quarterly, during beachwalk surveys on Santa Rosa Island. Shorebirds tend not to be very abundant on most of the island beaches. Skunk Point Beach, not sampled this summer, tends to have the highest populations of shorebirds on Santa Rosa Island (Richards and Rich 2004)



Kelp fly abundance was not measured except as pupae or larvae found in upper beach transects. Adult kelp flies were common to abundant on all beaches. Very few larvae or pupae were found in transects at all beaches except at Abalone Rocks where none were found. Kelp flies represent a large amount of biomass on the beaches and a food source for birds foraging there.

Beachhopper amphipod densities at Soledad West and Sandy Point exceed any previous samples on Santa Rosa Island (fig. 4). *Alloniscus* numbers were somewhat lower than previous years, while the numbers of various beetles were higher in 2004. Comparisons of species composition of each site by year can be seen in figures 5-9. The coarse sand with a high proportion of shell fragments on Abalone Rocks and China Camp may be responsible for the lower abundance of amphipod and other organisms in the upper beach samples. Bechers Pier beach has a higher gravel component in the lower stretches of beach than Soledad West and Sandy Point

Bloodworm, *Euzonus mucronata,* abundance was above the mean since 1994 at all the beaches. *Euzonus mucronata* were not found in the washzone at abalone rocks but they were found in upper beach transects. Sandy Point upper beach transects also had some *E. mucronata*.

CONCLUSIONS AND RECOMMENDATIONS

2004 was a fairly typical year for the sand beach community on Santa Rosa Island. The beaches appear to be getting more kelp wrack as the kelp beds increase offshore, and this is leading to increases in the beach hopper amphipod populations that scavenge the kelp wrack. The sand beach hosts a highly variable community of organisms in an environment very much influenced by the physical forces of nature. Continued monitoring is important for understanding the inherent variability in the system.

