

Marine Resources of Redwood National and State Parks

Comprehensive Report (2004-2005) for
Humboldt and Del Norte County, California



Pollicipes polymerus
Photo by Yoav Bar-Ness



Phaeostrophion irregulare
Wendell Wood



Dermasterias imbrica
Katherine Hedges



Oligocottus snyderi
Wendell Wood

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Humboldt and Del Norte County, California**

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Disclaimer

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Marine Resources of Redwood National and State Parks

National Park Service

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INTRODUCTION

The coastline of northern California is home to a diverse array of nearshore habitats from bays and estuaries to wind-swept sandy shores and surf sculpted rocky intertidal areas. These habitats contain a stunning variety of species. Geographic location, habitat diversity, and complex oceanographic patterns are all thought to contribute to the rich diversity of marine life in this area. This region forms the boundary of two major biogeographic provinces; the cold, temperate Oregonian, and the warm, temperate Californian provinces (Miner et al. in prep). The coastline of Redwood National and State Parks (RNSP) is primarily composed of sand beaches (of varying grain size) and rocky intertidal areas dominated by boulders and small bench areas. The major focus of this report is to provide an account of the algal, invertebrate, and fish diversity found in the nearshore habitats of RNSP, and to describe the patterns of variability of the abundant and ecologically important species. Biodiversity surveys and population monitoring provide baseline information essential for detection, assessment, and study of the short- and long-term effects of natural as well as anthropogenic disturbances such as severe storms, flood events, tsunamis, and oil spills. Monitoring also provides fundamental ecological knowledge of system dynamics. When incorporated on a regional scale, monitoring studies can also be utilized to plan more effective management strategies (Miner et al. in prep).

OBJECTIVES

This project was initiated in order to provide a report on the marine resources of the Redwood National and State Parks. The intent of this report is to effectively characterize the 35-mile coastline with regards to the physical habitat and the invertebrate, algal, and fish intertidal communities. The species distribution in the intertidal was examined on a broad species presence/absence scale and then at a finer scale focusing on discrete plots or pools. This entailed both an inventory of the algal, invertebrate, and fish species present at selected sites, as well as seasonal monitoring of abundant and/or ecologically important organisms.

Goals of the inventory program include:

1. Creating an exhaustive species list of the intertidal marine algae, invertebrates, and fish.
2. Comparing this list with previous studies conducted in RNSP (Boyd and DeMartin 1977 and 1981)
3. Establishing a voucher collection of identified specimens for use at RNSP.

Goals of the monitoring program include:

1. Establishing baseline data on the intertidal communities of the RNSP.
2. Collecting data on the spatial and temporal distribution of target species throughout the intertidal area.
3. Presenting information that could be used to help assess damage caused by oil spills or other disturbances.
4. Setting up a long-term program in order to monitor natural changes over time.

STUDY REGION

Much of Redwood National and State Parks is underlain by rocks of the Franciscan assemblage. The Franciscan assemblage consists of rock that has been sheared and lifted from the ocean floor as a result of plate action along the Cascadia subduction zone (Bailey 1966). The rock along the coast from Enderts Beach to the mouth of Redwood Creek is primarily composed of sandstone and mudstone. Beaches in the southern half of RNSP were created by wave induced erosion of the coastal cliffs (Boyd and DeMartini 1977). This coast is exposed to the open ocean with regular waves predominately striking the shore from the northwest. Wave height typically ranges from 1-2 meters, but occasional storm events produce waves of greater than 7 meters. The average significant wave height registered at the National Oceanic Atmospheric Association's Point St. George marine bouy, 8 nautical miles west- northwest of Crescent City, CA, registered an average significant wave height of 2.24 meters for 2004. The max wave height measured for 2004 was 7.55 meters (data from NOAA marine buoy #46027). The organisms inhabiting this wave exposed intertidal region have evolved many specialized life history and physiological adaptations to withstand the strong forces resulting from wave action. They must be able to hang on, by means of strong attachment, or hide, by finding shelter beneath rocks or other organisms.

The consistently cold water temperatures of this coastline are regulated by the north to south flowing California current. The west coast of North America experiences seasonal upwelling of cold, nutrient rich subsurface waters. This is a result of wind patterns that cause surface waters to be pushed offshore and subsurface water to rise and replace it. Seasonal upwelling produces increased primary productivity, which is thought to contribute to some of the variability in annual recruitment of many species. Upwelling is generally greatest in spring and summer and decreases in early fall. In 2005 upwelling occurred later in the year (PFEL annual upwelling anomaly). We monitored water temperatures at three sites using ONSET tidbit© temperature loggers set at 15 minute time intervals. Surface water temperatures recorded at the study sites fluctuated between 9 and 15 °C (Figure 1). Salinity at the sites remained at around 33-34 PPT with the exception of a few instances after heavy rains which decreased salinity, especially near river mouths.

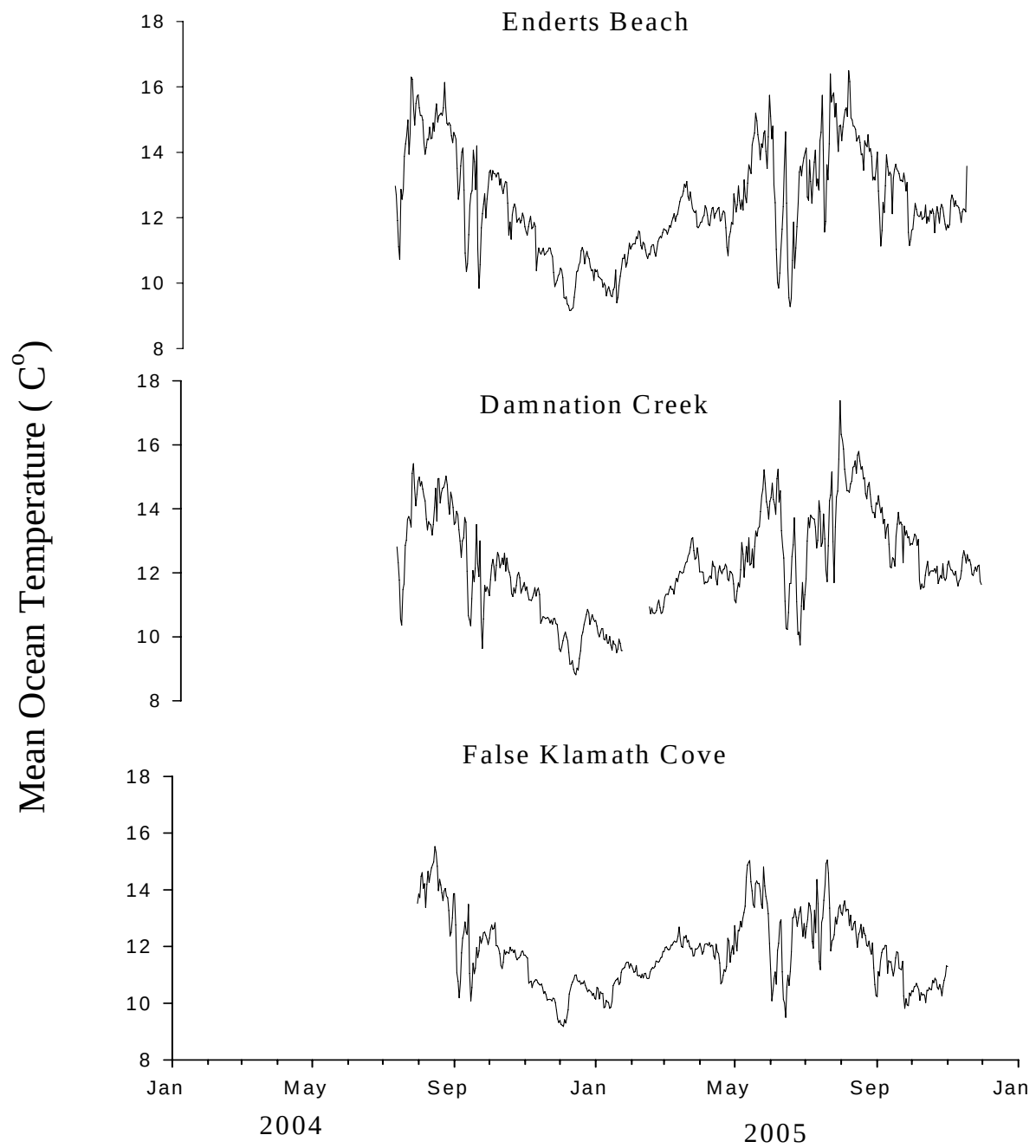


Figure 1. Mean daily temperatures (°C) for three rocky intertidal study sites within the RNSP for July 2004 to November 2005.

STUDY LOCATIONS

All study sites are located within the Redwood National and State Parks on the northern California coast, USA (Figure 2) Rocky intertidal sites included: False Klamath Cove, Enderts Beach, and Damnation Creek. Inventories, monitoring, and tidepool fish surveys were conducted at each of these beaches.

Enderts Beach (N 41.69592, W 124.14245) is the northern-most site, located just south of the rocks jutting out of the point at the south end of Crescent Beach (Figure 3). The site is comprised of a large, gently sloping bench (approx. 100 m wide) and a series of three smaller benches separated by rocky trenches and cobble beds. Rocky intertidal inventory and monitoring took place on the three small rocky benches. Tidepool fish monitoring occurred 0.5 k upcoast from these benches (Figure 4).

Damnation Creek (N 41.65249, W 124.12784) is 6.5 kilometers north of False Klamath Cove and 5 kilometers south of Enderts Beach. It is an extensive rocky bench cut by channels, with a few large sedentary boulders at its seaward edge (Figure 5). The landward edge of the bench has an accumulation of smooth cobble. The site is near the mouth of Damnation Creek, but monitoring plots were established on either side of the creek's outflow, far enough away to avoid freshwater input.

False Klamath Cove (N 41.59377, W 124. 10773) is located just south of Wilson Creek, about 5 miles north of the Klamath River mouth. It is the southern-most rocky intertidal site surveyed (Figure 6). This site has variable substrate that ranges from coarse sand to large boulders. There is potential for temporal variation in sand scour and boulder movement. The intertidal study site is peninsula-like with ocean to the north and south, and a sea stack (approx. 75 m tall and 100 m wide) at the west end. The peninsula stretches approximately 250 meters long with a width of approximately 100 meters. It is a gently sloping field of boulders and small rock benches. Sampling was restricted to large sedentary boulders and small rocky benches.

Sandy intertidal sites, from north to south, include: Crescent Beach (N 41.72508, W 124.15252), Gold Bluffs Beach (N 41.35922, W 124.07476), and Redwood Creek Beach (N 41.28788, W 124.09130). These three beaches are representative of the range of beach types found within RNSP.

Crescent Beach is located on the northern border of the park, 38 kilometers north of Gold Bluffs Beach (Figure 7). It has the shallowest slope of the three sand beach study sites and fine grain sand. Because it is so flat, waves linger over the sand longer than they would on a steep or reflective beach such as Redwood Creek Beach. As the wave swash lingers, detritus settles out into the sand providing the nutrients that contribute to the high productivity and diversity of Crescent Beach (Boyd and DeMartini 1977).

Gold Bluffs Beach is located approximately 14.4 kilometers north of Redwood Creek Beach, in the center of the park near Fern Canyon. It has intermediate sediment size, slope and productivity (Figure 8).

Redwood Creek Beach is located near the southern end of RNSP (Figure 9). It is characterized by coarse sand, a steep beach slope, and low biological productivity. Sand beach inventories and monitoring for amphipod and sand crab populations were conducted at all three sites. Beach seines were used to inventory nearshore fish at Gold Bluffs Beach and Crescent Beach. Strong surf at Redwood Creek Beach was prohibitive to beach seining.



Figure 2. Map of northern Redwood National and State Parks showing locations of study sites. Modified from RNSP website: www.nps.gov/redw/pphtml/maps.html.



Figure 3. Enderts Beach, site for rocky intertidal monitoring. Aerial photograph: copyright © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org



Figure 4. Enderts Beach, RNSP rocky intertidal site used for tidepool fish studies.



Figure 5. Damnation Creek, RNSP site for rocky intertidal monitoring, inventory and tidepool fish studies. Aerial photograph: copyright © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org.



Figure 6. False Klamath Cove, RNSP site for rocky intertidal monitoring and tidepool fish studies.



Figure 7. The south end of Crescent Beach, just inside the boundary of Redwood National and State Parks. Northern-most site for sand beach sampling and fish seining. Aerial photograph: copyright © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org



Figure 8. Gold Bluffs Beach near Espa Lagoon, RNSP central sandy beach site. Aerial photograph: copyright © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org



Figure 9. Redwood Creek Beach, RNSP is the southern most sandy beach site sampled. Aerial photograph: copyright © 2002-2005 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org

ROCKY INTERTIDAL INVENTORIES

Inventories of Enderts Beach and False Klamath Cove

Biological inventories are important indicators of biodiversity within specific sites or habitats. We have conducted biological inventories at three rocky intertidal sites to determine the diversity of invertebrate and algal species present. Biological inventories had not been conducted in Redwood National and State Park's rocky intertidal since the late 1970's (Boyd and DeMartini 1977 and 1981). Boyd and DeMartini's inventories were conducted at Enderts Beach, False Klamath Cove, and Point Saint George (North of Crescent City and outside of RNSP boundaries). We have re-inventoried Enderts Beach and False Klamath Cove using the same techniques as Boyd and DeMartini (1977 and 1981). The biological inventory at Damnation Creek was conducted using a slightly different protocol, discussed below.

Multiple teams of two to three people spread out over the study site with a checklist of species. Teams targeted a zone or taxonomic group based on their expertise. All student researchers were required to have taken invertebrate zoology and/or phycology courses in order to assist with the inventory. Phycology experts, Dr. Frank Shaughnessy and Ginger Tennent, assisted with collection and identification of algae. Voucher specimens were collected for all possible invertebrate and algal species. Some species were photographed in lieu of collection due to preservation difficulties. Algae were identified using Abbott and Hollenberg (1976) and Gabrielson et al. (2004). Invertebrates were identified using Morris et al. (1980) Kozloff (1993), and Kozloff (1996).

A total of 114 algal taxa were recorded in inventories of False Klamath Cove and Enderts Beach (Table 1). Thirty eight algal species were found at these sites in 2005 that were not listed by Boyd and DeMartini (1977 and 1981; Appendix C). Invertebrate inventories at False Klamath Cove and Enderts Beach recorded a total of 176 invertebrates (Table 2). Of these, 77 were not previously recorded within RNSP (Boyd and DeMartini 1977 and 1981, Appendix C). A number of nomenclature updates have also been noted in Appendix C.

Table 1. Algal taxa inventoried at False Klamath Cove and Enderts Beach in July, 2005. Abundance categories are as follows: (A) Abundant, (C) Common, (P) Present, (U) Uncommon, (R) Rare. Zone categories indicate that a taxa is generally found in the (H) High, (M) Mid, or (L) Low intertidal zone.

Phylum	Current Scientific Name	Zone	Abundance	
			END 2005	FKC 2005
Anthophyta	<i>Phyllospadix scouleri</i>	M/L	C	A
Anthophyta	<i>Phyllospadix torreyi</i>	M/L	U	R
Chlorophyta	<i>Acrosiphonia arcta</i>	M	P	U
Chlorophyta	<i>Acrosiphonia coalita</i>	M	P	P
Chlorophyta	<i>Acrosiphonia mertensii</i>	M	R	P
Chlorophyta	<i>Blindingia minima</i> var. <i>minima</i>	H	U	U
Chlorophyta	<i>Cladophora columbiana</i>	H/M	U	P
Chlorophyta	<i>Cladophora hutchinsiae</i>	H/M	R	U
Chlorophyta	<i>Codium setchellii</i>	M	R	
Chlorophyta	<i>Ulva californica</i>	H/M	U	C
Chlorophyta	<i>Ulva intestinalis</i>	H/M	R	P
Chlorophyta	<i>Ulva lactuca</i>	M		U
Chlorophyta	<i>Ulva linza</i>	M	U	C
Chlorophyta	<i>Ulva lobata</i>	M	U	P
Chlorophyta	<i>Ulva</i> spp	M	U	P
Chlorophyta	<i>Ulva taeniata</i>	M/L		P
Phaeophyta	<i>Alaria marginata</i>	L	P	P
Phaeophyta	<i>Analipus japonicus</i>	M	U	U
Phaeophyta	<i>Analipus</i> spp	M	U	U
Phaeophyta	<i>Berkeleya</i> spp	H/M	C	C
Phaeophyta	<i>Colpomenia</i> spp	M/L	U	C
Phaeophyta	<i>Cystoseira osmundacea</i>	L	DRIFT	DRIFT
Phaeophyta	<i>Desmarestia ligulata</i>	L/M		R
Phaeophyta	<i>Egregia menziesii</i>	M	C	C
Phaeophyta	<i>Fucus gardneri</i>	H/M	P	A
Phaeophyta	<i>Haplogloia andersonii</i>	L	U	
Phaeophyta	<i>Hedophyllum sessile</i>	M/L	C	C
Phaeophyta	<i>Laminaria setchellii</i>	L	C	P
Phaeophyta	<i>Laminaria sinclairii</i>	L	P	P
Phaeophyta	<i>Leathesia difformis</i>	H/M	U	C
Phaeophyta	<i>Lessoniopsis littoralis</i>	L	U	R
Phaeophyta	<i>Nereocystis luetkeana</i>	L	U	U
Phaeophyta	<i>Pelvetiopsis limitata</i>	H/M	A	A
Phaeophyta	<i>Phaeostrophion irregulare</i>	M/L		U
Phaeophyta	<i>Postelsia palmaeformis</i>	L		U
Phaeophyta	<i>Pterygophora californica</i>	L	P	
Phaeophyta	<i>Ralfsia</i> spp	L	U	U
Phaeophyta	<i>Ralfsiaceae</i>	H/M	P	P
Phaeophyta	<i>Scytosiphon lomentaria</i>	M/L		R
Phaeophyta	<i>Soranthra ulvoidea</i>	H/M	P	C
Rhodophyta	<i>Ahnfeltia fastigiata</i>	H	U	U

Phylum	Current Scientific Name	Zone	Abundance	
			END 2005	FKC 2005
Rhodophyta	<i>Ahnfeltiopsis gigartinoidea</i>	M	U	U
Rhodophyta	<i>Ahnfeltiopsis leptophyllus</i>	H/M		U
Rhodophyta	<i>Ahnfeltiopsis linearis</i>	H/M	P	U
Rhodophyta	<i>Bossiella chiloensis</i>	L	U	C
Rhodophyta	<i>Bossiella orbigniana dichotoma</i>	L	P	C
Rhodophyta	<i>Bossiella plumose</i>	L	P	U
Rhodophyta	<i>Calliarthron tuberosum</i>	L	U	
Rhodophyta	<i>Callithamnion pikeanum</i>	H	P	P
Rhodophyta	<i>Callithamnion spp</i>	H	P	P
Rhodophyta	<i>Callophyllis pinnata</i>	L	U	U
Rhodophyta	<i>Ceramium pacificum</i>	M/L	P	C
Rhodophyta	<i>Chondracanthus canaliculatus</i>	M/L	U	U
Rhodophyta	<i>Chondracanthus spinosus</i>	L	U	R
Rhodophyta	<i>Clathromorphum reclinatum</i>	L	R	R
Rhodophyta	<i>Constantinea simplex</i>	L	P	P
Rhodophyta	<i>Corallina officinalis chilensis</i>	L	P	P
Rhodophyta	<i>Corallina vancouveriensis</i>	L	C	P
Rhodophyta	<i>Cryptopleura lobulifera</i>	L	U	P
Rhodophyta	<i>Cryptopleura ruprechtiana</i>	L	U	U
Rhodophyta	<i>Cryptopleura violacea</i>	L	U	U
Rhodophyta	<i>Cryptosiphonia spp</i>	M	P	U
Rhodophyta	<i>Cryptosiphonia woodii</i>	M	P	U
Rhodophyta	<i>Dilsea californica</i>	L	P	P
Rhodophyta	<i>Endocladia muricata</i>	H/M	A	C
Rhodophyta	<i>Erythrophyllum delesserioides</i>	L		U
Rhodophyta	<i>Farlowia mollis</i>	M	P	P
Rhodophyta	<i>Gelidium coulteri</i>	H/M	U	U
Rhodophyta	<i>Gloiopeltis furcata</i>	M	U	U
Rhodophyta	<i>Grateloupia lanceolata</i>	L	U	P
Rhodophyta	<i>Grateloupia setchellii</i>	L	R	
Rhodophyta	<i>Halosaccion glandiforme</i>	H/M	R	U
Rhodophyta	<i>Halymenia californica</i>	L		U
Rhodophyta	<i>Halymenia schizymenoides</i>	H/M	U	U
Rhodophyta	<i>Hildebrandia/Peyssonnelia spp</i>	M/L	P	P
Rhodophyta	<i>Hymenena cuneifolia</i>	L	R	U
Rhodophyta	<i>Hymenena flabelligera</i>	L	U	U
Rhodophyta	<i>Hymenena multiloba</i>	M/L	U	U
Rhodophyta	<i>Lithophyllum dispar</i>	L	U	R
Rhodophyta	<i>Mastocarpus jardinii</i>	H/M	C	C
Rhodophyta	<i>Mastocarpus papillatus</i>	H/M	C	C
Rhodophyta	<i>Mastocarpus spp (sporophyte stage)</i>	H/M	C	A
Rhodophyta	<i>Mazzaella flaccida</i>	M	U	P
Rhodophyta	<i>Mazzaella oregona</i>	M	P	P
Rhodophyta	<i>Mazzaella splendens</i>	L	P	A
Rhodophyta	<i>Melobesia mediocris</i>	L	P	P
Rhodophyta	<i>Microcladia borealis</i>	L	C	C
Rhodophyta	<i>Microcladia coulteri</i>	M/L	P	P

Phylum	Current Scientific Name	Zone	Abundance	
			END 2005	FKC 2005
Rhodophyta	<i>Neoptilota hypnoides</i>	L	U	U
Rhodophyta	<i>Neorhodomela larix</i>	M	C	P
Rhodophyta	<i>Odonthalia floccosa</i>	M	C	C
Rhodophyta	<i>Odonthalia washingtoniensis</i>	L		U
Rhodophyta	<i>Opuntella californica</i>	L	U	U
Rhodophyta	<i>Osmundea spectabilis</i>	L	P	P
Rhodophyta	<i>Palmaria spp</i>	L	U	U
Rhodophyta	<i>Pikea robusta</i>	L	U	
Rhodophyta	<i>Plocamium oregonum</i>	L	P	U
Rhodophyta	<i>Plocamium pacificum</i>	M	P	U
Rhodophyta	<i>Plocamium violaceum</i>	M	P	U
Rhodophyta	<i>Polyneura latissima</i>	M/L	U	U
Rhodophyta	<i>Polysiphonia hendryi</i> var. <i>gardneri</i>	L	P	P
Rhodophyta	<i>Polysiphonia hendryi</i> var. <i>hendryi</i>	L	P	P
Rhodophyta	<i>Polysiphonia spp</i>	L	P	P
Rhodophyta	<i>Porphyra lanceolata</i>	H	P	C
Rhodophyta	<i>Porphyra perforata</i>	H	U	A
Rhodophyta	<i>Porphyra smithii</i>	H/M	U	P
Rhodophyta	<i>Prionitis filiformis</i>	L	U	C
Rhodophyta	<i>Prionitis lanceolata</i>	H/M/L	P	P
Rhodophyta	<i>Prionitis linearis</i>	L	U	R
Rhodophyta	<i>Prionitis lyallii</i>	L	P	C
Rhodophyta	<i>Pterosiphonia bipinnata</i>	M/L	U	P
Rhodophyta	<i>Pterosiphonia dendroidea</i>	M/L		U
Rhodophyta	<i>Ptilota filicina</i>	L	P	P
Rhodophyta	<i>Ptilota spp</i>	L	P	P
Rhodophyta	<i>Schizymenia pacifica</i>	L	U	R
Rhodophyta	<i>Schizymenia spp</i>	L	U	R

Table 2. Invertebrate taxa inventoried at False Klamath Cove and Enderts Beach in July, 2005. Abundance categories are as follows: (A) Abundant, (C) Common, (P) Present, (U) Uncommon, (R) Rare.

Phylum	Class	Current Scientific Name	Abundance	
			END 2005	FKC 2005
Annelida	Polychaeta	<i>Anaitides williamsi</i>	U	U
Annelida	Polychaeta	<i>Chaetopterus variopedatus</i>	R	R
Annelida	Polychaeta	<i>Dodecaceria fewkesi</i>	R	R
Annelida	Polychaeta	<i>Eudistylia vancouveri</i>	P	R
Annelida	Polychaeta	<i>Glycera spp</i>	R	R
Annelida	Polychaeta	<i>Halosydna brevisetosa</i>	P	P
Annelida	Polychaeta	<i>Neanthes spp</i>	U	U
Annelida	Polychaeta	<i>Nereida spp</i>	P	P
Annelida	Polychaeta	<i>Pista elongata</i>	U	U
Annelida	Polychaeta	<i>Platynereis bicanaliculata</i>	R	U
Annelida	Polychaeta	<i>Potomilla ocellata</i>	R	U
Annelida	Polychaeta	<i>Serpula columbiana</i>	U	U
Annelida	Polychaeta	<i>Spiochaetopterus costarum</i>	U	R
Annelida	Polychaeta	<i>Typosyllis alternate</i>		R
Arthropoda	Arachnida	<i>Achelia nudusclia</i>	R	R
Arthropoda	Crustacea	<i>Balanus crenatus</i>	U	U
Arthropoda	Crustacea	<i>Balanus glandula</i>	A	A
Arthropoda	Crustacea	<i>Balanus nubilus</i>	U	U
Arthropoda	Crustacea	<i>Cancer antennarius</i>	U	U
Arthropoda	Crustacea	<i>Cancer jordani</i>	U	U
Arthropoda	Crustacea	<i>Cancer magister</i>	P	P
Arthropoda	Crustacea	<i>Cancer oregonensis</i>	U	U
Arthropoda	Crustacea	<i>Cancer productus</i>	P	P
Arthropoda	Crustacea	<i>Caprella californica</i>	C	C
Arthropoda	Crustacea	<i>Chthamalus dalli</i>	C	C
Arthropoda	Crustacea	<i>Cymadusa umcinta</i>	A	A
Arthropoda	Crustacea	<i>Dynamenella sheareri</i>	P	P
Arthropoda	Crustacea	<i>Hemigrapsus nudus</i>	C	C
Arthropoda	Crustacea	<i>Hemigrapsus oregonensis</i>	P	P
Arthropoda	Crustacea	<i>Heptocarpus spp</i>	A	A
Arthropoda	Crustacea	<i>Hymenodora frontalis</i>	C	C
Arthropoda	Crustacea	<i>Idotea fewkesi</i>	C	C
Arthropoda	Crustacea	<i>Idotea kirchanskii</i>	U	U
Arthropoda	Crustacea	<i>Idotea schmitti</i>	P	P
Arthropoda	Crustacea	<i>Idotea wosnesenskii</i>	P	P
Arthropoda	Crustacea	<i>Ligia occidentalis</i>	C	A
Arthropoda	Crustacea	<i>Megabalanus californicus</i>	P	P
Arthropoda	Crustacea	<i>Oedignathus inermis</i>	P	P
Arthropoda	Crustacea	<i>Pachycheles rudis</i>	P	P
Arthropoda	Crustacea	<i>Pagurus granosimanus</i>	P	P
Arthropoda	Crustacea	<i>Pagurus hirsutiusculus</i>	C	C
Arthropoda	Crustacea	<i>Pagurus samuelis</i>	U	U

Phylum	Class	Current Scientific Name	Abundance	
			END 2005	FKC 2005
Arthropoda	Crustacea	<i>Parallorchestes ochotensis</i>	C	A
Arthropoda	Crustacea	<i>Petrolisthes cinctipes</i>	P	C
Arthropoda	Crustacea	<i>Petrolisthes manimculis</i>	P	P
Arthropoda	Crustacea	<i>Pollicipes polymerus</i>	C	C
Arthropoda	Crustacea	<i>Pugettia producta</i>	P	C
Arthropoda	Crustacea	<i>Semibalanus cariosus</i>	P	C
Arthropoda	Crustacea	<i>Synidotea laticauda</i>	C	C
Brachipoda	Inarticulata	<i>Terebratalia transversa</i>	R	
Bryozoa	Gymnolaemata	<i>Bugula californica</i>	C	C
Bryozoa	Gymnolaemata	<i>Eurystomella bilabiata</i>	P	P
Bryozoa	Gymnolaemata	<i>Flustrellidra corniculata</i>	C	C
Chordata	Tunicata	<i>Aplidium californicum</i>	C	A
Chordata	Tunicata	<i>Aplidium solidum</i>	C	P
Chordata	Tunicata	<i>Aplidium spp.</i>	C	P
Chordata	Tunicata	<i>Archidistoma ritteri</i>	P	C
Chordata	Tunicata	<i>Chelysoma columbium</i>	C	P
Chordata	Tunicata	<i>Clavelina huntsmani</i>	C	C
Chordata	Tunicata	<i>Ritterella spp</i>	C	A
Chordata	Tunicata	<i>Ritterella spp</i>	P	A
Chordata	Tunicata	<i>Styela montereyensis</i>	P	C
Cnidaria	Anthozoa	<i>Anthopleura Artemisia</i>	P	P
Cnidaria	Anthozoa	<i>Anthopleura elegantissima</i>	A	A
Cnidaria	Anthozoa	<i>Anthopleura xanthogrammica</i>	A	A
Cnidaria	Anthozoa	<i>Balanophyllia elegans</i>	R	R
Cnidaria	Anthozoa	<i>Epiactis prolifera</i>	U	U
Cnidaria	Anthozoa	<i>Gersemia rudiformis</i>		R
Cnidaria	Anthozoa	<i>Urticina coriacea</i>	U	U
Cnidaria	Anthozoa	<i>Urticina crassicornis</i>	U	U
Cnidaria	Hydrozoa	<i>Abietinaria spp</i>	P	P
Cnidaria	Hydrozoa	<i>Aglaophenia latirostris</i>	P	P
Cnidaria	Hydrozoa	<i>Dynamenia operculata</i>	C	C
Cnidaria	Hydrozoa	<i>Ectopleura marina</i>	P	P
Cnidaria	Hydrozoa	<i>Garveia annulata</i>	P	P
Cnidaria	Hydrozoa	<i>Obelia dichotoma</i>	C	C
Cnidaria	Hydrozoa	<i>Plumularia spp</i>	P	P
Cnidaria	Hydrozoa	<i>Sertularia furcata</i>	C	C
Cnidaria	Hydrozoa	<i>Symplectoscyphus turgidus</i>	C	P
Cnidaria	Hydrozoa	<i>Thuiaria spp</i>	U	U
Echinodermata	Asteroidea	<i>Patiria miniata</i>	U	U
Echinodermata	Asteroidea	<i>Dermasterias imbricate</i>	P	C
Echinodermata	Asteroidea	<i>Evasterias troschelii</i>	P	P
Echinodermata	Asteroidea	<i>Henricia leviuscula</i>	P	P
Echinodermata	Asteroidea	<i>Henricia sanguinolenta</i>	P	P
Echinodermata	Asteroidea	<i>Leptasterias hexactis</i>	C	C
Echinodermata	Asteroidea	<i>Pisaster ochraceus</i>	A	A
Echinodermata	Asteroidea	<i>Pycnopodia helianthoides</i>	C	C

Phylum	Class	Current Scientific Name	Abundance	
			END 2005	FKC 2005
Echinodermata	Asteroidea	<i>Solaster stimpsoni</i>	P	U
Echinodermata	Echinoidea	<i>Strongylocentrotus purpuratus</i>	P	C
Echinodermata	Holothuroidea	<i>Cucumaria miniata</i>	P	P
Echinodermata	Holothuroidea	<i>Eupentacta quinquesemita</i>	U	C
Mollusca	Bivalvia	<i>Crassadoma spp</i>	P	P
Mollusca	Bivalvia	<i>Mya arenaria</i>	P	U
Mollusca	Bivalvia	<i>Mytilus californianus</i>	A	A
Mollusca	Bivalvia	<i>Pododesmus cepio</i>	P	U
Mollusca	Bivalvia	<i>Protothaca staminea</i>	U	P
Mollusca	Cephalopoda	<i>Enteroctopus dofleini</i>	R	U
Mollusca	Gastropoda	<i>Acmaea mitra</i>	P	P
Mollusca	Gastropoda	<i>Alia carinata</i>	P	P
Mollusca	Gastropoda	<i>Amphissa columbiana</i>	C	C
Mollusca	Gastropoda	<i>Amphissa versicolor</i>	C	C
Mollusca	Gastropoda	<i>Anisodoris nobilis</i>	U	U
Mollusca	Gastropoda	<i>Archidoris montereyensis</i>	P	U
Mollusca	Gastropoda	<i>Bittium eschrichtii</i>	U	R
Mollusca	Gastropoda	<i>Cadlina inteomarginata</i>	U	U
Mollusca	Gastropoda	<i>Calliostoma canaliculatum</i>	P	U
Mollusca	Gastropoda	<i>Calliostoma ligatum</i>	U	P
Mollusca	Gastropoda	<i>Ceratostoma foliatum</i>	U	U
Mollusca	Gastropoda	<i>Cutiona spp</i>		R
Mollusca	Gastropoda	<i>Dendronotus albopunctuatus</i>	U	U
Mollusca	Gastropoda	<i>Diaulula sandiegensis</i>	U	U
Mollusca	Gastropoda	<i>Diodora aspera</i>	U	R
Mollusca	Gastropoda	<i>Dirona picta</i>	U	P
Mollusca	Gastropoda	<i>Homolapoma subobsoletum</i>	P	P
Mollusca	Gastropoda	<i>Janolus barbarensis</i>	U	U
Mollusca	Gastropoda	<i>Janolus fuscus</i>	U	P
Mollusca	Gastropoda	<i>Lacuna marmorata</i>	P	P
Mollusca	Gastropoda	<i>Lacuna porrecta</i>	C	C
Mollusca	Gastropoda	<i>Lirabuccinum dirum</i>	U	U
Mollusca	Gastropoda	<i>Littorina keenae</i>	C	C
Mollusca	Gastropoda	<i>Littorina scutulata</i>	A	A
Mollusca	Gastropoda	<i>Lottia digitalis</i>	A	A
Mollusca	Gastropoda	<i>Lottia paradigitalis</i>	C	C
Mollusca	Gastropoda	<i>Lottia pelta</i>	A	A
Mollusca	Gastropoda	<i>Lottia scutum</i>		C
Mollusca	Gastropoda	<i>Lottia strigatella</i>	C	
Mollusca	Gastropoda	<i>Margarites pupillus</i>		C
Mollusca	Gastropoda	<i>Nitidiscala tinctoria</i>	C	U
Mollusca	Gastropoda	<i>Nucella canaliculata</i>	P	R
Mollusca	Gastropoda	<i>Nucella lamellosa</i>	U	R
Mollusca	Gastropoda	<i>Nucella ostrina</i>	A	A
Mollusca	Gastropoda	<i>Ocenebrina lurida</i>	U	U
Mollusca	Gastropoda	<i>Onchidella borealis</i>	P	C

Phylum	Class	Current Scientific Name	Abundance	
			END 2005	FKC 2005
Mollusca	Gastropoda	<i>Opalia chacei</i>	U	U
Mollusca	Gastropoda	<i>Phidiana crassicornis</i>	P	P
Mollusca	Gastropoda	<i>Rostanga pulchra</i>	U	P
Mollusca	Gastropoda	<i>Tectura paleacea</i>	C	C
Mollusca	Gastropoda	<i>Tectura persona</i>	U	
Mollusca	Gastropoda	<i>Tectura scutum</i>	U	U
Mollusca	Gastropoda	<i>Tegula funebris</i>	A	A
Mollusca	Gastropoda	<i>Triopha catilinae</i>	U	U
Mollusca	Gastropoda	<i>Triopha maculata</i>	U	U
Mollusca	Polyplacophora	<i>Cryptochiton stelleri</i>	U	R
Mollusca	Polyplacophora	<i>Lepidochitona (Cyanoplax) dentiens</i>	P	P
Mollusca	Polyplacophora	<i>Katharina tunicata</i>	C	C
Mollusca	Polyplacophora	<i>Lepidozonia mertensii</i>	P	P
Mollusca	Polyplacophora	<i>Mopalia ciliata</i>	C	C
Mollusca	Polyplacophora	<i>Mopalia hindsii</i>	P	P
Mollusca	Polyplacophora	<i>Mopalia lignosa</i>	P	P
Mollusca	Polyplacophora	<i>Mopalia muscosa</i>	P	P
Mollusca	Polyplacophora	<i>Tonicella lineata</i>	C	C
Nemertea	Anopla	<i>Emplectonema gracile</i>	P	P
Nemertea	Anopla	<i>Paranemertes peregrina</i>	C	C
Nemertea	Anopla	<i>Tubulanus polymorphus</i>	U	P
Nemertea	Anopla	<i>Tubulanus sexlinatus</i>	P	P
Porifera	Demospongia	<i>Cliona celata</i>	U	P
Porifera	Demospongia	<i>Dysidea fragilis</i>	P	P
Porifera	Demospongia	<i>Halichondria panicea</i>	P	P
Porifera	Demospongia	<i>Halichondria spp</i>	P	C
Porifera	Demospongia	<i>Haliclona ecbasis</i>	P	P
Porifera	Demospongia	<i>Haliclona permollis</i>	P	P
Porifera	Demospongia	<i>Haliclona spp</i>	U	C
Porifera	Demospongia	<i>Mycale macginitiei</i>	P	C
Porifera	Demospongia	<i>Neoesperiopsis digitata</i>	C	C
Porifera	Demospongia	<i>Ophlitaspongia pennata</i>	U	P
Porifera	Demospongia	<i>Suberites spp</i>	C	C
Sipuncula		<i>Phascolosoma agassizii</i>	U	U
Sipuncula		<i>Themiste pyroides</i>	P	C

Coastal Biodiversity Survey at Damnation Creek

At Damnation Creek, we have conducted an inventory of rocky intertidal algae and invertebrates in collaboration with a team of taxonomic experts from University of California at Santa Cruz (Figure 10). This group has been conducting Coastal Biodiversity Surveys (CBS) since 2001 at over 90 sites along the Pacific west coast. The CBS were developed to compliment the ongoing large scale monitoring program called the Community Dynamics Surveys (see section on monitoring program for more details). By using the CBS protocols at Damnation Creek, we can make biodiversity comparisons with the data collected from Baja, Mexico to Alaska.



Figure 10. Transect lines used for Damnation Creek inventory, RNSP, June 2004.

A basic overview of the protocols used for these surveys has been outlined here with permission from the UCSC CBS group. For more information about the CBS and more detailed protocols visit the website at: <http://cbsurveys.ucsc.edu>

The coastal biodiversity survey of Damnation Creek began by choosing a 30 meter wide section of rocky bench that is representative of the intertidal community of the entire site. The site was set up by laying out two permanent 30 meter baseline meter tapes that run parallel to the ocean (Figure 11). Next, parallel lines were laid out perpendicular to the baselines every 3 meters from the high zone to the low zone. Permanent bolts were placed to mark the line intersections and detailed maps were drawn with compass bearings and measurements to facilitate re-sampling efforts.

Point-contact surveys were conducted along each vertical transect line by identifying and recording each organism that is directly under 100 evenly spaced points on the line. These data were used to determine relative abundance (% cover). If there were multiple layers of organisms under a point, the taxa occupying the different layers were identified and assigned a letter; A for the top layer, B for the second layer, and C for the third. If fewer than three taxa were recorded under a point, then data were collected on the identity of the next one or two species closest to that point. These data were used to describe the spatial distribution of species, and were not used when calculating relative abundances.

Mobile invertebrate surveys were conducted using a different protocol because most mobile species are not spatially common. Mobile invertebrate abundances were determined using 50 x 50 cm quadrats placed at three locations along each transect within each zone.

Each transect was first divided into three zones; the low zone is the area below the lower extent of mussel growth, the mid-zone includes the mussels and the rock weeds (e.g. *Fucus* and *Pelvetiopsis*), and the high zone is the area dominated by barnacles and littorines. Within each zone a quadrat was randomly placed on the transect, and all mobile species found within the quadrat were identified and counted. The only mobile species not counted were worms and amphipods. Sea stars were also not spatially common. Their abundances were measured along a two-meter swath centered over each vertical transect. Within this swath, the following sea star species were recorded: *Patiria miniata*, *Dermasterius imbricata*, *Pisaster ochraceus*, *Pisaster giganteus*, and *Pycnopodia helianthoides*.