Figure 5. Abalone Rocks upper beach transects- species composition by year

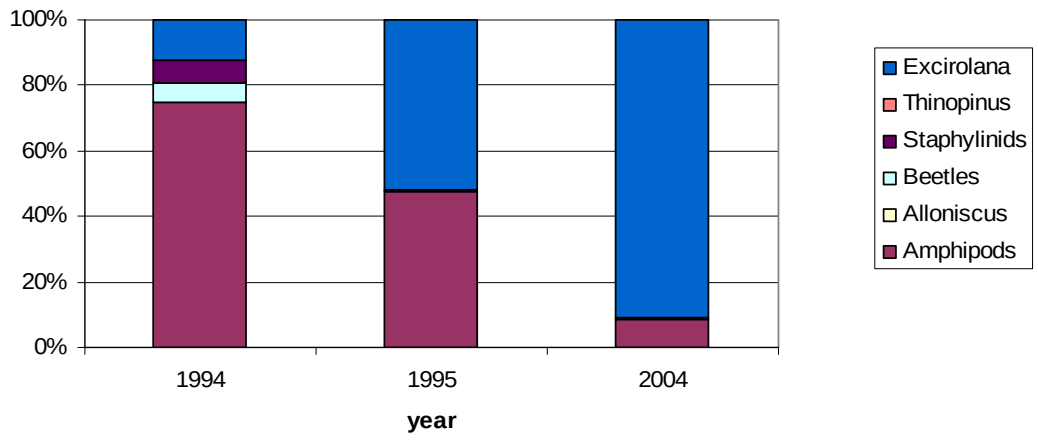


Figure 6. Bechers Pier Upper Beach Transects- species composition by year

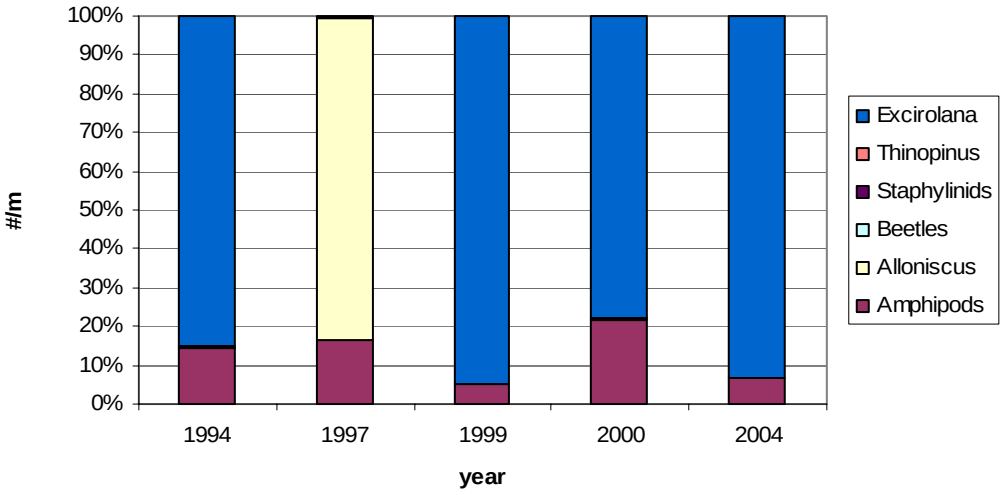


Figure 7. China Camp Upper Beach Transects- species composition by year

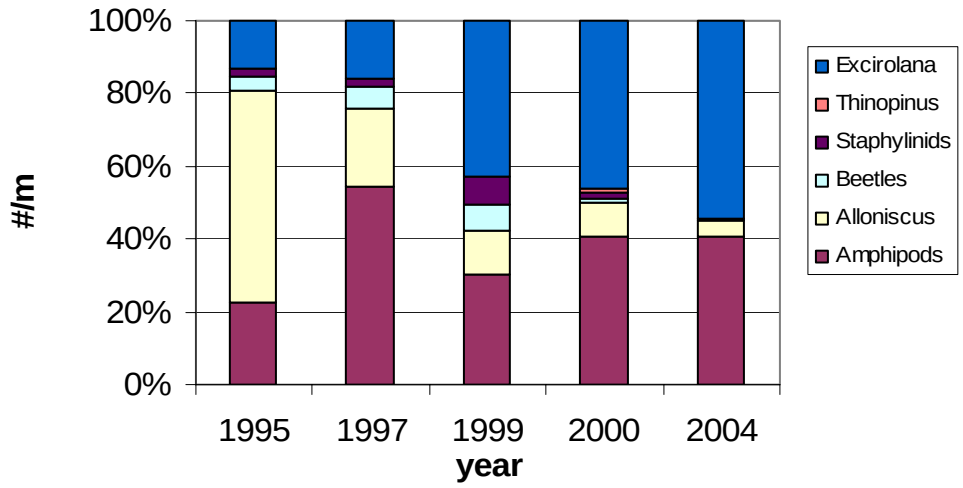


Figure 8. Sandy Point Upper Beach Transects- species composition by year

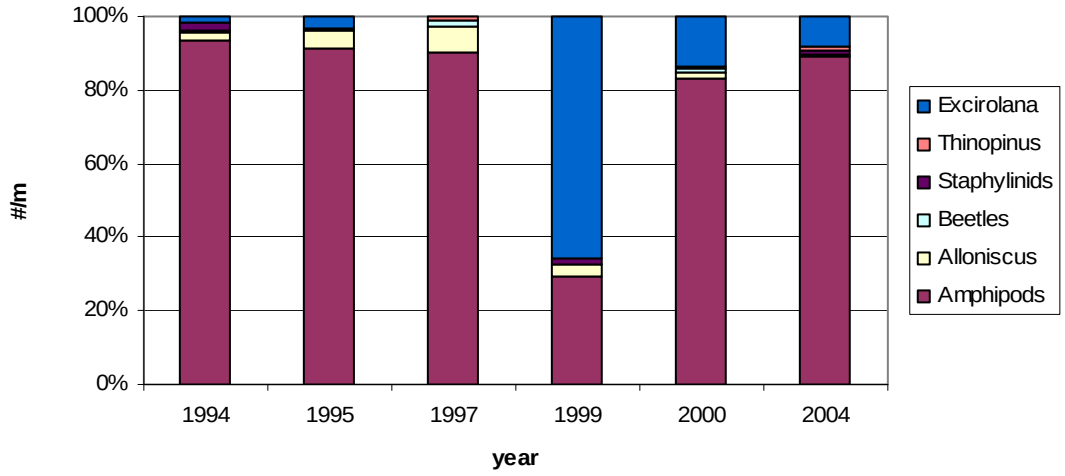
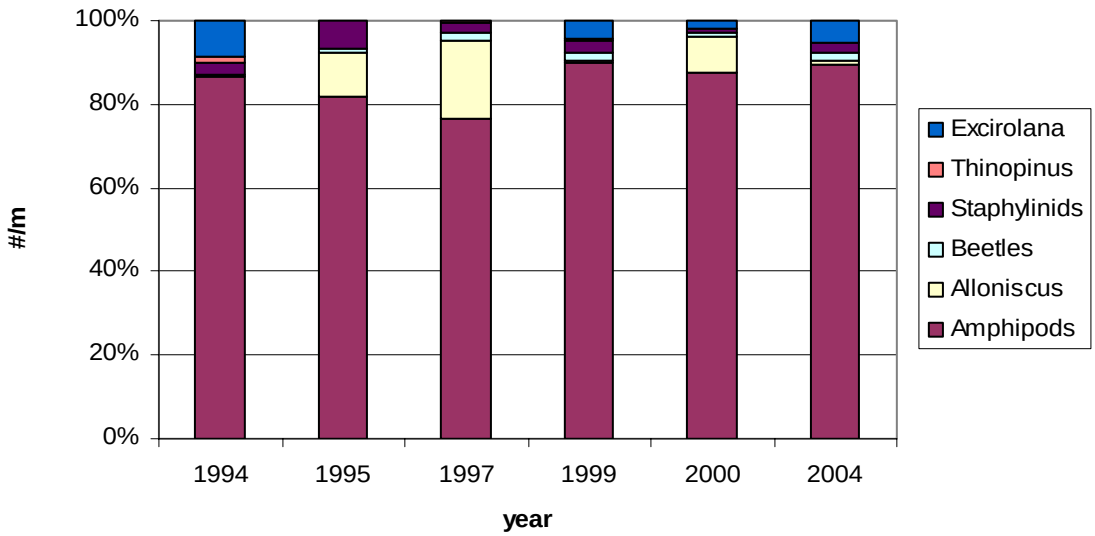