A three-dimensional map of the study area was created using a rotating laser leveler and a stadia rod to measure the topography of each vertical transect line (Figure 12). The laser leveler was positioned so that the topography of all eleven transects could be measured. Measurements were taken along each transect wherever there was a change in height. Thus, measurements were taken infrequently (every few meters) for gradual slopes, but more frequently (tens of centimeters) when necessary to capture the presence of smaller ridges and pools. These measurements were converted to tidal heights (meters above mean low-low water) by measuring sea level at low tide. This was done by finding at least three locations that were covered and uncovered by waves for equal amounts of time. The height of these locations, and the time they were measured, were recorded and subsequently converted to tidal height using a tidal table.

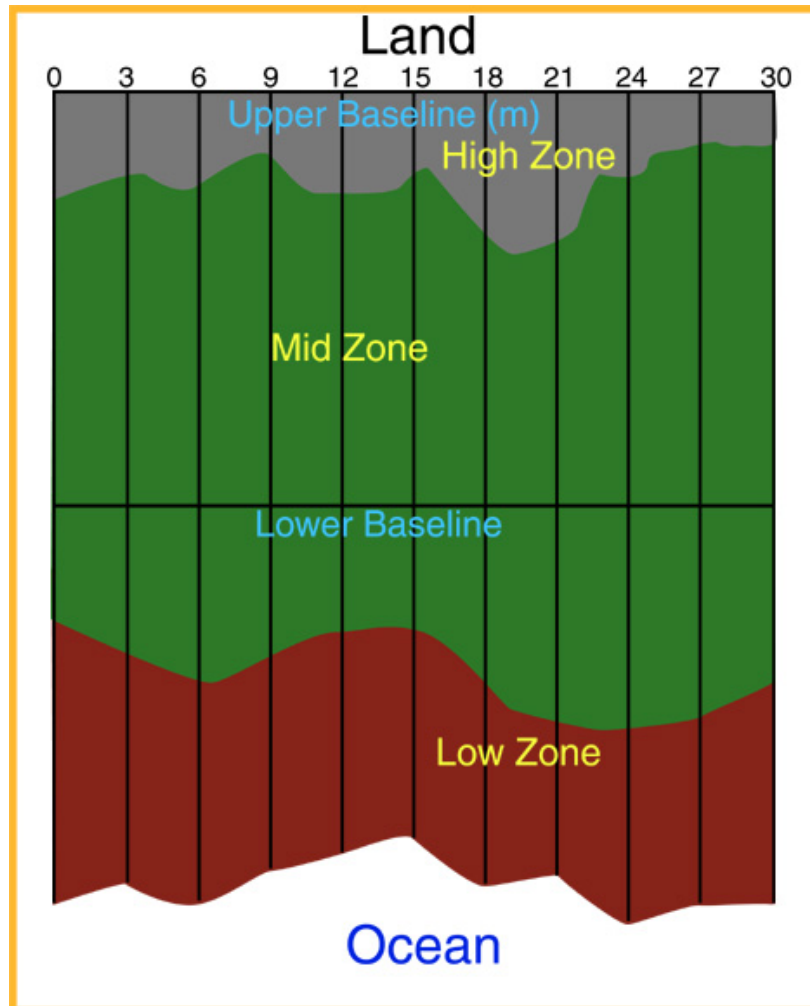


Figure 11. Schematic of the grid setup used in the biodiversity site survey showing the transect lines running from the baseline to the ocean, parallel to the 0m and 30m lines, every three meters along the upper baseline resulting in 11 transect lines.

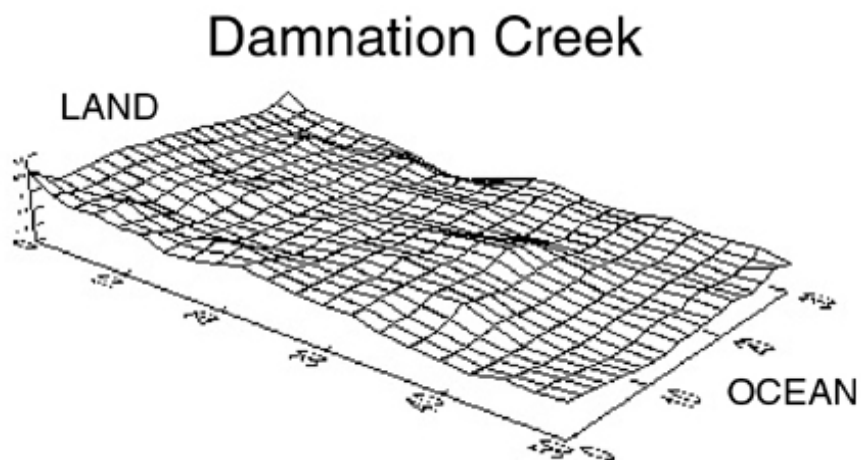


Figure 12. Topographic map of Damnation Creek created by UCSC coastal biodiversity survey team.

Table 3. List of invertebrate and algal taxa from inventory conducted in June 2004 at Damnation Creek, RNSP by UCSC coastal biodiversity survey team.

<i>Acanthinucella</i> spp	<i>Encrusting coralline</i>	<i>Neoptilota/Ptilota</i> spp
<i>Acmaea</i> mitra	<i>Endocladia muricata</i>	<i>Neorhodomela larix</i>
<i>Acrosiphonia</i> spp	<i>Farlowia/Pikea</i> spp	<i>Neorhodomela oregona</i>
<i>Ahnfeltia</i> spp	<i>Fucus</i> spp	<i>Nucella ostrina</i>
<i>Alaria marginata</i>	<i>Gelidium coulteri</i>	<i>Nuttallina</i> spp
<i>Alia</i> spp	<i>Gelidium coulteri/pusillum</i>	<i>Odonthalia floccosa</i>
<i>Amphissa versicolor</i>	<i>Grateloupia doryphora</i>	<i>Osmundea spectabilis</i>
<i>Anthopleura elegantissima</i>	<i>Halichondria</i> spp	<i>Pachygrapsus crassipes</i>
<i>Anthopleura sola</i>	<i>Halosaccion glandiforme</i>	<i>Pagurus hirsutiusculus</i>
<i>Anthopleura xanthogrammica</i>	<i>Halymenia/Schizymenia</i> spp	<i>Pagurus samuelis</i>
<i>Patiria miniata</i>	<i>Hedophyllum sessile</i>	<i>Pelvetiopsis</i> spp
<i>Balanus glandula</i>	<i>Henricia</i> spp	<i>Petrocelis</i> spp
<i>Bossiella</i> spp	<i>Hermisenda crassicornis</i>	<i>Petrospongium rugosum</i>
<i>Bugula</i> spp	<i>Hildenbrandia/Peyssonnelia</i> spp	<i>Phyllospadix scouleri</i>
<i>Calliarthron</i> spp	<i>Homalopoma luridum</i>	<i>Pisaster ochraceus</i>
<i>Callithamnion pikeanum</i>	<i>Idotea</i> spp	<i>Pista</i> spp
<i>Cancer oregonensis</i>	<i>Katharina tunicata</i>	<i>Plocamium cartilagineum</i>
<i>Centroceras/Ceramium/Polysiphonia</i> spp	<i>Lacuna</i> spp	<i>Plocamium violaceum</i>
<i>Chondracanthus canaliculatus</i>	<i>Laminaria setchellii</i>	<i>Pollicipes polymerus</i>
<i>Chondracanthus spinosus</i>	<i>Laminaria sinclairii</i>	<i>Porphyra</i> spp
<i>Chthamalus</i> spp	<i>Laurencia pacifica/masonii</i>	<i>Prionitis lanceolata</i>
<i>Cirolana</i> spp	<i>Lepidochitona dentiens</i>	<i>Prionitis lyallii</i>
<i>Cladophora columbiana</i>	<i>Lepidozona</i> spp	<i>Prionitis</i> spp
<i>Colpomenia/Leathesia</i> spp	<i>Leptasterias</i> spp	<i>Pterosiphonia bipinnata</i>
<i>Constantinea simplex</i>	<i>Littorina plena/scutulata</i>	<i>Pterosiphonia dendroidea</i>
<i>Corallina</i> spp	<i>Lottia austrodigitalis/digitalis</i>	<i>Pugettia producta</i>
<i>Cryptochiton stelleri</i>	<i>Lottia limatula</i>	<i>Pycnopodia helianthoides</i>
<i>Cryptopleura/Hymenena</i> spp	<i>Lottia paradigitalis/strigatella</i>	<i>Ralfsiaceae</i>
<i>Cryptosiphonia woodii</i>	<i>Lottia pelta</i>	<i>Sculpin</i>
<i>Dermasterias imbricata</i>	<i>Lottia scutum</i>	<i>Searlesia dira</i>
<i>Desmarestia ligulata</i>	<i>Mastocarpus jardinii</i>	<i>Semibalanus cariosus</i>
<i>Diatoms</i>	<i>Mastocarpus papillatus</i>	<i>Styela montereyensis</i>
<i>Diaulula sandigensis</i>	<i>Mazzaella</i> spp	<i>Tegula funebris</i>
<i>Dilsea californica</i>	<i>Membranipora</i> spp	<i>Tiffaniella snyderiae</i>
<i>Dirona picta</i>	<i>Microcladia borealis</i>	<i>Tonicella lineata</i>
<i>Ectocarpales</i>	<i>Microcladia coulteri</i>	<i>Ulva</i> spp
<i>Egregia menziesii</i>	<i>Mytilus californianus</i>	<i>Ulva taeniata</i>

ROCKY INTERTIDAL MONITORING PROGRAM

Rocky Intertidal Monitoring

Introduction

Several coastal parks, including Cabrillo National Monument and Channel Islands National Park, have become involved in intertidal monitoring to establish baseline datasets of their marine resources (Davis 1996, 2005). Monitoring intertidal assemblages allows changes to be tracked within and between communities over seasonal and yearly time scales. Monitoring intertidal communities is critical for making informed management decisions. Tracking changes in these communities allows determination of “normal” limits of variation as well as seasonal and long-term patterns. Understanding these patterns is necessary for detecting anthropogenic changes resulting from disturbances such as oil spills or global warming. Minerals Management Service and PISCO (Partnership for the Interdisciplinary Studies of Coastal Oceans) have been working in concert with a number of academic and government organizations to conduct intertidal monitoring in the form of Community Dynamics Surveys along the coast of California. These surveys have been conducted by members of MARINe (Multi-Agency Rocky Intertidal Network) and PISCO and include over twenty coastwide agencies.

The Community Dynamics Surveys have been used to determine abundance and distribution patterns of intertidal species along the southern California coast since the early 1990s. The focus of these surveys is to examine temporal changes within permanent study plots. We have adapted the protocols used in these surveys for monitoring intertidal organisms within Redwood National and State Parks (Engle 2005). This will allow comparisons of population dynamics to be made with sites throughout the state. The addition of sites within the Redwood National and State Parks fills a noticeable gap in the geographic coverage of existing community surveys. Prior to this addition, no intertidal survey sites existed between southern Humboldt County and southern Oregon.

Methods

Using the MARINe protocols, permanent photo-plots and sea star plots were set up at False Klamath Cove, Damnation Creek, and Enderts Beach. The photo plots were established to record changes in the cover of certain populations including: mussels (*Mytilus californianus*), barnacles (*Chthamalus dalli*/*Balanus glandula*), and three species of algae (*Endocladia muricata*, *Pelvetiopsis limitata*, and *Fucus gardneri*). These five species were chosen for monitoring because they are conspicuous, bed-forming, abundant, and ecologically important. *Fucus gardneri* was not dense and continuous enough at Enderts Beach, nor was there dense enough *P. limitata* at Damnation Creek when the study was initiated, to merit plot establishment for those species at those sites. At Damnation Creek, five additional mussel plots were sampled. These plots were located in the outflow of Damnation Creek where salinity is often much lower than in the other mussel plots. Otherwise, each species type was monitored in five replicate plots at each site (Table 4).

Table 4. Photo-plot type and number of replicates at each site, RNSP.

Site	Mussels	Barnacles	<i>Pelvetiopsis limitata</i>	<i>Endocladia muricata</i>	<i>Fucus gardneri</i>
Damnation Creek	10 plots*	5 plots	NP	5 plots	5 plots
False Klamath Cove	5 plots	5 plots	5 plots	5 plots	5 plots
Enderts Beach	5 plots	5 plots	5 plots	5 plots	NP

* Five mussel plots located in full salinity, and 5 plots located near the outflow of Damnation Creek

Photo plots (of 75 x 50 cm) were marked by three permanent bolts which were digitally photographed every other month (Figure 13). Plots were photographed with an Olympus 560 digital camera mounted on a 50 x 75 cm PVC photo framer (Figure 14), to ensure equal scale among plots. Photo plots were scored for percent cover of sessile species using a rectangular grid (10 x 10 units) of one-hundred evenly-spaced points created on an LCD computer monitor using Adobe Photoshop. This grid was overlaid on the digital photos, and was switched on and off to determine what taxon was below each point. Different layers of algae were not scored separately, so the total percent cover was constrained to 100%. The top-most layer that was attached to the substrate (not an obvious epibiont) was always scored. Limpets, chitons, and sea stars were scored as such. For other mobile invertebrates, whatever was beneath the organism, was scored if possible. Otherwise, the point was scored as “unidentified”. This photo plot scoring technique was adopted from the MARINe monitoring group (Engle 2005). Data were entered into Microsoft Excel for organization and descriptive statistics. NCSS was used for statistical analyses.

In addition to percent cover measurements; mobile invertebrates were counted within each photo plot area. With the exception of burrowing organisms and amphipods, all mobile invertebrates were counted in the field within a 50 x 75 cm PVC quadrat. The quadrat was aligned with three plot marker bolts to ensure accurate replication. Algal over-story was gently moved so that hidden invertebrates could be located. For select species, such as *Tegula funebris* and *Nucella ostrina*, the length of the shell (measured at its longest axis) was recorded to determine the size distribution of individuals present. This was done for the first 10 individuals recovered from each plot, unless fewer were present. In mussel beds, forceps were used to remove *N. ostrina*, *T. funebris*, and other species that were partially hidden in between mussels. Extremely abundant mobile invertebrates, such as limpets (smaller than 15 mm) and littorines (*Littorina* spp.), were sub-sampled using a smaller quadrat. Limpets larger than 15 mm were counted in the entire 50 x 75 cm plot. Small (0-15 cm) limpets were counted in two size categories (< 5 mm and 5-15 cm) within three 20 x 20 cm quadrats laid diagonally through the larger quadrat. Limpets occurring on rocky or other substrata (including barnacle tests) were recorded separately from those occurring on mussel valves. Littorines were counted in three 10 x 10 cm quadrats placed diagonally through the larger quadrat. Data were entered into a Microsoft Excel spreadsheet for analysis.

All plots were sampled and photographed every two to three months from June 2004 through November 2005 (Appendix A). Sampling was done for all three sites within six days during lowest tides. Each site required a full day of sampling employing a team of six scientists. The monitoring that has occurred constitutes a thorough representation of seasonal data for the year.



Enderts- Spring 2004



Enderts- Summer 2004



False Klamath Cove, June 2004



False Klamath Cove, October 2004



Damnation Creek Plot with 100 point grid overlaid on photo.

Figure 13. Example of photoplots from sites within the RNSP taken in the 2004 monitoring surveys. The top two pairs of photos are of plots from different sampling periods showing change in species cover, over time. Bottom plot shows photo over laid with 100 point grid.



Figure 14. PVC photo framer for photographing permanent 50 x 75 cm plots. A camera (not shown here) was mounted to the top brackets to ensure accurate replicate size.

Results

The following results are for each plot type monitored. In the original plot designation, the target species percent cover was greater than 75%. To date, monitoring data has indicated disturbance and recovery in some plots, for organisms such as barnacles and *Endocladia*. Other plots, such as mussels have been highly stable over the course of this study.

Chthamalus dalli* and *Balanus glandula (Barnacles)

Barnacle cover varied substantially over time and among sites, which may be due to their relatively short lifespan (Figure 15). At Damnation Creek, barnacle cover decreased steadily in summer and fall of 2004, but remained relatively stable throughout the rest of the study (Figure 15A) Percent cover of *Endocladia* and non-coralline crusts increased in 2005. These species may continue to increase in percent cover due to the high amount of free space (rock cover). At Enderts Beach, barnacle percent cover reached a maximum in October of 2004, and declined slightly after that (Figure 15B). Similar to trends at Damnation Creek, cover of *Endocladia* and non-coralline crusts has increased slightly in barnacle plots throughout 2005. There was also a spring-time pulse of *Porphyra* cover in barnacle plots. At False Klamath Cove, barnacle cover underwent periodic spring-time declines followed by recovery (Figure 15C).

Endocladia muricata (Turfweed)

The percent cover of *Endocladia muricata* varied seasonally at all three sites (Figure 16), with cover generally reaching maximum in spring and summer, and minimum in winter. When percent cover of *Endocladia* was low, cover of non-coralline crust and *Fucus* tended to be higher. Non-coralline crust (usually the sporophyte stage of *Mastocarpus* spp) is a common understory cover, so it was difficult to tell if crust percent cover is actually

increasing or only being exposed in the absence of *Endocladia* overstorey. Increased *Fucus* cover may be a result of recruitment facilitation by *Endocladia*. *Endocladia* is known to facilitate the recruitment of *Silvetia*, a southern California rockweed, similar to *Fucus* (Miner et al. in prep).

***Fucus gardneri* (Rockweed)**

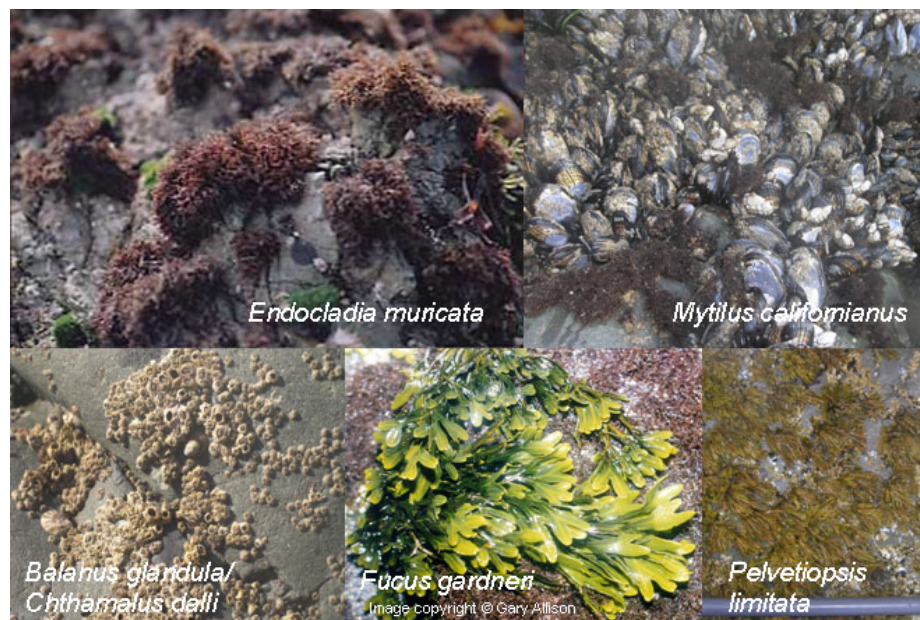
Percent cover of *Fucus* did not vary seasonally (Figure 17). At Damnation Creek, percent cover declined to 70 percent in winter of 2004/2005, but recovered to above 80 percent the following fall (Figure 17A). Percent cover of rock indicated an opposite trend indicating this change in percent cover of *Fucus* was not due to a species replacement, although percent cover of *Endocladia* did increase slightly throughout the study. At False Klamath Cove, percent cover of *Fucus* declined steadily throughout the study, while percent cover of non-coralline crust, an understorey species, increased proportionately (Figure 17B).

***Mytilus californianus* (Mussel)**

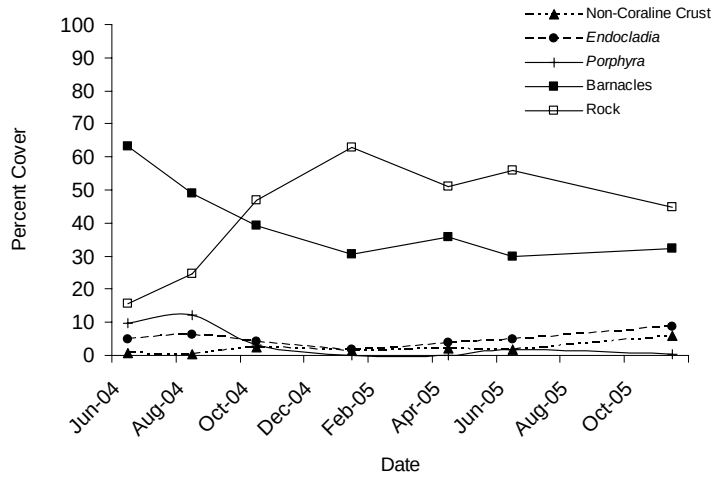
Mussel cover remained high and stable throughout the course of this study (Figure 18). At Damnation Creek and Enderts Beach, decreases in mussel cover corresponded to increases in the percent cover of the barnacle *Polycipes polymerus* (A and B). At False Klamath Cove, percent cover of mussels was slightly more variable and generally corresponded to changes in percent cover of rock (Figure 18).

***Pelvetiopsis limitata* (Rockweed)**

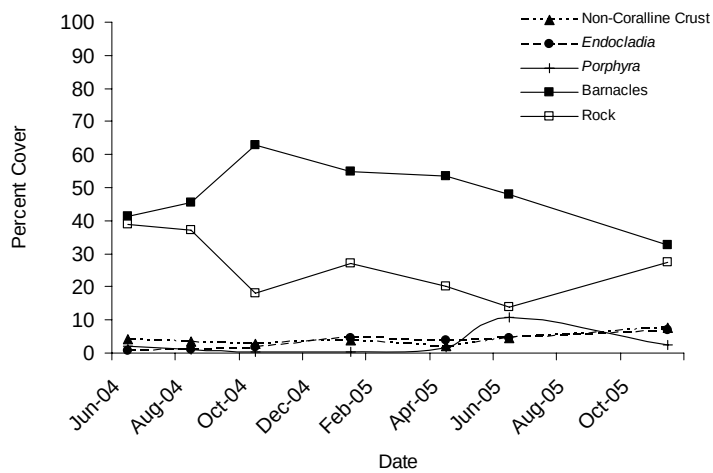
At Enderts Beach, *Pelvetiopsis* cover was lowest in October 2004, but remained relatively stable throughout the remainder of the monitoring period. Decreases in *Pelvetiopsis* cover corresponded to increases in the percent cover of rock and barnacles (Figure 19A). At False Klamath Cove, *Pelvetiopsis* cover remained between 70 and 80 percent throughout the study period. Rock and barnacles accounted for most of the remaining 20-30 percent cover (Figure 19B).



A



B



C

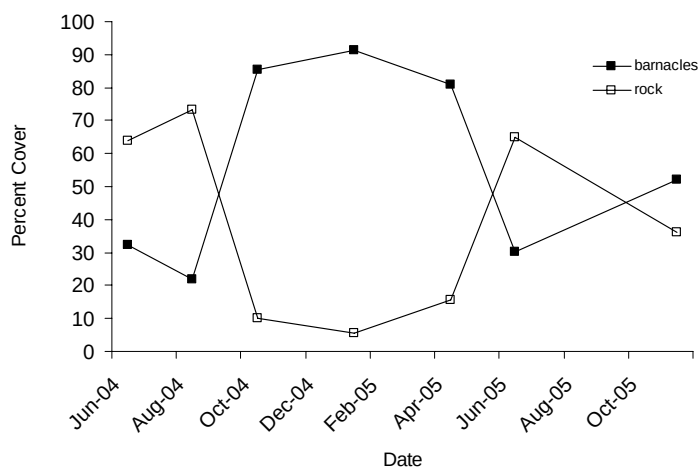
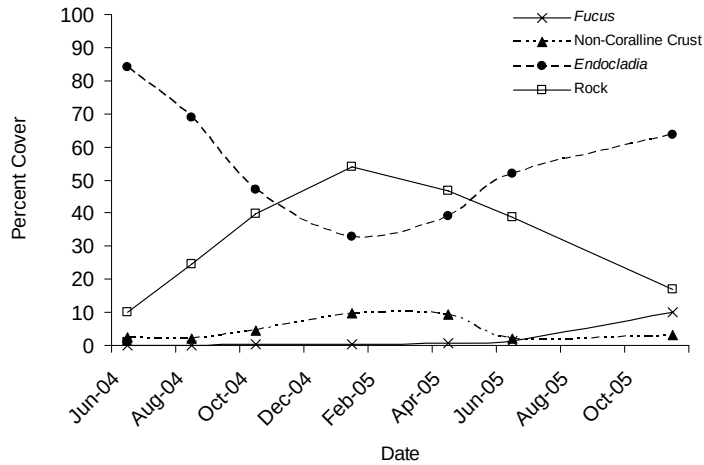
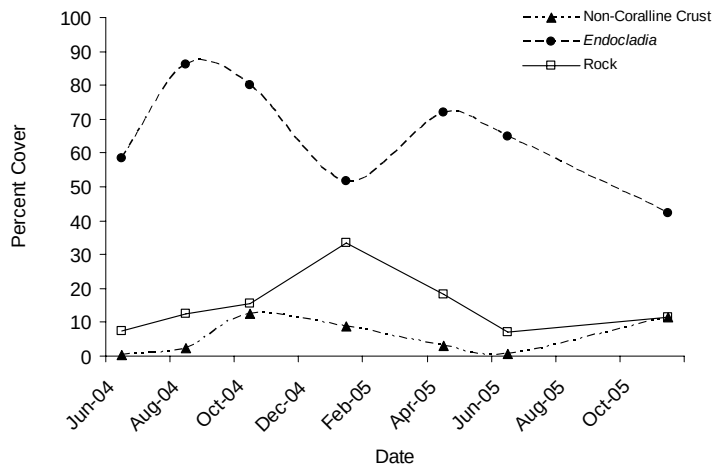


Figure 15. Percent coverage in five permanent barnacle (*Chthamalus dalli*/*Balanus glandula*) plots monitored from June 2004 to November 2005 at (A) Damnation Creek, (B) Enderts Beach, and (C) False Klamath Cove, RNSP.

A



B



C

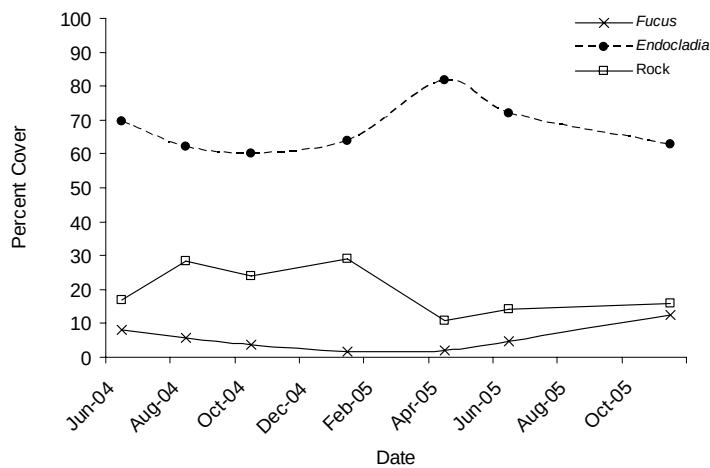
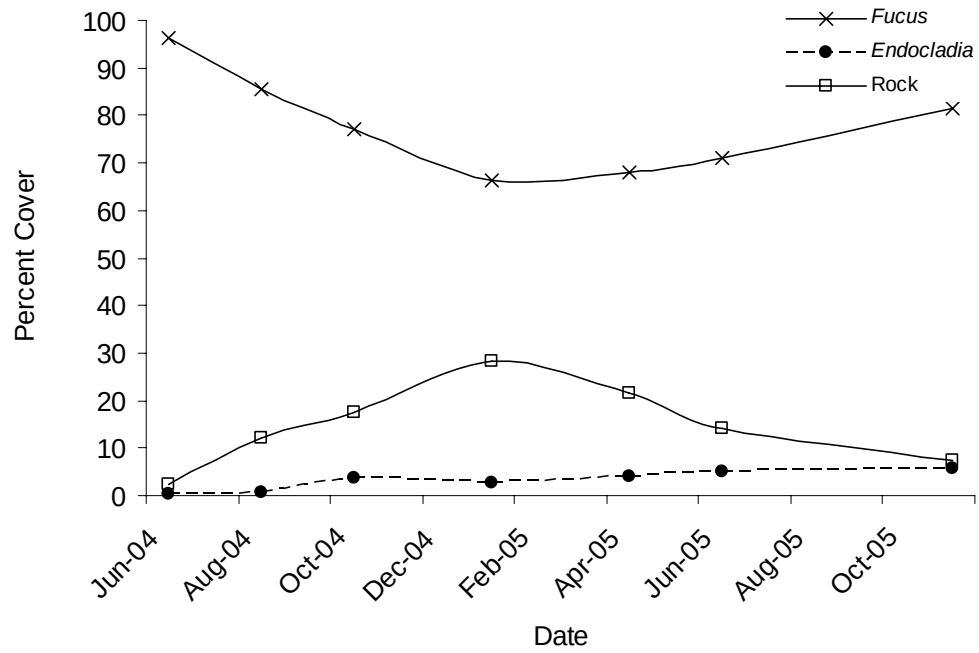


Figure 16. Percent coverage in five permanent *Endocladia muricata* plots monitored from June 2004 to November 2005 at (A) Damnation Creek, (B) Enderts Beach, and (C) False Klamath Cove, RNSP.

A



B

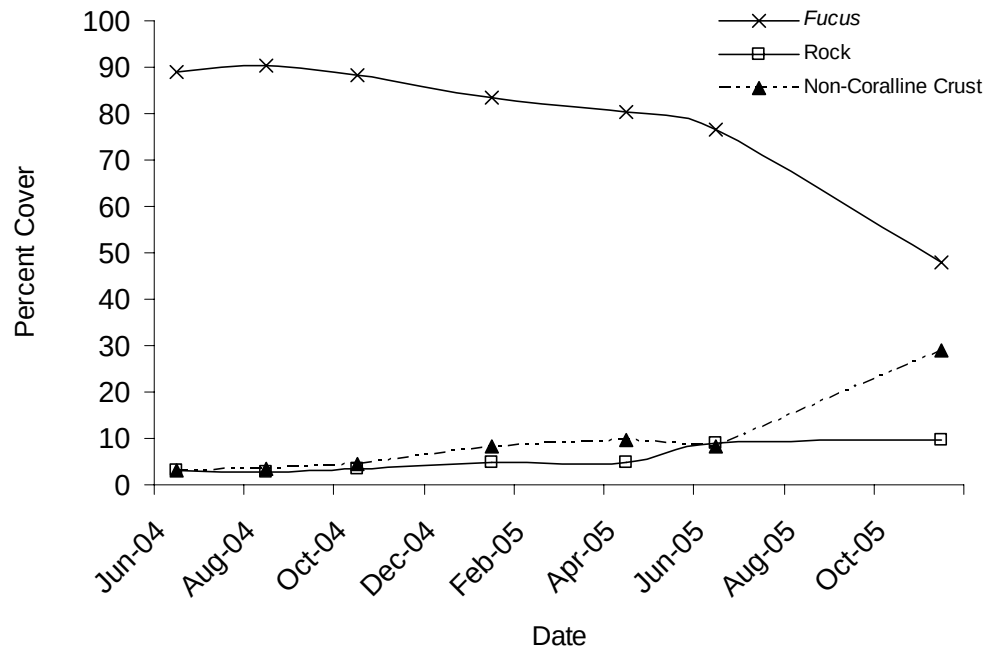
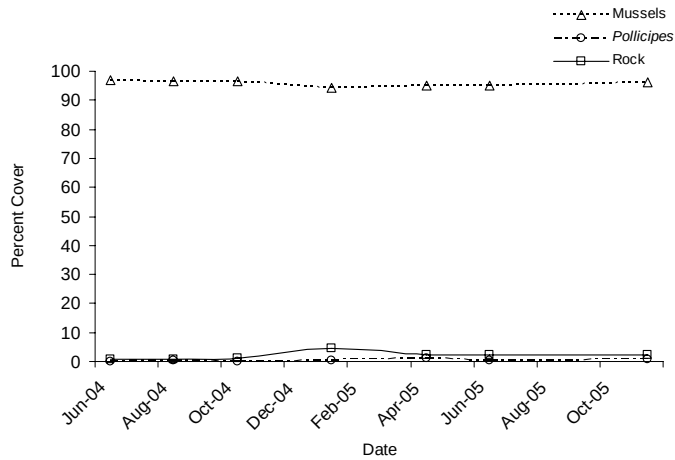
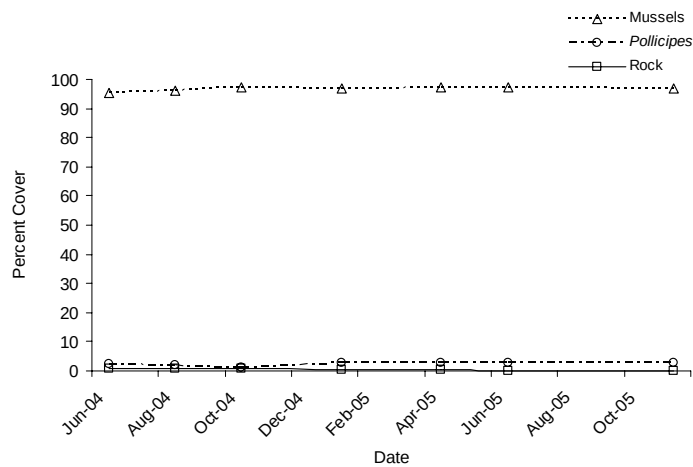


Figure 17. Percent coverage in five permanent *Fucus gardneri* plots monitored from June 2004 to November 2005 at (A) Damnation Creek and (B) False Klamath Cove, RNSP.

A



B



C

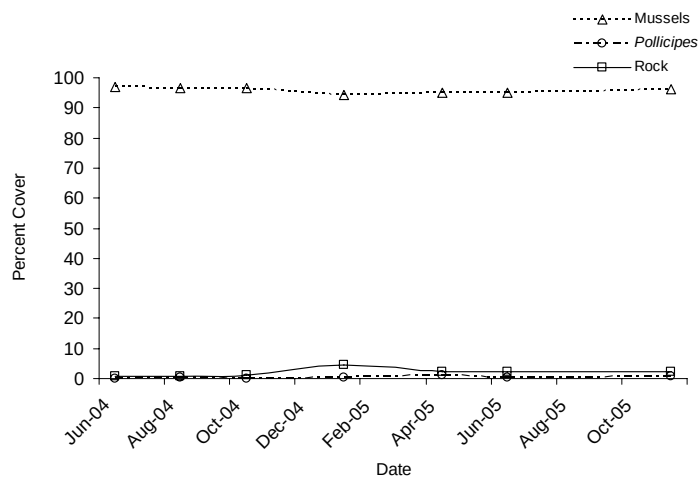
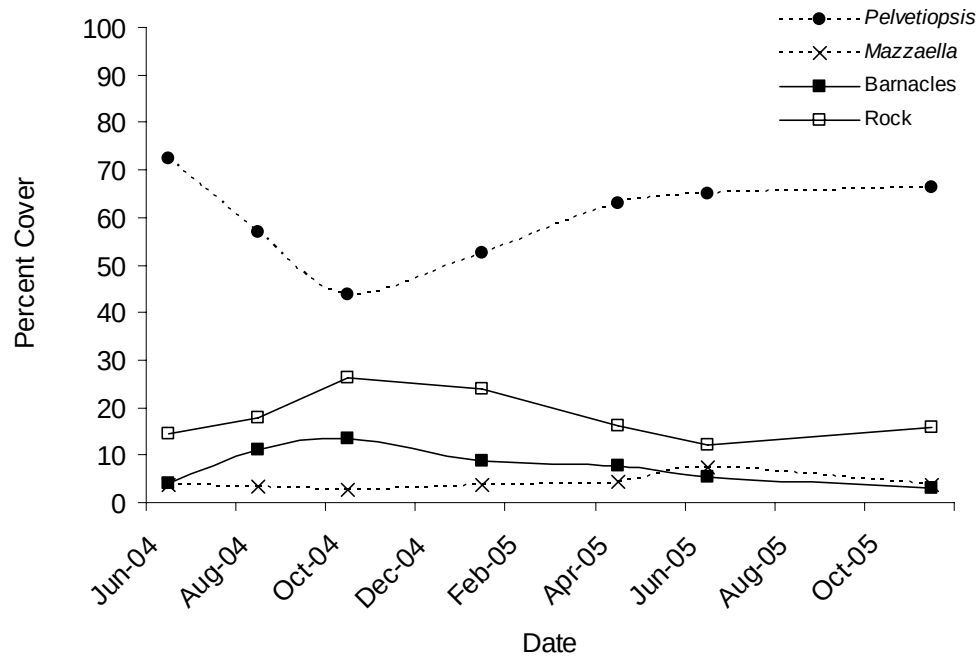


Figure 18. Percent coverage in five permanent mussel (*Mytilus californianus*) plots monitored from June 2004 to November 2005 at (A) Damnation Creek, (B) Enderts Beach, and (C) False Klamath Cove, RNSP.

A



B

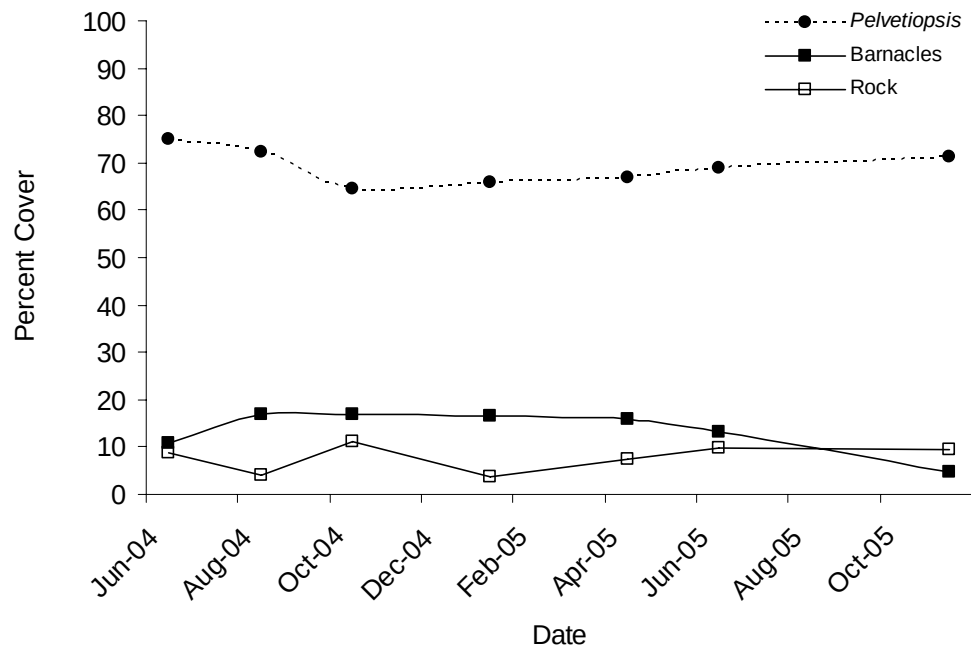


Figure 19. Percent coverage in five permanent *Pelvetiopsis limitata* plots monitored from June 2004 to November 2005 at (A) Enderts Beach, and (B) False Klamath Cove, RNSP.

Mobile Invertebrates

Trends in the abundance of mobile invertebrates associated with barnacle plots were similar at Damnation Creek and Enderts Beach (Figure 20A - D). *Nucella ostrina*, a predatory gastropod that feeds on mussels and barnacles, occurred at highest densities (15-25 per plot on average) in barnacle plots in summer and fall of both sampling years (Figure 20A and C). *Tegula funebris*, a herbivorous snail, reached a mean abundance of 5 per plot in winter of 2004/2005 at Damnation Creek (Figure 20A). However, this snail was generally absent in warmer months and did not reach a mean density higher than 2 per plot in any month at Enderts Beach (Figure 20C). Littorine abundance increased in spring then peaked in June sampling events of both years at Damnation Creek and Enderts Beach. Limpets were most abundant in fall and winter for both of these sites (Figure 20B and D). At False Klamath Cove, *Nucella* abundance remained at a mean of 3 snails per plot or less with a maximum in April of 2005 (Figure 20E). Low *Nucella* populations may be due to strong fluctuations in the percent cover of these barnacle plots. The decrease in mean abundance of *Nucella* in April 2005 corresponds to a drastic decrease in the percent cover of barnacles occurring in the same month (Figure 15C). Littorine abundance generally increased through April 2005 as well, but decreased thereafter. Limpet abundance remained low throughout the study period (Figure 20F).