Figure 9. Soledad West Upper Beach Transects- species composition by year



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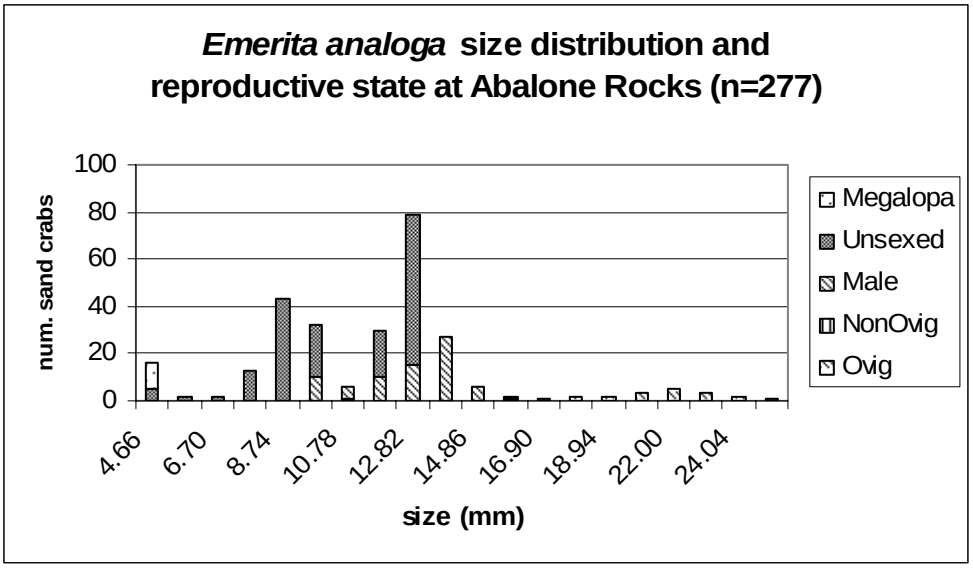
APPENDIX A. EMERITA ANALOGA SIZE DISTRIBUTION

ABALONE ROCKS

Year	*SiteCode*	*Box*	*Size*	*Ovig*	*NonOvig*	*Male*	*Unsexed*	*Megalopa*
2004	AR	6	4.66	0	0	0	5	11
2004	AR	8	5.68	0	0	0	2	0
2004	AR	10	6.70	0	0	0	2	0
2004	AR	12	7.72	0	0	0	13	0
2004	AR	14	8.74	0	0	0	43	0
2004	AR	16	9.76	0	0	10	22	0
2004	AR	18	10.78	0	1	5	0	0
2004	AR	20	11.80	0	0	10	20	0
2004	AR	22	12.82	0	0	15	64	0
2004	AR	24	13.84	0	0	27	0	0
2004	AR	26	14.86	0	0	6	0	0
2004	AR	28	15.88	1	0	1	0	0
2004	AR	30	16.90	1	0	0	0	0
2004	AR	32	17.92	2	0	0	0	0
2004	AR	34	18.94	2	0	0	0	0
2004	AR	38	20.98	3	0	0	0	0
2004	AR	40	22.00	5	0	0	0	0
2004	AR	42	23.02	3	0	0	0	0
2004	AR	44	24.04	2	0	0	0	0
2004	AR	48	26.08	1	0	0	0	0
			total	**20**	**1**	**74**	**171**	**11**

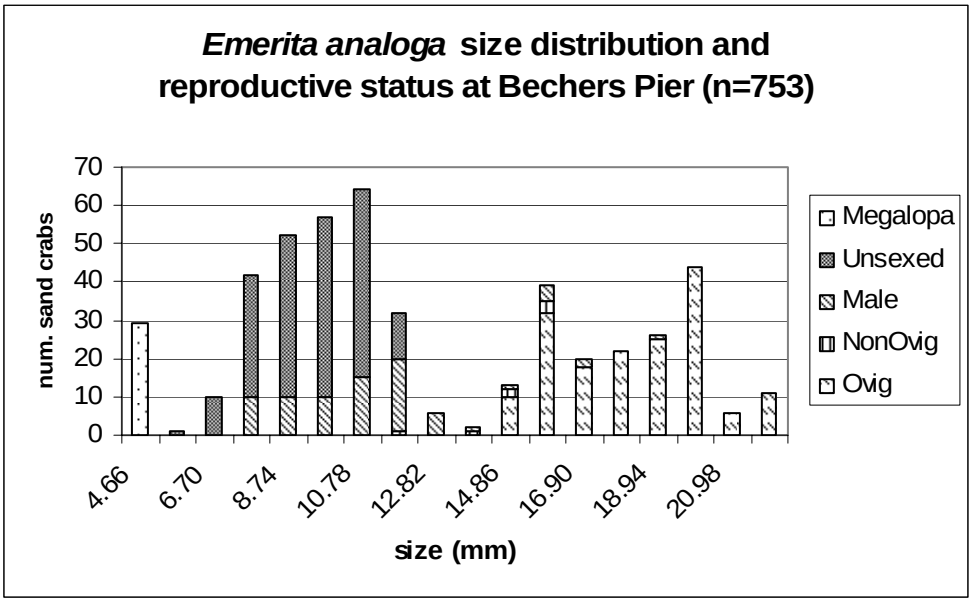


Washzone clam-gun transects. *Emerita analoga* numbers by size categories (sieve number) and totals by transect

Location	**Abalone Rocks**				
Transect	1	2	3	4	5
Length	10	9.6	9.7	9	8.7
Cores	20	20	20	20	20
Total38	1	2	0	1	2
Ovig38	1	2	0	1	2
Total28	0	0	0	2	1
Ovig28	0	0	0	2	1
Total18	17	15	13	16	15
Ovig18	0	0	0	0	0
Total08	11	3	14	9	18
Ovig08	0	0	0	0	0
Total04	7	1	1	0	5
Total Megalopa	7	1	1	0	5
Total ovigerous *Emerita*	1	2	0	3	3
Total *Emerita*	36	21	28	28	41
Emerita sp./m	2292.99	1284.08	1729.94	1605.10	2271.97
Excirolana spp.	0	3	1	2	2
Olivella spp.	0	0	0	0	0
Euzonus spp.	0	0	0	0	0
Nephtys spp.	0	1	0	1	0
Blepharipoda sp.	0	0	0	0	0

BECHERS PIER

Year	*SiteCode*	*Box*	*Size*	*Ovig*	*NonOvig*	*Male*	*Unsexed*	*Megalopa*
2004	BB	6	4.66	0	0	0	0	29
2004	BB	8	5.68	0	0	0	1	0
2004	BB	10	6.70	0	0	0	10	0
2004	BB	12	7.72	0	0	10	32	0
2004	BB	14	8.74	0	0	10	42	0
2004	BB	16	9.76	0	0	10	47	0
2004	BB	18	10.78	0	0	15	49	0
2004	BB	20	11.80	0	1	19	12	0
2004	BB	22	12.82	0	0	6	0	0
2004	BB	24	13.84	0	1	1	0	0
2004	BB	26	14.86	10	2	1	0	0
2004	BB	28	15.88	32	3	4	0	0
2004	BB	30	16.90	18	0	2	0	0
2004	BB	32	17.92	22	0	0	0	0
2004	BB	34	18.94	25	0	1	0	0
2004	BB	36	19.96	44	0	0	0	0
2004	BB	38	20.98	6	0	0	0	0
2004	BB	40	22.00	11	0	0	0	0
			total	**188**	**8**	**153**	**364**	**40**