Mobile invertebrate abundance in *Endocladia* plots was highly variable among sites. *Nucella* abundance peaked in winter of 2004/2005 at all three sites but actual mean abundance was less than 12 snails per plot (Figure 21A, C, and F). At Damnation Creek, where *Nucella* abundance in *Endocladia* plots was generally highest, an additional peak in abundance occurred in August, 2004 (Figure 21A). *Tegula* occurred at up to an average of 25 individuals per plot in the autumn of 2004 (Figure 21A), but this snail occurred at very low density in *Endocladia* plots at the other two sites. Littorine abundance remained low in *Endocladia* plots at Damnation Creek until April, 2005. In June of 2005 mean littorine density increased drastically to approximately 800 per plot (Figure 21B). This increase does not appear to correspond to any change in algal cover, however (Figure 16A). At Enderts Beach, littorines density reached an average of over 2000 individuals per plot in October, 2004, but littorines populations remained low in *Endocladia* plots for all other sampling events (Figure 21D). This peak corresponds to a peak in *Endocladia* cover in the same month (Figure 16B). Littorine abundance remained between 200 and 1200 snails per plot throughout the study period, with peaks in August, 2004 (800 littorines per plot) and January, 2005 (1200 littorines per plot; Figure 21F). Limpet populations undulated between 200 and 500 individuals per plot at both Damnation Creek and Enderts Beach (Figure 21B and D). Whereas mean limpet populations were between 50 and 200 individuals per plot at False Klamath Cove (Figure 21F)

In *Fucus* plots at Damnation Creek, *Nucella* reached a mean abundance of 9 individuals per plot in October, 2004. Mean abundance remained between 1 and 4 individuals per plot in all other sampling periods (Figure 22A). *Tegula* counts were 0-2 individuals per plot in *Fucus* plots at Damnation Creek until June 2005, when mean abundance reached 6 snails per plot (Figure 22B). *Nucella* abundance was generally higher at False Klamath Cove, remaining between 10 and 15 individuals per plot for all months except August, 2004, when mean abundance dropped to 4 individuals per plot (Figure 22C). At False Klamath Cove, abundance of *Tegula funebris* remained between 13 and 22 individuals per plot throughout the study, with the maximum density occurring in January 2005 (Figure 22C). Limpet counts undulated between 30 and 115 in *Fucus* plots at both Damnation Creek and False Klamath Cove, reaching maximum abundance in August 2004 at

both sites (Figure 22B and D). Littorines density generally increased over the study period in *Fucus* plots at Damnation Creek, reaching a maximum of 2060 individuals per plot in June 2005 (Figure 22B). At False Klamath Cove, littorines were more variable. Abundance was highest in August 2004 at 480 individuals per plot, and lowest in January 2005 at 41 individuals per plot. These trends do not seem to correspond to changes in percent cover, however (Figure 17A and B).

Variation in mobile invertebrate abundance in mussel plots was seasonally similar among sites, but the magnitude of these fluctuations varied by site. *Nucella* were generally more abundant at Enderts Beach and False Klamath Cove. Abundance peaked in October at Damnation Creek (5 snails per plot) and False Klamath Cove (43 snails per plot), and in August at Enderts Beach (75 snails per plot). *Nucella* abundance peaked again in June 2005 at Damnation Creek (15 snails per plot) and Enderts Beach (62 snails per plot) (Figure 23A, C, and E). Mean *Tegula* abundance remained low in mussel plots at all sites (Figure 23A, C, and E). Limpet counts were highest in August 2004 at Damnation Creek (270 per plot) and Enderts Beach (510 per plot), and in October 2004 at False Klamath Cove (520 per plot). Limpet abundance was lowest in April 2005 at all three sites (Figure 23 B, D, F). Littorines reached a mean density of 750 snails per plot in October 2004 at Enderts Beach, but littorine abundance remained low through spring 2005 at the other two sites. Littorines reached a mean density of 110 snails per plot in April 2005 at Damnation Creek, and 820 snails per plot at False Klamath Cove in June 2005 (Figure 23 B, D, F).

Abundance of *Nucella* and *Tegula* remained low in *Pelvetiopsis limitata* plots at Enderts Beach. *Tegula* reached a maximum mean density of 2.5 snails per plot in winter 2004/2005 (Figure 24A). *Nucella* counts were highly variable at False Klamath Cove, with peaks occurring in October 2004 (12 snails per plot) and April 2005 (19 snails per plot) (Figure 24C). Limpet counts remained fairly stable, between 135 and 240, at Enderts Beach (Figure 24B). Limpet abundance was also stable but slightly lower (60-210) at False Klamath Cove (Figure 24D).

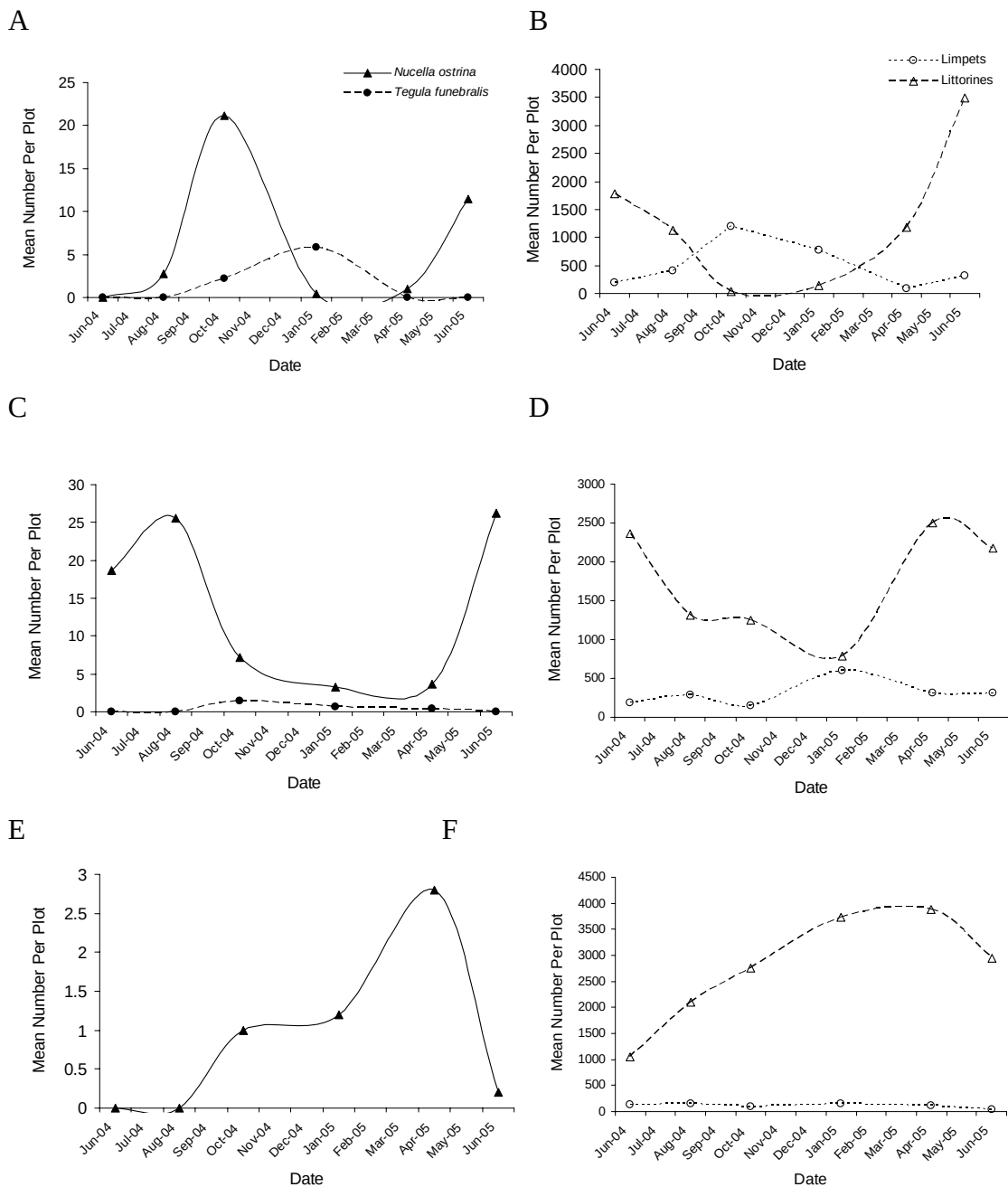


Figure 20. Abundance of mobile invertebrates in five permanent barnacle (*Chthamalus dalli*/*Balanus glandula*) plots monitored from June 2004 to June 2005 at (A and B) Damnation Creek, (C and D) Enderts Beach, and (E and F) False Klamath Cove, RNSP.

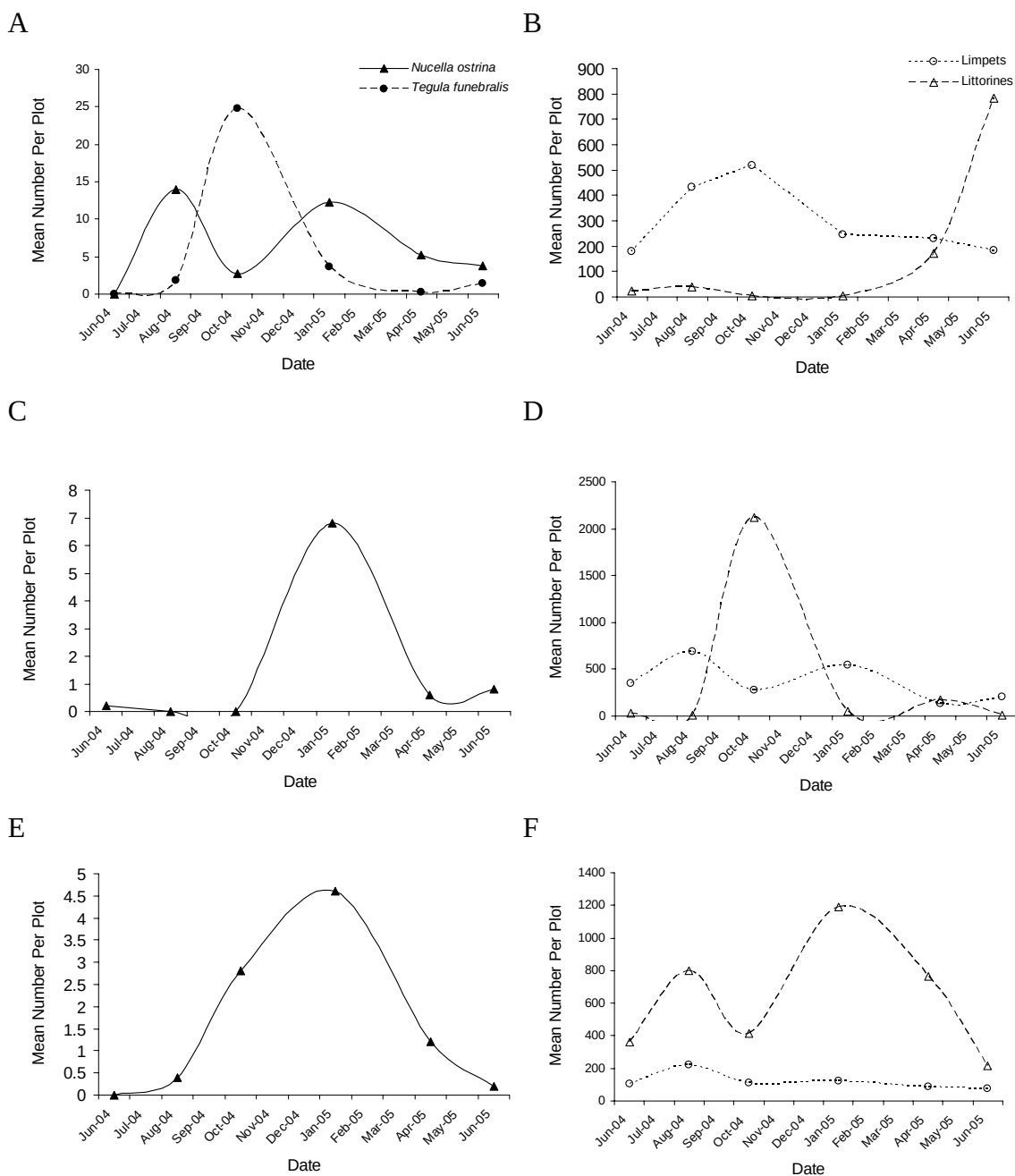


Figure 21. Abundance of mobile invertebrates in five permanent *Endocladia muricata* plots monitored from June 2004 to June 2005 at (A and B) Damnation Creek, (C and D) Enderts Beach, and (E and F) False Klamath Cove, RNSP.

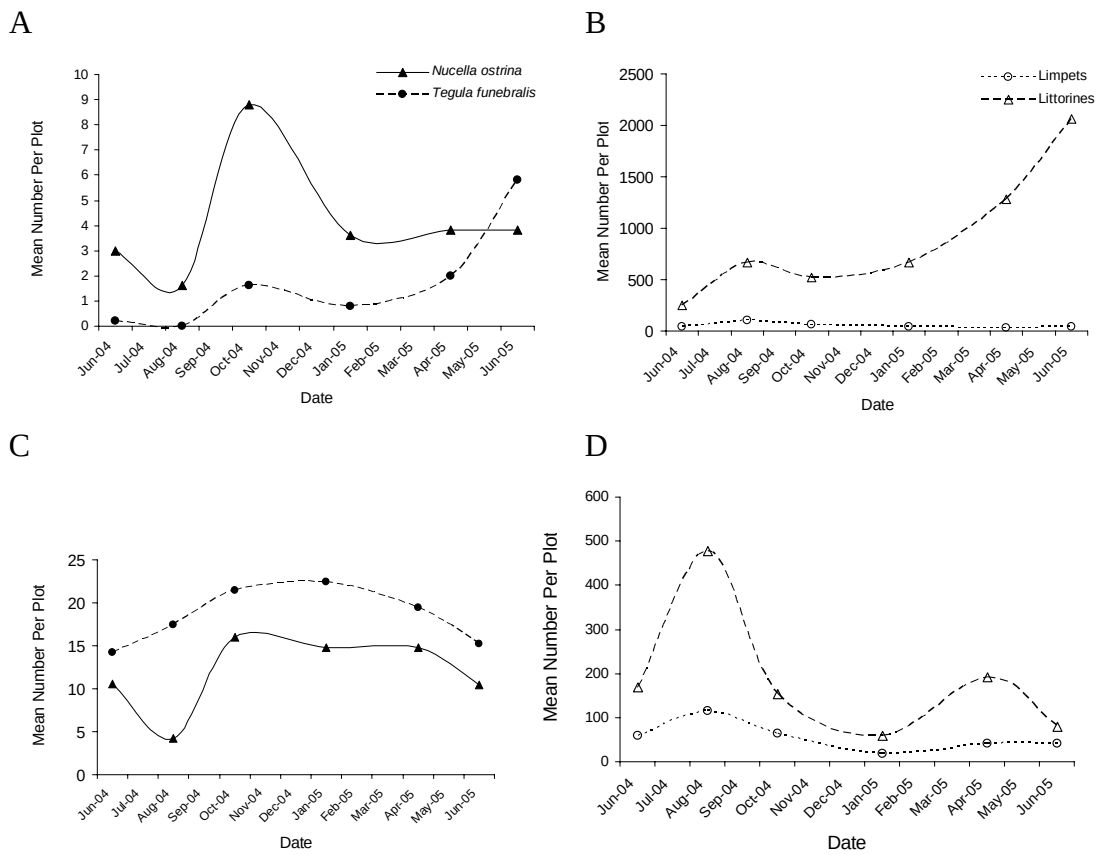


Figure 22. Abundance of mobile invertebrates in five permanent *Fucus gardneri* plots monitored from June 2004 to June 2005 at (A and B) Damnation Creek and (C and D) False Klamath Cove, RNSP.

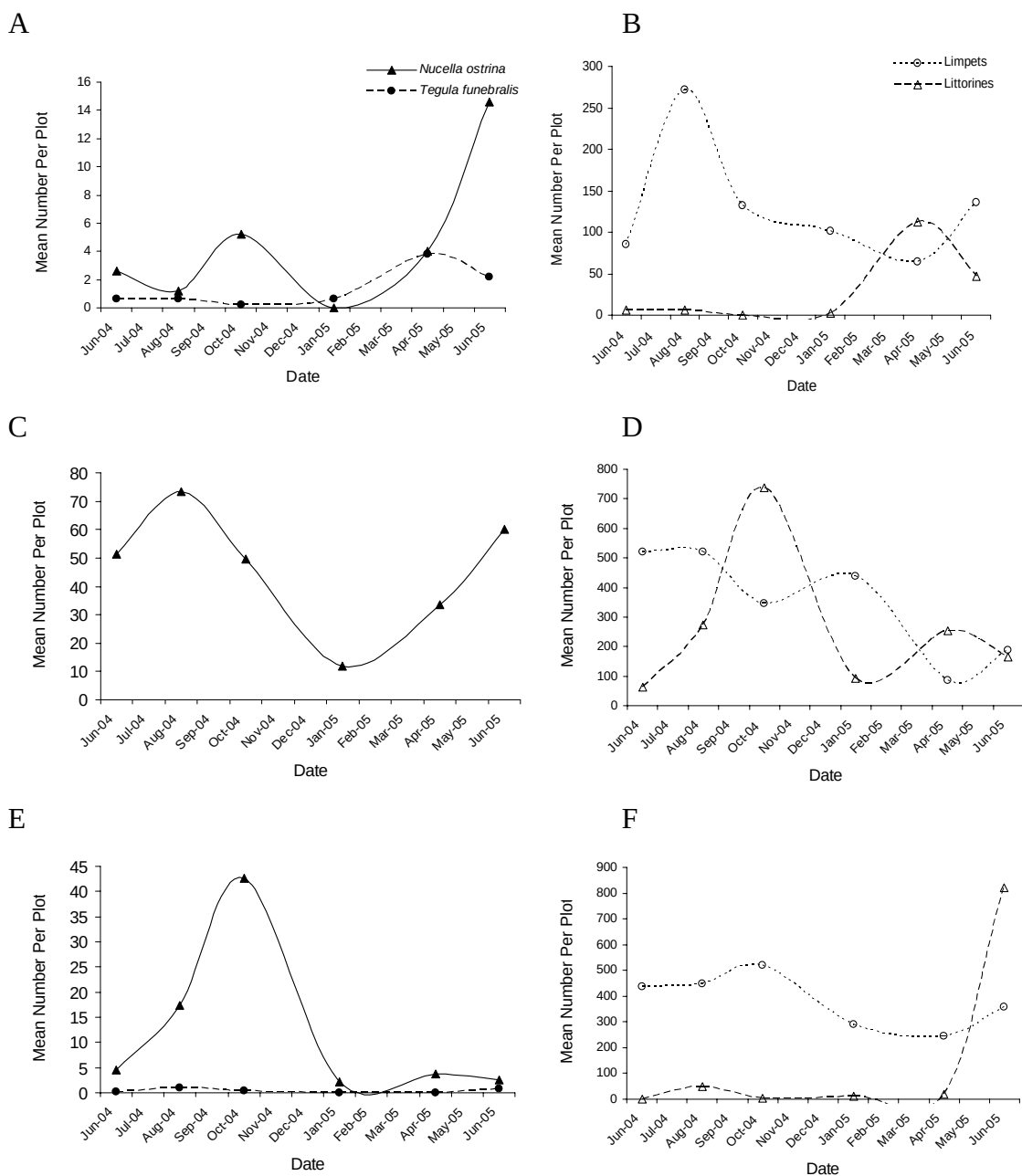


Figure 23. Abundance of mobile invertebrates in five permanent mussel (*Mytilus californianus*) plots monitored from June 2004 to June 2005 at (A and B) Damnation Creek, (C and D) Enderts Beach, and (E and F) False Klamath Cove, RNSP.

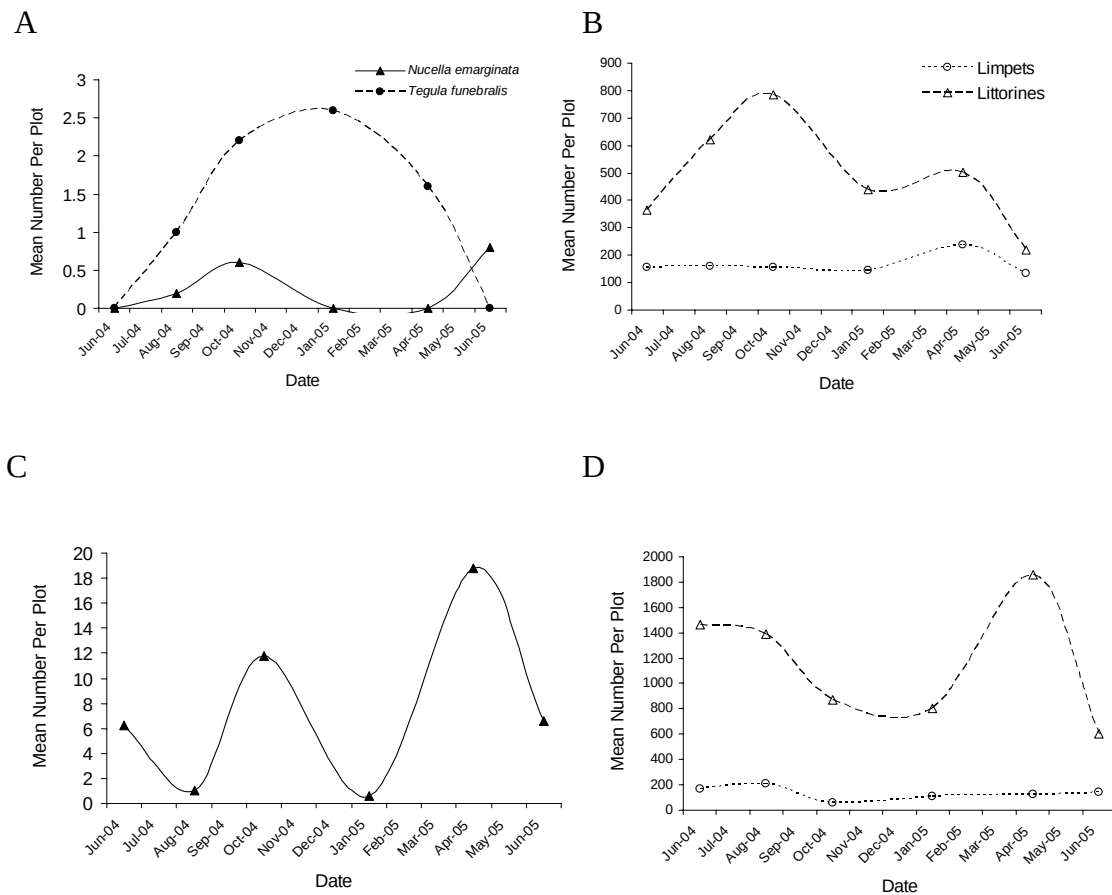


Figure 24. Abundance of mobile invertebrates in five permanent *Pelvetiopsis limitata* plots monitored from June 2004 to June 2005 at (A and B) Enderts Beach and (C and D) False Klamath Cove, RNSP.

Species Interactions

To determine if the abundance of mobile species was correlated with changes in the percent cover of algae and sessile invertebrates, two correlation analyses were performed, on the three sites combined. Data from June of 2004 and June 2005 were run separately to ensure that associations are consistent between years. The correlation tables (Table 5) show Spearman rank values, because data were non-normal for most taxa. However, equal variance assumptions were met. Results in the correlation table for June 2004 are generally consistent with results from 2005, indicating that associations continued from one year to the next. Spearman correlation values of 0.3 and greater were considered to be indicative of an association. In both years, *T. funebralis* was associated with *F. gardneri*, small limpets (less than 5 mm) with *E. muricata*, limpets (5-15 mm) with *P. limitata*, *N. ostrina* with mussels and *Pollicipes polymerus*, and littorines with barnacles and rock. Limpets (<5mm and 5-15mm size classes) were counted on mussels and rock separately, so their association is a given. *Nucella ostrina* and both limpet size classes on mussel classes are positively associated with *P. polymerus*, but these barnacles are only found in mussel plots, so it is difficult to determine if this was a direct or indirect association. The percent cover of *P. polymerus* is low in all plots, so further correlative analysis was not calculated. Littorines were positively correlated with *P. limitata* in 2004, but not the following year. The association between *N. ostrina* and *P. polymerus* was still present in 2005, but it was weaker than in the previous year. The association between small limpets (< 5 mm) and the rock class

was weaker in 2004 than in 2005. A linear regression was run on each correlated pair to test for positive relationships. In each case the slope of the linear relationship was positive and significantly greater than zero.

Table 5. Correlation matrix shows associations between mobile invertebrates and sessile taxa. Spearman correlation values ≥ 0.3 indicate an association. These associations are generally consistent between the matrices for (A) June 2004 and (B) June 2005.

A

Mobile Invertebrate	<i>Fucus gardneri</i>	<i>Endocladia muricata</i>	<i>Pelvetiopsis limitata</i>	Mussel	Barnacles	<i>Pollicipes polymerus</i>	Rock
<i>Nucella ostrina</i>	0.073	-0.268	0.057	0.454*	-0.276	0.398*	-0.528
<i>Tegula funebris</i>	0.387*	-0.018	-0.013	0.113	-0.387	-0.001	-0.438
Limpets < 5 mm	0.031	0.517*	0.123	-0.475	0.046	-0.143	0.266
Limpets < 5 mm on mussel	-0.327	-0.458	-0.060	0.667*	-0.137	0.520*	-0.332
Limpets 5-15 mm	0.156	0.030	0.308*	-0.397	0.252	-0.225	0.377*
Limpets 5-15 mm on mussel	-0.317	-0.461	-0.198	0.731*	-0.142	0.409*	-0.365
<i>Littorina</i> spp.	0.106	-0.104	0.338*	-0.431	0.571*	-0.342	0.502*

B

Mobile Invertebrate	<i>Fucus gardneri</i>	<i>Endocladia muricata</i>	<i>Pelvetiopsis limitata</i>	Mussel	Barnacles	<i>Pollicipes polymerus</i>	Rock
<i>Nucella ostrina</i>	-0.012	-0.151	-0.275	0.513*	-0.162	0.268	-0.377
<i>Tegula funebris</i>	0.428*	-0.170	-0.304	0.088	-0.343	-0.133	-0.106
Limpets < 5 mm	0.132	0.644*	0.135	-0.633	0.269	-0.345	0.450*
Limpets < 5 mm on mussel	-0.311	-0.396	-0.210	0.888*	-0.348	0.593*	-0.648
Limpets 5-15 mm	0.150	0.027	0.521*	-0.528	0.701*	-0.330	0.429*
Limpets 5-15 mm on mussel	-0.310	-0.402	-0.208	0.888*	-0.354	0.469*	-0.593
<i>Littorina</i> spp.	0.133	-0.015	-0.026	-0.302	0.519*	-0.207	0.516*

*Strong positive correlations

Size Distribution of Mobile Invertebrates

Tegula were generally smaller and more abundant in *Fucus* plots at False Klamath Cove than at Damnation Creek (Figure 25). At Damnation Creek, *Fucus* plots contained fewer individuals, but many of these were of larger size (Figure 22 and Figure 25). A pulse of small individuals occurred in January, 2005 at both sites, followed by a spike in the abundance of *Tegula* over 10 mm in summer and fall (Figure 25).

Mussel plots at Enderts Beach contained a high proportion of large *Nucella ostrina* especially in summer and fall months (Figure 26B). While individuals at the other two sites were more evenly distributed among size classes, there is a prevalence of larger individuals in summer and fall as well (Figure 26A and C). Small individuals (<15mm) were present throughout the year at all sites, but are most common in August and October, 2004 (Figure 26). *Nucella* in mussel plots at the mouth of Damnation Creek show a more distinct seasonal shift in size distribution than the population living in the mussel plots with more stable salinity. Small (<10mm) *Nucella* were present in January of 2005, but decreased in abundance in April, 2005 and in both June surveys. Larger individuals (15-20mm) are present in nearly every survey, but reach maximum abundance in August and October, 2004 (Figure 27).

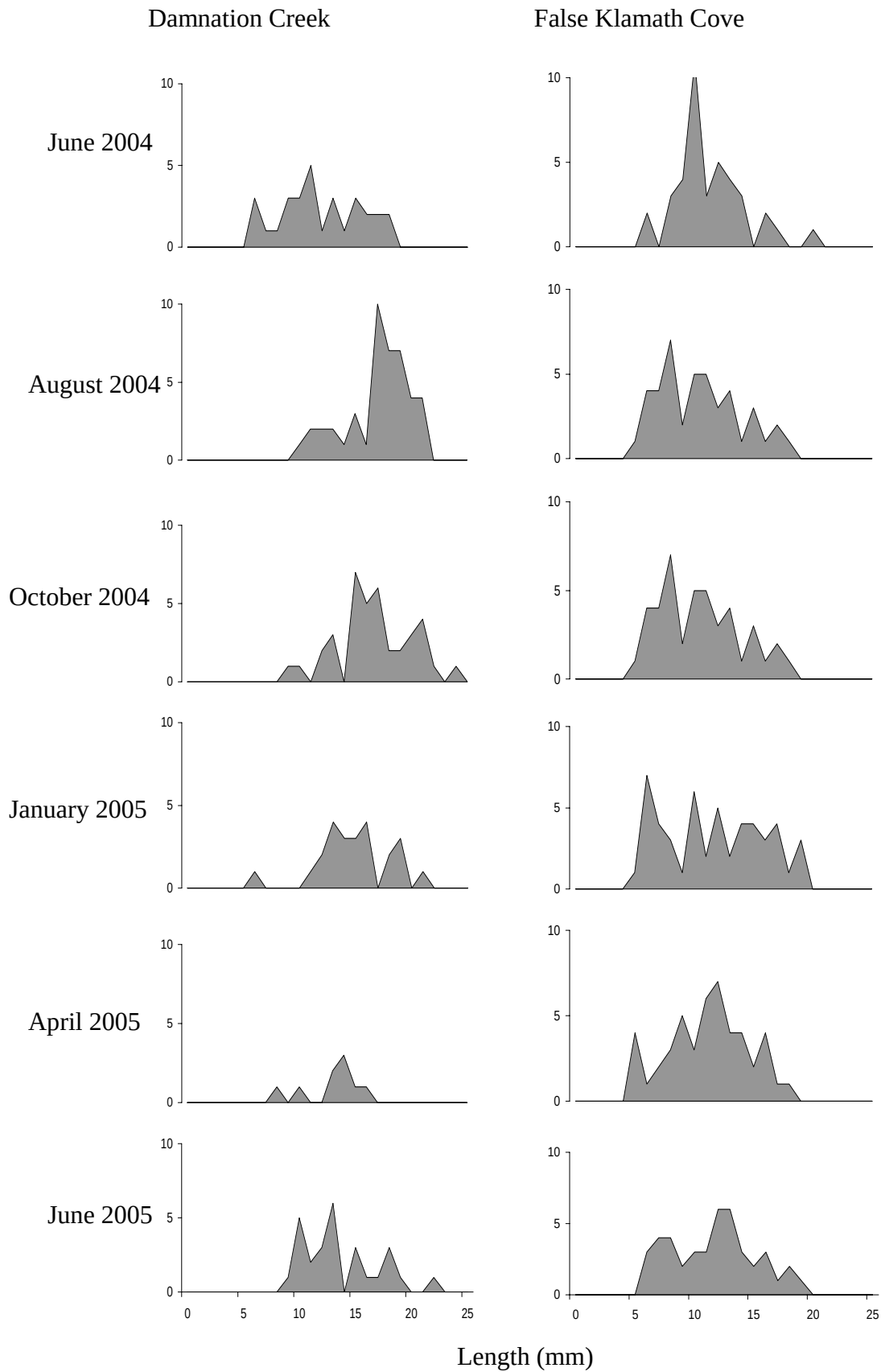


Figure 25. Size distribution of *Tegula funebris* in *Fucus* plots, RNSP.

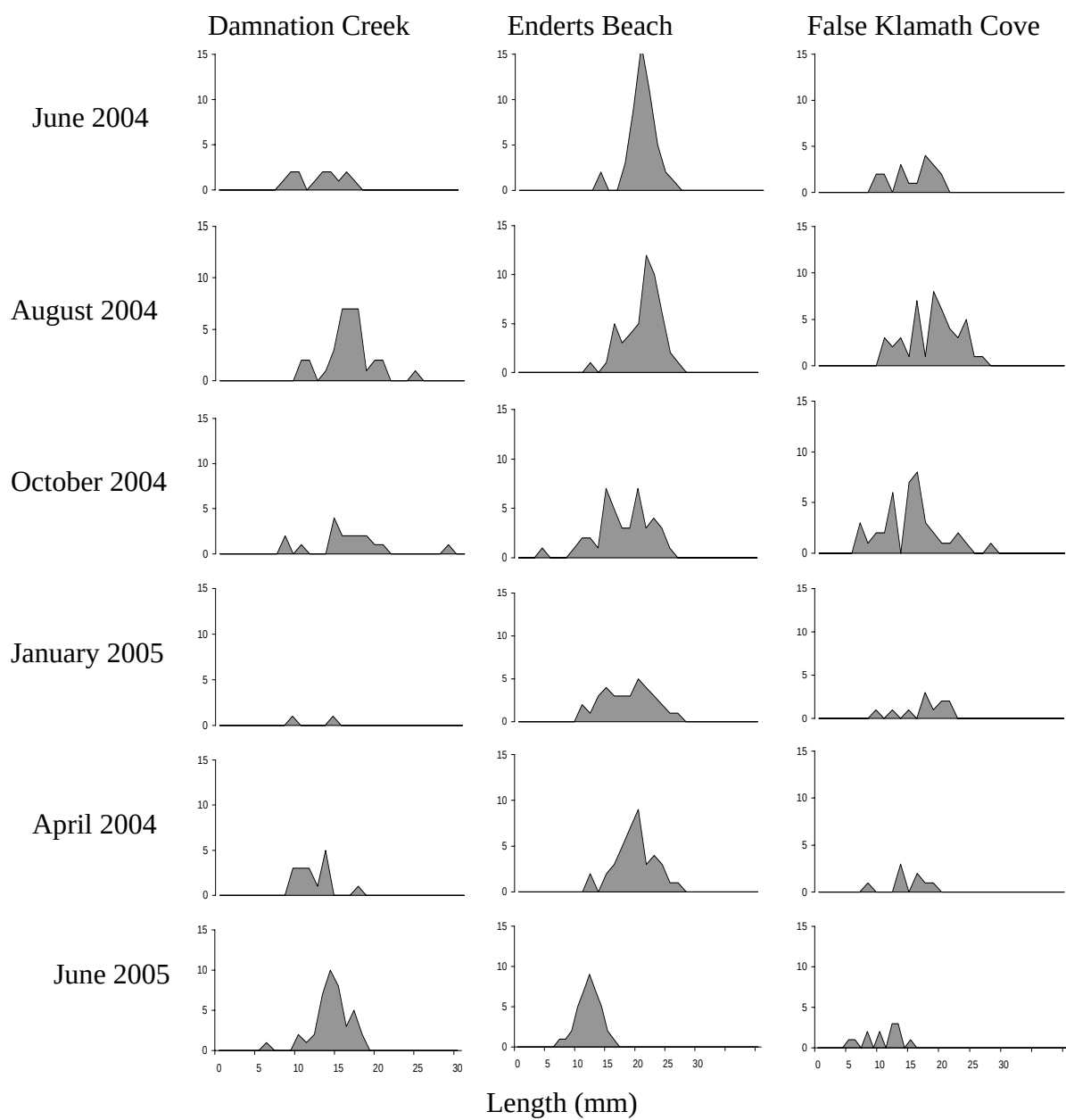


Figure 26. Size distribution of *Nucella ostrina* in mussel plots, RNSP.

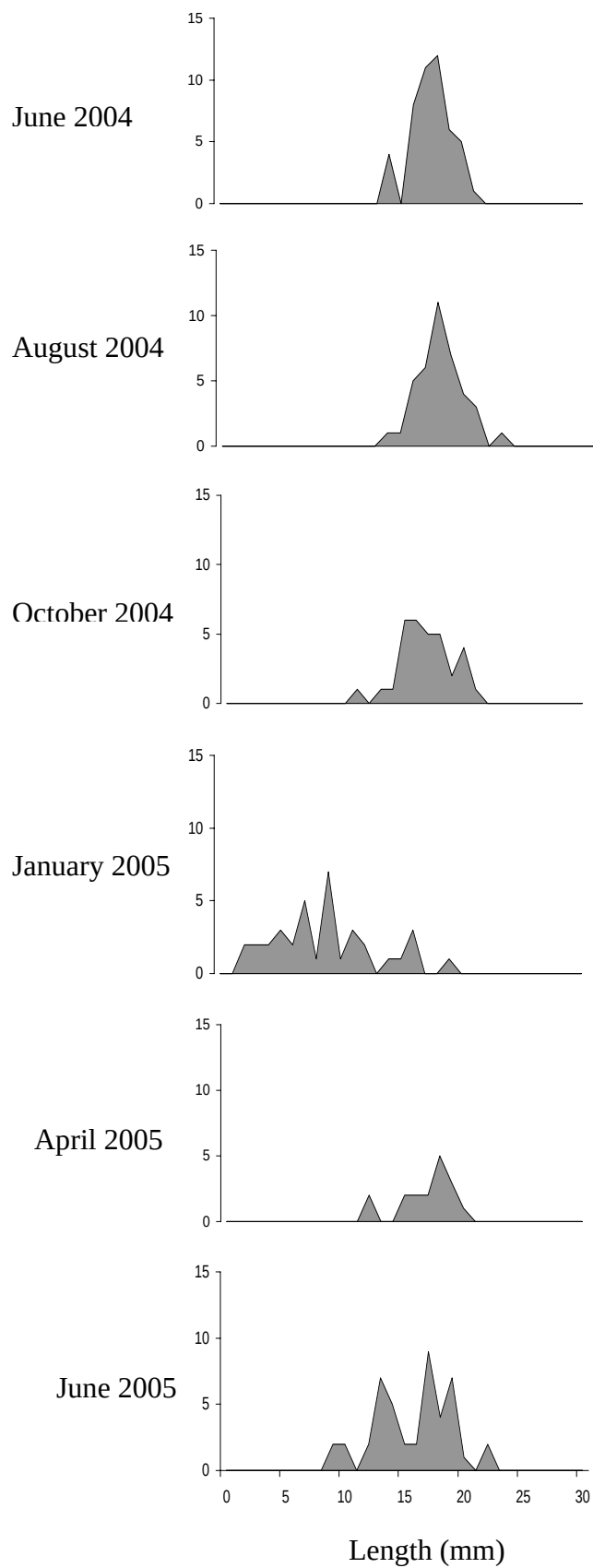


Figure 27. Size distribution of *Nucella ostrina* in low salinity mussel plots located near the mouth of Damnation Creek, RNSP.

Sea Star Monitoring

Methods

Permanent plots were established at each of our rocky intertidal sites to monitor the size and abundance of sea stars. Protocols were adapted from the MARINE Handbook in order to create plots comparable over a large geographic range (Engle 2005). The plots were irregular in shape encompassing an area with high densities of sea stars. These plots were not intended to quantify densities at an overall site, but were meant to provide discrete plots where abundance and size distribution of sea stars could be monitored over time. Irregular plots were marked by four or more "corner" bolts, one of which was notched with the plot number. The plots were placed in areas of high sea star density to obtain as many counts and measurements for size-frequency as possible. At Damnation Creek and False Klamath Cove three plots were established, while at Enderts Beach, two plots were monitored.

To survey a plot, at sufficiently low tide, a meter tape was laid out around the irregular plot perimeter and the entire area encompassed by the boundary tape was searched carefully. All sea stars within the plot were recorded while only ochre sea stars (*Pisaster ochraceus*) were measured. *Pisaster ochraceus* were recorded if any part of the animal was inside the plot. Each sea star was temporarily marked with a yellow forestry crayon to avoid duplicate counts. Ochre sea stars were measured with a ruler from the center of the disc to the tip of the longest ray to the nearest 5 mm for animals <10mm and the nearest 10 mm for larger sea stars. Often sizes had to be estimated because sea stars were wedged in tight spots with rays curved. A flashlight was used to see in cracks and overhangs. Sea stars were never "straightened" or removed from the rock. Other species of sea stars counted in plots included *Patiria miniata*, *Pisaster giganteus*, and *Pycnopodia helianthoides*. Rarer species of sea stars such as *Leptasterias hexactis* and *Dermasterias imbricata* were also noted when seen.

Results and Discussion

Pisaster ochraceus was the most abundant species found at every site where sea stars were sampled. In the spring 2005 sampling event, ochre star populations within most of the plots, at all three sites, showed a decline from previous numbers (Figure 28). The following sampling event, in fall 2005, resulted in a higher proportion of smaller individuals (Figure 29). The fluctuations in sea star numbers over time are thought to reflect movement into and out of our permanent plots in response to factors such as tidal height and food availability, and should not be interpreted as true increases and decreases in the population at the site overall (Miner et al. in prep).

Changes in abundance and size frequency occur over time and across sites for *Pisaster ochraceus*, however; the color ratio of "other" (everything other than orange) to orange remains an approximate 3:1 ratio at most sites (Figure 28). This ratio is also consistent with data from sites throughout the California coast (Miner et al. in prep). Figure 29 displays size structure for the two color groups. Sizes ranged from 5 to 160 mm and these data showed an overall bell shaped distribution of size frequencies. The mean size of ochre stars decreased in 2005 across all sites with a larger proportion of smaller size classes. This pattern may be related to the decrease in abundances within the plots. Purple ochre stars show a slightly greater mean size than orange stars, however these values were not statistically different and may have been driven by the greater abundances of purple stars (Figure 30).

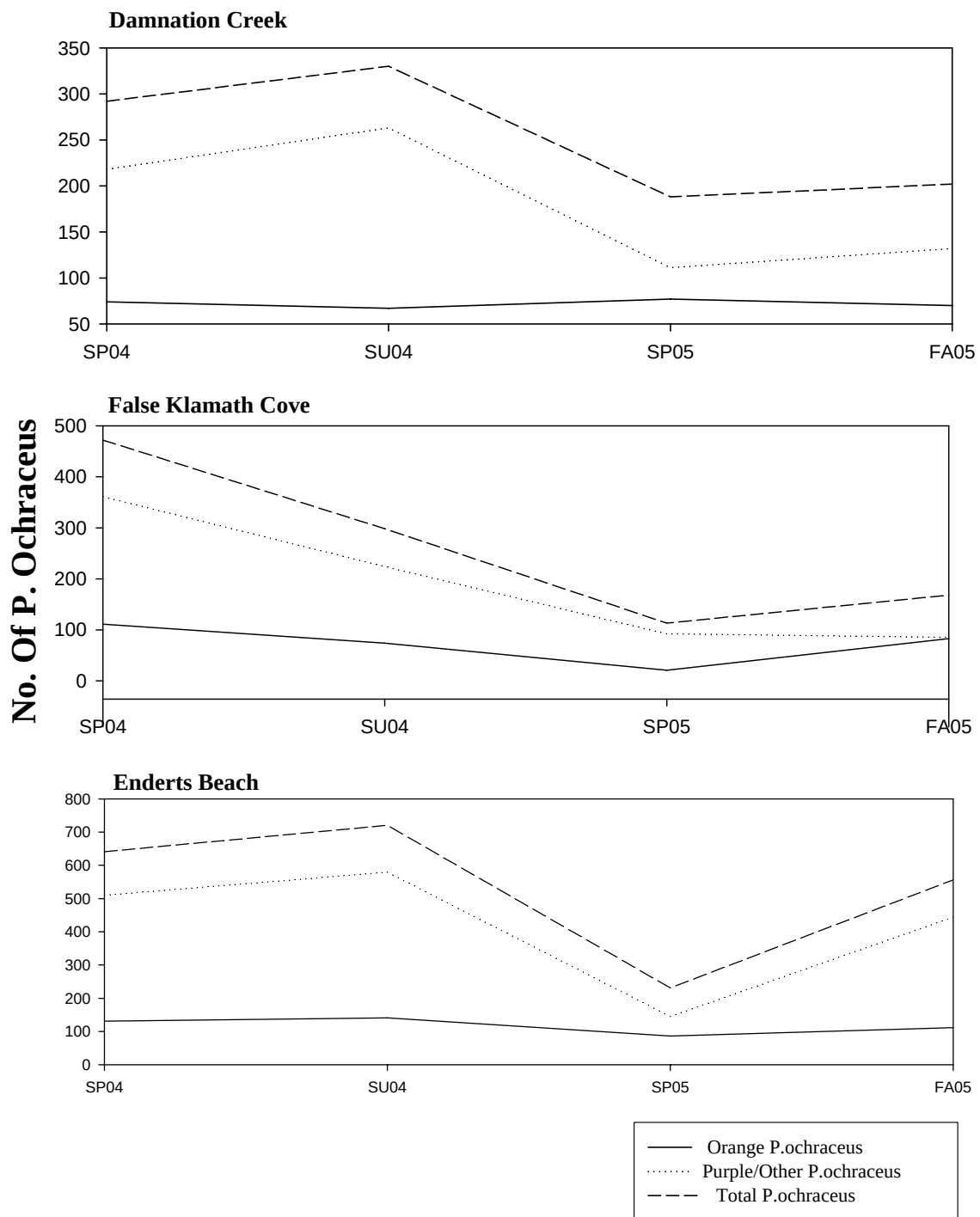


Figure 28. *Pisaster ochraceus* abundances and colors. Note differences in scale. SP=spring samples, FA=fall samples, SU=summer samples.

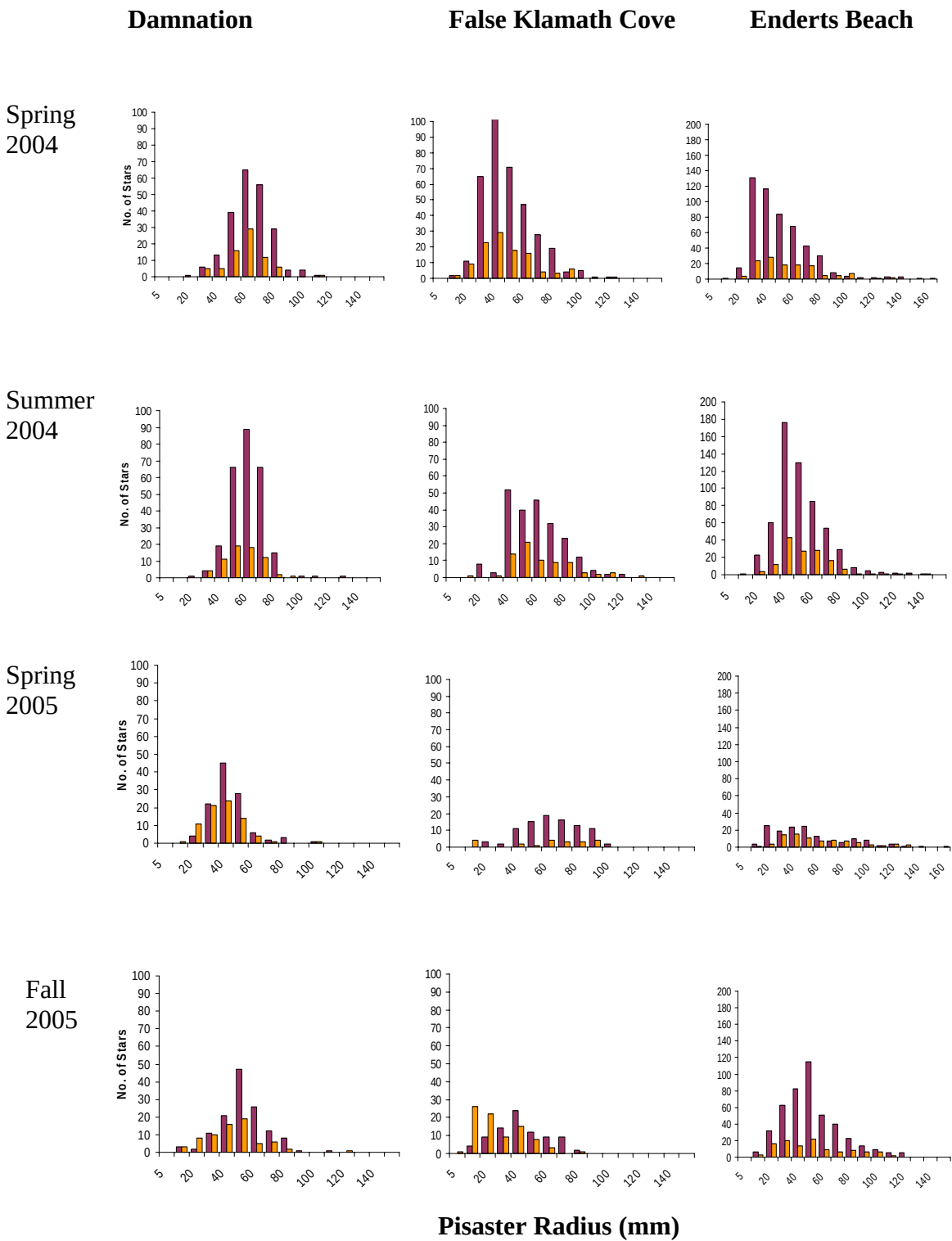


Figure 29. *Pisaster ochraceus* radius (mm) length frequency and abundances for orange (orange bars) and purple/other (purple bars) sea stars. Note different scale on y-axis for Enderts Beach. Data from four sampling events in 2004 and 2005 at three sites within RNSP.

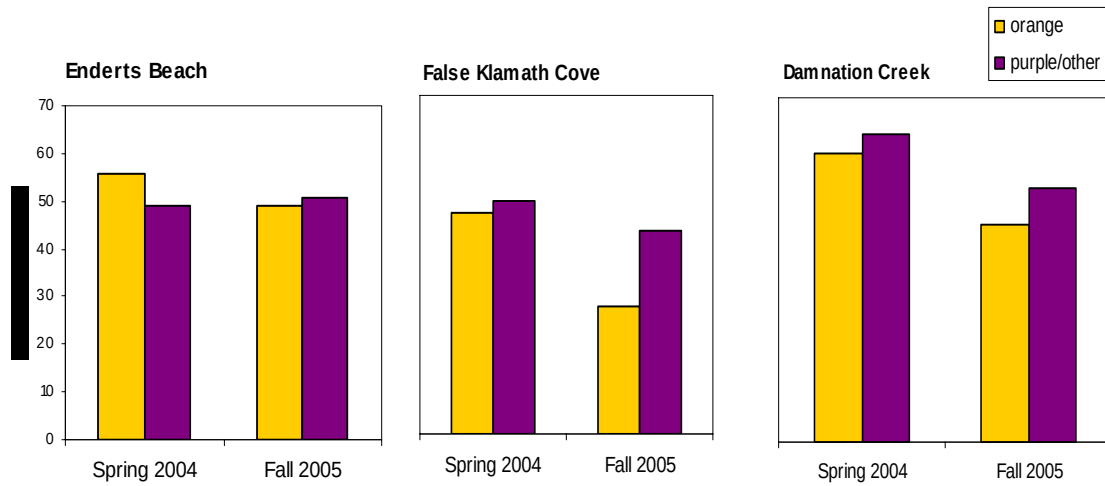


Figure 30. Mean sizes of *P. ochraceus* at Enderts Beach, False Klamath Cove, and Damnation Creek, RNSP in 2004 and 2005 sampling events.



Clump of *Pisaster ochraceus*, ochre sea stars.
Photo by Cara McGary

Monitoring Discussion

The rocky intertidal monitoring program has been ongoing for 1.5 years in Redwood National and State Parks. Results presented here are preliminary and are meant to serve as a baseline for monitoring intertidal communities in RNSP. Data was collected seasonally to assess the amount of within-year variation that occurs in the target assemblages. This information is important for deciding what months are optimal for sampling over a longer time scale. Seasonal variation in abundance of mobile invertebrates or percent cover of target species was common at all sites, and differences were strongest between early summer and fall or winter (Figures 13-17). Because of frequent, often severe storms in winter, we suggest that monitoring occur in late May or early June and late October or early November. These seasonal differences may be linked to changes in recruitment (Roughgarden et al. 1988, 1991), nutrient availability (Bosman et al. 1987, Wootton et al. 1996, Bracken 2004, Nielsen and Navarrette 2004), or wave activity (Paine 1979).

Initial monitoring results from Redwood National and State Parks do not indicate any strong community changes over the study period. However, comparisons between current assessment and those made by Boyd and DeMartini (1977) indicate a strong successional shift from a highly disturbed community, to a more stable, late successional community. Percent cover variation resulting from small scale spatial clearance has also decreased since the earlier study periods. Historically, community differences may be attributed to increased sediment loads and higher quantities of driftwood at rocky intertidal sites (McGary 2005). Without monitoring data before and after the years of intense logging, it is not possible to directly assess the impacts of increased sediment loads and driftwood scouring intertidal communities. This highlights the need for continued monitoring. In the event that degradation was to occur from natural or anthropogenic drivers, monitoring data would enable managers to assess the impacts and determine biological responses (Raimondi et al. 1999).

SAND BEACH INVENTORY

In late August of 2005 we conducted an exhaustive inventory of sand beach invertebrates at Crescent Beach, Gold Bluffs Beach, and Redwood Creek Beach. Late summer was chosen for this survey, because it is typically a time of peak productivity and invertebrate abundance. Invertebrates were collected during sampling for sand crabs and beach hoppers (see below), and by opportunistic digging at various shore levels.

A total of 19 invertebrate species were inventoried (Table 6). Seven of these species were not previously recorded in Redwood National and State Parks (Boyd and DeMartini 1977 and 1981, Appendix C). Crescent Beach was home to the highest number of species, while Redwood Creek Beach was least diverse. This trend was expected given the differences in beach slope among these three sites (Figure 31).

Table 6. Sand beach invertebrate taxa inventoried at Crescent Beach, Gold Bluffs Beach, and Redwood Creek Beach in August, 2005. Abundance categories are as follows: (A) Abundant, (C) Common, (P) Present, (U) Uncommon, (R) Rare.

Phylum	Class	Current Scientific Name	Abundance		
			Crescent Beach	Gold Bluffs Beach	Redwood Creek Beach
Annelida	Polychaeta	<i>Euzonus mucronatus</i>	A	P	
Annelida	Polychaeta	<i>Lumbrineris zonata</i>	U		
Annelida	Polychaeta	<i>Nephtys californiensis</i>	A	A	C
Arthropoda	Crustacea	<i>Alloniscus perconvexus</i>	P	P	R
Arthropoda	Crustacea	<i>Archaeomysis grebnitzkii</i>	A	A	R
Arthropoda	Crustacea	<i>Crangon nigricauda</i>	A	A	R
Arthropoda	Crustacea	<i>Emerita analoga</i>	A	A	A
Arthropoda	Crustacea	<i>Eohaustorius washingtonianus</i>	C	C	U
Arthropoda	Crustacea	<i>Excirolana linguifrons</i>	C	C	C
Arthropoda	Crustacea	<i>Excirolana spp</i>	P	P	U
Arthropoda	Crustacea	<i>Megalorcestia californiana</i>	A	C	U
Arthropoda	Crustacea	<i>Megalorcestia columbiana</i>	C	C	P
Arthropoda	Insecta	<i>Thinopinus pictus</i>	U		
Cnidaria	Scyphozoa	<i>Aurelia aurita</i>	R		
Echinodermata	Echinoidea	<i>Dendraster excentricus</i>	P	U	R
Mollusca	Gastropoda	<i>Nassarius fossatus</i>	A	C	U
Mollusca	Gastropoda	<i>Nassarius obsoletus</i>	P	U	R
Mollusca	Gastropoda	<i>Olivella baetica</i>	P	U	
Mollusca	Gastropoda	<i>Olivella biplicata</i>	C	C	R

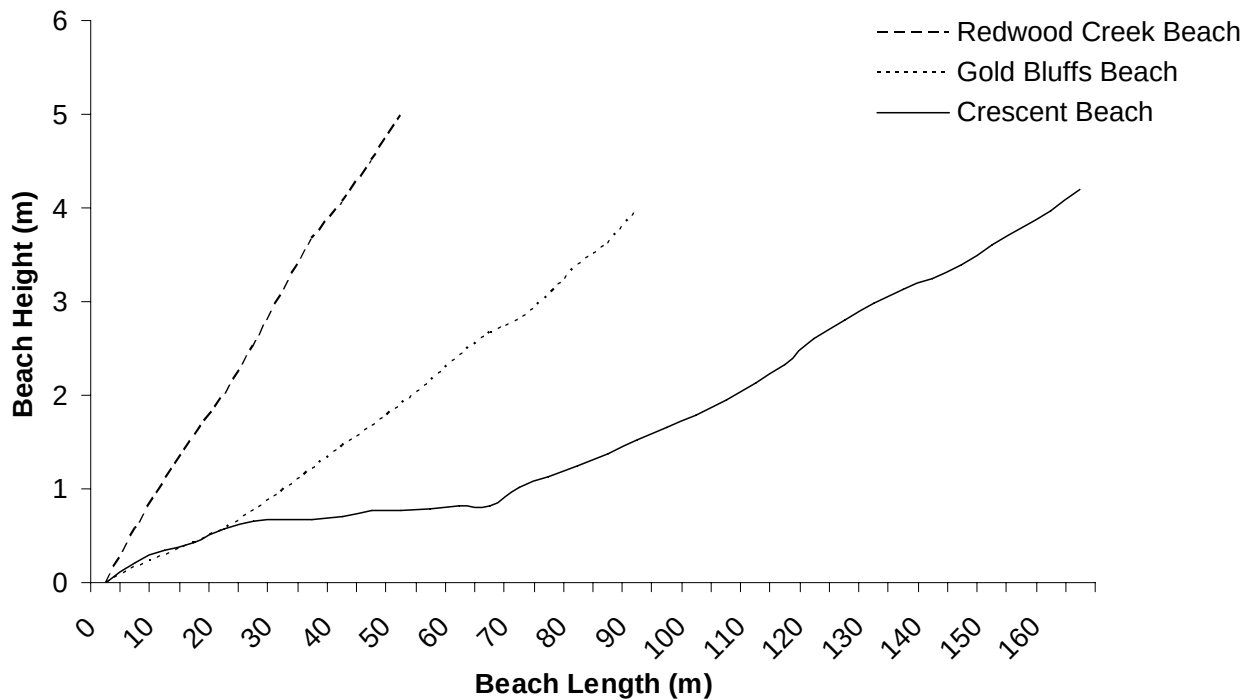


Figure 31. Relative steepness of beach slopes at three study sites in RNSP, June 2004.

SAND BEACH MONITORING

Introduction

Sandy beaches comprise approximately 70% (estimated from aerial photographs) of the coastline within Redwood National and State Parks. Sandy beaches are important components of the land-sea interface, although understudied and often overlooked (Richards 2005). Sand beaches accumulate high densities of detritus, an important food source for sand beach macroinvertebrates and infauna. These sand beach organisms are the primary food source for a number of birds and mammals (Dugan et al. 2000). Sand beaches are also important as nesting grounds for shorebirds.

A protocol for monitoring sand beaches in Channel Islands National Park was developed by Dugan, et al. (1990). We have utilized this study design to monitor three sandy shore sites in RNSP: Crescent Beach, Gold Bluffs Beach at Espau Lagoon, and Redwood Creek Beach (Figure 7Figure 8Figure 9). All three sites were sampled during early morning low tides in May and July 2004 and in August 2005. This report summarizes the abundance and distribution patterns of sand crab (*Emerita analoga*) and beach hopper (*Megalorchestia* spp) populations.

Methods

Study sites were selected based on Boyd and DeMartini's (1977) previous characterizations. The three sites vary with respect to beach slope and sediment size. These physical factors may affect the abundance and distribution of associated fauna (Richards 2005). Crescent Beach is a wide, dissipative beach with a shallow slope and fine sediment. Redwood Creek beach is relatively steep and reflective with courser sand. Gold Bluffs Beach is intermediate with respect to both slope and grain size. These three sites represent the range of beach types that can be found within Redwood National and State Parks.

All three sites were sampled on 21-22 May 2004; 15-19 July 2004, and 18-20 August 2005. Sand beach monitoring techniques are described in full detail in the Monitoring Handbook for Sand Beaches and Coastal Lagoons (Dugan et al. 1990). Sampling involves processing clam gun core samples of sand along transect lines to remove the invertebrates within the sand. Five randomly selected transects were run perpendicular to the water line, in the swash zone for sand crabs (*Emerita analoga*), and five on the upper beach slope for beach hoppers (*Megalorchestia* spp.). Sand cores (10 cm deep) were taken every half meter along each transect line and sifted through a 1mm mesh bag to expose invertebrates (Figure 32). Monitoring was focused on beach hopper and sand crab abundance, but all other invertebrates sampled were recorded for inventory purposes. The size distribution and reproductive condition was also recorded for sand crabs.

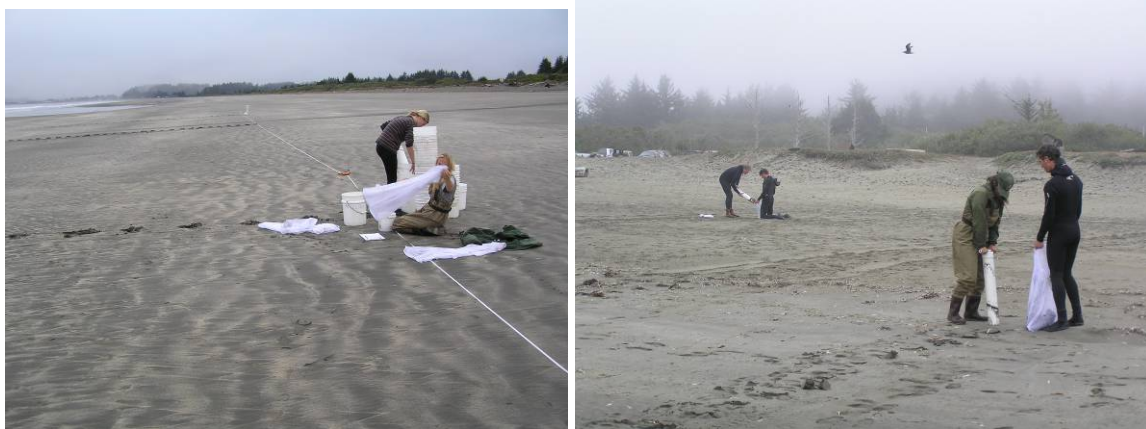


Figure 32. Layout for sand crab (left) and beach hopper (right) population assessments at Crescent Beach, RNSP.

Results

Sand crab, *Emerita analoga* densities ranged from 1 to 101 individuals per meter across sites and sampling periods. Densities were generally lowest at Redwood Creek Beach and highest at Crescent Beach. Sand crab density also increased from spring to late summer (Table 7). The percentage of ovigerous crabs also varied across sites and sampling periods. At Crescent Beach, 24% of the population was composed of ovigerous female crabs in May, 2004, dropping slightly in July. In August of the next year, only 6% of the population was ovigerous females. The percent of ovigerous sand crabs at Gold Bluffs Beach increased from May to July, 2004, but only 1% of the population was ovigerous females in August 2005. Reproductive output was low at Redwood Creek Beach in all sampling periods, with no ovigerous females in 2004 surveys, and only 1% ovigerous females in the population in August 2005 (Table 8). Egg development in ovigerous sand crabs was recorded only in August, 2005. At all three sites, the majority of eggs were new. About half of the ovigerous

females at Crescent Beach had eggs that were developed enough to have eyespots, while only one third of the ovigerous females held eggs with eyespots at Redwood Creek Beach. This could be an indication of later development at Redwood Creek Beach. Unfortunately there were very few ovigerous females sampled at Gold Bluffs Beach at this sampling period, so it is not possible to comment on egg development there (Table 9).

Amphipod abundance was highest in spring at Redwood Creek Beach, and remained close to 200 individuals per meter in July 2004 and August 2005 (Table 10) At Gold Bluffs Beach and Crescent Beach South, amphipod density was highest in August 2005 (Table 10).

Table 7. Washzone transect species abundance summary. Mean number of sand crabs (*Emerita analoga*) per meter of beach sampled on (A) May 2004, (B) July 2004, and (C) August 2005.

A

Site	<i>Emerita</i> /m
Redwood Creek Beach	1
Gold Bluffs Beach	33
Crescent Beach	15

B

Site	<i>Emerita</i> /m
Redwood Creek Beach	1
Gold Bluffs Beach	81
Crescent Beach	17

C

Site	<i>Emerita</i> /m
Redwood Creek Beach	16
Gold Bluffs Beach	26
Crescent Beach	101



Sandy beach collection of invertebrates, RNSP.

Table 8. *Emerita analoga* reproductive population percentage. Totals and mean/m from five transects per beach sampled on (A) May 2004, (B) July 2004, and (C) August 2005, RNSP.

A

Site	Ovigerous	Non-Ovigerous	Total crabs	%Ovigerous in population
Redwood Creek Beach	0	7	7	0%
Gold Bluffs Beach	31	934	965	3%
Crescent Beach	26	81	107	24%

B

Site	Ovigerous	Non-Ovigerous	Total crabs	%Ovigerous in population
Redwood Creek Beach	0	1	1	0%
Gold Bluffs Beach	102	501	603	17%
Crescent Beach	43	193	236	18%

C

Site	Ovigerous	Non-Ovigerous	Total crabs	%Ovigerous in population
Redwood Creek Beach	2	175	177	1%
Gold Bluffs Beach	6	536	542	1%
Crescent Beach	9	1944	1975	0%

Table 9. *Emerita analoga* numbers by gender and egg developmental stage sampled August 2005, RNSP.

Site	New Eggs	Eyespot Eggs	Grey Eggs	Just Dropped	Non-Ovigerous	Male	Unsexed	Total crabs	Megalopa
Redwood Creek Beach	4	2	0	0	202	368	61	637	0
Gold Bluffs Beach	0	1	0	0	41	31	105	178	0
Crescent Beach	23	25	1	0	523	525	762	1859	0

Table 10. Summarized abundance of amphipods in upper-beach transects. Numbers represent the mean abundances from five transects at three sandy beach sites in RNSP.

Site	Amphipods/m May 2004	Amphipods/m July 2004	Amphipods/m August 2005
Redwood Creek Beach	434	242	183
Gold Bluffs Beach	105	166	272
Crescent Beach	245	63	644

Discussion

Our data indicate a general increase in the abundance of beach hoppers and sand crabs from spring to fall. This is the same result that Boyd and DeMartini (1977) noted in their surveys of sand beach invertebrates at the same sites in the mid 1970's. Fluctuations in abundance are likely due to short-term life cycle variation and nutrient availability within a site (Boyd and DeMartini 1977, Dugan et al. 2000). Trends in the amphipod abundance at Redwood Creek were contrary to the other sites. Population estimates were higher in May, compared to the other two summer surveys. It is possible that the amphipod population temporarily increased at this site in response to elevated nutrient levels. The creek may have provided additional nutrients during heightened spring flow.

Sand crab and amphipod abundances varied among sites as well. This is probably due to differences in beach morphology and nutrient availability. Beaches that have a steeper slope generally have lower nutrient content than beaches with a shallower slope. Beaches with steep slopes are more reflective, thus detritus (invertebrate food) has a shorter amount of time to settle. Flat beaches have high nutrient availability, thus a higher abundance of invertebrates and these tend to be larger than con-specifics at other sites (Dugan et al. 2000, Lerma and Richards 2000). Redwood Creek has the steepest beach slope, Gold Bluffs Beach is intermediate, and Crescent Beach is the most dissipative (Figure 31). Respective population abundances follow the same trends (Table 7 and Table 10). Both of these results are likely due to nutrient availability and water temperature.

While short term fluctuations are valuable for understanding beach dynamics and invertebrate population variation, much would be gained from long term monitoring of this system. Sand beach monitoring has been implemented at Channel Islands in an effort to study the system's natural variation such that anthropogenic perturbations could be detected, distinguished, and assessed. These surveys are also valuable for indicating the productivity of a sand beach at multiple trophic levels. Surveys can be used as an indication of food availability and can be linked to avian surveys to determine habitat use by shorebirds (Dugan et al. 2000, Richards 2005). Sand beach monitoring should continue, especially at Crescent Beach and Gold Bluffs Beach, and shorebird surveys should be integrated with the protocol. Ideally, sand beach sampling should occur in late July/early August when populations reach maximum abundance and reproductive output. It is not advised to conduct surveys in September as tides shift and become too early for practical surveys.

INTERTIDAL FISHES

The tidepool fishes of Redwood National and State Parks were inventoried and monitored during 2004 and 2005 (Table 11). The goal of the inventory was to create a species list for Enderts Beach, Damnation Creek, and False Klamath Cove and to compare species richness with regards to varying habitats. This was a qualitative approach using multiple methods of collection. In addition, beach seines were used to access nearshore fish species over sand beach areas. The monitoring involved repeated sampling of the same rocky tidepools in a consistent manner. This approach provided a more quantitative assessment of specific resident species of tidepool fishes. Research was also conducted on juvenile black rockfish, *Sebastes melanops*, which utilize tidepools as nursery areas for short periods of time.

Table 11. Intertidal and nearshore fish sampling for Enderts Beach, Damnation Creek, and False Klamath Cove in 2004 and 2005 RNSP surveys.

Method	Sites	Sampling Frequency	Replicates per Site
Tidepool Collections	3	Bi-monthly	7-9
Beach Seines	2	Annually	5-10
Inventory	2	Annually	3
Juvenile Rockfish surveys	3	Seasonally	5

Rocky Intertidal Fish Inventory

Rocky intertidal fish inventories were conducted on 5 February 2005 at Damnation Creek and 6 February 2005 at False Klamath Cove, RNSP. The inventory was supervised by fisheries graduate student Karah Cox, Humboldt State University's Ichthyology professor Dr. Andrew Kinziger, and Marine Fish Ecology professor Dr. Timothy Mulligan. The coordinated efforts of approximately twenty students for each sampling event provided an extensive range of effort for this survey. Multiple methods of collection were utilized to sample a wide range of species that inhabit various niches within the intertidal habitat.



Bothragonus swanii, rockhead poacher

Census procedure

This sampling occurred during low tidal events when the mean low water level was between -1.2 and +1.0 feet. The census for each site was conducted by dividing the site, using meter tapes, into zones relative to the mean tidal height. Teams of five to eight samplers and at least one taxonomic expert sampled each zone for 30 minute increments. At the end of each time increment the collected fish were enumerated, identified and measured. Teams were rotated so that all teams sampled each zone. This was done to ensure that sampling effort for each zone was the same and so that each zone was thoroughly sampled. A small subset of fish was kept for species verification while the remaining fish were returned to the area sampled.

Capture Methods

Methods used for fish collection included bailing pools of various sizes with buckets and bilge pumps, poke polling, hook and line fishing, and rolling boulders. Bailing tidepools required the cooperation of several people using buckets and manual bilge pumps to remove the water. This allowed for the easy and complete retrieval of all fish from emptied pools. Sampling included searching beneath large boulders and in crevices. Poke polling is a modified hook and line method where a simple line with a wire hook is attached to a bamboo pole (Figure 33). The pole can then be stuck into rock crevices in the intertidal to catch the more cryptic fish species. Hook and line methods were carried out by experienced fishers just off the rocky shores and focused on nearshore species. Several species of intertidal fish burrow under boulders and can remain out of water for some time (Horn et. al. 1999). Pricklebacks and gunnels are not commonly seen unless boulders are moved. Moving boulders was accomplished by hand and with the aid of a crow bar for larger boulders.



Figure 33. HSU students using poke-polling as a method for intertidal fish inventory at Damnation Creek, RNSP on 5 February 2005.

Habitat

The rocky intertidal may be divided into habitat zones that can be distinguished by temperature differences and varying species composition (Menge 2000). During periods of low tides, temperature, salinity, oxygen, and pH levels change with varying exposure levels along a vertical gradient. Dividing this habitat into tidal height zones is readily accomplished with regards to exposed algae and invertebrates, however, these distinctions are more complicated with regards to submerged pools. Determining clear borders for these zones is difficult because the depth of the pools adds another dimension. For example, a large deep pool in the high intertidal zone may have similar physical characteristics and species composition to a shallower pool in the low zone.

For the purpose of this inventory the areas were divided into low, middle, and high zones for the Damnation Creek site and into high and low zones for False Klamath Cove. False Klamath Cove was divided into two zones due to the shape of this site. At low tide this site is surrounded on both sides by water with a central margin of exposed intertidal area. The peninsula stretches 175 meters in length and is between 60 and 100 meters wide (Figure 34). The areas near the ocean were deemed low zone and the band between the two low zones was characterized as a high zone. Further delineation of this narrow site was not deemed appropriate. False Klamath Cove and Damnation Creek also differ greatly in substrate composition. False Klamath Cove is a boulder field with potential for temporal variation in sand scour and boulder movement. Damnation Creek is 6.5 kilometers north of False Klamath Cove and has rocky intertidal benches with relatively stable substrate. The intertidal bench at Damnation Creek is 175 meters in length by 65 meters in width (Figure 35).

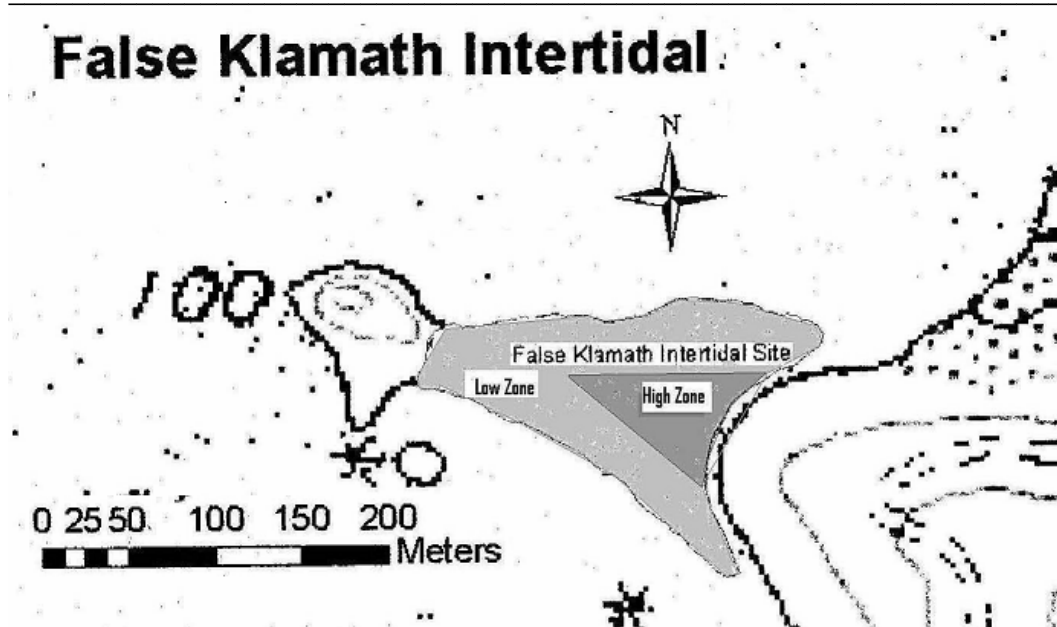


Figure 34. False Klamath Cove, RNSP intertidal area showing high and low zones (shaded).

Damnation Creek Intertidal

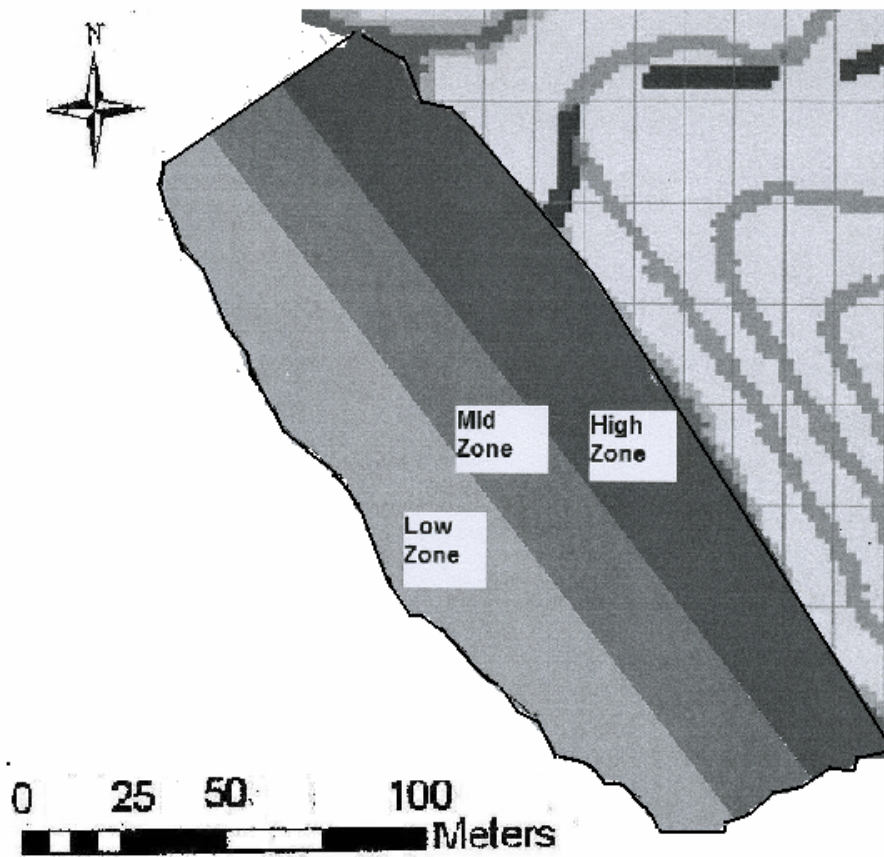


Figure 35. Damnation Creek, RNSP intertidal area showing high, mid and low zones (shaded).

Species Identification

Most species were identified in the field by Karah Cox, Dr. Mulligan and Dr. Kinziger. At least one specimen of each species was collected and taken back to the fish laboratory at HSU for verification and preservation purposes. Verification procedures included morphometric and/or meristic counts to verify species identification. Several identification books were referenced (Miller and Lea 1976; Mecklenburg et al. 2002).

Results

Twenty two species of fish were identified from Damnation Creek and False Klamath Cove intertidal areas in the February 2005 census. The two rocky intertidal sites sampled for this census varied in both species composition and abundance. Damnation Creek yielded 21 species with a total of 148 fish collected where False Klamath Cove had 93 fish comprising 12 species (Table 12). The abundances of each species for the two sites is shown in Figure 36. The diversity of fishes found at False Klamath Cove was 60% of that found at Damnation. The most abundant species found in the intertidal at both sites were two sculpin species, *Oligocottus maculosus* and *Oligocottus snyderi*. This genus of cottids comprised over half (51.3%) of the total fish sampled. Other genera of cottid species; *Artedius* spp. and *Clinocottus* spp., also comprised a significant portion of the total fish inventoried (6.7% and 9.2% respectively). All cottid species combined contributed 73.8% of the fish found in the

intertidal inventory. It should be noted that juvenile black rockfish, *Sebastes melanops*, were found in tidepools at both sites in much greater abundances during the summer months when they occupy tidepools for one to three months.

Tidal zonation influences the patterns of distribution and abundance of fish. Data for both sites were combined to examine the overall influence of tidal zonation. The high zone contained 81 fish (33.6%), the mid zone contained 54 (22.4%), and the low zone had 106 fish (44.0%). The low zone contained the greatest number of fish species (17) as well as the greatest abundance of fish. The mid and low zone had 10 and 13 fish species respectively. It should be restated here that False Klamath Cove only had a low and high zone so the mid zone is under-represented in these data.

Table 12. Count of fish species sampled at Damnation Creek and False Klamath Cove, RNSP during an inventory conducted 5-6 February 2005.

Genus Species	Common Name	Damnation	False Klamath Cove	Grand Total
<i>Apodichthys flavidus</i>	Penpoint gunnel	2		2
<i>Anoplarchus purpureus</i>	High Cockscomb	1		1
<i>Artedius lateralis</i>	Smoothhead sculpin	18		18
<i>Artedius spp.</i>	Sculpin spp.		4	4
<i>Ascelichthys rhodorus</i>	Rosylip sculpin	4	4	8
<i>Bothragonus swanii</i>	Rockhead poacher	1		
<i>Cebidichthys violaceus</i>	Monkeyface-eel	8	1	8
<i>Clinocottus acuticeps</i>	Sharpnose sculpin	1		1
<i>Clinocottus globiceps</i>	Mosshead sculpin	11	4	15
<i>Embiotoca lateralis</i>	Striped surfperch	4		4
<i>Enophrys bison</i>	Buffalo sculpin	2		2
<i>Gobiesox maeandricus</i>	Northern clingfish	8	6	14
<i>Hemilepidotus spinosus</i>	Brown Irish lord	2	5	7
<i>Hexagrammos decagrammus</i>	Kelp greenling	3	1	4
<i>Hexagrammos superciliosus</i>	Rock greenling	1		1
<i>Liparis florae</i>	Tidepool snailfish	2		2
<i>Oligocottus maculosus</i>	Tidepool sculpin	7	20	27
<i>Oligocottus snyderi</i>	Fluffy sculpin	66	30	96
<i>Pholis ornata</i>	Saddleback gunnel	1		1
<i>Scorpaenichthys marmoratus</i>	Cabazon	2	4	6
<i>Sebastes melanops</i>	Black rockfish	2	8	10
<i>Xerorpes fucorum</i>	Rockweed gunnel	2		2
<i>Xiphister atropurpureus</i>	Black prickleback		6	6
Grand Total		148	93	241

Bailing of tidepools was by far the most successful method of catching fish, with 97% of the total fish collected using this method. The hook and line method, using shrimp as bait, collected two *Embiotica lateralis*, striped surfperch, one *Scorpaenichthys marmoratus*, cabezon, and one *Hexagrammos decagrammus*, kelp greenling. Poke polling was used to catch one *Artedius lateralis*, smoothhead sculpin, one *Embiotica lateralis*, striped surfperch and two *Enophrys bison*s, buffalo sculpin. This was the only method that captured *Enophrys bison*, demonstrating the importance of utilizing various collection methods in order to capture the greatest diversity of fish species.