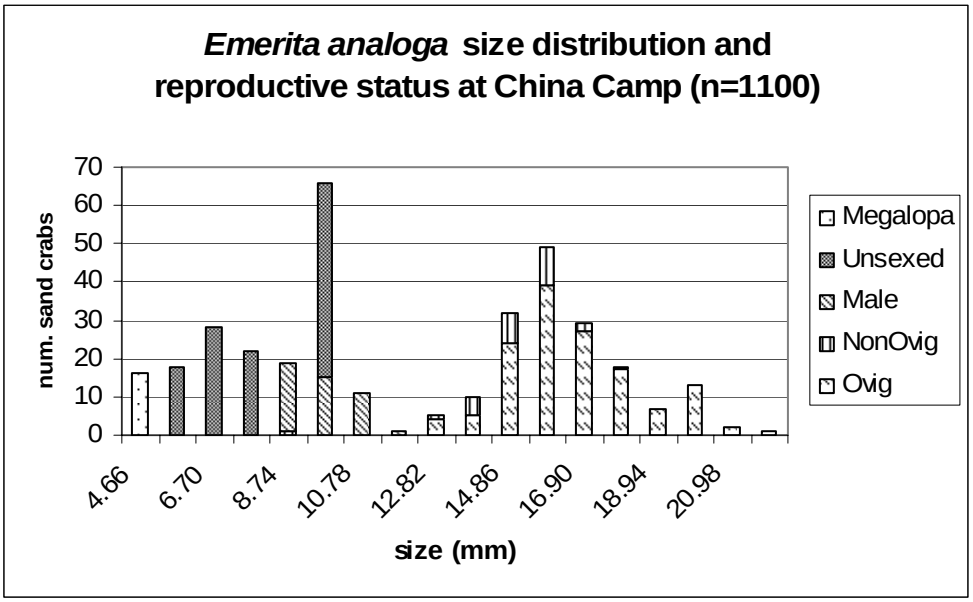


Washzone clam-gun transects. *Emerita analoga* numbers by size categories (sieve number) and totals by transect

Location	**Bechers Pier**				
Transect	1	2	3	4	5
Length	10.0	9.6	9.5	8.7	8.0
Cores	25	25	25	25	25
Total38	5	4	7	4	1
Ovig38	5	4	7	4	1
Total28	42	35	35	28	14
Ovig28	41	31	34	25	14
Total18	18	22	34	35	17
Ovig18	5	7	0	7	1
Total08	59	32	22	21	41
Ovig08	0	0	0	0	0
Total04	8	7	4	3	7
Total Megalopa	8	7	4	3	7
Total ovigerous *Emerita*	51	42	41	36	16
Total *Emerita*	132	100	102	91	80
Emerita sp./m	6726.11	4891.72	4937.58	4034.14	3261.15
Excirolana spp.	32	9	17	15	24
Olivella spp.	0	0	0	0	0
Euzonus spp.	31	105	71	117	157
Nephtys spp.	0	0	1	1	0
Blepharipoda sp.	0	0	0	0	0

CHINA CAMP

Year	*SiteCode*	*Box*	*Size*	*Ovig*	*NonOvig*	*Male*	*Unsexed*	*Megalopa*
2004	CC	6	4.66	0	0	0	0	16
2004	CC	8	5.68	0	0	0	18	0
2004	CC	10	6.70	0	0	0	28	0
2004	CC	12	7.72	0	0	0	22	0
2004	CC	14	8.74	0	1	18	0	0
2004	CC	16	9.76	0	0	15	51	0
2004	CC	18	10.78	0	0	11	0	0
2004	CC	20	11.80	0	0	1	0	0
2004	CC	22	12.82	4	1	0	0	0
2004	CC	24	13.84	5	5	0	0	0
2004	CC	26	14.86	24	8	0	0	0
2004	CC	28	15.88	39	10	0	0	0
2004	CC	30	16.90	27	2	0	0	0
2004	CC	32	17.92	17	1	0	0	0
2004	CC	34	18.94	7	0	0	0	0
2004	CC	36	19.96	13	0	0	0	0
2004	CC	38	20.98	2	0	0	0	0
2004	CC	40	22.00	1	0	0	0	0
			total	**327**	**36**	**198**	**483**	**56**