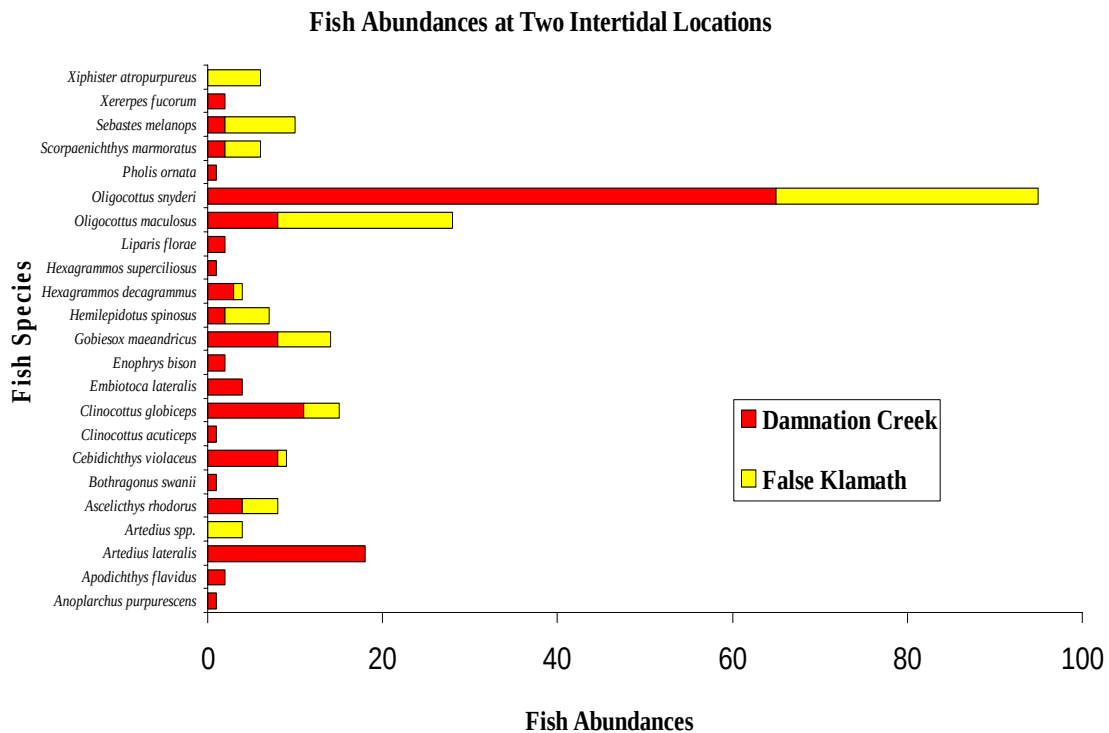


Figure 36. Number of total fish collected at False Klamath Cove on 5 February 2005 and Damnation Creek on 6 February 2005, during an intertidal fish inventory of RNSP.

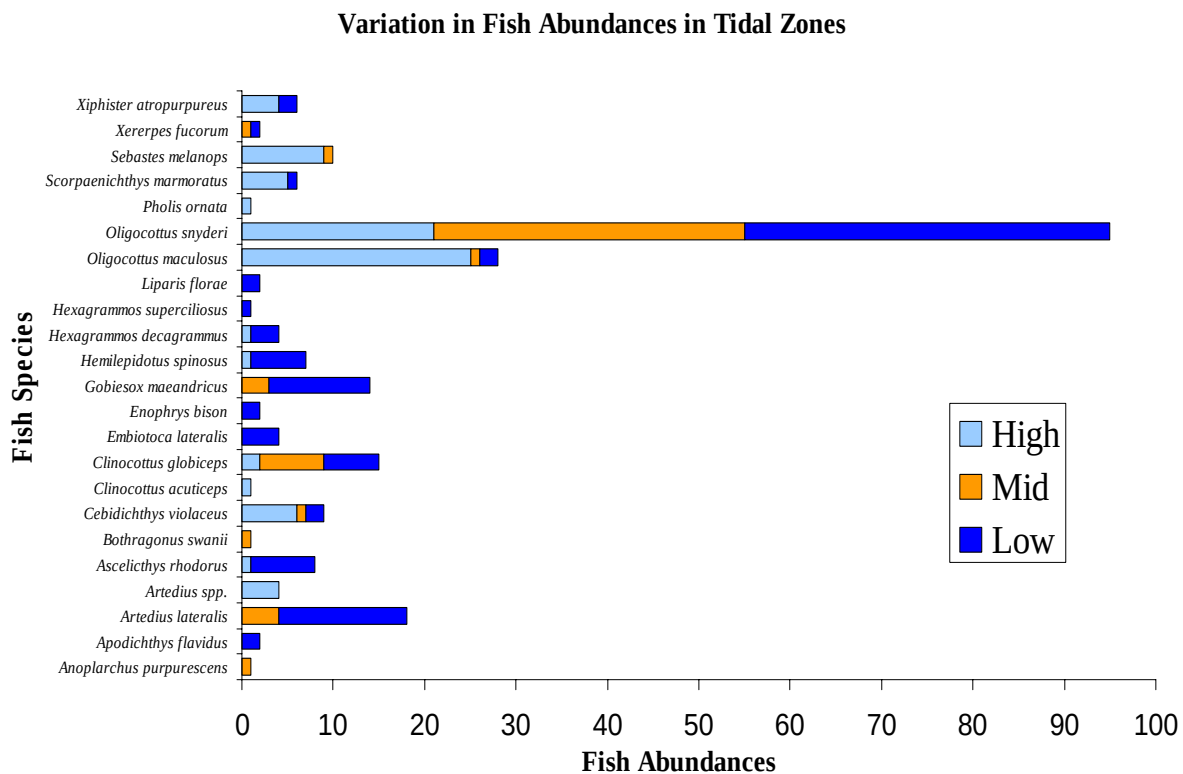


Figure 37. Number of total fish collected in high, mid, and low tidal zones during intertidal inventory. Numbers were for combined sampling events on 5-6 February 2005 at False Klamath Cove and Damnation Creek, RNSP.



Enophrys bison, buffalo sculpin
Photo by Rebecca Studebaker

Oligocottus Tidal Zone Abundances

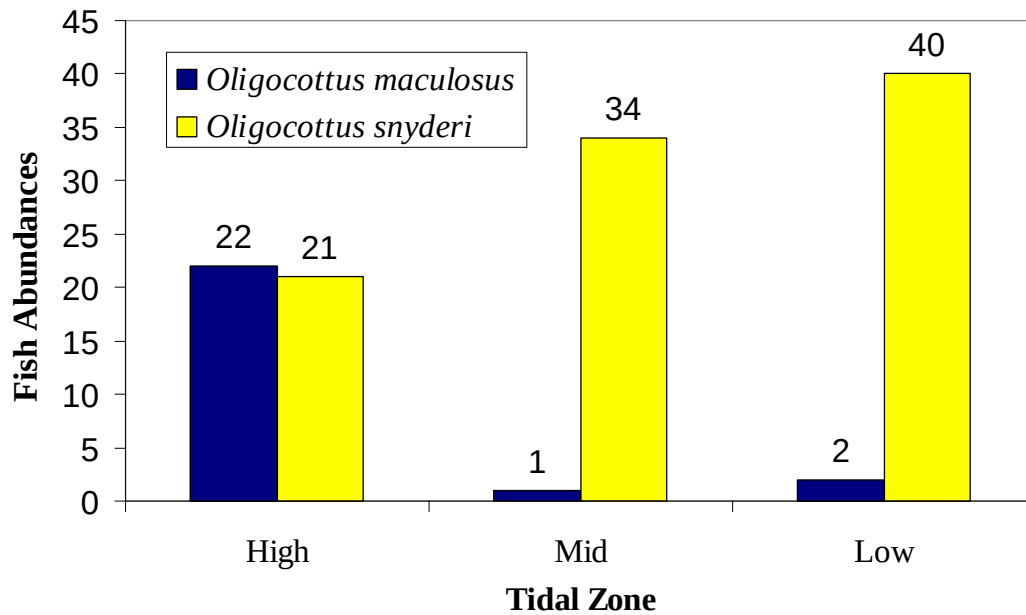
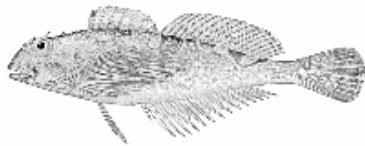
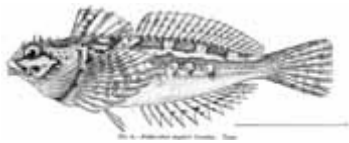


Figure 38. Total abundances of two sculpin species, *Oligocottus snyderi* and *Oligocottus maculosus*, during an intertidal fish inventory. Numbers are from sampling events on 5 February 2005 at Damnation Creek and 6 February 2005 at False Klamath Cove, RNSP.



Oligocottus maculosus, tidepool sculpin



Oligocottus snyderi, fluffy sculpin

Rocky Intertidal Fish Monitoring

Monitoring of intertidal communities is critical to the ecological understanding and protection of these sensitive areas. Fish species are often excluded in rocky intertidal monitoring regimes due to several factors. The lack of attention given to intertidal fish may be mostly due to their low abundances, cryptic nature and difficulty in studying these organisms (Horn et al. 1999). The lack of convincing correlative data between intertidal algae and invertebrate communities, and the fish communities may also contribute to this omission.

Inclusion of fish in this Marine Resource Study for RNSP represents a new trend in intertidal monitoring. With a total of 13 sampling events at three sites sampled from March 2004 to September 2005, this has been the most extensive undertaking of intertidal fish research within RNSP. Monitoring fish within the rocky intertidal area of RNSP included identifying and measuring approximately 5,000 total fish comprising 26 species (Table 13).

Table 13. Monitoring list of rocky intertidal fishes found in Redwood National and State Parks 2004.

Family	Common Name	Species	Functional Group
Atherinidae	Jacksmelt	<i>Atherinops affinis</i>	Atheriniformes
Clinidae	Kelpfish spp.	<i>Clinidae spp.</i>	Clinidae
Cottidae	Coralline sculpin	<i>Artedius corallinus</i>	Artedius
Cottidae	Padded sculpin	<i>Artedius fenestralis</i>	Artedius
Cottidae	Smoothhead sculpin	<i>Artedius lateralis</i>	Artedius
Cottidae	Fluffy sculpin	<i>Oligocottus snyderi</i>	Clinocottus Oligocottus Complex
Cottidae	Mosshead sculpin	<i>Clinocottus globiceps</i>	Clinocottus Oligocottus Complex
Cottidae	Sharpnose sculpin	<i>Clinocottus acuticeps</i>	Clinocottus Oligocottus Complex
Cottidae	Tidepool sculpin	<i>Oligocottus maculosus</i>	Clinocottus Oligocottus Complex
Cottidae	Brown Irish lord	<i>Hemilepidotus spinosus</i>	Other Cottidae
Cottidae	Buffalo sculpin	<i>Enophrys bison</i>	Other Cottidae
Cottidae	Staghorn sculpin	<i>Leptocottus armatus</i>	Other Cottidae
Cottidae	Cabazon	<i>Scorpaenichthys marmoratus</i>	Other Cottidae
Cottidae	Rosylip sculpin	<i>Ascelichthys rhodorus</i>	Other Cottidae
Gobiesocidae	Northern clingfish	<i>Gobiesocidae</i>	Gobiesocidae
Hexagrammidae	Kelp greenling	<i>Hexagrammos decagrammus</i>	Hexagrammidae
Liparidae	Tidepool Snailfish	<i>Liparis florae</i>	Liparidae
Pholidae	Penpoint gunnel	<i>Apodichthys flavidus</i>	Pholidae Stichaeidae Complex
Pholidae	Rockweed gunnel	<i>Xerperes fucorum</i>	Pholidae Stichaeidae Complex
Pholidae	Saddleback gunnel	<i>Pholis ornata</i>	Pholidae Stichaeidae Complex
Scorpaenidae	Black rockfish	<i>Sebastes melanops</i>	Sebastes
Scorpaenidae	Blue rockfish	<i>Sebastes mystinus</i>	Sebastes
Stichaeidae	Black prickleback	<i>Xiphister atropurpureus</i>	Pholidae Stichaeidae Complex
Stichaeidae	High cockscomb	<i>Anoplarchus purpureus</i>	Pholidae Stichaeidae Complex
Stichaeidae	Monkeyface prickleback	<i>Cebidichthys violaceus</i>	Pholidae Stichaeidae Complex
Stichaeidae	Rock prickleback	<i>Xiphister mucosus</i>	Pholidae Stichaeidae Complex

Many fishes inhabit the intertidal zones for only part of their life history or in a transient fashion. Fish that permanently reside in the intertidal throughout their life history are specialized for the highly variable and often harsh condition of this habitat. Resident intertidal fish are usually small and cryptic which explains some of the lack of attention given to these groups by monitoring agencies (Horn et al. 1999). Sculpins of the Order

Scorpaeniformes, family Cottidae, comprise the most abundant group of intertidal fishes in the Pacific Northwest. Sculpins have been shown to comprise 98% of the fish species in the intertidal zone (Webster in press).

Methods

For a more quantitative comparison of three rocky intertidal sites, specific pools were monitored on a regular schedule to ascertain the population structure of resident sculpin species between and within sites and over seasons. The monitoring sites included False Klamath Cove, Damnation Creek (described in previous section) and Enderts Beach. Enderts Beach was the northern most site monitored, comprised of a narrow bench 30 meters wide by 100 meters long. The sampling schedule depended on the periodicity of low tidal events causing study intervals to vary slightly (Table 14). Sampling occurred monthly from March to August of 2004 and every other month from September 2004 to September 2005. Sampling was conducted at the lowest tidal events of each month and required five to eight researchers working four to six hours per site.

Table 14. Sampling schedule for Enderts Beach, Damnation Creek, and False Klamath Cove, RNSP rocky intertidal fish monitoring 2004-2005.

Year	Sampling Period	Month/Day
2004	1	13-16 March
	2	10-24 March
	3	9-11 May
	4	1-6 June
	5	2-4 July
	6	1-3 August
	7	28-30 August
	8	1-15 September
	9	10-12 December
2005	10	5-7 February
	11	24 April, 1May
	12	5-9 June
	13	16-18 September

A series of discrete tidepools were established at each site throughout the intertidal zones in which fish species were monitored. Eight pools were established and monitored at Damnation Creek and False Klamath Cove, and nine pools were monitored at Enderts Beach. The tidepools were selected based on their representation at the site and within the tidal zones. Selection was also based on a set of criteria that included manageable volume (100-800 liters), access, as well as suitable potential fish habitat. The edges of the selected pools were marked with a marine epoxy and mapped to ensure that the same pools were sampled on each subsequent visit.

Monitoring involved entirely draining the tidepools with buckets and bilge pumps to ensure that all fish were collected. The fish from each pool were identified, measured (total length to nearest mm), and recorded before being returned to the same pool (Figure 39).

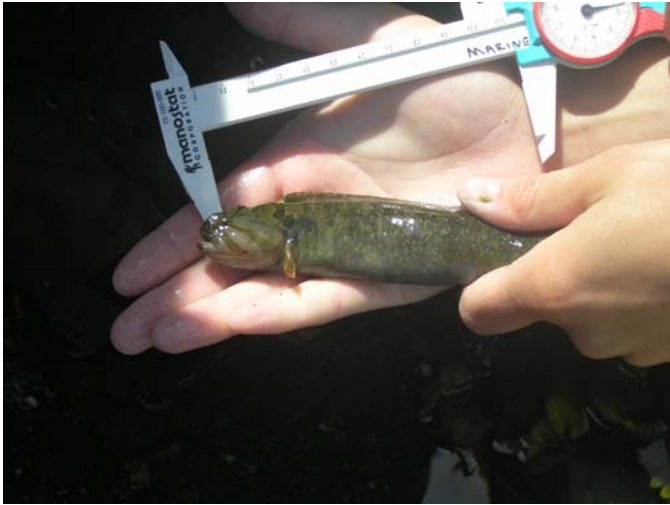


Figure 39. Monkeyface prickleback, *Cebidichthys violaceus*, being measured with calipers by researcher at RNSP (left). Researchers bailing tidepools at Enderts Beach for intertidal fish surveys (right).

Tagging of the resident intertidal fish, from the Cottidae family, was done in 2004 to determine patterns of site fidelity and movement. Injection of various colored elastomer tags were administered to the cottids. Fish from each tidepool were given a unique tag. The location on the fish and color of tag corresponded with a specific pool. Recapture of previously tagged fish allowed the movement patterns of cottids in the rocky intertidal to be described.

Results

The 24 species of fish noted during the tidepool monitoring of RNSP were grouped into 10 functional groups to simplify the summary of distribution patterns (Table 13). The groups were determined as a combination of taxonomic grouping and ecological niche utilization. For example, the seven species from the Stichaeidae and Pholidae families (pricklebacks and gunnels) were grouped together due to their similar habitat utilization. These elongate, eel-like fish reside beneath boulders and can breathe air if out of water. The young of this group are difficult to distinguish and were often identified only to group level. Larval fish of the genera *Clinocottus* and *Oligocottus* were also difficult to distinguish and were often found in the same habitat. This group was comprised of four common intertidal species within the family Cottidae. Other species from this family were combined into the 'Other Cottidae' group. The *Artedius*, Atherinidae, Liparidae, Gobiosocidae, Clinidae, Hexagrammidae, and *Sebastes* groups were all comprised of one or more species of the same family.

A total of 4,868 fish were recorded during this study. Many of these fish may have been recaptured on one or more sampling occasions, therefore the total counts should not be considered a population estimate. The total number of fish and their corresponding total length ranges and averages show that most of the fish collected were small in size (Table 15). Many of the tidepool groups were represented only by the juvenile stage (i.e. *Sebastes*, Atheriniformes and Hexagrammids.) The adults of these species are found in deeper off shore water. Summary statistics for the fish groups sampled are displayed in Table 16, Table 17 and Table 18.

Enderts Beach, the northern most site, had the greatest number of fish, yielding nearly twice the total number of fish sampled at the other two sites. Damnation Creek and False Klamath Cove had similar total fish counts over the sampling periods (Table 16). Because *Clinocottus* and *Oligocottus* sculpins comprised, by far, the greatest number of fish sampled (88.5% of total), their numbers drive the patterns of total abundance and distribution. The majority of juvenile *Sebastes* recorded in this study were inhabiting tidepools at False Klamath Cove. This site is comprised of many large boulders that create a three dimensional, complex habitat that juvenile rockfish may prefer when recruiting into nearshore habitats (Love et al., 1991). *Pholidae* and *Stichaeidae* were rarely seen at Enderts Beach. Scarcity of boulders, the preferred habitat cover for these species, at this site may explain this pattern.

Table 15. Abundance, average total length (mm) and size range (mm) for intertidal fish groups sampled at Damnation Creek, False Klamath Cove, and Enderts Beach, RNSP during 13 sampling periods in 2004-2005.

Fish Group	No. of Species in Group	Total No. of Fish	Total Length Range (mm)	Average Total Length (mm)
<i>Artedius</i>	3	76	17 - 134	66
<i>Atheriniformes</i>	1	1	84	--
<i>Clinidae</i>	1	1	68	--
<i>Clinocottus Oligocottus</i> Complex	4	4308	10 - 186	38
Other <i>Cottidae</i>	5	80	23 - 180	70
<i>Gobiesocidae</i>	1	156	12 - 80	43
<i>Hexagrammidae</i>	1	11	63 - 97	69
<i>Liparidae</i>	1	8	20 - 100	47
<i>Pholidae Stichaeidae</i> Complex	8	105	24 - 210	69
<i>Sebastes</i>	2	122	35 - 77	57

Table 16. Abundances of intertidal fish sampled at Damnation Creek, Enderts Beach and False Klamath Cove, RNSP during sampling periods, 2004-2005.

Fish Group	Damnation Creek	Enderts Beach	False Klamath Cove	Grand Total
<i>Artedius</i>	41	17	18	76
<i>Atheriniformes</i>		1		1
<i>Clinidae</i>			1	1
<i>Clinocottus Oligocottus</i> Complex	921	2361	1026	4308
Other <i>Cottidae</i>	14	37	29	80
<i>Gobiesocidae</i>	17	78	61	156
<i>Hexagrammidae</i>	2	6	3	11
<i>Liparidae</i>	1	2	5	8
<i>Pholidae Stichaeidae</i> Complex	40	6	59	105
<i>Sebastes</i>	6	2	114	122
Grand Total	1042	2510	1316	4868

Fish were monitored at Enderts Beach and False Klamath Cove 13 times from 2004 and 2005. Due to weather constraints, Damnation Creek was sampled 12 times. The highest abundance of total fish occurred during the summer and early fall sampling periods (Table 17). These patterns varied between sites and were again driven by high abundances of *Clinocottus* and *Oligocottus* sculpins. Larval recruitment of these species occurs in the summer months (Moring, 1981) and contributed to increased numbers during this time.

Size distribution for the two most abundant fish species, *Oligocottus maculosus* and *O. snyderi* were similar (Figure 40). Both species had the greatest number of individuals in the 30-35 mm size range. Many more *O. snyderi* were collected in this study (note scale differences); however the size frequency curves remained similar. These species are closely related and have similar characteristics. They do differ slightly in habitat utilization as *O. maculosus* are more commonly found in higher zones and *O. snyderi* are more common in low and mid intertidal pools (Yoshiyama 1981). This is possibly a result of greater adabtation by *Oligocottus maculosus* to the harsher conditions in the higher zones (Nakamura, 1976).

Table 17. Total number of fish sampled during each sampling period in 2004-2005 at False Klamath Cove, Damnation Creek and Enderts Beach, RNSP. Refer to Table 14 for corresponding sampling schedule.

Fish Group	Sampling Periods Month												
	2004					2005							
	1 M	2 M	3 M	4 J	5 J	6 A	7 A	8 S	9 D	10 F	11 A	12 J	13 S
False Klamath Cove													
<i>Artedius</i>		3	1	5	1	1			5			1	1
<i>Clinidae</i>				1									
<i>Clinocottus/Oligocottus</i>	79	64	58	136	42	110	145	107	69	60	27	36	93
<i>Gobiesocidae</i>	1	2	1	6	1	6	17	4	3	9	3	1	7
<i>Hexagrammidae</i>			2	1									
<i>Liparidae</i>				2	1	1	1						
Other Cottidae	2	2	5	6	1	2	1	1		3	1	4	1
<i>Pholida/Stichaeidae</i>	1	5	3	13	3	4	3	7	3	1	3	4	9
<i>Sebastes</i>			1	54	22	15						22	
Damnation Creek													
<i>Artedius</i>		10	n/a	4	4	9	2	2	2	2	1		5
<i>Clinocottus/Oligocottus</i>	46	64	n/a	50	123	105	78	117	100	52	43	40	103
<i>Gobiesocidae</i>	1	2	n/a	1	2	2		1	4	2		1	1
<i>Hexagrammidae</i>			n/a	1	1								
<i>Liparidae</i>			n/a	1									
Other Cottidae		2	n/a	3	2		3	3		1			
<i>Pholidae/Stichaeidae</i>	3	3	n/a	4	2	7	2	4	1	1	2	4	7
<i>Sebastes</i>					3							3	
Enderts Beach													
<i>Artedius</i>		2			3	1		4	4			1	2
<i>Atheriniformes</i>		1											
<i>Clinocottus/Oligocottus</i>	61	93	176	346	545	308	252	49	42	44	75	178	192
<i>Gobiesocidae</i>		5	12	17	12	6	10		7	3	2	3	1
<i>Hexagrammidae</i>			3	2	1								
<i>Liparidae</i>			2										
Other Cottidae	1			12	9	8	5		1	1			
<i>Pholidae/Stichaeidae</i>		1		1		1						3	
<i>Sebastes</i>					1							1	

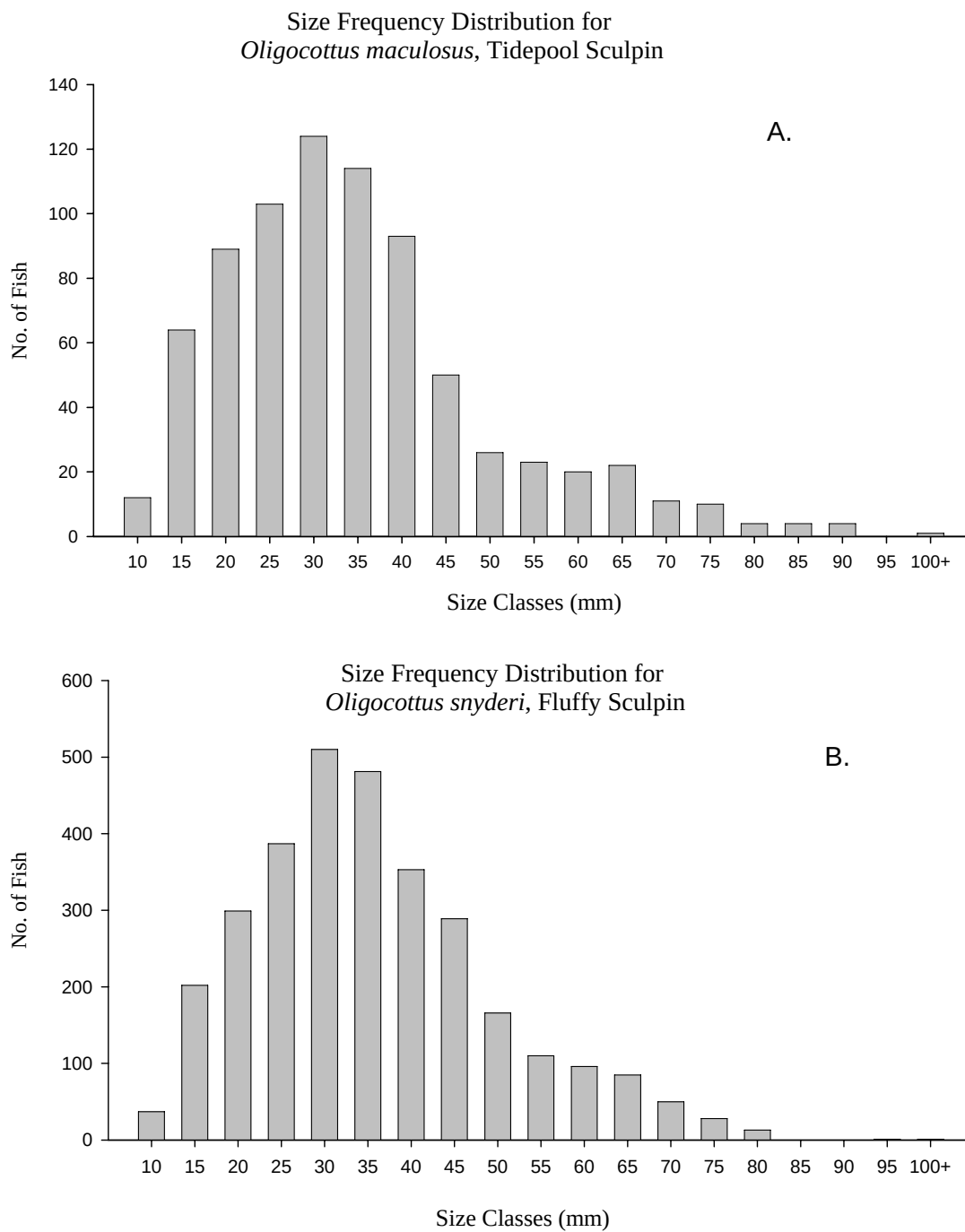


Figure 40. Size frequency distribution for (A.) *Oligocottus maculosus*, Tidepool Sculpin and (B.) *Oligocottus snyderi*, Fluffy Sculpin in combined sampling events from Damnation Creek, Enderts Beach, and False Klamath Cove, 2004-2005.

Zonation patterns in the intertidal sites of RNSP had a high degree of variability. The species present, their abundances, and size structure all varied among zones. There was a trend toward greater fish abundance in lower pools. Fish abundances in tidal zones were calculated per volume of water to account for the increased number of fish in larger pools. This was done by dividing the average number of fish collected in each pool per sampling event by the volume of water in each pool. This is displayed as the average number of fish for each pool per cubic centimeter (Figure 41, Figure 42, and Figure 43). The seasonal influx of juvenile cottids during the summer months into higher pools tended to lessen the degree of variation among zones.

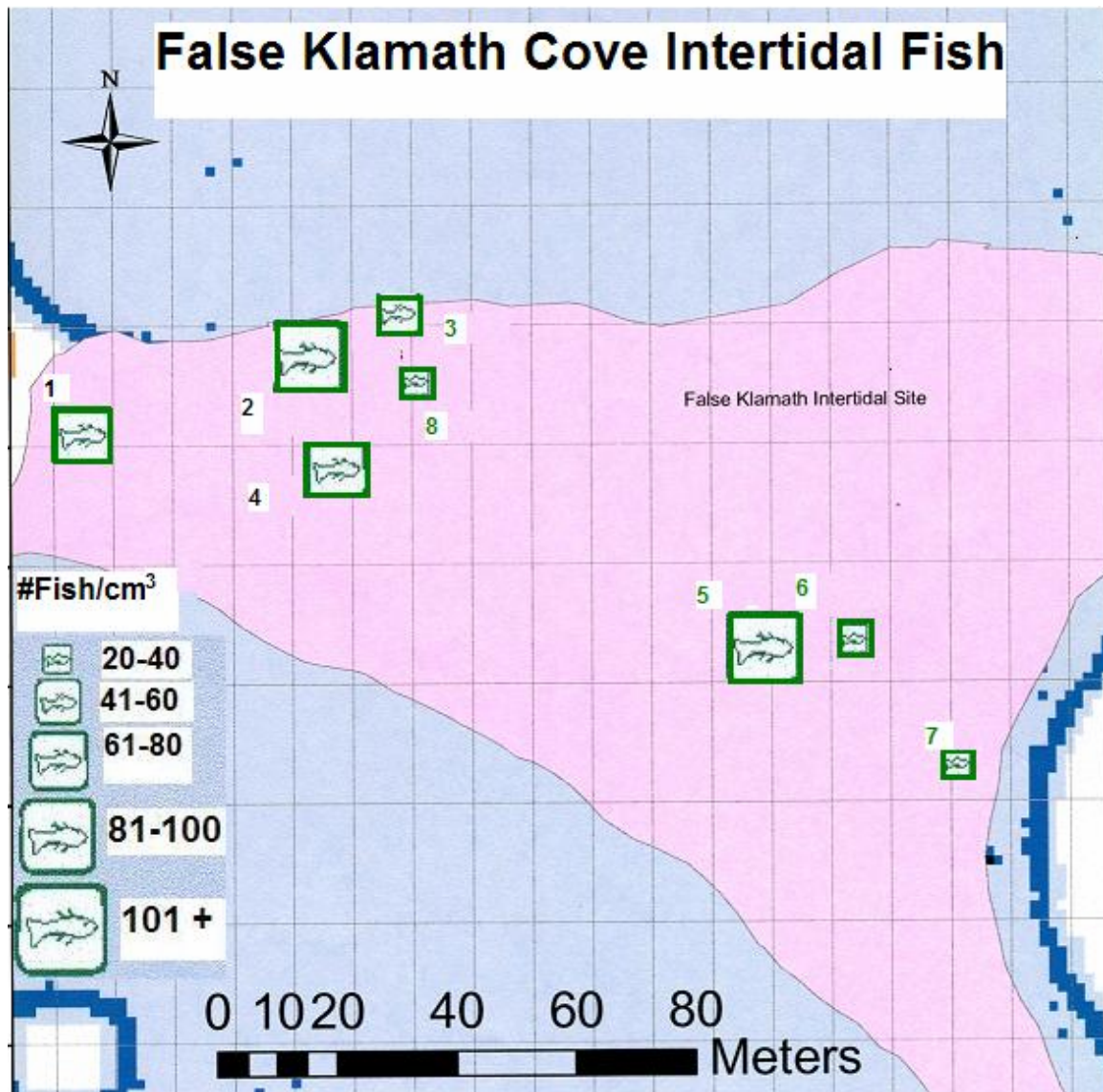


Figure 41. False Klamath Cove, RNSP intertidal fish site showing monitored tidepools (1-8) with the average number of fish caught per sampling event, 2004-2005 per volume (cm³) of water.

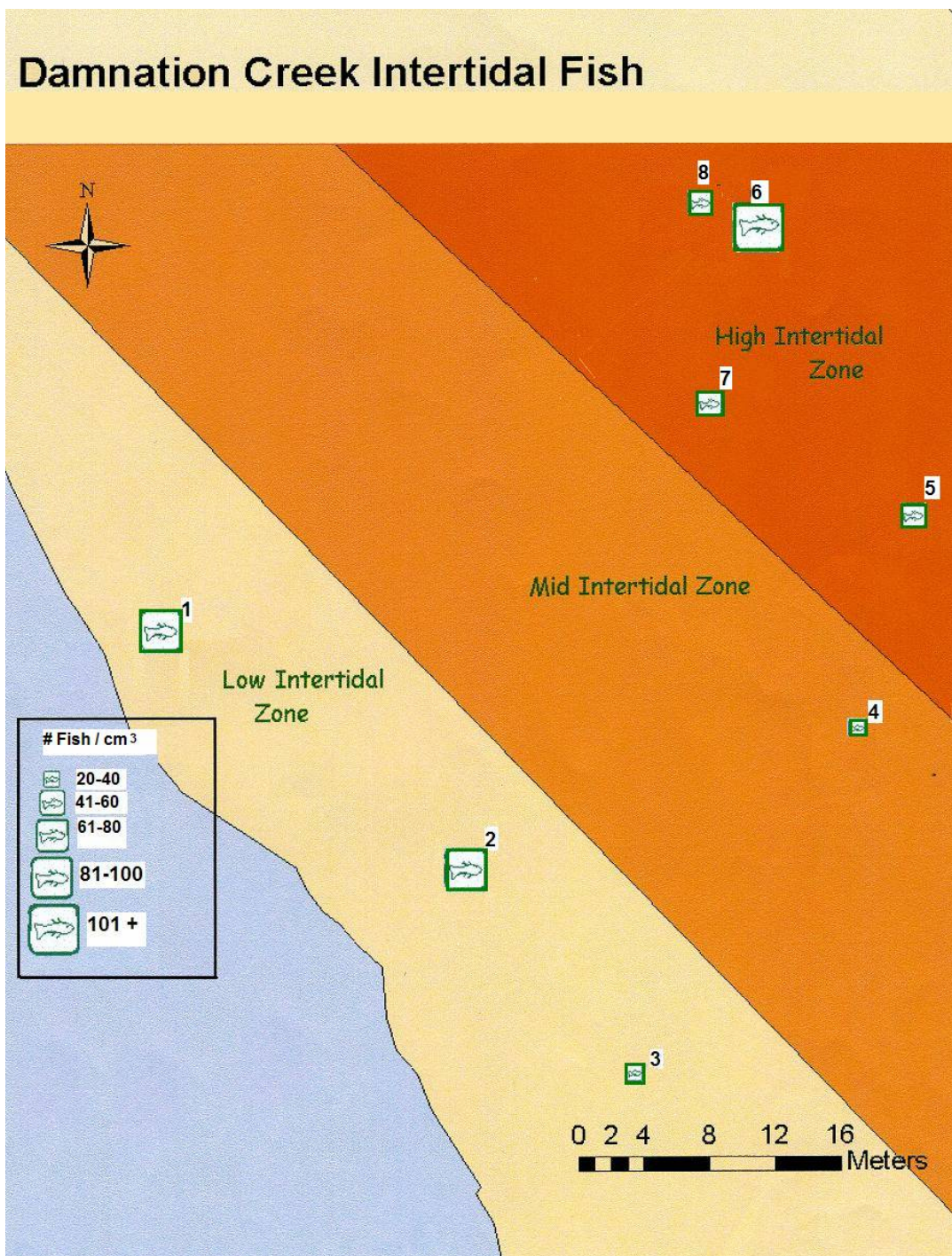


Figure 42. Damnation Creek, RNSP intertidal fish site showing monitored tidepools (1-8) with the average number of fish caught per sampling event, 2004-2005 per volume (cm³) of water.

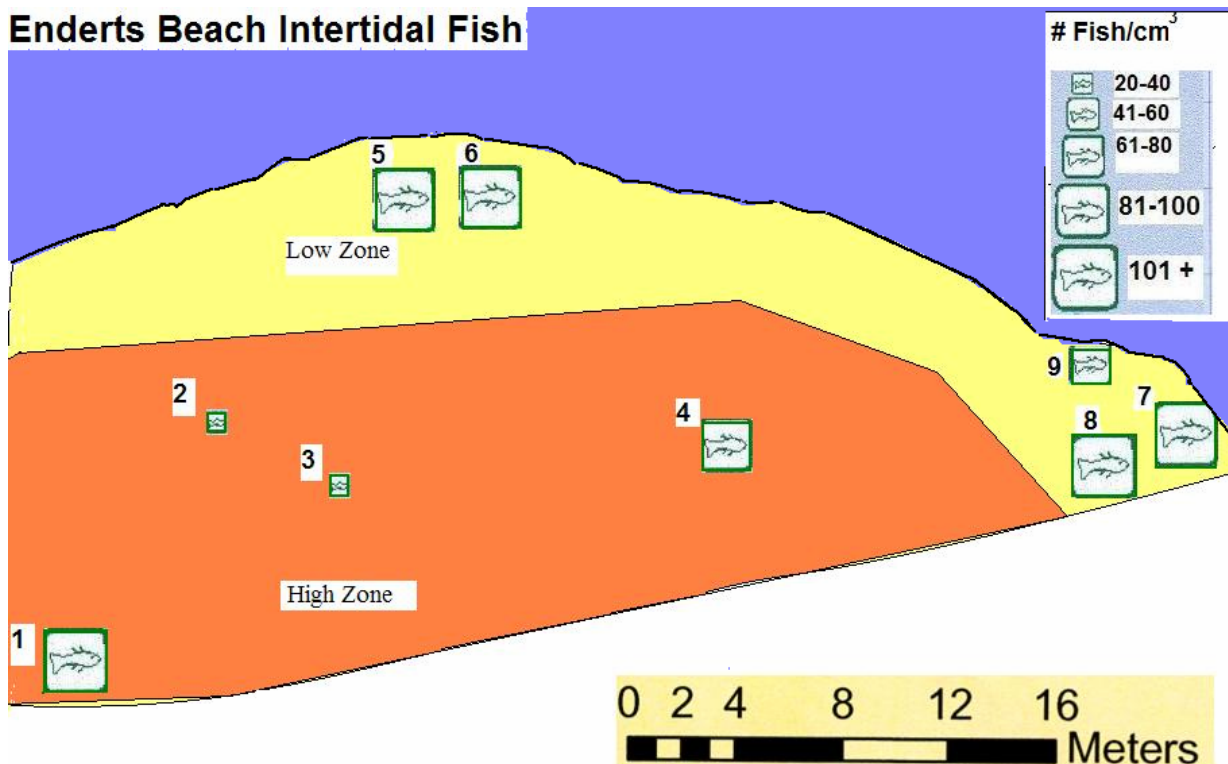


Figure 43. Enderts Beach, RNSP intertidal fish site showing monitored tidepools (1-8) with the average number of fish caught per sampling event, 2004-2005 per volume (cm³) of water.

Fish from the family Cottidae were injected with elastomer tags over five sampling periods between April and September 2004. Tagging data from this study showed high pool fidelity with very little evidence of movement between pools. A total of 797 fish were tagged over the course of this study. Of these, a total of 326 recaptures were recorded with only six individuals recaptured outside of their original tagging tidepool. Less than 2% of fish were recaptured in a different pool from their original capture location, suggesting high pool fidelity for the Cottid fish. Site fidelity for this group has been well documented in previous studies (Green 1971, Yoshiyama et al. 1992).

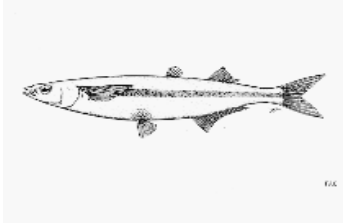
Discussion

This study was designed to describe the biodiversity of intertidal and nearshore fishes within Redwood National and State Parks and to track intertidal fish populations at selected tidepools. The temporal and spatial variation of intertidal fish distribution and abundance includes several components. Collectively, these factors determine the habitat utilization of these species. Temporal variation includes time of day, tidal fluctuations, and seasonality. These components determine the amount and level of exposure that organisms must withstand. Spatial variability exists within sites (zonation) and among sites along the coast (latitude). For example, a section of rocky shore may be affected by low salinity due to adjacent river runoff. Describing the fish assemblages in the rocky intertidal region requires observations of the specific zonation patterns of a site and assessment of the linkages of the habitat factors in determining the community ecology (Yoshiyama 1986).

Many studies along the Pacific Northwest coast have investigated rocky intertidal fish communities (Moring 1979, Davis 2000, Webster et al. in prep.). However, fish studies

usually remain separate from the other rocky intertidal community studies and are commonly overlooked in intertidal monitoring programs. A new trend in intertidal monitoring may come with the regular integration of fish into monitoring programs, as is now being done at Cabrillo Monument National Park. The difficulties in correlating fish data with other intertidal community data was noted in this study. The tidepools in which fish are sampled in the intertidal differ from the areas monitored for intertidal algae and invertebrates. The water depth of the pools creates a different degree of exposure from those regions that are completely uncovered for some period. This fundamental difference in habitat makes correlating intertidal fish data with those data regularly collected on intertidal algae and invertebrates difficult. The questions that may be addressed with regards to fish in intertidal communities are more likely to be those pertaining to the influence of other intertidal organisms on fish, such as algae cover in tidepools and food source availabilities (ie. macro-invertebrates). Monitoring fish in the intertidal may seem disjunct from the typical monitoring schemes, but it may be possible to approach the regular assessment of tidepool fishes in a similar manner to the irregular sea star or abalone plots that are used to track population changes over time (see sea star monitoring section of this report). With global climate change and increased pollution as potential threats to the marine communities, monitoring programs are essential tools to track changes and provide insight to managers. The greater the range of organisms monitored the better the understanding researchers and managers will have of this complex ecosystem.

Sandy Nearshore Fishes



Jacksmelt (*Atherinopsis californiensis*)
A common fish found when beach seining within
the Redwood National and State Parks.

Methods

Beach seining within RNSP provided a species list of nearshore fishes as well as relative abundances and length data for these species. Sites included Gold Bluffs Beach, near Espau lagoon in the southern part of RNSP and Crescent Beach in the far northern end of RNSP. Sampling occurred in spring and summer of 2004 and during the summer in 2005. At sandy beach sites a six foot deep by 100 foot long beach seine was used to collect fish in the nearshore habitat (Figure 44). Mesh size of the seine was 8mm. Seining occurred after a low tide event when tidal height was ca. 0 feet. The seine was pulled in a half circle from shore by eight to ten people spaced out along the net to insure that the lead line was kept on the sea floor. The net surrounded the fish and was hauled to shore. All fish collected in the net were identified, enumerated, measured and released (Table 18). Minimal specimen collection occurred, and was for identification purposes only. Seining has occurred successfully two times each at Gold Bluffs Beach and Crescent Beach (Table 18). The number of tows for each site and sampling date varied due to weather conditions.



Figure 44. Researchers deploying a beach seine at Gold Bluffs Beach, RNSP 2004.

Table 18. Inventory of sandy nearshore fishes from beach seining efforts at Gold Bluffs Beach and Crescent Beach, RNSP in 2004 - 2005.

Species	Common Name	Total # of Fish Collected
<i>Leptocottus armatus</i>	Staghorn sculpin	1
<i>Amphistichus rhodoterus</i>	Redtail surfperch	539
<i>Psettichthys melanostictus</i>	Sand sole	3
<i>Atherinopsis californiensis</i>	Jack smelt	67
<i>Hyperprosopon argenteum</i>	Walleye surfperch	283
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	2
<i>Citharichthys stigmaeus</i>	Speckled sanddab	2

Results

Fish seining in RNSP yielded a relatively low diversity of fish, as only seven species were sampled. Nearshore, ocean seining does not sample all present species due to the nature of the collection method and the variability associated with the technique and ocean conditions. The most abundant fish caught were *Amphistichus rhodoterus*, the redbtail surfperch with a total of 539 individuals and *Hyperprosopon argenteum*, the walleye surfperch with a total of 283 fish (Table 18). *Atherinopsis californiensis*, jacksmelt made up a significant proportion of the fish sampled in 2004 with 67 total fish sampled (Figure 45).

Annual and site variation was considerable, but due to the low sample size this should not be over emphasized. In 2004 redbtail surfperch were much more abundant than walleye surfperch, but in 2005 this trend was reversed. Only three species were collected in 2005 compared to seven in 2004. In 2004 both sites were sampled in the spring and summer while sampling occurred only in the summer of 2005 (Figure 45 and Figure 46). There was some seasonal variation between the summer and spring sampling events in both abundance and size of individuals (Table 19 and Table 20). Biodiversity was lower for the spring 2004 sampling events as only two species were collected compared to six species collected in summer 2004.

Redtail surfperch is an important recreational and commercial fishery along the California coast; according to the California Department of Fish and Game (DFG) it ranks first in the total California perch catch (CalCOFI 2004). Seining operations collected a range of size classes of redbtail surfperch, suggesting it is an adequate method for sampling various life stages of this species. Total length of redbtail surfperch individuals was greater in spring 2004 than both the summer sampling events of 2004 and 2005 (Table 20). Smaller individuals were only collected in the summer sampling events suggesting that juveniles are born in summer months where they are found associated with adult conspecifics. Jacksmelt is a popular recreational species along the California coast, although it does not contribute to the northern California commercial catch (CalCOFI DFG statistics 2004).

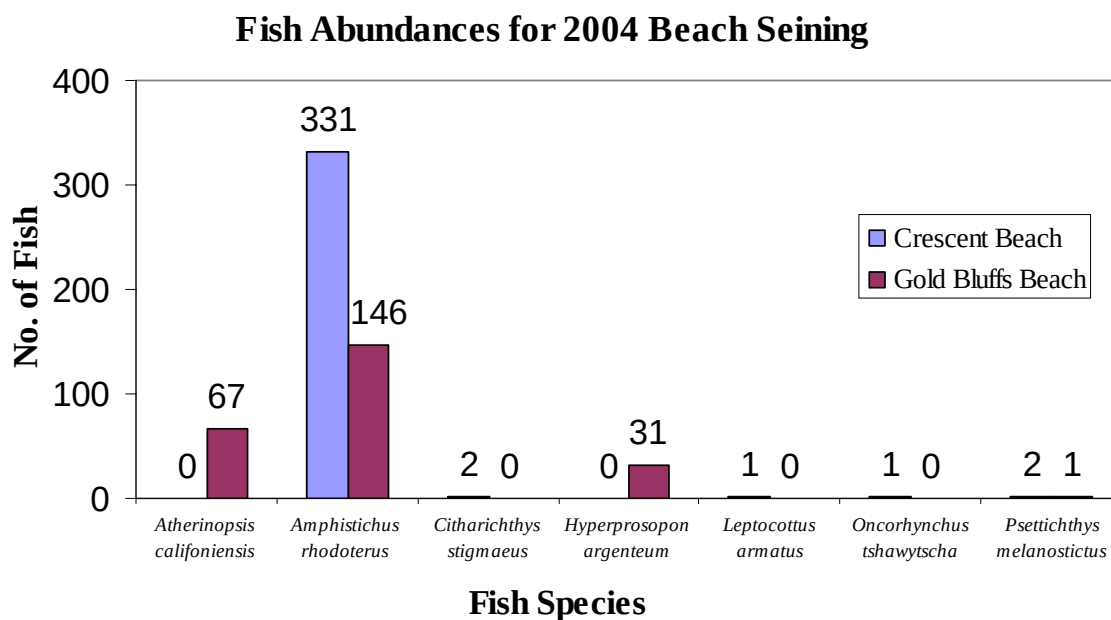


Figure 45. Fish abundances for 2004 beach seining efforts at Gold Bluffs Beach and Crescent Beach, RNSP. Numbers are totaled for all dates and all tows.

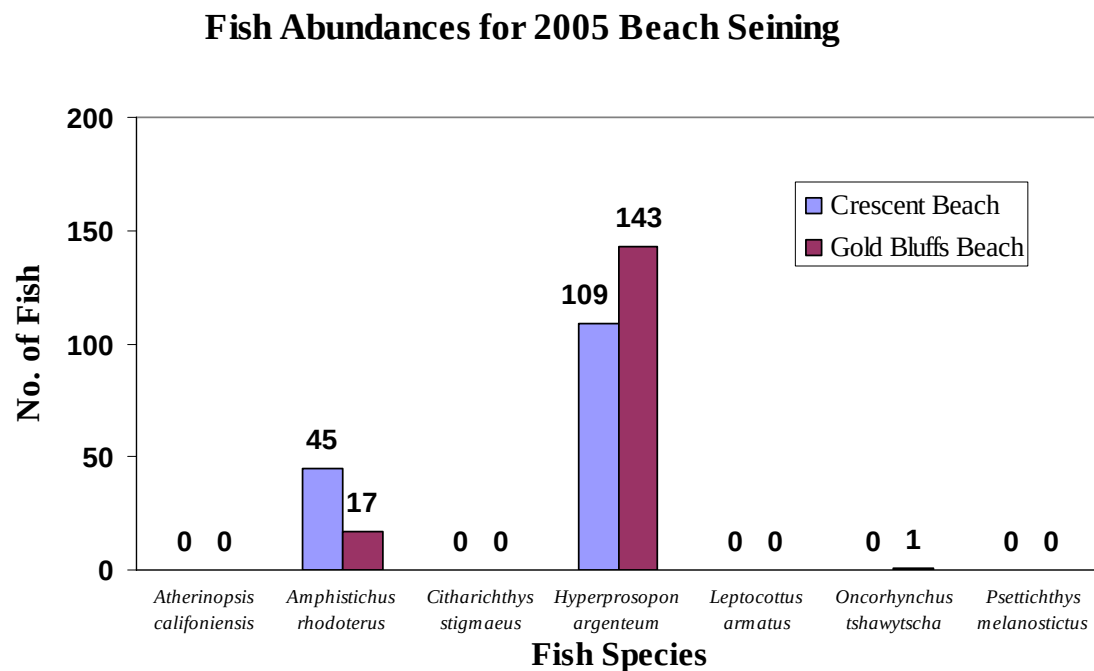


Figure 46. Fish abundances for 2005 beach seining efforts at Gold Bluffs Beach and Crescent Beach, RNSP. Numbers are totaled for all dates and all tows.

Table 19. Total number of fish collected for combined beach seines during spring (20-21 May 2004) and summer (15-18 July 2004 and 18-19 August 2005) at Gold Bluffs Beach and Crescent Beach, RNSP. Numbers in parenthesis show average number per tow.

Species	2004				2005	
	<u>Spring</u>		<u>Summer</u>		<u>Summer</u>	
	Gold Bluffs Beach (2 tows)	Crescent Beach (6 tows)	Gold Bluffs Beach (8 tows)	Crescent Beach (5 tows)	Crescent Beach (7 tows)	Gold Bluffs Beach (5 tows)
<i>Atherinopsis californiensis</i>			67 (9.6)			
<i>Amphistichus rhodoterus</i>	143 (71.5)	23 (3.8)	3 (0.4)	308 (61.6)	45 (9)	16 (3.4)
<i>Citharichthys stigmaeus</i>		2 (0.3)				
<i>Hyperprosopon argenteum</i>			31 (4.4)		109 (21.8)	143 (28.6)
<i>Leptocottus armatus</i>				1 (0.2)		
<i>Oncorhynchus tshawytscha</i>				1 (0.2)		1 (0.2)
<i>Psettichthys melanostictus</i>			1 (0.1)	2 (0.4)		

Table 20. Average size (TL,mm) of fish species collected for combined beach seines during spring (20-21 May 2004) and summer (15-18 July 2004 and 18-19 August 2005) at Gold Bluffs Beach and Crescent Beach, RNSP. Numbers in parenthesis show minimum and maximum sizes (TL, mm).

Species	2004				2005	
	<u>Spring</u>		<u>Summer</u>		<u>Summer</u>	
	Gold Bluffs Beach	Crescent Beach	Gold Bluffs Beach	Crescent Beach	Crescent Beach	Gold Bluffs Beach
<i>Atherinopsis californiensis</i>			138 (71-193)			
<i>Amphistichus rhodoterus</i>	131 (109-183)	142 (126-232)	72 (71-74)	97 (55-151)	215 (75-306)	148 (71-173)
<i>Citharichthys stigmaeus</i>		40				
<i>Hyperprosopon argenteum</i>			58 (55-65)		115 (67-192)	81 (58-174)
<i>Leptocottus armatus</i>				136		
<i>Oncorhynchus tshawytscha</i>				104		93
<i>Psettichthys melanostictus</i>			132	109		

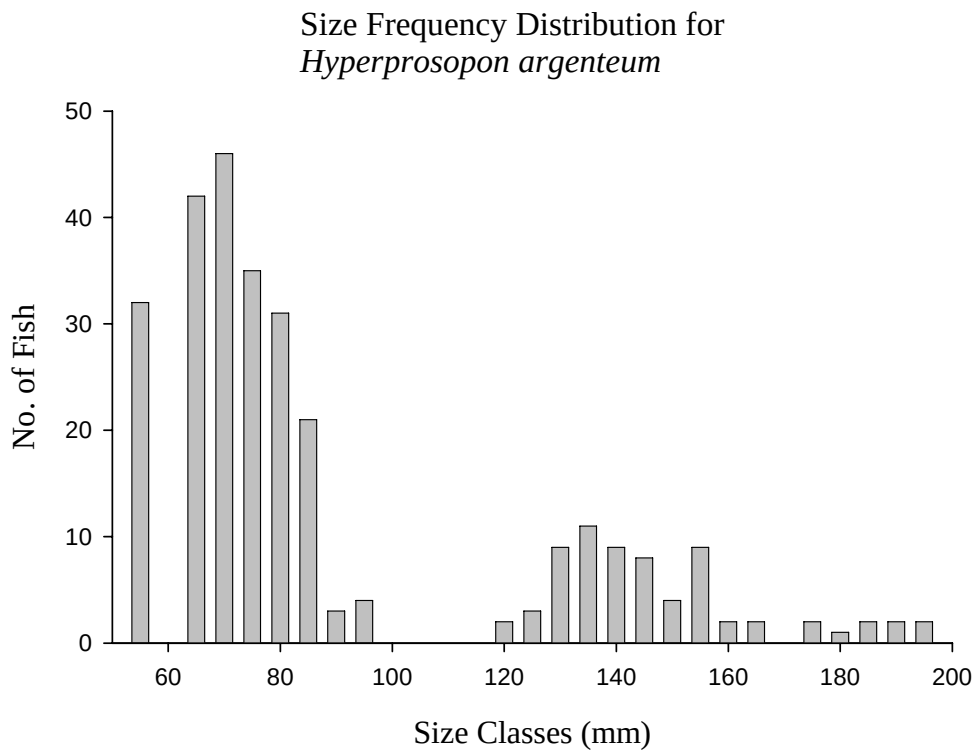


Figure 47. Size frequency distribution for Walleye surfperch, *Hyperprosopon argenteum*, for combined beach seining events, 2004 and 2005 at Gold Bluffs Beach and Crescent Beach, RNSP.

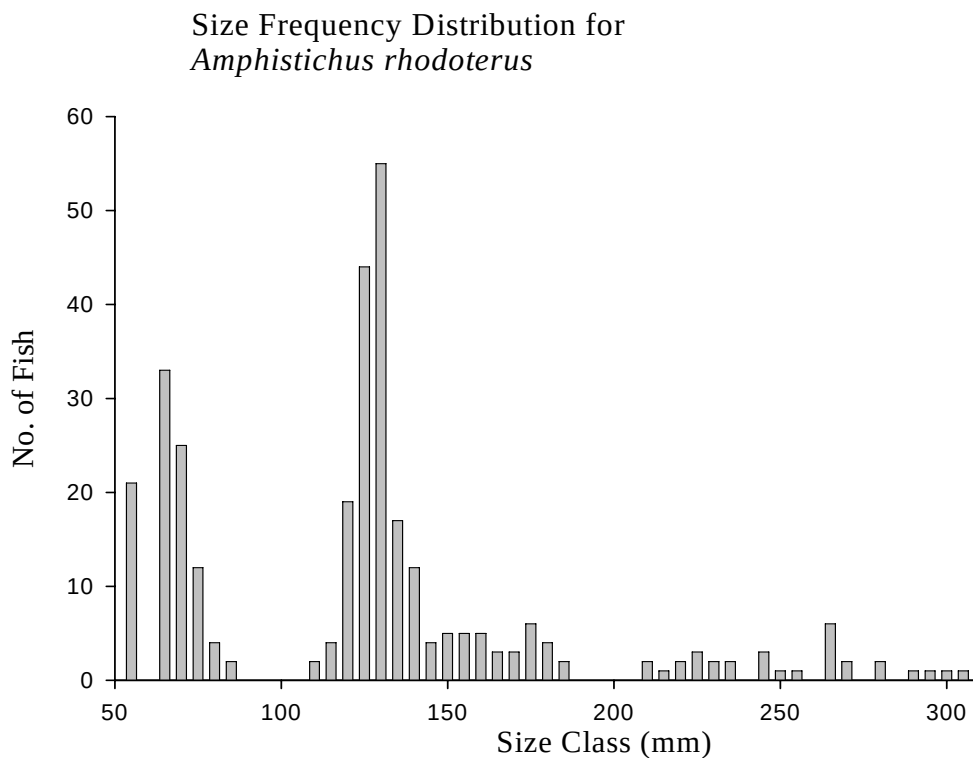


Figure 48. Size frequency distribution for Redtail surfperch, *Amphistichus rhodoterus*, for combined beach seining events, 2004 and 2005 at Gold Bluffs Beach and Crescent Beach, RNSP.



Figure 49. Scientists preparing to deploy a beach seine in RNSP (left). Juvenile redbtail surfperch, *Amphistichus rhodotus*, being measured during nearshore fish inventory (right).

Discussion

Seining efficiency is highly variable depending on ocean and site conditions, tow success and fish behavior. The purpose of these seines was to expand the nearshore fish species inventory. Seining was used to gather qualitative data on the fish species present and their abundance and size. Many species are not likely to be captured by seining. For example, due to wave swells most flatfish elude capture.

Each tow was highly variable in both species composition and fish abundance (Table 19). Some of the variability was due to the efficiency of each individual tow. Wave action made some tows less successful than others. The success of each tow was assessed and recorded. These data show a slight correlation between level of tow success and number of fish caught. A larger source of variation between the tows may have been due to fish behavior. Several of the fish species that we collected exhibit schooling behavior (i.e. smelt and surfperch). Surfperch and jacksmelt are schooling fish that often occur in dense schools. This behavior is probably responsible for the large amount of variation in numbers caught in individual tows. When a tow happens to run through a school of fish, large numbers are collected, and when a tow happens to miss a school, it may come up empty. The limitations of the height of the net also prevented tows from occurring far offshore and consequently captured only those species that occur very close to shore. Few bottom dwelling fish were collected in the seines. This may have been due to the lack of these species in the very nearshore waters; however, the difficulty in keeping the net completely on the bottom to prevent these fishes from escaping may have contributed to the low numbers.

Intertidal Juvenile Rockfish (*Sebastes*) Surveys

The Northern California coast supports more than 40 species of rockfish, *Sebastes spp.*, several of which have high commercial and recreational value. In California, black rockfish, *Sebastes melanops*, account for 27% of coastwide total rockfish landings and for 70% of Northern California's total rockfish landings (Thompson 1999). In Oregon, black rockfish make up more than 50% (weight and number) of the total recreational groundfish catch (Love et al. 2002).



Juvenile rockfish in a tidepool at False Klamath Cove, Redwood National and State Parks, California. Photo by Mark Lomeli 2004.

The juvenile life history stage of rockfishes is critical to local recruitment and continues to be understudied (Love et al. 2002). Young-of-the-year (YOY) rockfish studies are sparse in our area due to the difficulty of sampling subtidal habitats which are often inaccessible, rough and turbid. Previous studies have noted small, disjunct scatterings of juvenile *Sebastes* in rocky intertidal areas along the Pacific coast. Species include blue rockfish, *Sebastes mystinus*, black rockfish, *S. melanops*, bocaccio, *S. paucispinis* (Moring 1972, 1976), canary rockfish, *S. pinniger* (Chadwick 1976), and grass rockfish, *S. rastrelliger* (Davis 2000). In Northern California, black rockfish comprise 99% of the rockfish species present in the intertidal. Little is known about how or why juvenile rockfish utilize rocky intertidal areas, and to date only studies by Studebaker and Mulligan (in prep) and Lomeli et. al. (in prep) have focused solely on juvenile *Sebastes spp.* in the rocky intertidal area of northern California.

Several sites within the Redwood National and State Parks provide the unique opportunity to study the early life history of a commercially important nearshore species of rockfish. Young-of-the-year black rockfish generally recruit to nearshore environments between May and June at an age of four to six months. After utilizing nearshore habitats they migrate to deeper adult habitats. The use of nearshore, subtidal environments as nursery areas has been well documented for many species of rockfish. However, our research is the first to address use of the intertidal as a potential nursery area for rockfish. To date, studies initiated in our laboratory have examined habitat utilization by juvenile rockfishes at rocky intertidal sites in Northern California (Studebaker and Mulligan in prep. 2006).

Abundances of black rockfish were determined at False Klamath Cove and Damnation Creek, RNSP during Summer 2005. Timed searches done at these two sites will be compared to additional sites ranging from central California to the Oregon/Washington border.

A second study conducted in our laboratory examined site fidelity of juvenile black rockfish in intertidal areas. Previous studies suggest that many rockfish species show site fidelity and develop some type of a home range where they may reside for several months, years, or perhaps life. Site fidelity has been observed in some sub-adult and adult rockfish species, but has not been observed for most YOY rockfish species. The newly settled juvenile stage of rockfish is perhaps the least studied aspect of their life history. The focus of this pilot study was to determine if black rockfish show site fidelity while inhabiting the intertidal during the YOY life history stage.

Intertidal sites for this study included tidepools at False Klamath Cove and Endert's Beach within RNSP. Specimens were batch tagged with pool and date specific marks using subcutaneous injections of visible implant fluorescent elastomer (Figure 50).

This mark recapture study showed that black rockfish utilize rocky intertidal areas for up to 74 days. In addition YOY black rockfish showed strong site fidelity not only to an intertidal site, but to particular tidepools within the rocky intertidal. Overall recapture rates were nearly 30%.



Figure 50. YOY black rockfish, *Sebastes melanops*, displaying elastomer tag used to mark fish in study (Lomeli et al. 2004).

At False Klamath Cove, five tidepools were sampled 14 times over 83 days. A total of 1,109 YOY black rockfish were marked (Figure 51). Of tagged fish, 328 were recaptured and 89% of recaptured specimens were collected from their source pool. One fish, receiving a unique mark, was recaptured four times over 37 days moving only a distance of 18.5 m. Recaptures were noted at up to 74 days (Figure 52). Similar results were noted at the Enderts Beach site.

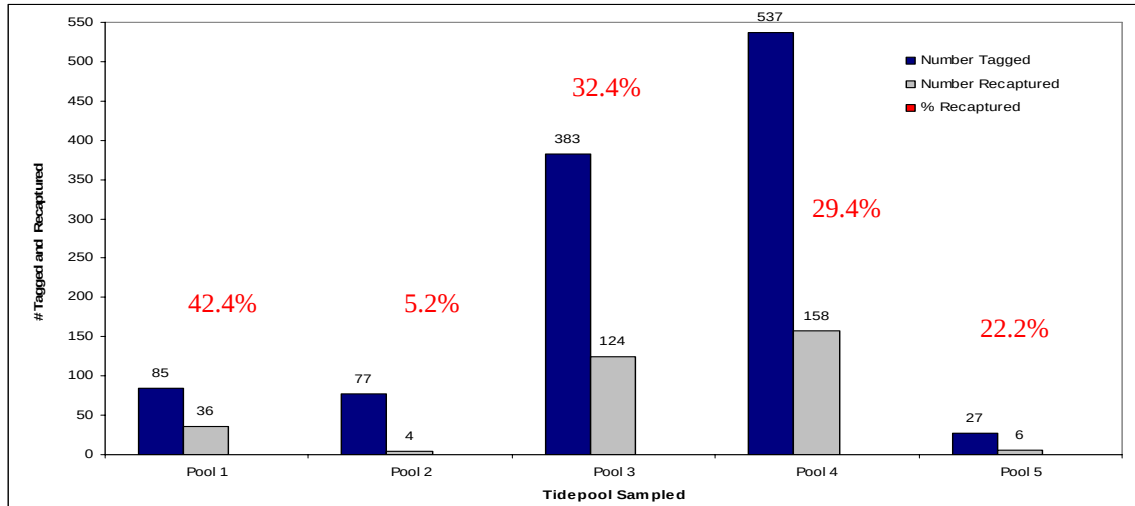


Figure 51. Total number of black rockfish, *Sebastes melanops*, marked and recaptured per pool at False Klamath Cove, Redwood National and State Park, CA, 06 June to 28 August 2004. Values in red above bars show the percent of total tagged fish that were recaptured per pool.

These results strongly suggest that YOY black rockfish exhibit site fidelity and are utilizing the rocky intertidal areas of False Klamath Cove and Endert's Beach as nursery areas. In most instances YOY black rockfish showed site fidelity to particular tidepools in the intertidal.

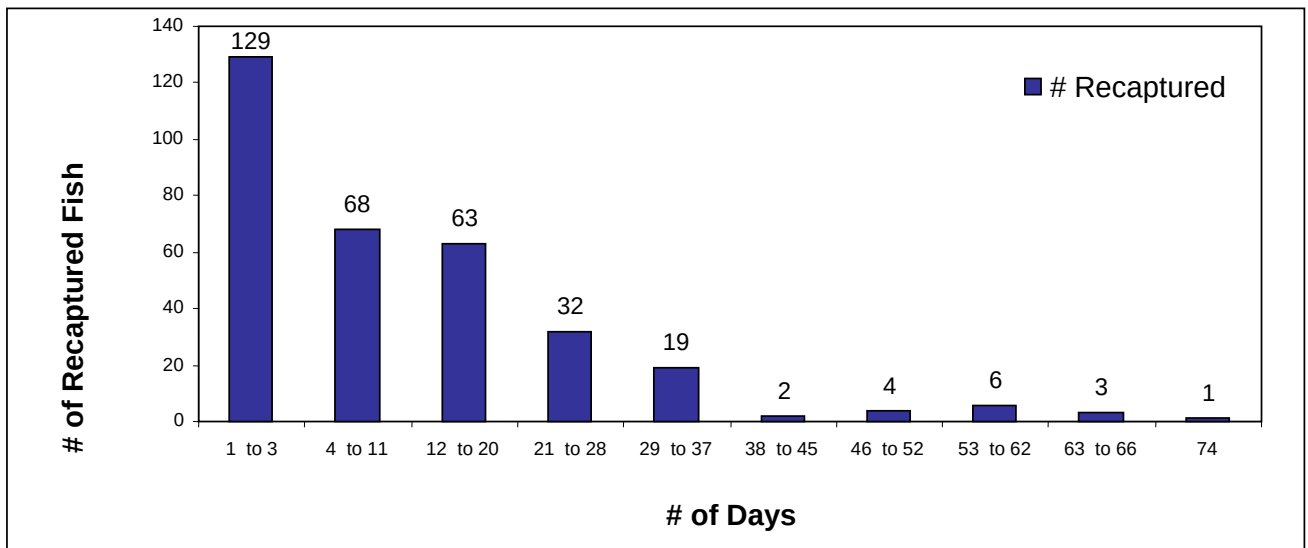


Figure 52. Total number of tagged *Sebastes melanops* recaptured over time (from 1 to 74 days) at False Klamath Cove, Redwood National and State Park, CA.

The presence of juvenile rockfish in the rocky intertidal has been briefly noted in several fish inventory studies (Moring, 1972, 1976; Chadwick 1976; Davis 2000). However, the abundance of juvenile black rockfish observed at our Northern Californian intertidal sites is much greater than previously noted. Intertidal areas of Humboldt and Del Norte counties may be unique in that they serve as nursery grounds, for at least juvenile black rockfish. The unique opportunity to continue studying a valuable local resource may aid in the management of the fishery. Furthermore, this information may be an important component in the delineation of marine protected areas as it links a subtidal species to intertidal habitats.

Future Studies to be Conducted:

During 2005-2006 we will continue juvenile black rockfish studies at the False Klamath Cove and Enderts Beach site. If numbers prove sufficient we will also initiate studies at the Damnataion Creek site. These data will be used to correlate juvenile black rockfish abundance and distribution to critical rocky intertidal habitats within RNSP and adjacent coastal areas.

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

The ultimate goals of the Redwood National and State Parks marine resource study were two-fold: (1) to compile an exhaustive inventory of algal, invertebrate, and fish species living in rocky intertidal and sand beach habitats, and (2) to monitor the spatial and temporal variation inherent in intertidal communities. Inventories provide documentation of biodiversity (Table 1, Table 2, and Appendix C) and allow for tracking changes in the species composition in a given area over time.

The monitoring data collected in this study will serve as baseline information for the various intertidal and nearshore communities within RNSP. This baseline data is the first stage necessary for documentation of natural dynamics. Continuation of this monitoring program is vital for detecting community response to natural and anthropogenic disturbances. For example, if an oil spill were to occur off the Northern California coast, our baseline data could be used to assess the impacts on the intertidal community. Determining the effects of any anthropogenic disturbance on the intertidal community requires monitoring to be of sufficient temporal and spatial scales to differentiate between natural variation and anthropogenic disturbances. Results from both intertidal invertebrate and algal studies have demonstrated the importance of long-term monitoring for accurate assessment of pre- and post-impact population dynamics (Driskell et al. 2001, Forde 2002). In addition, having pre-spill data greatly enhanced the analysis of intertidal impacts of an oil spill in the Galapagos Archipelago (Edgar et al. 2003). The ultimate purpose of long term monitoring is to understand and predict how environmental change, including human impacts, influence physical and ecological processes and how communities respond to such changes.

Regular monitoring familiarizes researchers with the localized ecology and community composition of an area. Routine contact increases the likelihood of detecting fluctuations due to disturbance, species invasions and species distribution shifts. For example, an increase in the abundance of the potentially invasive alga, *Caulacanthus ustulatus*, was recognized by a monitoring group in southern California (Miner et al. in prep). Without routine monitoring of these southern California sites, this invasion would likely have been overlooked. Recording shifts in species abundances and distribution may also be relevant for providing evidence for the effects of global warming. It has been suggested that species range shifts are occurring in response to elevated ocean temperatures (Barry et al. 2001, Sagarin et al. 1999).

Establishing a monitoring project and collecting baseline data is only the first stage of a monitoring program. The next stage requires a long-term, spatially extensive and integratable program. For maintenance of the established community structure assessments we propose a twice annual sampling scheme of the three rocky intertidal sites and annual sampling of the three sand beach sites. The sampling regime should include continued use of the adapted MARINe protocols (Engle 2005). We also recommend continually updating the species inventory. Sand beach sampling should be enhanced with the inclusion of shore bird data. Coupling of these data would indicate the productivity of the sandy beaches at multiple trophic levels. Sand beach invertebrates are important forage for shorebirds including the western snowy plover (Dugan 1990, Richards 2005).

The monitoring protocols we have established are appropriate for assessing intertidal communities at a given site, but scaling up to encompass the many miles of coastline in Redwood National and State Parks requires further efforts. As was learned from the Exxon Valdez oil spill in 1989, accurate baseline information about intertidal communities is paramount for determining appropriate cleanup and restoration procedures (Sharman et al.

2004). It is also necessary for the baseline data to be appropriate to the scale of the anthropogenic disturbance event. Having site specific monitoring data is important, however; managers must also know what resources exist throughout the park and the natural spatial and temporal variation thereof (Schoch 1994, Schoch and Dethier 1996). The site specific monitoring data needs to be put into context of a larger spatial scale and related to other similar locations. This requires both habitat assessments and mapping of the entire coastal area, as well as comparisons among sites on a larger geographic scale.

The Glacier Bay Coastal Resources Mapping Program is designed to assess coastlines on a larger scale. These protocols couple biological and physical shoreline data with GIS (Geographic Information System) layers (Sharman et al. 2004). Field work requires two-person teams to walk the shoreline during low tide and map polygons of similar substrate and composition on enlargements of 1:24,000 scale color infra-red photographs (Sharman et al. 2005). The field data includes substrate characterization, four-minute biological inventories of certain intertidal organisms, zonation transects from the water's edge to woody vegetation, site photographs, and presence/absence documentation of a variety of resource attributes. GPS points are collected in the field to denote the location of these attributes and for geo-reference on aerial photographs (see www.nps.gov/glba/InDepth).

Clearly this would be an appropriate method for characterizing the coastline of Redwood National and State parks. Collaborations should be pursued with the protocol developers in Glacier Bay, as well as those utilizing the protocols in California. The Glacier Bay protocol is currently being used to assess the coastline of Point Reyes National Seashore. Collaborations and communication among investigators is crucial for ensuring accurate data collection and for making comparisons among geographic locations.

Studying the marine resources of RNSP on larger geographic scale requires a collaborative effort. In order to put the monitoring data from the RNSP in a much broader geographical context, this study was conducted with the cooperation of two intertidal monitoring agencies, MARINe (Multi-Agency Rocky Intertidal Network) and PISCO (Partnership for the Interdisciplinary Study of Coastal Oceans). The primary function of MARINe is to monitor rocky intertidal ecosystems on the coast of California. They have provided protocols, training, field assistance, data entry assistance, and advice on many aspects of this monitoring project. In turn, RNSP sites contribute data to the MARINe consortium for a more complete comparison of California intertidal ecosystems.

The MARINe protocol has been used in other parts of California to document disturbance events associated with El Nino Southern Oscillation (Miner et al. in prep), population declines resulting from disease and over-harvesting (Raimondi et al. 2002, Miner et al. in prep), and invasions by non-native species (Miner et al. in prep). Clearly, this is an effective manner of monitoring intertidal communities. Using the MARINe protocols also allows us to make large scale geographic comparisons, because data from sites within Redwood National and State Parks are directly comparable with data collected from over 85 sites from southern California to southern Oregon.

Past efforts directed at monitoring intertidal patterns have been compromised because of variation in sampling design, sampling effort and sampler expertise. The protocols for the MARINe Community Dynamics Surveys use identical sampling in terms of design, effort and expertise at all sites. This consistency provides the ability to track changes at an ecosystem level. The monitoring effort of these groups addresses questions related to biogeography, effects of human use, management of coastal resources and conservation along the temperate West Coast of North America.

We have been granted access to a database that was established last year and includes monitoring data from 23 groups along the California coast. The Channel Islands National

Park, Cabrillo National Monument, and National Park Service are also entering their data into this data base. This will allow our data to be compared with sites along the coast and provide for data organization and handling.

UCSC conducts coastal biodiversity surveys (CBS) at 96 rocky intertidal sites along the eastern Pacific Coast. In June, a group of their highly trained taxonomic experts helped us conduct a rocky intertidal inventory at Damnation Creek using highly specialized protocols that are in place at numerous sites from Alaska to Baja California, MX. This collaboration will provide a source for coast-wide comparison of the marine intertidal data from Redwood National and State Park.

Future monitoring of the marine resources within RNSP using the established program is essential to track declines or introductions of specific species as well as shifts in species distribution or abundances. Additionally, we recommend monitoring of the sea palm, *Postelsia palmaeformis*. This alga occurs on mid-intertidal rocks exposed to heavy surf. The sea palm is protected by regulations of the Fish and Game Commission, which allows only commercial harvest with an annual permit. The harvest of this desirable kelp has been increasing and populations cannot withstand heavy harvesting (Miller 2002). This alga occurs at False Klamath Cove and on rocks near Hidden Beach. We suggest monitoring these populations and any others located within park boundaries that can be accessed safely.

Managing areas of special interest such as the coastal habitats within the National Parks requires establishing and maintaining a balance between conservation of the resources and providing public use and enjoyment of these spaces. Decisions regarding managing these resources require scientific based knowledge of the coastal marine ecology.

Long-term monitoring as a method of understanding the intertidal marine environment is more superior to having disparate snapshot studies. Long-term monitoring of shoreline resources provides the data needed for knowledge-based decision making and strong resource management programs. By combining resources with the network of monitoring groups noted above, RNSP can contribute to a better understanding of the dynamics of rocky intertidal communities.

Since the establishment of the Marine Life Management Act (MLMA) and Marine Life Protection Act (MLPA) in 1999 identifying sensitive marine habitats and providing protective status for these regions is spreading along the coast of California. The MLMA encompasses many aspects of conservation of California's marine resources and takes a preventative approach to management. The Act shifts the importance of management from short-term gains to long-term sustainability by requiring regulatory action to be taken before marine habitat is destroyed and depletion of marine species occurs. The MLPA acknowledges the importance of the entire marine ecosystem and has established guidelines for Marine Protected Areas (MPA) and reserves.

While many MPAs allow a variety of potentially harmful activities, the central scientific and policy issue in the national MPA debate continues to be the degree to which an existing or proposed MPA restricts the extraction of living marine resources. *Extraction* is defined as all forms of capture, hunting, harvest or collection (including catch-and-release fishing) of fish, invertebrates, plants, birds or mammals living in or transiting through the MPA's boundaries (Weber 2003). Using this approach, most MPAs in the U.S. can be classified into one of seven degrees of restriction on extraction. Most National Parks fall into the category of Managed Extraction. This type of MPA allows multiple types of extraction but has site-specific regulatory restrictions imposed by the MPA, or by another management authority, that govern when and where fishing and other extractive activities may occur within the site's boundaries. Increasing the protective status of a MPA to reserve status requires sound scientific knowledge and much consideration in the design (Airme et al. 2003)

Currently, southern and central California are leading the discussion of marine reserves but as we gain insight into the future of our marine resources, establishing reserves will soon become a reality in the more remote stretches of northern California coasts. The issue of MPA and reserve establishment is often shrouded in mistrust and misunderstanding by local interest groups, such as both commercial and recreational fishermen. This is often fueled by lack of scientific based knowledge to back the claims of the importance and benefits of these proposals. Creating and maintaining a sound monitoring program now will provide evidence to help managers and scientists determine the future need for enhanced protective status for these parks. The parks are promoting the importance of marine resources by establishing long term monitoring programs supported by the public and scientific community. This will translate into a better appreciation for these resources and an awareness of the importance of maintaining them for future generations.

This study has enhanced the information available on marine resources within Redwood National and State Parks, and we hope that continuation of the established program will broaden the understanding of these communities in a larger temporal and geographic context.

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APPENDIX A: TIMELINE SUMMARY

2004/2005 Field Time and Personnel: 55 Days of Field Work

- **Grad Students**: 2 students x 3 sites x 6 hrs x 20 sampling periods = 720 hours
- **Paid Undergraduate Help**: 3 students x 3 sites x 6 hrs x 10 sampling periods = 500+ hours
- **Park Assistance**: 2-6 employees x 6 hrs x 10 sampling periods = 200+ hours
- **PISCO/MARINE workers**: 8 days x 4 people x 8 hrs = 256 hrs (**free expert assistance**).
- **Volunteers**: 4-6 helpers x 6hrs x 3 sites x 20 sampling periods = 1800+ hours (**free help**).

Total Field Time Requirements for 2004/2005 Rocky and Sandy Sampling to occur
= 3,000+ hours yearly

2004/2005 Sampling Events

- Rocky Intertidal Monitoring
May, January, April, June, November
- Rocky Intertidal Inventories
Damnation May 2004, False Klamath Cove & Enderts May & July 2005
- Sand crab/beach hopper census
August 2004, 2005
- Sand Beach Fish and In-fauna Inventory
August 2005
- Rocky Intertidal Fish Monitoring/Inventory
February, March, April, July, and October

Data Entry Requirements: 400+ annual hours

- Photo Plot Analysis = 2 people x 5 hrs per site/per sampling period x 3 sites x 6 sampling = **180 hours** annually (+ 3 days of intensive training)
- Seagrass, sea stars, mobile inverts = 2 people x 2-4 hrs per site/per sampling period = **80-140 hours** annually
- Fish data entry = 1person x 5hrs x 3 sites x 10 sampling periods = **150 hours** annually

Data Analysis required a significant amount of time working with Humboldt State University Biometricians and PISCO/MARINE analysts.

APPENDIX B: NATURAL HISTORY OF TARGET SPECIES

These brief descriptions provide context for the selection of these target species by including information on life history, ecological importance, and sensitivity to anthropogenic activities. Descriptions of the natural history of the target species monitored in this study have been adapted from the annual MMS report (Miner et. al. in prep).