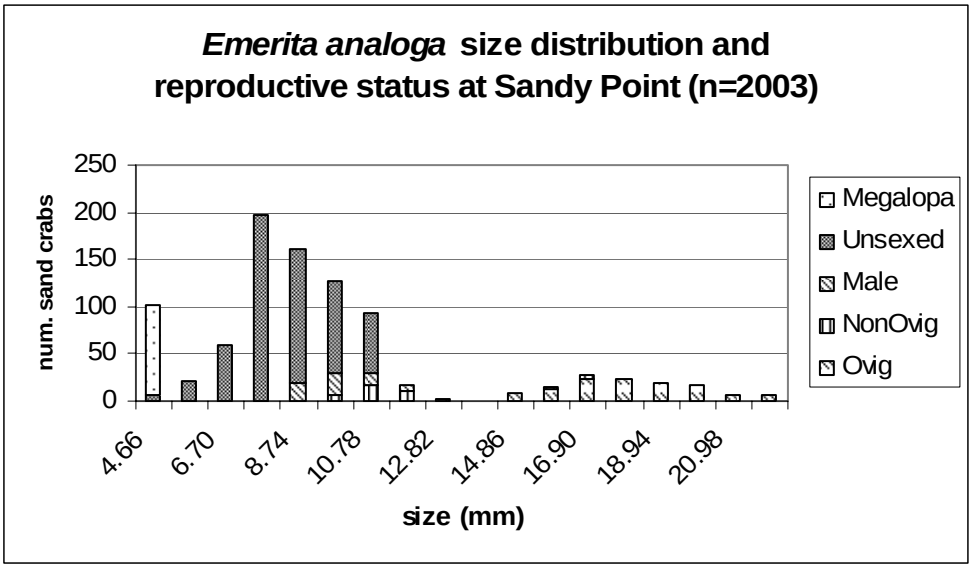


Washzone clam-gun transects. *Emerita analoga* numbers by size categories (sieve number) and totals by transect

Location	**China Camp**				
Transect	1	2	3	4	5
Length	10.3	11.5	10.5	11.5	10.5
Cores	25	25	25	25	25
Total38	1	0	1	0	0
Ovig38	1	0	1	0	0
Total28	18	16	14	14	21
Ovig28	16	13	12	12	19
Total18	7	10	7	7	6
Ovig18	5	1	2	2	3
Total08	14	18	27	28	29
Ovig08	0	0	0	0	0
Total04	1	4	4	4	2
Total Megalopa	1	4	4	4	2
Total ovigerous *Emerita*	22	14	15	14	22
Total *Emerita*	41	48	53	53	58
Emerita sp./m	6726.11	4891.72	4937.58	4034.14	3261.15
Excirolana spp.	1	6	7	5	0
Olivella spp.	0	0	0	0	0
Euzonus spp.	0	0	5	4	1
Nephtys spp.	0	0	0	0	0
Blepharipoda sp.	0	0	0	0	0

SANDY POINT

Year	*SiteCode*	*Box*	*Size*	*Ovig*	*NonOvig*	*Male*	*Unsexed*	*Megalopa*
2004	SP	6	4.66	0	0	0	6	95
2004	SP	8	5.68	0	0	0	22	0
2004	SP	10	6.70	0	0	0	59	0
2004	SP	12	7.72	0	0	0	198	0
2004	SP	14	8.74	0	0	20	141	0
2004	SP	16	9.76	0	6	24	97	0
2004	SP	18	10.78	0	16	14	63	0
2004	SP	20	11.80	0	11	7	0	0
2004	SP	22	12.82	0	2	0	0	0
2004	SP	24	13.84	0	1	0	0	0
2004	SP	26	14.86	8	0	0	0	0
2004	SP	28	15.88	13	1	0	0	0
2004	SP	30	16.90	24	3	0	0	0
2004	SP	32	17.92	23	0	0	0	0
2004	SP	34	18.94	20	0	0	0	0
2004	SP	36	19.96	16	0	0	0	0
2004	SP	38	20.98	7	0	0	0	0
2004	SP	40	22.00	6	0	0	0	0
			total	**444**	**76**	**263**	**1069**	**151**

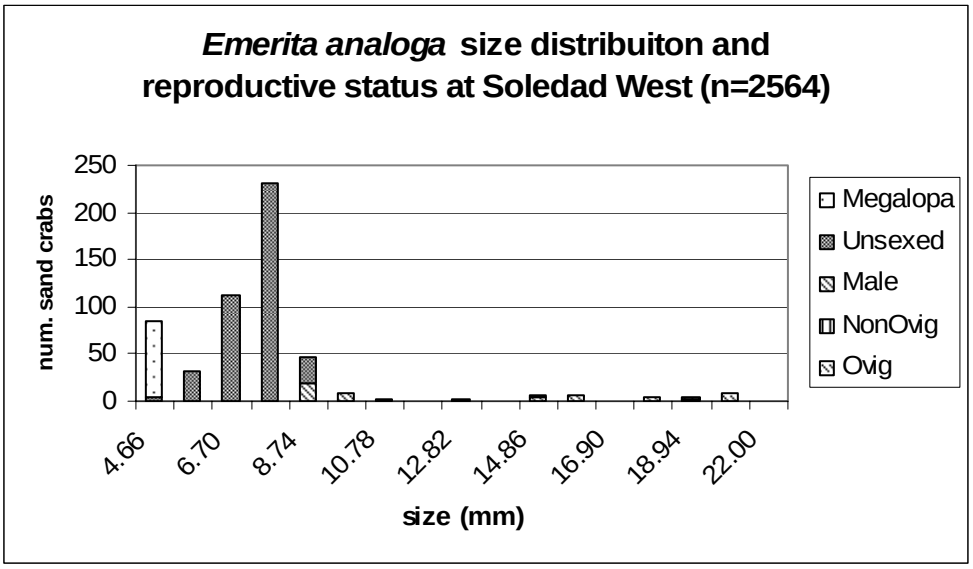


Washzone clam-gun transects. *Emerita analoga* numbers by size categories (sieve number) and totals by transect

Location	**Sandy Point**				
Transect	1	2	3	4	5
Length	9.4	9.7	9.9	9.3	9.3
Cores	20	20	20	20	20
Total38	1	2	0	3	3
Ovig38	1	2	0	3	3
Total28	13	5	21	35	23
Ovig28	12	4	20	34	21
Total18	22	9	21	37	17
Ovig18	1	0	3	1	2
Total08	95	58	107	138	54
Ovig08	0	0	0	0	0
Total04	14	18	29	25	6
Total Megalopa	14	18	29	25	6
Total ovigerous *Emerita*	14	6	23	38	26
Total *Emerita*	145	92	178	238	103
Emerita sp./m	8681.53	5654.78	11224.20	14098.09	6101.27
Excirolana spp.	101	134	87	148	104
Olivella spp.	0	0	0	0	0
Euzonus spp.	2	1	1	0	0
Nephtys spp.	0	0	0	0	0
Blepharipoda sp.	0	0	0	0	0

SOLEDAD WEST

Year	*SiteCode*	*Box*	*Size*	*Ovig*	*NonOvig*	*Male*	*Unsexed*	*Megalopa*
2004	SW	6	4.66	0	0	0	4	81
2004	SW	8	5.68	0	0	0	31	0
2004	SW	10	6.70	0	0	0	113	0
2004	SW	12	7.72	0	0	0	230	0
2004	SW	14	8.74	0	0	20	27	0
2004	SW	16	9.76	0	0	9	0	0
2004	SW	18	10.78	0	0	3	0	0
2004	SW	20	11.80	0	0	1	0	0
2004	SW	22	12.82	0	2	0	0	0
2004	SW	24	13.84	1	0	0	0	0
2004	SW	26	14.86	4	3	0	0	0
2004	SW	28	15.88	7	0	0	0	0
2004	SW	30	16.90	0	1	0	0	0
2004	SW	32	17.92	4	0	0	0	0
2004	SW	34	18.94	3	1	0	0	0
2004	SW	36	19.96	8	1	0	0	0
2004	SW	40	22.00	1	0	0	0	0
			total	**478**	**84**	**296**	**1474**	**232**



Washzone clam-gun transects. *Emerita analoga* numbers by size categories (sieve number) and totals by transect

Location	**Soledad West**				
Transect	1	2	3	4	5
Length	11.0	10.8	11.2	10.9	10.9
Cores	25	25	25	25	25
Total38	1	0	0	0	0
Ovig38	1	0	0	0	0
Total28	2	1	0	4	2
Ovig28	2	1	0	4	2
Total18	1	3	0	0	1
Ovig18	0	2	0	0	0
Total08	67	106	8	1	34
Ovig08	0	0	0	0	0
Total04	17	11	1	2	10
Total Megalopa	17	11	1	2	10
Total ovigerous *Emerita*	3	3	0	4	2
Total *Emerita*	88	121	9	7	47
Emerita sp./m	4932.48408	6658.85362	513.630565	388.789795	2610.44577
Excirolana spp.	4	7	6	19	3
Olivella spp.	0	0	0	0	0
Euzonus spp.	32	30	59	61	13
Nephtys spp.	0	0	0	0	0
Blepharipoda sp.	0	0	0	0	0