Endocladia muricata

Distinctive dark bands of the low-growing red turfweed, *Endocladia muricata*, are characteristic of nearly all high rocky intertidal shores of the northern Pacific Coast. *Endocladia* forms dense 4-8 cm tall, perennial tufts made up of tiny spine-covered branchlets (Abbott & Hollenberg 1976). Together with spiny-bladed *Mastocarpus papillatus*, the *Endocladia/Mastocarpus* carpet traps sediment and seawater, thus providing a sheltered microhabitat for a host of small organisms, including other algae, worms, crustaceans, and mollusks. Glynn (1965) found over 90 species associated with *Endocladia* clumps in Monterey. Turfweed can also provide habitat for attachment of young mussels. Expanding mussel patches may displace *Endocladia*, but it can then grow on the mussel shells, creating a layered assemblage. Some *Endocladia* clumps appear donut- or crescent-shaped; this condition may be caused by storms tearing out center areas possibly weakened by accumulated anoxic sediment. *Endocladia* is hardy and quite resistant to desiccation, yet vulnerable to oiling from spills. Recovery from natural or human disturbances may vary from on to more than six years (Kinnetics 1992).

***Phyllospadix* spp.**

Surfgrass (*Phyllospadix* spp.) is one of only two types of marine flowering plants on the West Coast. Unlike the eelgrass *Zostera* (often confused with surfgrass) that grows in quiet-water mud or sand habitats, surfgrass attaches by short roots to rock on surf-swept shores from the low intertidal down to 10-15 m depths. The 0.5-2 m tall, bright green grass commonly occurs in dense perennial beds formed primarily by vegetative growth from spreading rhizomes. Two species (*P. torreyi* & *P. scouleri*) overlap in geographical distribution and morphological characteristics (see Dawson and Foster 1982). *P. torreyi* generally has longer (1-2 m), narrower (1-2 mm) leaves, longer flower stems with several spadices, and occurs more in semi-protected habitats as well as at deeper depths. *P. scouleri* tends to have shorter (<50 cm), broader (2-4 mm) leaves, shorter flower stems with 1-2 spadices, and is found more often in wave-swept intertidal areas. Surfgrass meadows are highly productive ecosystems, providing structurally complex microhabitats for a rich variety of epiphytes, epibenthos, and infauna. Some organisms, such as the red algae *Smithora naiadum* and *Melobesia mediocris*, are exclusive epiphytes on surfgrass (or eelgrass) (Abbott & Hollenberg 1976). *Phyllospadix* beds provide nursery habitat for various fishes and invertebrates. Surfgrass cannot tolerate much heat or drying; the leaves will bleach quickly when midday low tides occur during hot, calm-water periods. Surfgrass can be particularly sensitive to sewage discharge (Littler and Murray 1975) and oil pollution (see Foster et al. 1988). Recovery can be relatively rapid if the rhizome systems remain functional, but might take many years if entire beds are lost, because recruitment is irregular and must be facilitated by the presence of perennial turf algae to which surfgrass seeds attach (Turner 1983, 1985).

Chthamalus dalli* and *Balanus glandula

White acorn barnacles, *Chthamalus dalli* and *Balanus glandula*, typically dominate high intertidal zones along the Pacific North Coast. Acorn barnacle species can be difficult to distinguish, especially in photographic monitoring. *C. dalli* are smaller (to 8mm) than *Balanus glandula* (to 22 mm) which are whiter in color and have differing shell plate arrangements. Acorn barnacles spawn often, at variable times throughout the year (Hines 1978), and settle in extremely high densities (to 70,000/m²), forming distinct white bands along the upper intertidal that contain few other invertebrates except littorines and the hardiest limpets. *Balanus* can out compete *Chthamalus* by crowding or smothering, but *Chthamalus* can occupy higher tide levels than *Balanus*, because it is more resistant to desiccation. Slightly lower down, acorn barnacles mix in with the *Endocladia* assemblage, and are common on mussel shells. *Chthamalus* species grow rapidly, but only survive a few months to a few years. *Balanus* can live longer (to 10 years), but its larger size and lower tidal position subject it to higher levels of mortality from predatory gastropods and ochre sea stars.

White acorn barnacles are highly vulnerable to smothering from oil spills because floating oil often sticks along the uppermost tidal levels. Significant, widespread barnacle impacts were reported after the 1969 Santa Barbara oil platform blow-out (Foster et al. 1971) and the 1971 collision of two tankers off San Francisco (Chan 1973). However, high recruitment rates may promote relatively rapid recovery of acorn barnacles; disturbance recovery times ranging from several months to several years have been reported (see Vesco & Gillard 1980).

A condition referred to as “hummocking” was observed in acorn barnacles at several sites. Hummocking occurs in response to high recruitment densities and growth rates, which intensify competition for primary substrate space (Bertness et. al. 1997). This condition causes crowded barnacles to grow up instead of out until they eventually grow so high that they are susceptible to removal by wave action. Evidence of hummocking was observed at all three monitored sites within RNSP. Frequently, large patches of barnacles would be entirely removed from one sampling period to the next.

Mytilus californianus

The California mussel, *Mytilus californianus*, is abundant at middle to low levels of exposed rocky shores along the entire Pacific Coast. These 10-20 cm black/blue/gray mussels firmly attach to rocks or other mussels by tough byssal threads, forming dense patches or beds. The literature on *Mytilus californianus* is extensive, including key ecological studies on the effects of predation, grazing, and disturbance on succession and community structure (Morris et al. 1980, Ricketts et al. 1985, Kinnetics 1992). Thick (>20 cm) beds of California mussels trap water, sediment, and detritus that provide food and shelter for an incredible diversity of plants and animals, including cryptic forms inhabiting spaces between mussels as well as biota attached to mussel shells (Paine 1966, MacGinitie & MacGinitie 1968, Suchanek 1979; Kanter 1980, Lohse 1993). For example, MacGinitie & MacGinitie (1968) counted 625 mussels and 4,096 other invertebrates in a single 25 cm² clump, and Kanter (1980) identified 610 species of animals and 141 species of algae from mussel beds at the Channel Islands. Mussels feed on suspended detritus and plankton. Young mussels settle preferentially into existing beds at irregular intervals, grow at variable rates depending on environmental conditions, and eventually reach ages of 8 years or more (see Morris et al. 1980, Ricketts et al. 1985). Mussels can tolerate typical rigors of intertidal life quite successfully. However, desiccation likely limits the upper extent of mussel beds, storms tear out various-sized mussel patches, and sea stars prey especially on lower zone mussels. *Mytilus* are adversely affected by oil spills (Chan 1973, Foster et al. 1971). Recovery from disturbance varies from fairly

rapid (if clearings are small and surrounded by mussels that can move in) to periods greater than 10 years (if clearings are large and recruitment is necessary for recolonization (Vesco & Gillard 1980; Kinnetics 1992).

Pisaster ochraceus

The ochre sea star, *Pisaster ochraceus*, is found on middle and low tide levels of waveswept, rocky coasts from Alaska to Baja California. Its relatively large size (to 45 cm diameter), variety of colors (yellow, orange, purple, brown), and ability to withstand air exposure (at least 8 hours) attract considerable attention from visitors exploring the shore at low tide. The ochre sea star typically is associated with mussels, which constitute its chief food, but barnacles, limpets, snails, and chitons also may be taken (Morris et al. 1980). Predator-prey interactions involving ochre sea stars have been intensely studied, especially the role of *P. ochraceus* in determining the lower limit of northern mussel beds (Paine 1966, 1974; Dayton 1971). Ochre sea stars are relatively slow-growing, long-lived, and apparently variable in recruitment success. They are tolerant of high surf, using their numerous tube feet to remain firmly in place, often in cracks and crevices. They have few predators, except for curious tidepool visitors. Sensitivity to oil spills is not well known; Chan (1973) saw no obvious effects from a San Francisco oil spill. Recovery time from any major population loss likely would be very long.

Pelvetiopsis limitata

The rockweed, *Pelvetiopsis limitata* is described as light tan to olive; densely branched, cylindrical at the base becoming flattened to cylindrical in the upper fronds; dichotomous; thalli 4-8 cm tall; (Abott and Hollenberg 1976). This algae is seen commonly in the upper intertidal of more wave-exposed sites in RNSP. *Pelvetiopsis* ranges on the Pacific coast from Vancouver Island, British Columbia, to Cambria (San Luis Obispo County), CA. Little scientific attention has been given to *Pelvetiopsis* so little is known about its reproductive periodicity, longevity, or ecology.

Fucus gardneri

Another common rockweed in RNSP, *Fucus gardneri*, has similar olive brown, branching, dichotomous thalli morphology to *Pelvetiopsis*. It is distinguished by having taller thalli, 10-25 cm, and prominent midribs in older portions (Abott and Hollenberg 1976). This conspicuous brown alga is commonly found in the mid to high intertidal on rocks. Many species of invertebrates find vital shelter from the harsh conditions characteristic of the intertidal, within the fronds of rockweeds such as *Fucus* and *Pelvetiopsis*. *Fucus* is also a food source for many gastropods (Houghton et al. 1998). Recovery time of *Fucus gardneri* after the Exxon Valdez oil spill of 1989 was studied. Results suggested that the population dynamics and structure did not fully recover seven years after the spill despite initial biomass recovery (Driskell et al. 2001).

APPENDIX C: ROCKY INTERTIDAL INVENTORY LISTS:

Algae of the Rocky Intertidal

Phylum	Current Scientific Name	DMN/ SWAT	END 2005	FKC 2005	END 1977	FKC 1977	Name used by B & D 1977
Anthophyta	<i>Phyllospadix scouleri</i>	X	C	A			
Anthophyta	<i>Phyllospadix torreyi</i>		U	R			
Chlorophyta	<i>Acrosiphonia arcta</i>	X	P	U			
Chlorophyta	<i>Acrosiphonia coalita</i>		P	P	X	X	<i>Spongomorpha coalita</i>
Chlorophyta	<i>Acrosiphonia mertensii</i>		R	P			
Chlorophyta	<i>Blindingia minima</i> var. <i>minima</i>		U	U			
Chlorophyta	<i>Cladophora columbiana</i>		U	P	X		<i>Cladophora columbiana</i>
Chlorophyta	<i>Cladophora hutchinsiae</i>		R	U			
Chlorophyta	<i>Codium setchellii</i>		R				
Chlorophyta	<i>Ulva californica</i>		U	C			
Chlorophyta	<i>Ulva intestinalis</i>		R	P			
Chlorophyta	<i>Ulva lactuca</i>			U			
Chlorophyta	<i>Ulva linza</i>		U	C		X	<i>Enteromorpha linza</i>
Chlorophyta	<i>Ulva lobata</i>		U	P			
Chlorophyta	<i>Ulva</i> spp	X	U	P	X	X	<i>Ulva</i> spp
Chlorophyta	<i>Ulva taeniata</i>	X		P		X	<i>Ulva taeniata</i>
Phaeophyta	<i>Alaria marginata</i>	X	P	P	X	X	<i>Alaria marginata</i>
Phaeophyta	<i>Alaria nana</i>				X		<i>Alaria nana</i>
Phaeophyta	<i>Analipus japonicus</i>		U	U	X	X	<i>Analipus japonicus</i>
Phaeophyta	<i>Analipus</i> spp		U	U			
Phaeophyta	<i>Berkeleya</i> spp		C	C			
Phaeophyta	<i>Colpomenia</i> spp		U	C			
Phaeophyta	<i>Cystoseira osmundacea</i>		DRIFT	DRIFT	X	X	<i>Cystoseira osmundacea</i>
Phaeophyta	<i>Desmarestia ligulata</i>	X		R	X	X	<i>Desmarestia ligulata</i>
Phaeophyta	<i>Ectocarpus fasciculatus</i>					X	<i>Ectocarpus actus haplogloine</i>
Phaeophyta	<i>Egregia menziesii</i>	X	C	C	X	X	<i>Egregia menziesii</i>
Phaeophyta	<i>Fucus gardneri</i>	X	P	A		X	<i>Fucus distichus</i>
Phaeophyta	<i>Haplogloia andersonii</i>		U		X	X	<i>Haplogloia andersonii</i>
Phaeophyta	<i>Hedophyllum sessile</i>	X	C	C	X	X	<i>Hedophyllum sessile</i>
Phaeophyta	<i>Laminaria setchellii</i>	X	C	P	X	X	<i>Laminaria dentigera</i>
Phaeophyta	<i>Laminaria sinclairii</i>	X	P	P	X	X	<i>Laminaria sinclairii</i>
Phaeophyta	<i>Leathesia difformis</i>	X	U	C	X		<i>Leathesia difformis/nana</i>
Phaeophyta	<i>Lessoniopsis littoralis</i>		U	R	X	X	<i>Lessoniopsis littoralis</i>
Phaeophyta	<i>Nereocystis luetkeana</i>		U	U	X		<i>Nereocystis luetkeana</i>
Phaeophyta	<i>Pelvetiopsis limitata</i>	X	A	A	X	X	<i>Pelvetiopsis limitata</i>
Phaeophyta	<i>Petalonia fascia</i>					X	<i>Petalonia fascia</i>
Phaeophyta	<i>Petrospongium rogium</i>	X					
Phaeophyta	<i>Phaeostrophion irregulare</i>			U			
Phaeophyta	<i>Postelsia palmaeformis</i>			U	X	X	<i>Postelsia palmaeformis</i>
Phaeophyta	<i>Pterygophora californica</i>		P		X	X	<i>Pterygophora californica</i>
Phaeophyta	<i>Ralfsia</i> spp		U	U		X	<i>Ralfsia</i> spp
Phaeophyta	<i>Ralfsiaceae</i>	X	P	P			
Phaeophyta	<i>Scytosiphon lomentaria</i>			R	X	X	<i>Scytosiphon lomentaria</i>

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Phaeophyta	<i>Soranthera ulvoidea</i>		P	C	X	X	<i>Soranthera ulvoidea</i>
Rhodophyta	<i>Ahnfeltia concinda</i>	X			X		<i>Ahnfeltia concinda</i>
Rhodophyta	<i>Ahnfeltia fastigiata</i>		U	U	X		<i>Ahnfeltia plicata</i>
Rhodophyta	<i>Ahnfeltiopsis gigartinoides</i>		U	U			
Rhodophyta	<i>Ahnfeltiopsis leptophyllus</i>			U			
Rhodophyta	<i>Ahnfeltiopsis linearis</i>		P	U	X	X	<i>Gymnogongrus linearis</i>
Rhodophyta	<i>Bossiella chiloensis</i>	X	U	C	X		<i>Bossiella chiloensis</i>
Rhodophyta	<i>Bossiella orbigniana dichotoma</i>	X	P	C	X		<i>Bossiella orbigniana dichotoma</i>
Rhodophyta	<i>Bossiella plumosa</i>	X	P	U	X		<i>Bossiella plumose</i>
Rhodophyta	<i>Calliarthron tuberculosum</i>	X	U		X		<i>Calliarthron tuberculosum</i>
Rhodophyta	<i>Callithamnion pikeanum</i>	X	P	P	X	X	<i>Callithamnion pikeanum</i>
Rhodophyta	<i>Callithamnion spp</i>		P	P			
Rhodophyta	<i>Callophyllis pinnata</i>		U	U	X		<i>Callophyllis peinnata</i>
Rhodophyta	<i>Ceramium pacificum</i>	X	P	C			
Rhodophyta	<i>Chondracanthus canaliculatus</i>	X	U	U			
Rhodophyta	<i>Chondracanthus spinosus</i>	X	U	R			
Rhodophyta	<i>Clathromorphum reclinatum</i>		R	R	X		<i>Neopolyporolithon reclinatum</i>
Rhodophyta	<i>Constantinea simplex</i>	X	P	P	X	X	<i>Consiantinea simplex</i>
Rhodophyta	<i>Corallina officinalis chilensis</i>	X	P	P	X		<i>Corallina officinalis chilensis</i>
Rhodophyta	<i>Corallina vancouveriensis</i>	X	C	P	X	X	<i>Corallina vancouveriensis</i>
Rhodophyta	<i>Cryptopleura lobulifera</i>	X	U	P	X	X	<i>Cryptopleura lobelifera</i>
Rhodophyta	<i>Cryptopleura ruprechtiana</i>	X	U	U	X		<i>Botryoglossum farlowianum</i>
Rhodophyta	<i>Cryptopleura violacea</i>	X	U	U	X		<i>Cryptopleura violacea</i>
Rhodophyta	<i>Cryptosiphonia spp</i>		P	U			
Rhodophyta	<i>Cryptosiphonia woodii</i>	X	P	U	X	X	<i>Cryptosiphonia woodii</i>
Rhodophyta	<i>Dilsea californica</i>	X	P	P	X	X	<i>Dilsea californica</i>
Rhodophyta	<i>Endocladia muricata</i>	X	A	C	X	X	<i>Endocladia muricata</i>
Rhodophyta	<i>Erythrophyllum delesserioides</i>			U	X		<i>Erythrophyllum delesserioides</i>
Rhodophyta	<i>Farlowia mollis</i>	X	P	P	X	X	<i>Farlowia mollis</i>
Rhodophyta	<i>Gelidium coulteri</i>	X	U	U			
Rhodophyta	<i>Gloiopeltis furcata</i>		U	U	X	X	<i>Gloiopeltis furcata</i>
Rhodophyta	<i>Grateloupia doryphora</i>	X					
Rhodophyta	<i>Grateloupia lanceolata</i>		U	P	X		<i>Prionitis lanceolata</i>
Rhodophyta	<i>Grateloupia setchellii</i>		R		X		<i>Grateloupia setchellii</i>
Rhodophyta	<i>Halosaccion glandiforma</i>	X	R	U	X		<i>Halosaccion glandiforme</i>
Rhodophyta	<i>Halymenia californica</i>	X		U			
Rhodophyta	<i>Halymenia schizymenoides</i>	X	U	U			
Rhodophyta	<i>Hildebrandia/Peyssonnelia spp</i>	X	P	P			
Rhodophyta	<i>Hymenena cuneifolia</i>	X	R	U		X	<i>Hymenena cuneifolia</i>
Rhodophyta	<i>Hymenena flabelligera</i>	X	U	U	X	X	<i>Hymenena flabelligera</i>
Rhodophyta	<i>Hymenena multiloba</i>	X	U	U	X		<i>Hymenena multiloba</i>
Rhodophyta	<i>Laurencia pacifica/masonii</i>	X					
Rhodophyta	<i>Lithophyllum dispar</i>		U	R	X		<i>Tenarea dispar</i>
Rhodophyta	<i>Mastocarpus jardinii</i>	X	C	C	X	X	<i>Gigartina agardhii</i>
Rhodophyta	<i>Mastocarpus papillatus</i>	X	C	C	X	X	<i>Gigartina papillata</i>
Rhodophyta	<i>Mastocarpus spp (sporophyte stage)</i>	X	C	A		X	<i>Petrocelis franciscana</i>
Rhodophyta	<i>Mazzaella flaccida</i>	X	U	P	X	X	<i>Iridaea flaccida</i>
Rhodophyta	<i>Mazzaella oregona</i>	X	P	P	X	X	<i>Iridaea heterocarpa</i>

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Rhodophyta	<i>Mazzaella splendens</i>	X	P	A	X	X	<i>Iridaea cordata</i>
Rhodophyta	<i>Melobesia mediocris</i>		U	P			
Rhodophyta	<i>Membranoptera dimorpha</i>	X			X		<i>Membranoptera dimorpha</i>
Rhodophyta	<i>Microcladia borealis</i>	X	C	C	X	X	<i>Microcladia borealis</i>
Rhodophyta	<i>Microcladia coulteri</i>	X	P	P			
Rhodophyta	<i>Neoptilota hypnoides</i>	X	U	U	X		<i>Neoptilota hypnoides</i>
Rhodophyta	<i>Neorhodomela larix</i>	X	C	P	X	X	<i>Rhodomela larix</i>
Rhodophyta	<i>Neorhodomela oregona</i>	X			X	X	<i>Odonthalia oregona</i>
Rhodophyta	<i>Odonthalia floccosa</i>	X	C	C	X	X	<i>Odonthalia floccose</i>
Rhodophyta	<i>Odonthalia lyallii</i>				X	X	<i>Odonthalia lyallii</i>
Rhodophyta	<i>Odonthalia washingtoniensis</i>			U		X	<i>Odonthalia washingtoniensis</i>
Rhodophyta	<i>Opuntia californica</i>		U	U	X		<i>Opuntia californica</i>
Rhodophyta	<i>Osmundea spectabilis</i>	X	P	P	X	X	<i>Laurencia spectabilis</i>
Rhodophyta	<i>Palmaria spp</i>		U	U			
Rhodophyta	<i>Pikea robusta</i>	X	U		X	X	<i>Pikea robusta</i>
Rhodophyta	<i>Plocamium oregonum</i>		P	U		X	<i>Plocamium oregonum</i>
Rhodophyta	<i>Plocamium pacificum</i>	X	P	U	X	X	<i>Plocamium cartilagineum</i>
Rhodophyta	<i>Plocamium violaceum</i>	X	P	U	X	X	<i>Plocamium violaceum</i>
Rhodophyta	<i>Polyneura latissima</i>		U	U	X	X	<i>Polyneura latissima</i>
Rhodophyta	<i>Polysiphonia hendryi</i> var. <i>gardneri</i>		P	P			
Rhodophyta	<i>Polysiphonia hendryi</i> var. <i>hendryi</i>		P	P			
Rhodophyta	<i>Polysiphonia spp</i>	X	P	P	X		<i>Polysiphonia spp</i>
Rhodophyta	<i>Porphyra lanceolata</i>	X	P	C	X		<i>Porphyra lanceolata</i>
Rhodophyta	<i>Porphyra perforata</i>	X	U	A	X	X	<i>Porphyra perforate</i>
Rhodophyta	<i>Porphyra smithii</i>		U	P	X		<i>Porphyra smithii</i>
Rhodophyta	<i>Porphyropsis coccinea</i>				X		<i>Porphyropsis coccinea</i>
Rhodophyta	<i>Prionitis filiformis</i>		U	C		X	<i>Prionitis filiformis</i>
Rhodophyta	<i>Prionitis lanceolata</i>	X	P	P			
Rhodophyta	<i>Prionitis linearis</i>		U	R			
Rhodophyta	<i>Prionitis lyallii</i>	X	P	C	X	X	<i>Prionitis lyallii</i>
Rhodophyta	<i>Pterosiphonia bipinnata</i>	X	U	P			
Rhodophyta	<i>Pterosiphonia dendroidea</i>	X		U			
Rhodophyta	<i>Ptilota filicina</i>		P	P	X	X	<i>Ptilota filicina</i>
Rhodophyta	<i>Ptilota spp</i>	X	P	P			
Rhodophyta	<i>Schizymenia pacifica</i>		U	R	X	X	<i>Schizymenia pacifica</i>
Rhodophyta	<i>Schizymenia spp</i>		U	R			
Rhodophyta	<i>Tiffaniella snyderae</i>	X					

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Phylum	Class	Current Scientific Name	DMN/ SWAT	END 2005	FKC 2005	B&D 1977	Name Used by B&D 1977
Annelida	Polychaeta	<i>Ampharete</i> spp				X	<i>Ampharete</i> spp
Annelida	Polychaeta	<i>Anaitides williamsi</i>		U	U	X	<i>Anaitides williamsi</i>
Annelida	Polychaeta	<i>Arctonoe vittata</i>				X	<i>Arctonoe vittata</i>
Annelida	Polychaeta	<i>Armandia brevis</i>				X	<i>Armandia brevis</i>
Annelida	Polychaeta	<i>Autolytus</i> spp				X	<i>Autolytus</i> spp
Annelida	Polychaeta	<i>Boccardia proboscidea</i>				X	<i>Boccardia proboscidea</i>
Annelida	Polychaeta	<i>Branchiomaldane vincentii</i>				X	<i>Branchiomaldane vincentii</i>
Annelida	Polychaeta	<i>Chaetopterus variopedatus</i>		R	R		
Annelida	Polychaeta	<i>Chone ecaudata</i>				X	<i>Chone ecaudata</i>
Annelida	Polychaeta	<i>Dodecaceria fewkesi</i>		R	R		
Annelida	Polychaeta	<i>Eudistylia vancouveri</i>		P	R		
Annelida	Polychaeta	<i>Eulalia aviculiseta</i>				X	<i>Eulalia aviculiseta</i>
Annelida	Polychaeta	<i>Eupolymnia crescentis</i>				X	<i>Eupolymnia crescentis</i>
Annelida	Polychaeta	<i>Exogone lourei</i>				X	<i>Exogone lourei</i>
Annelida	Polychaeta	<i>Fabricia</i> spp				X	<i>Fabricia</i> spp
Annelida	Polychaeta	<i>Glycera</i> spp		R	R		
Annelida	Polychaeta	<i>Glycinde polygnatha</i>				X	<i>Glycinde polygnatha</i>
Annelida	Polychaeta	<i>Halosydna brevisetosa</i>		P	P	X	<i>Halosydna brevisetosa</i>
Annelida	Polychaeta	<i>Harmothoe imbricata</i>				X	<i>Harmothoe imbricata</i>
Annelida	Polychaeta	<i>Lumbrineris</i> spp				X	<i>Lumbrineris</i> spp
Annelida	Polychaeta	<i>Naineris dendritica</i>				X	<i>Naineris dendritica</i>
Annelida	Polychaeta	<i>Neanthes</i> spp		U	U	X	<i>Neanthes succinea</i>
Annelida	Polychaeta	<i>Neoamphitrite robusta</i>				X	<i>Neoamphitrite robusta</i>
Annelida	Polychaeta	<i>Nereida</i> spp		P	P		
Annelida	Polychaeta	<i>Nereis</i> spp				X	<i>Nereis</i> spp
Annelida	Polychaeta	<i>Nereis vexillosa</i>				X	<i>Nereis vexillosa</i>
Annelida	Polychaeta	<i>Nothria elegans</i>				X	<i>Nothria elegans</i>
Annelida	Polychaeta	<i>Paleanotus bellis</i>				X	<i>Paleanotus bellis</i>
Annelida	Polychaeta	<i>Pista elongata</i>	X	U	U		
Annelida	Polychaeta	<i>Platynereis bicanaliculata</i>		R	U	X	<i>Platynereis bicanaliculata</i>
Annelida	Polychaeta	<i>Polydora giardi</i>				X	<i>Polydora giardi</i>
Annelida	Polychaeta	<i>Polydora socialis</i>				X	<i>Polydora socialis</i>
Annelida	Polychaeta	<i>Polydora</i> spp				X	<i>Polydora</i> spp
Annelida	Polychaeta	<i>Potomilla ocellata</i>		R	U		
Annelida	Polychaeta	<i>Pseudopotamilla</i> spp				X	<i>Pseudopotamilla</i> spp
Annelida	Polychaeta	<i>Rhyncospio arenicola</i>				X	<i>Rhyncospio arenicola</i>
Annelida	Polychaeta	<i>Schistocomus hiltoni</i>				X	<i>Schistocomus hiltoni</i>
Annelida	Polychaeta	<i>Schizobanchia insignis</i>				X	<i>Schizobanchia insignis</i>
Annelida	Polychaeta	<i>Serpula columbiana</i>		U	U	X	<i>Serpula vermicularis</i>
Annelida	Polychaeta	<i>Sphaerosyllis</i> spp				X	<i>Sphaerosyllis</i> spp
Annelida	Polychaeta	<i>Spiochaetopterus costarum</i>		U	R		
Annelida	Polychaeta	<i>Spiophanes</i> spp				X	<i>Spiophanes</i> spp
Annelida	Polychaeta	<i>Sthenelais fusca</i>				X	<i>Sthenelais fusca</i>
Annelida	Polychaeta	<i>Syllis elongata</i>				X	<i>Syllis elongata</i>
Annelida	Polychaeta	<i>Typosyllis alternata</i>			R	X	<i>Typosyllis alternate</i>

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Arthropoda	Arachnida	<i>Achelia nudusclia</i>		R	R		
Arthropoda	Crustacea	<i>Balanus balanus pugetensis</i>				X	<i>Balanus balanus pugetensis</i>
Arthropoda	Crustacea	<i>Balanus crenatus</i>		U	U	X	<i>Balanus crenatus</i>
Arthropoda	Crustacea	<i>Balanus glandula</i>	X	A	A	X	<i>Balanus glandula</i>
Arthropoda	Crustacea	<i>Balanus nubilus</i>		U	U	X	<i>Balanus nubilus</i>
Arthropoda	Crustacea	<i>Cancer antennarius</i>		U	U	X	<i>Cancer antennarius</i>
Arthropoda	Crustacea	<i>Cancer jordani</i>		U	U	X	<i>Cancer jordani</i>
Arthropoda	Crustacea	<i>Cancer magister</i>		P	P	X	<i>Cancer magister</i>
Arthropoda	Crustacea	<i>Cancer oregonensis</i>	X	U	U		
Arthropoda	Crustacea	<i>Cancer productus</i>		P	P	X	<i>Cancer productus</i>
Arthropoda	Crustacea	<i>Caprella californica</i>		C	C		
Arthropoda	Crustacea	<i>Chthamalus dalli</i>	X	C	C	X	<i>Chthamalus dalli</i>
Arthropoda	Crustacea	<i>Cirolana spp</i>	X	P	P		
Arthropoda	Crustacea	<i>Cryptolithodes sitchensis</i>				X	<i>Cryptolithodes sitchensis</i>
Arthropoda	Crustacea	<i>Cymadusa umcinta</i>		A	A		
Arthropoda	Crustacea	<i>Dynamenella sheareri</i>		P	P		
Arthropoda	Crustacea	<i>Gnorimosphaeroma oregonensis</i>				X	<i>Gnorimosphaeroma oregonensis</i>
Arthropoda	Crustacea	<i>Hapalogaster mertensii</i>				X	<i>Hapalogaster mertensii</i>
Arthropoda	Crustacea	<i>Hemigrapsus nudus</i>		C	C	X	<i>Hemigrapsus nudus</i>
Arthropoda	Crustacea	<i>Hemigrapsus oregonensis</i>		P	P	X	<i>Hemigrapsus oregonensis</i>
Arthropoda	Crustacea	<i>Heptocarpus spp</i>		A	A		
Arthropoda	Crustacea	<i>Hymenodora frontalis</i>		C	C		
Arthropoda	Crustacea	<i>Idotea fewkesi</i>		C	C		
Arthropoda	Crustacea	<i>Idotea kirchanskii</i>		U	U		
Arthropoda	Crustacea	<i>Idotea schmitti</i>		P	P		
Arthropoda	Crustacea	<i>Idotea spp</i>	X				
Arthropoda	Crustacea	<i>Idotea wosnesenskii</i>		P	P		
Arthropoda	Crustacea	<i>Ligia occidentalis</i>		C	A		
Arthropoda	Crustacea	<i>Megabalanus californicus</i>		P	P		
Arthropoda	Crustacea	<i>Oedignathus inermis</i>		P	P		
Arthropoda	Crustacea	<i>Pachycheles rudis</i>		P	P		
Arthropoda	Crustacea	<i>Pachygrapsus crassipes</i>	X	P	P		
Arthropoda	Crustacea	<i>Pagurus granosimanus</i>		P	P	X	<i>Pagurus granosimanus</i>
Arthropoda	Crustacea	<i>Pagurus hirsutiusculus</i>	X	C	C	X	<i>Pagurus hirsutiusculus</i>
Arthropoda	Crustacea	<i>Pagurus samuelis</i>	X	U	U	X	<i>Pagurus samuelis</i>
Arthropoda	Crustacea	<i>Parallorchestes ochotensis</i>		C	A	X	<i>Parallorchestes ochotensis</i>
Arthropoda	Crustacea	<i>Petrolisthes cinctipes</i>		P	C	X	<i>Petrolisthes cinctipes</i>
Arthropoda	Crustacea	<i>Petrolisthes manimculis</i>		P	P		
Arthropoda	Crustacea	<i>Pollicipes polymerus</i>	X	C	C	X	<i>Pollicipes polymerus</i>
Arthropoda	Crustacea	<i>Pugettia producta</i>	X	P	C	X	<i>Pugettia producta</i>
Arthropoda	Crustacea	<i>Pugettia richii</i>				X	<i>Pugettia richii</i>
Arthropoda	Crustacea	<i>Scyra acutifrons</i>				X	<i>Scyra acutifrons</i>
Arthropoda	Crustacea	<i>Semibalanus cariosus</i>	X	P	C	X	<i>Balanus cariosus</i>
Arthropoda	Crustacea	<i>Synidotea laticauda</i>		C	C		
Brachipoda	Inarticulata	<i>Terebratalia transversa</i>		R		X	<i>Terebratalia transversa</i>
Bryozoa	Gymnolaemata	<i>Bicrisia edwardsiana</i>				X	<i>Bicrisia edwardsiana</i>

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Bryozoa	Gymnolaemata	<i>Bugula californica</i>	X	C	C	X	<i>Bugula californica</i>
Bryozoa	Gymnolaemata	<i>Crisia occidentalis</i>				X	<i>Crisia occidentalis</i>
Bryozoa	Gymnolaemata	<i>Eurystomella bilabiata</i>		P	P		
Bryozoa	Gymnolaemata	<i>Filicrisia franciscana</i>				X	<i>Filicrisia franciscana</i>
Bryozoa	Gymnolaemata	<i>Flustrellidra corniculata</i>		C	C	X	<i>Flustrellidra corniculata</i>
Bryozoa	Gymnolaemata	<i>Membranipora spp</i>	X				
Chordata	Tunicata	<i>Aplidium californicum</i>		C	A		
Chordata	Tunicata	<i>Aplidium solidum</i>		C	P		
Chordata	Tunicata	<i>Aplidium spp.</i>		C	P		
Chordata	Tunicata	<i>Archidistoma ritteri</i>		P	C		
Chordata	Tunicata	<i>Chelysoma columbium</i>		C	P		
Chordata	Tunicata	<i>Clavelina huntsmani</i>		C	C		
Chordata	Tunicata	<i>Ritterella spp</i>		P	A		
Chordata	Tunicata	<i>Ritterella spp</i>		C	A		
Chordata	Tunicata	<i>Styela montereyensis</i>	X	P	C	X	<i>Styela montereyensis</i>
Cnidaria	Anthozoa	<i>Anthopleura artemisia</i>		P	P	X	<i>Anthopleura Artemisia</i>
Cnidaria	Anthozoa	<i>Anthopleura elegantissima</i>	X	A	A	X	<i>Anthopleura elegantissima</i>
Cnidaria	Anthozoa	<i>Anthopleura sola</i>	X				
Cnidaria	Anthozoa	<i>Anthopleura xanthogrammica</i>	X	A	A	X	<i>Anthopleura xanthogrammica</i>
Cnidaria	Anthozoa	<i>Balanophyllia elegans</i>		R	R	X	<i>Balanophyllia elegans</i>
Cnidaria	Anthozoa	<i>Epiactis prolifera</i>		U	U	X	<i>Epiactis prolifera</i>
Cnidaria	Anthozoa	<i>Tealia coriacea</i>		U	U	X	<i>Tealia coriacea</i>
Cnidaria	Anthozoa	<i>Tealia crassicornis</i>		U	U	X	<i>Tealia crassicornis</i>
Cnidaria	Hydrozoa	<i>Abietinaria spp</i>		P	P	X	<i>Abietinaria spp</i>
Cnidaria	Hydrozoa	<i>Aglaophenia latirostris</i>		P	P	X	<i>Aglaophenia sp</i>
Cnidaria	Hydrozoa	<i>Dynanmena operculata</i>		C	C		
Cnidaria	Hydrozoa	<i>Ectopleura marina</i>		P	P	X	<i>Tubularia marina</i>
Cnidaria	Hydrozoa	<i>Ectopleura spp</i>				X	<i>Tubularia spp</i>
Cnidaria	Hydrozoa	<i>Eudendrium californicum</i>				X	<i>Eudendrium californicum</i>
Cnidaria	Hydrozoa	<i>Garveia annulata</i>		P	P	X	<i>Garveia annulata</i>
Cnidaria	Hydrozoa	<i>Obelia dichotoma</i>		C	C	X	<i>Obelia geniculata</i>
Cnidaria	Hydrozoa	<i>Plumularia spp</i>		P	P		
Cnidaria	Hydrozoa	<i>Sertularia turgidus</i>		C	C		
Cnidaria	Hydrozoa	<i>Sertularia furcata</i>		C	P		
Cnidaria	Hydrozoa	<i>Thuiaria spp</i>		U	U		
Echinodermata	Astroidea	<i>Patiria mminiata</i>	X	U	U		
Echinodermata	Astroidea	<i>Dermasterias imbricata</i>	X	P	C	X	<i>Dermasterias imbricate</i>
Echinodermata	Astroidea	<i>Evasterias troschelii</i>		P	P	X	<i>Evasterias troschelii</i>
Echinodermata	Astroidea	<i>Henricia leviuscula</i>	X	P	P	X	<i>Henricia leviuscula</i>
Echinodermata	Astroidea	<i>Henricia sanguinolenta</i>		P	P		
Echinodermata	Astroidea	<i>Leptasterias hexactis</i>	X	C	C	X	<i>Leptasterias hexactis</i>
Echinodermata	Astroidea	<i>Leptasterias pusilla</i>				X	<i>Leptasterias pusilla</i>
Echinodermata	Astroidea	<i>Pisaster ochraceus</i>		A	A	X	<i>Pisaster ochraceus</i>
Echinodermata	Astroidea	<i>Pycnopodia helianthoides</i>	X	C	C	X	<i>Pycnopodia helianthoides</i>
Echinodermata	Astroidea	<i>Solaster stimpsoni</i>		P	U	X	<i>Solaster stimpsoni</i>
Echinodermata	Echinoidea	<i>Strongylocentrotus purpuratus</i>		P	C	X	<i>Strongylocentrotus purpuratus</i>

Phylum	Class	Current Scientific Name	DMN/ SWAT	END 2005	FKC 2005	B&D 1977	Name Used by B&D 1977
Echinodermata	Holothuroidea	<i>Cucumaria miniata</i>		P	P	X	<i>Cucumaria miniata</i>
Echinodermata	Holothuroidea	<i>Eupentacta quinquesemita</i>		U	C	X	<i>Eupentacta quinquesemita</i>
Echinodermata	Ophiuroidea	<i>Ophiopholis aculeata</i>				X	<i>Ophiopholis aculeate</i>
Mollusca	Bivalvia	<i>Clinocardium nuttallii</i>		R		X	<i>Clinocardium nuttallii</i>
Mollusca	Bivalvia	<i>Crassadoma spp</i>		P	P	X	<i>Hinnites giganteus</i>
Mollusca	Bivalvia	<i>Mya arenaria</i>		P	U		
Mollusca	Bivalvia	<i>Mytilus californianus</i>	X	A	A	X	<i>Mytilus californianus</i>
Mollusca	Bivalvia	<i>Pododesmus cepio</i>		P	P	X	<i>Pododesmus cepio</i>
Mollusca	Bivalvia	<i>Protothaca staminea</i>		U	P	X	<i>Protothaca staminea</i>
Mollusca	Cephalopoda	<i>Enteroctopus dofleini</i>		R	U	X	<i>Octopus dofleini</i>
Mollusca	Gastropoda	<i>Acanthinucella</i>	X				
Mollusca	Gastropoda	<i>Acanthodoris nanaimoensis</i>				X	<i>Acanthodoris nanaimoensis</i>
Mollusca	Gastropoda	<i>Acmaea mitra</i>	X	P	P	X	<i>Acmaea mitra</i>
Mollusca	Gastropoda	<i>Aeolidia papillosa</i>				X	<i>Aeolidia papillosa</i>
Mollusca	Gastropoda	<i>Alia carinata</i>	X	P	P	X	<i>Mitrella carinata</i>
Mollusca	Gastropoda	<i>Amphissa columbiana</i>		C	C		
Mollusca	Gastropoda	<i>Amphissa versicolor</i>	X	C	C	X	<i>Amphissa versicolor</i>
Mollusca	Gastropoda	<i>Anisodoris nobilis</i>		U	U	X	<i>Antiopella barbarensis</i>
Mollusca	Gastropoda	<i>Archidoris montereyensis</i>		P	U		
Mollusca	Gastropoda	<i>Barleeia spp</i>				X	<i>Barleeia spp</i>
Mollusca	Gastropoda	<i>Bittium eschrichtii</i>		U	R	X	<i>Bittium eschrichtii</i>
Mollusca	Gastropoda	<i>Cadlina inteomarginata</i>		U	U		
Mollusca	Gastropoda	<i>Calliostoma canaliculatum</i>		P	U		
Mollusca	Gastropoda	<i>Calliostoma ligatum</i>		U	P	X	<i>Calliostoma ligatum</i>
Mollusca	Gastropoda	<i>Ceratostoma foliatum</i>		U	U	X	<i>Ceratostoma foliatum</i>
Mollusca	Gastropoda	<i>Coryphella pricei</i>				X	<i>Coryphella pricei</i>
Mollusca	Gastropoda	<i>Coryphella trilineata</i>				X	<i>Coryphella trilineata</i>
Mollusca	Gastropoda	<i>Cutiona spp</i>			R		
Mollusca	Gastropoda	<i>Dendronotus albopunctuatus</i>		U	U	X	<i>Dendronotus frondosus</i>
Mollusca	Gastropoda	<i>Dendronotus frondosus</i>				X	<i>Diodora aspera</i>
Mollusca	Gastropoda	<i>Diaulula sandiegensis</i>	X	U	U	X	<i>Diaulula sandiegensis</i>
Mollusca	Gastropoda	<i>Diodora aspera</i>		U	R		
Mollusca	Gastropoda	<i>Dirona albolineata</i>				X	<i>Dirona albolineata</i>
Mollusca	Gastropoda	<i>Dirona picta</i>	X	U	P	X	<i>Dirona picta</i>
Mollusca	Gastropoda	<i>Doto amyra</i>				X	<i>Doto amyra</i>
Mollusca	Gastropoda	<i>Homalopoma luridum</i>		P	P		
Mollusca	Gastropoda	<i>Janolus barbarensis</i>		U	U		
Mollusca	Gastropoda	<i>Janolus fuscus</i>		U	P		
Mollusca	Gastropoda	<i>Lacuna marmorata</i>	X	P	P	X	<i>Lacuna spp</i>
Mollusca	Gastropoda	<i>Lacuna porrecta</i>	X	C	C	X	<i>Lacuna porrecta</i>
Mollusca	Gastropoda	<i>Lamellaria spp</i>				X	<i>Lamellaria spp</i>
Mollusca	Gastropoda	<i>Lirabuccinum dirum</i>	X	U	U	X	<i>Searlesia dira</i>
Mollusca	Gastropoda	<i>Littorina keenae</i>		C	C		
Mollusca	Gastropoda	<i>Littorina scutulata</i>	X	A	A	X	<i>Littorina scutulata</i>
Mollusca	Gastropoda	<i>Lottia austrodigitalis/digitalis</i>	X	A	A	X	<i>Collisella digitalis</i>
Mollusca	Gastropoda	<i>Lottia limatula</i>	X				