APPENDIX B. UPPER BEACH TRANSECT RESULTS 2004

Year	*Site Code*	*Transect*	*Transect length (m)/# cores*	*Interval*	*Amphipods/M*	*Alloniscus/M*	*Beetles/M*	*Staphylinids/M*	*Thinopinus/M*	*Excirolana/M*
2004	AR	1	21.4/30	.71	2090	0	0	0	0	9360
2004	AR	2	22/30	.73	934	93	93	0	0	6446
2004	AR	3	21/30	.70	357	0	0	0	0	7758
2004	AR	4	21/30	.70	89	0	0	0	0	7490
2004	AR	5	21/30	.70	89	0	0	0	0	7401
				mean	712	19	19	0	0	7691
				sdev	844	42	42	0	0	1056
2004	BB	1	8.7/20	.43	388	0	0	0	0	11138
2004	BB	2	8.6/20	.43	164	0	0	0	0	4218
2004	BB	3	8.0/20	.40	815	0	0	0	0	2191
2004	BB	4	8.2/20	.41	157	0	0	0	0	4178
2004	BB	5	6.3/15	.42	268	0	0	0	0	3371
				mean	358	0	0	0	0	5019
				sdev	272	0	0	0	0	3518
2004	CC	1	29.3/25	1.17	1792	448	0	0	0	1194
2004	CC	2	27.1/25	1.08	1105	0	0	0	0	2900
2004	CC	3	29.5/25	1.18	1503	0	0	150	0	1503
2004	CC	4	28/25	1.12	1997	0	0	0	0	1427
2004	CC	5	29.4/25	1.18	899	300	0	0	0	2697
				mean	1459	150	0	30	0	1944
				sdev	459	211	0	67	0	791
2004	SP	1	33.5/30	1.12	44098	0	427	1280	569	3983
2004	SP	2	30.6/30	1.02	51195	260	390	0	520	8836
2004	SP	3	29.6/30	.99	52161	0	503	1257	503	3394
2004	SP	4	28.6/30	.95	65458	0	607	729	121	5344
2004	SP	5	29.8/30	.99	57322	0	506	380	253	3923
				mean	54047	52	487	729	393	5096
				sdev	7931	116	84	556	195	2211
2004	SW	1	19.1/20	.96	28468	365	730	1095	0	2433
2004	SW	2	21.3/20	1.06	49248	407	407	1085	0	2306
2004	SW	3	20/20	1.00	43185	510	1529	255	127	2038
2004	SW	4	19.2/20	.96	42191	1101	122	856	0	1468
2004	SW	5	21/20	1.05	24879	401	803	1605	134	2809
				mean	37594	557	718	979	52	2211
				sdev	10406	309	528	489	72	500

APPENDIX C. MACROPHYTE WRACK DATA FROM POINT INTERCEPT TRANSECTS

Site	*Sample Date*	*Transect*	*SpeciesName*	*Spacing (m)*	*Length (m)*	*Count*	*Avg. Height (cm)*
Abalone Rocks	7/29/2004	1	Macrocystis	.25	25	1	2
		1	Phyllospadix	.25	25	5	1
		1	Terrestrial	.25	25	1	1
		2	Egregia	.25	25	2	3
		2	Green algae	.25	25	1	1
		2	Macrocystis	.25	25	1	3
		2	Phyllospadix	.25	25	6	2
		2	Red algae	.25	25	2	1
		2	Terrestrial	.25	25	2	1
		3	Green algae	.25	25	1	1
		3	Macrocystis	.25	25	4	2
		3	Phyllospadix	.25	25	12	1
		3	Terrestrial	.25	25	8	1
Bechers Pier	7/29/2004	1	Brown algae	.20	20	1	2
		1	Phyllospadix	.20	20	21	1
		2	Phyllospadix	.20	20	6	2
		2	Red algae	.20	20	2	4
		2	Terrestrial	.20	20	1	1
		3	Phyllospadix	.20	20	5	1
China Camp	8/1/2004	1	Brown algae	.50	50	1	1
		1	Macrocystis	.50	50	15	1
		1	Phyllospadix	.50	50	4	1
		1	Tar	.50	50	1	1
		1	Terrestrial	.50	50	2	1
		2	Brown algae	.50	50	1	2
		2	Macrocystis	.50	50	15	1
		2	Phyllospadix	.50	50	8	1
		2	Terrestrial	.50	50	1	1
		3	Macrocystis	.50	50	3	1
		3	Phyllospadix	.50	50	3	1

Appendix C. Macrophyte Wrack Data (continued)

SiteCode	*Sample Date*	*Transect*	*SpeciesName*	*Spacing (m)*	*Length (m)*	*Count*	*Avg. Height (cm)*
Sandy Point	7/30/2004	1	Brown algae	.50	50	2	3
		1	Egregia	.50	50	2	11
		1	Macrocystis	.50	50	23	4
		1	Phyllospadix	.50	50	11	1
		2	Egregia	.50	50	1	1
		2	Macrocystis	.50	50	28	6
		2	Phyllospadix	.50	50	5	2
		3	Brown algae	.50	50	1	1
		3	Macrocystis	.50	50	37	3
		3	Phyllospadix	.50	50	12	3
Soledad West	7/31/2004	1	Macrocystis	.50	50	29	4
		1	Phyllospadix	.50	50	22	2
		2	Macrocystis	.50	50	19	2
		2	Phyllospadix	.50	50	26	1
		3	Macrocystis	.50	50	22	2
		3	Phyllospadix	.50	50	19	1
		3	Terrestrial	.50	50	1	1