Phylum	Class	Current Scientific Name	DMN/ SWAT	END 2005	FKC 2005	B&D 1977	Name Used by B&D 1977
Mollusca	Gastropoda	<i>Lottia paradigitalis/strigatella</i>	X	C	C		
Mollusca	Gastropoda	<i>Lottia pelta</i>	X	A	A	X	<i>Collisella pelta</i>
Mollusca	Gastropoda	<i>Lottia persona</i>				X	<i>Notoacmaea persona</i>
Mollusca	Gastropoda	<i>Lottia scutum</i>	X		C	X	<i>Notoacmaea scutum</i>
Mollusca	Gastropoda	<i>Lottia strigatella</i>		C		X	<i>Collisella strigatella</i>
Mollusca	Gastropoda	<i>Macclintockia scabra</i>				X	<i>Collisella scabra</i>
Mollusca	Gastropoda	<i>Margarites pupillus</i>			C	X	<i>Margarites pupillus</i>
Mollusca	Gastropoda	<i>Nitidiscala tinctoria</i>		C	U		
Mollusca	Gastropoda	<i>Nucella canaliculata</i>		P	R	X	<i>Nucella canaliculata</i>
Mollusca	Gastropoda	<i>Nucella lamellosa</i>		U	R	X	<i>Nucella lamellosa</i>
Mollusca	Gastropoda	<i>Nucella ostrina</i>	X	A	A	X	<i>Nucella emarginata</i>
Mollusca	Gastropoda	<i>Nuttallina spp</i>	X				
Mollusca	Gastropoda	<i>Ocenebrina lurida</i>		U	U	X	<i>Ocenebra lurida</i>
Mollusca	Gastropoda	<i>Onchidella borealis</i>		P	C	X	<i>Onchidella borealis</i>
Mollusca	Gastropoda	<i>Opalia chacei</i>		U	U		
Mollusca	Gastropoda	<i>Phidiana crassicornis</i>	X	P	P	X	<i>Hermisenda crassicornis</i>
Mollusca	Gastropoda	<i>Rostanga pulchra</i>		U	P	X	<i>Rostanga pulchra</i>
Mollusca	Gastropoda	<i>Tectura paleacea</i>		C	C		
Mollusca	Gastropoda	<i>Tectura persona</i>		U			
Mollusca	Gastropoda	<i>Tectura scutum</i>		U	U		
Mollusca	Gastropoda	<i>Tegula funebris</i>	X	A	A	X	<i>Tegula funebris</i>
Mollusca	Gastropoda	<i>Tricolia spp</i>				X	<i>Tricola spp</i>
Mollusca	Gastropoda	<i>Trinchesia spp</i>				X	<i>Trinchesia spp</i>
Mollusca	Gastropoda	<i>Triopha catilinae</i>		U	U		
Mollusca	Gastropoda	<i>Triopha maculata</i>		U	U		
Mollusca	Gastropoda	<i>Tritonia festiva</i>				X	<i>Tritonia festiva</i>
Mollusca	Polyplacophora	<i>Chaetopleura gemma</i>				X	<i>Chaetopleura gemma</i>
Mollusca	Polyplacophora	<i>Cryptochiton stelleri</i>	X	U	R	X	<i>Cryptochiton stelleri</i>
Mollusca	Polyplacophora	<i>Lepidochitona (Cyanoplax) denti</i>	X	P	P	X	<i>Cyanoplax denti</i>
Mollusca	Polyplacophora	<i>Katharina tunicata</i>	X	C	C	X	<i>Katharina tunicata</i>
Mollusca	Polyplacophora	<i>Lepidozona mertensii</i>	X	P	P	X	<i>Lepidozona mertensii</i>
Mollusca	Polyplacophora	<i>Mopalia ciliata</i>		C	C	X	<i>Mopalia ciliata</i>
Mollusca	Polyplacophora	<i>Mopalia hindsi</i>		P	P	X	<i>Mopalia hindsi</i>
Mollusca	Polyplacophora	<i>Mopalia lignosa</i>		P	P	X	<i>Mopalia lignosa</i>
Mollusca	Polyplacophora	<i>Mopalia muscosa</i>		P	P	X	<i>Mopalia muscosa</i>
Mollusca	Polyplacophora	<i>Tonicella lineata</i>	X	C	C	X	<i>Tonicella lineata</i>
Nemertea	Anopla	<i>Amphiporus imparispinosus</i>				X	<i>Amphiporus imparispinosus</i>
Nemertea	Anopla	<i>Emplectonema gracile</i>		P	P		
Nemertea	Anopla	<i>Paranemertes peregrina</i>		C	C	X	<i>Paranemertes peregrina</i>
Nemertea	Anopla	<i>Tubulanus polymorphus</i>		U	P		
Nemertea	Anopla	<i>Tubulanus sexlineatus</i>		P	P		
Porifera	Demospongia	<i>Cliona celata</i>		U	P	X	<i>Cliona celata</i>
Porifera	Demospongia	<i>Dysidea fragilis</i>		P	P		
Porifera	Demospongia	<i>Halichondria panicea</i>		P	P	X	<i>Halichondria panicea</i>
Porifera	Demospongia	<i>Halichondria spp</i>		P	C		
Porifera	Demospongia	<i>Haliclona ecbasis</i>		P	P		

Phylum	Class	Current Scientific Name	DMN/ SWAT	END 2005	FKC 2005	B&D 1977	Name Used by B&D 1977
Porifera	Demospongia	<i>Haliclona permollis</i>		P	P		
Porifera	Demospongia	<i>Haliclona spp</i>		U	C	X	
Porifera	Demospongia	<i>Hymendectyon lyoni</i>				X	<i>Hymendectyon lyoni</i>
Porifera	Demospongia	<i>Hymeniacidon ungodon</i>				X	<i>Hymeniacidon ungodon</i>
Porifera	Demospongia	<i>Mycale macginitiei</i>		P	C	X	<i>Mycale macginitiei</i>
Porifera	Demospongia	<i>Mycale richardsoni</i>				X	<i>Mycale richardsoni</i>
Porifera	Demospongia	<i>Neoesperiopsis digitata</i>		C	C		
Porifera	Demospongia	<i>Ophlitaspongia pennata</i>		U	P	X	<i>Ophlitaspongia pennata</i>
Porifera	Demospongia	<i>Pachychalina lunisimilis</i>				X	<i>Pachychalina lunisimilis</i>
Porifera	Demospongia	<i>Reniera spp</i>				X	<i>Reniera spp</i>
Porifera	Demospongia	<i>Sigmatocia spp</i>				X	<i>Sigmatocia spp</i>
Porifera	Demospongia	<i>Suberites spp</i>		C	C	X	<i>Suberites spp</i>
Sipuncula		<i>Phascolosoma agassizii</i>		U	U		
Sipuncula		<i>Themiste pyroides</i>		P	C	X	<i>Themiste pyroides</i>

A = Abundant, C = Common, P = Present, U = Uncommon, R = Rare

M. J. Boyd and J. D. DeMartini, 1977. The Intertidal and Subtidal Biota of Redwood National Park. Submitted in fulfillment of U. S. Department of the Interior, National Park Service Contract No. CX8480 - 4 -0665. 162 p.

M. J. Boyd and J. D. DeMartini, 1981. Reconnaissance Survey of Redwood Natl. Park Area of Special Biological Significance. Calif. Fish Game Report. 121 p.

APPENDIX D: SITE INFORMATION

False Klamath Cove

GPS Coordinates

Up-coast site boundary: N 41.59377, W 124.10773

Site center: N 41.59476, W 124.10643

Down-coast site boundary: N 41.59526, W 124.10513

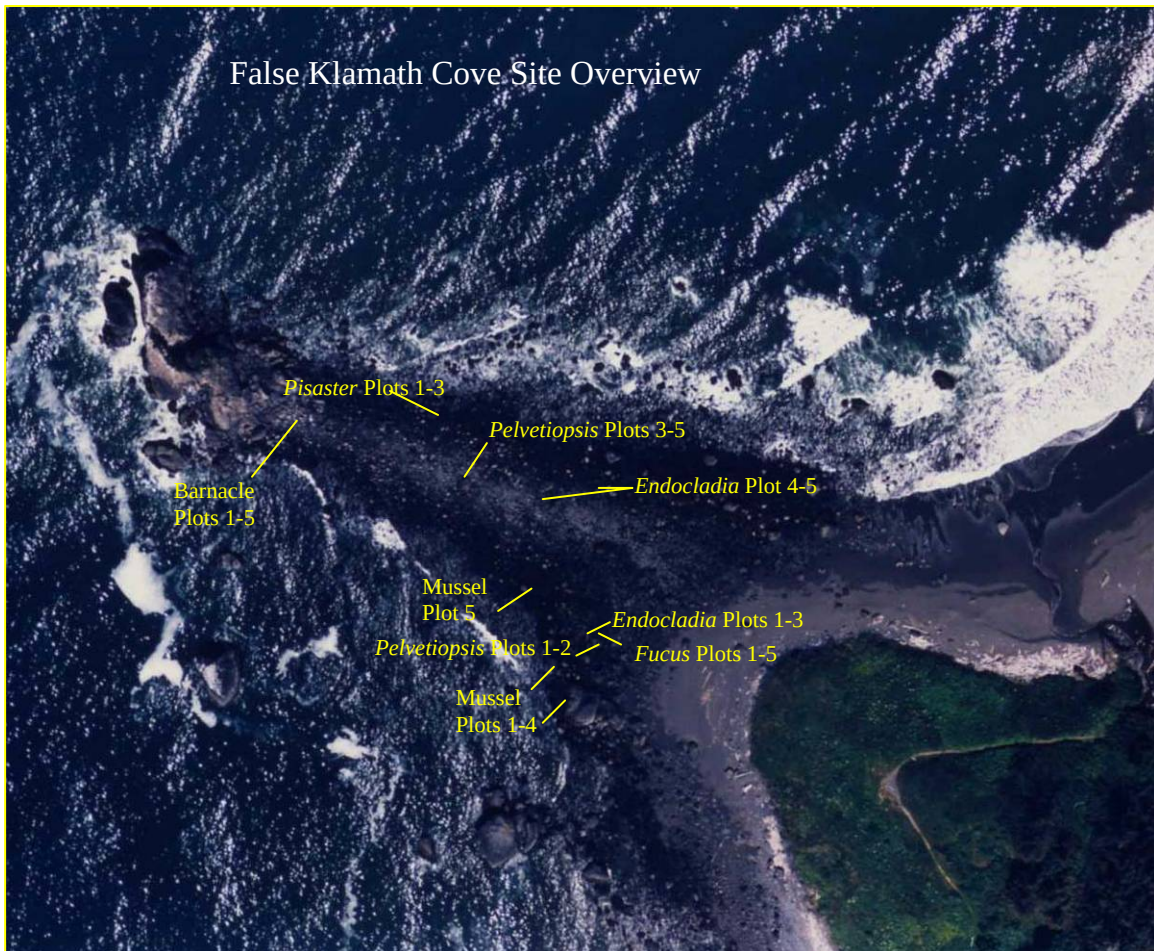


Photo courtesy of Redwood National Park

False Klamath Cove Barnacles Plots



From	To	Distance (m)	Bearing (degrees)
B1	B2	12.1	21 NE
B2	B3	4.8	272 NW
B3	B4	9.3	314 NW
B3	B5	9.8	306 NW
B4	B5	1.1	330 NW

False Klamath Cove *Endocladia* Plots



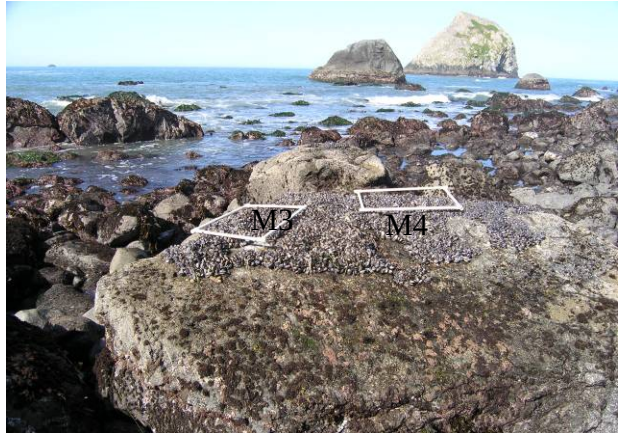
From	To	Distance (m)	Bearing (degrees)
E1	E2	0.9	329 NW
E2	E3	1.9	339 NW
E3	E4	43.9	12 NNE
E3	E5	49.6	4 NNE
E4	E5	13.8	55 NE
E1	M5	32.7	280 NW

False Klamath Cove *Fucus* Plots



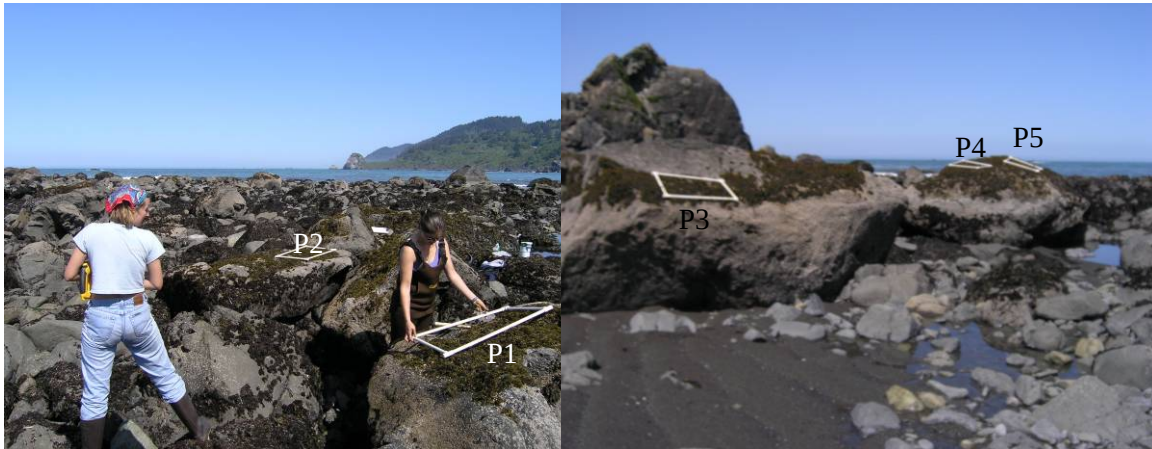
From	To	Distance (m)	Bearing (degrees)
F1	F2	1.2	249 WSW
F2	F3	1.5	350 NW
F3	F4	1.0	260 W
F4	F5	0.8	340 NW
F1	M3	21.3	200 SW
F1	P2	4.8	210 SW

False Klamath Cove Mussel Plots



From	To	Distance (m)	Bearing (degrees)
M1	M2	2.9	300 NW
M2	M3	17.6	305 NW
M3	M4	1.1	315 NW
M4	M5	42.7	305 NW

False Klamath Cove *Pelvetiopsis* Plots



From	To	Distance (m)	Bearing (degrees)
P1	P2	4.7	304 NW
P2	P3	47.5	310 NW
P3	P4	9.3	330 NW
P4	P5	1.1	15 NE

Enderts Beach

GPS Coordinates

Up-coast site boundary: N 41.69592, W 124.14245

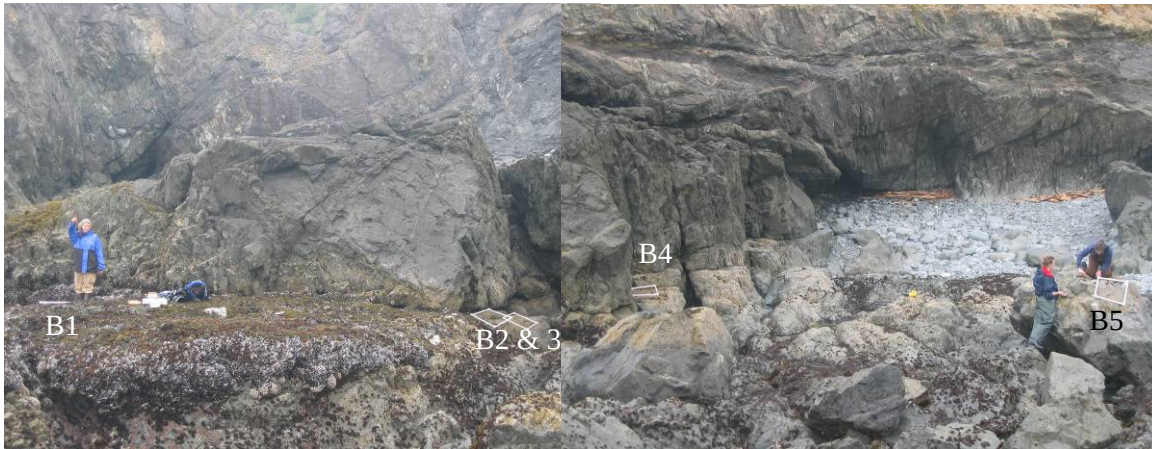
Site center: N 41.69590, W 124.14257

Down-coast site boundary: N 41.69526, W 124.14255



Photo courtesy of Redwood National Park

Enderts Beach Barnacle Plots



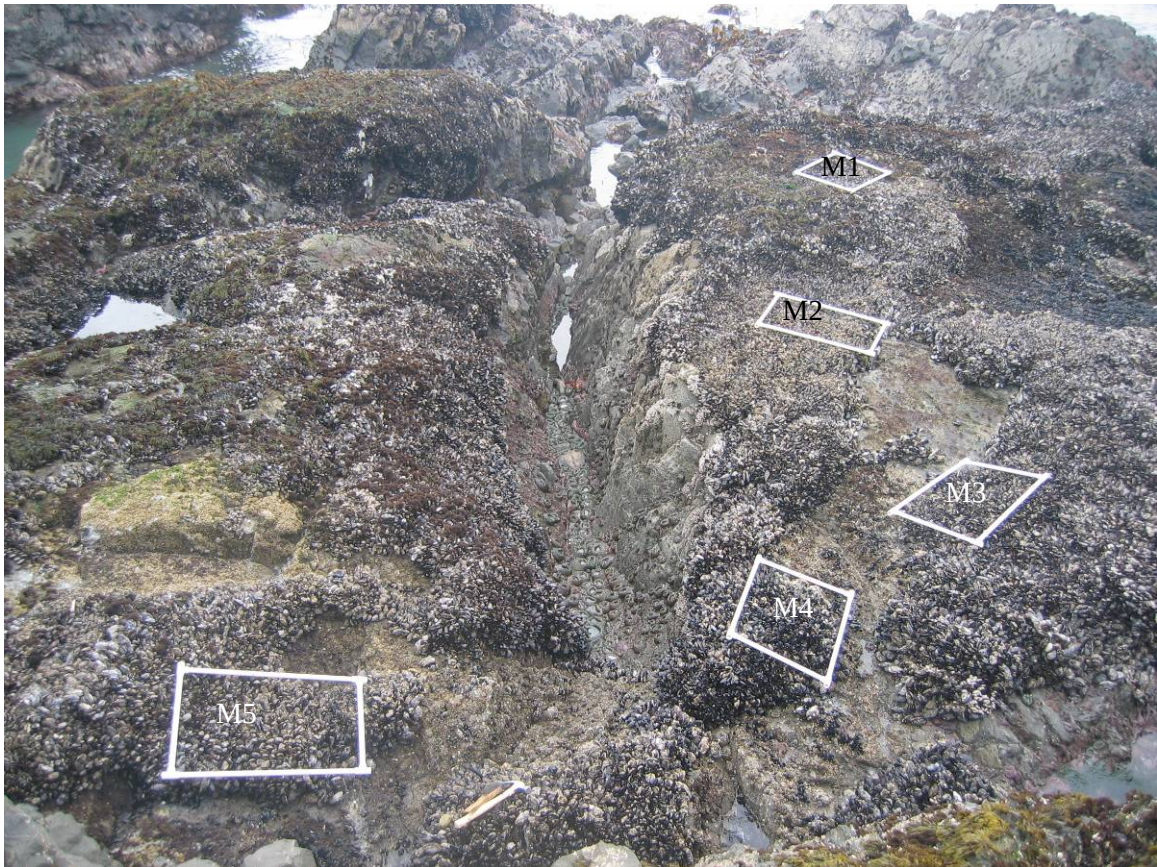
From	To	Distance (m)	Bearing (degrees)
B1	B2	8.0	110 W
B2	B3	1.08	268 W
B3	B4	7.4	146 S
B4	B5	9.2	178 SW
B1	M5	2.5	0 N

Enderts Beach *Endocladia* Plots



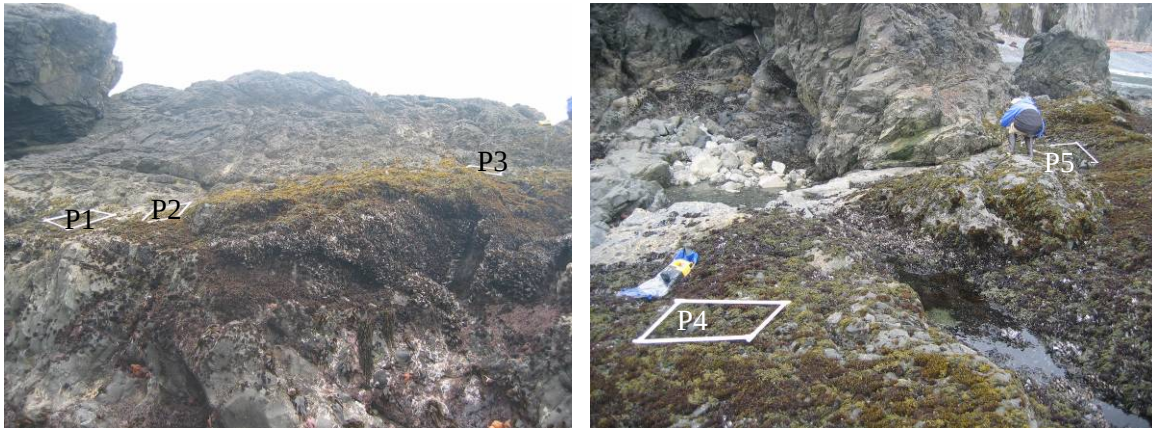
From	To	Distance (m)	Bearing (degrees)
E1	E2	2.8	144 SE
E2	E3	6.6	138 SE
E3	E4	7.4	327 NW
E4	E5	5.9	154 SE
E3	P4	18.6	164 SE

Enderts Beach Mussel Plots



From	To	Distance (m)	Bearing (degrees)
M1	M2	2.9	50 NE
M2	M3	1.5	30 NE
M3	M4	1.4	60 NE
M4	M5	2.8	100 SE

Enderts Beach *Pelvetiopsis* Plots



From	To	Distance (m)	Bearing (degrees)
P1	P2	5.0	80 E
P2	P3	2.2	92 E
P4	P5	6.9	118 E
P1	B1	8.6	224 SW

Damnation Creek

GPS Coordinates

Up-coast site boundary: N 41.65301, W 124.12907

Site center: N 41.65249, W 124.12784

Down-coast site boundary: N 41.65168, W 124.12696



Photo courtesy of Redwood National Park

Damnation Creek Barnacle Plots



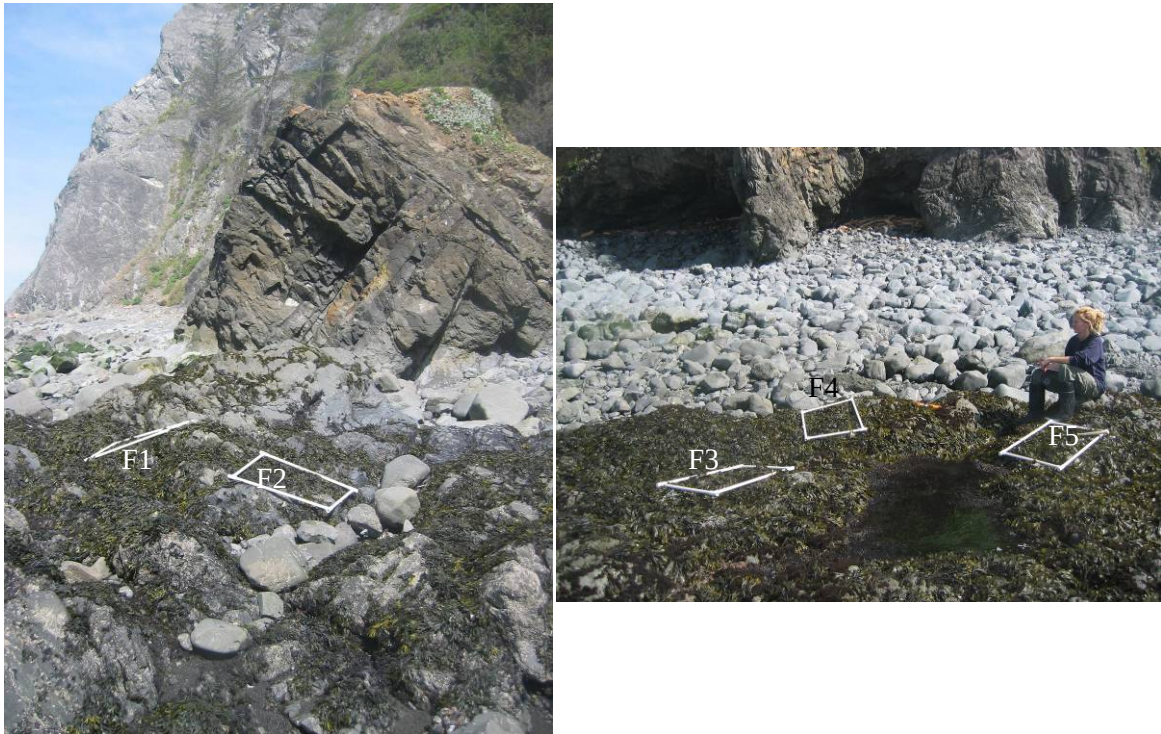
From	To	Distance (m)	Bearing (degrees)
B1	B2	1.2	98 SE
B2	B3	1.3	32 NE
B3	B4	17.4	108 SE
B4	B5	7.3	200 SW

Damnation Creek *Endocladia* Plots



From	To	Distance (m)	Bearing (degrees)
E1	E2	5.5	140 SE
E2	E3	3.8	215 SW
E3	E4	42.6	118 SE
E4	E5	6.4	42 NE
E4	B5	17.5	120 SE

Damnation Creek *Fucus* Plots



From	To	Distance (m)	Bearing (degrees)
F1	F2	1.7	91 NE
F2	F3	27.5	125 SE
F3	F4	2.8	30 NE
F4	F5	1.9	180 S
F1	M1	111.0	280 NW

Damnation Creek Mussel Plots



From	To	Distance (m)	Bearing (degrees)
M1	M2	1.3	232 SW
M2	M3	1.2	233 SW
M3	M4	2.1	245 W
M4	M5	1.7	0 N

Damnation Creek Mussel Plots (near creek outflow)



From	To	Distance (m)	Bearing (degrees)
MFW1	MFW2	6.2	30 NE
MFW2	MFW3	7.9	180 S
MFW3	MFW4	3.7	80 NE
MFW4	MFW5	9.1	230 SW
MFW1	F5	8.3	90 E

APPENDIX E: RAW INTERTIDAL MONITORING DATA

Percent Cover Data:

Barnacles

	Date	Barnacles		Rock		Non-Coralline Crust		<i>Endocladia</i>		<i>Porphyra</i>	
		mean %	std. dev.	mean %	std. dev.	mean %	std. dev.	mean %	std. dev.	mean %	std. dev.
DMN	Jun-2004	63.2	18.39021	15.6	10.50238	0.8	1.303841	5	3.807887	9.8	15.00667
DMN	Aug-2004	48.8	16.14621	24.6	14.01071	0.2	0.447214	6.2	4.494441	12	16.83746
DMN	Oct-2004	39.2	17.36951	47	14.12445	2.6	3.781534	4	1	3.2	5.215362
DMN	Jan-2005	30.4	21.73246	62.8	25.24282	1.4	2.19089	1.6	2.073644	0	0
DMN	Apr-2005	35.6	15.46932	51.2	23.66854	2.2	1.923538	3.8	2.774887	0	0
DMN	Jun-2005	30	14.71394	56	25.7779	1.6	1.516575	5	5.147815	1.6	2.50998
DMN	Nov-2005	32.2	9.257429	44.8	15.25451	5.8	4.549725	8.8	9.884331	0.4	0.547723
END	Jun-2004	41.4	18.67619	38.8	29.02068	4.2	6.26099	0.6	1.341641	2.2	4.91935
END	Aug-2004	45.4	14.53616	37.2	16.05304	3.4	4.722288	1	1.732051	1	1.732051
END	Oct-2004	63	11.59741	18	6.745369	2.8	4.086563	1.8	2.48998	0.4	0.894427
END	Jan-2005	54.8	14.4118	27	6.928203	3.8	4.494441	4.6	5.727129	0.2	0.447214
END	Apr-2005	53.4	22.78815	20.2	7.259477	2.2	1.923538	3.8	4.381781	1.8	2.683282
END	Jun-2005	47.8	19.46022	14	5.91608	4.4	3.209361	4.4	4.97996	10.8	9.731393
END	Nov-2005	32.6	21.6864	27.6	10.01499	7.8	9.95992	6.8	9.833616	2.6	3.781534
FKC	Jun-2004	32.4	32.41605	64	30.35622						
FKC	Aug-2004	21.8	10.35374	73.4	9.633276						
FKC	Oct-2004	85.4	3.04959	10.2	5.403702						
FKC	Jan-2005	91.2	3.898718	5.6	3.577709						
FKC	Apr-2005	80.8	5.890671	15.6	6.14817						
FKC	Jun-2005	30.2	16.39207	64.8	17.51285						
FKC	Nov-2005	52	14.86607	36.2	22.28677						

Endocladia

	Date	<i>Fucus</i>		Non-Coralline Crust		<i>Endocladia</i>		Rock	
		mean %	std. dev.	mean %	std. dev.	mean %	std. dev.	mean %	std. dev.
DMN	Jun-2004	0	0	2.4	1.81659	84	4.582576	10	4.636809
DMN	Aug-2004	0	0	2.2	2.949576	69	7.681146	24.6	9.838699
DMN	Oct-2004	0.2	0.447214	4.6	3.781534	47	12.38951	39.8	12.41773
DMN	Jan-2005	0.4	0.547723	9.6	14.01071	33	18.23458	54	19
DMN	Apr-2005	0.6	0.894427	9.4	15.05988	39.2	26.53677	46.8	23.56268
DMN	Jun-2005	1.4	2.19089	2	3.464102	52	27.70379	38.8	21.99318
DMN	Nov-2005	10	11.46735	3	4	63.8	21.85635	17	6.041523
END	Aug-2004			2.2	2.48998	86	9.77241	12.6	5.59464
END	Oct-2004			12.4	7.893035	80.2	9.757049	15.4	2.607681
END	Jan-2005			8.8	6.418723	51.8	11.41052	33.6	6.76757
END	Apr-2005			3.2	3.114482	71.8	11.81948	18.2	10.18332
END	Jun-2005			0.8	0.83666	64.8	13.60882	7	3.674235
END	Nov-2005			11.6	8.961027	42.2	18.30847	11.4	4.774935
END	Jun-2004			0.2	0.447214	58.4	10.71448	7.4	3.974921
FKC	Jun-2004	8	7.483315			69.6	14.75805	16.8	13.98928
FKC	Aug-2004	5.6	6.024948			62	5.385165	28.4	8.142481
FKC	Oct-2004	3.8	3.114482			60	14.50862	24	8.3666
FKC	Jan-2005	1.6	2.607681			64	18.98684	29.2	15.8019
FKC	Apr-2005	2	2.54951			81.8	9.523655	10.8	3.563706
FKC	Jun-2005	4.6	6.387488			71.8	13.27403	14.2	4.764452
FKC	Nov-2005	12.4	15.66206			62.8	15.02332	15.8	7.661592

Fucus

	Date	<i>Fucus</i>		<i>Endocladia</i>		Rock		Non-Coralline Crust	
		mean %	std. dev.	mean %	std. dev.	mean %	std. dev.	mean %	std. dev.
DMN	Jun-2004	96.4	2.408319	0.4	0.894427	2.4	2.302173		
DMN	Aug-2004	85.6	6.580274	0.6	1.341641	12.2	5.357238		
DMN	Oct-2004	77	10.48809	3.6	8.049845	17.4	11.39298		
DMN	Jan-2005	66.4	19.34683	2.8	5.215362	28.4	19.03418		
DMN	Apr-2005	68	12.64911	4	8.396428	21.6	10.47855		
DMN	Jun-2005	71	19.18333	5.2	8.899438	14.2	10.70981		
DMN	Nov-2005	81.4	15.69395	5.6	12.52198	7.4	3.130495		
FKC	Jun-2004	89	6.324555			3	3.316625	3	3.535534
FKC	Aug-2004	90.4	3.507136			2.8	1.923538	3.4	3.507136
FKC	Oct-2004	88.4	5.85662			3.4	4.393177	4.6	3.911521
FKC	Jan-2005	83.4	7.829432			4.8	5.44977	8.2	6.978539
FKC	Apr-2005	80.4	8.264381			5	5.385165	9.6	7.829432
FKC	Jun-2005	76.4	9.09945			8.8	7.52994	8.4	3.911521
FKC	Nov-2005	48	6.123724			9.8	9.731393	28.8	13.93557

Mussels

	Date	Mussels		<i>Pollicipes</i>		Rock	
		mean %	std. dev.	mean %	std. dev.	mean %	std. dev.
DMN	Jun-2004	97	5.09902	0	0	0.6	0.894427
DMN	Aug-2004	96.6	4.97996	0.4	0.894427	0.8	1.303841
DMN	Oct-2004	96.4	4.505552	0	0	1.2	1.643168
DMN	Jan-2005	94.2	7.155417	0.2	0.447214	4.4	6.228965
DMN	Apr-2005	95	4.743416	1	2.236068	2.2	1.788854
DMN	Jun-2005	95.2	7.120393	0.2	0.447214	2.2	2.683282
DMN	Nov-2005	96.2	4.266146	0.6	1.341641	2.4	2.880972
END	Jun-2004	95.2	4.086563	2.2	2.280351	0.8	1.303841
END	Aug-2004	96.2	3.49285	2	2.44949	0.6	0.894427
END	Oct-2004	97.2	1.095445	1.2	1.095445	0.8	1.303841
END	Jan-2005	97	2	2.8	1.923538	0.2	0.447214
END	Apr-2005	97.2	3.420526	2.6	3.130495	0.2	0.447214
END	Jun-2005	97.2	1.095445	2.8	1.095445	0	0
END	Nov-2005	97	2	2.8	2.167948	0	0
FKC	Jun-2004	94	3.316625	1.6	2.073644	2.8	3.420526
FKC	Aug-2004	94.2	4.764452	1.8	2.167948	2.8	3.420526
FKC	Oct-2004	84.8	14.44645	1.4	1.949359	12.2	13.70037
FKC	Jan-2005	88.8	13.91761	1.4	2.19089	8.4	12.77889
FKC	Apr-2005	86.6	12.75931	1.2	2.167948	10.8	12.27599
FKC	Jun-2005	83.2	18.9921	2	2.828427	5.8	6.220932
FKC	Nov-2005	87.8	13.84558	1.6	1.341641	4.4	4.929503

Mobile Invertebrate Data

Barnacles

	Date	<i>Nucella ostrina</i>		<i>Tegula funebris</i>		Limpets		Littorines	
		Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.
FKC	Jun-2004	0	0			128.75	58.22404	1057.5	414.1746
FKC	Aug-2004	0	0			153.9	91.90951	2097.5	511.957
FKC	Oct-2004	1	1			88.125	25.43374	2760	517.3158
FKC	Jan-2005	1.2	1.2			146.875	56.10224	3737.5	1094.739
FKC	Apr-2005	2.8	2.332381			118.75	29.18154	3882.5	516.8504
FKC	Jun-2005	0.2	0.2			35	15.91604	2935	1135.385
DMN	Jun-2004	0	0	0	0	195.625	44.65143	1777.5	341.4903
DMN	Aug-2004	2.8	1.157584	0	0	401.25	63.04915	1120	525.4849
DMN	Oct-2004	21.2	8.175573	2.2	1.157584	1195.625	391.4861	30	11.59202
DMN	Jan-2005	0.4	0.244949	5.8	2.672078	779.375	200.5622	137.5	51.99159
DMN	Apr-2005	1	1	0	0	81.875	33.3278	1185	196.4291
DMN	Jun-2005	11.4	8.417838	0	0	324.375	100.4015	3490	281.8854
END	Jun-2004	18.6	17.85945	0	0	187.5	22.16328	2362.5	580.4363
END	Aug-2004	25.6	21.72694	0	0	286.25	54.81325	1312.5	278.0513
END	Oct-2004	7.2	5.083306	1.4	0.748331	150	63.1683	1245	492.4524
END	Jan-2005	3.2	1.593738	0.6	0.4	597.5	228.1537	785	268.2524
END	Apr-2005	3.6	1.43527	0.4	0.4	306.875	154.0482	2495	678.5624
END	Jun-2005	26.2	14.77295	0	0	307.5	52.57621	2177.5	935.4093

Endocladia

	Date	<i>Nucella ostrina</i>		<i>Tegula funebris</i>		Limpets		Littorines	
		Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.
FKC	Jun-2004	0	0			103.75	8.580956	360	142.1597
FKC	Aug-2004	0.4	0.244949			221.875	34.24692	800	245.0765
FKC	Oct-2004	2.8	1.462874			111.875	50.60571	412.5	360.5335
FKC	Jan-2005	4.6	2.95973			122.5	14.02425	1187.5	112.5694
FKC	Apr-2005	1.2	0.969536			85.625	3.217384	765	235.8959
FKC	Jun-2005	0.2	0.2			78.125	20.08284	217.5	75.68438
DMN	Jun-2004	0	0	0	0	178.125	41.16231	25	14.25219
DMN	Aug-2004	14	2.04939	1.8	0.583095	432.5	74.87359	40	28.33946
DMN	Oct-2004	2.8	0.969536	24.8	6.359245	518.125	93.75208	5.4	4.915282
DMN	Jan-2005	12.2	6.272161	3.6	0.927362	243.75	59.76026	5	3.061862
DMN	Apr-2005	5.2	2.2	0.2	0.2	229.375	229.375	170	170
DMN	Jun-2005	3.8	1.984943	1.4	1.16619	181.25	31.21873	785	534.9562
END									
END	Jun-2004	0.2	0.2			346.25	69.67699	30	24.2384
END	Aug-2004	0	0			684.375	98.29106	10	10
END	Oct-2004	0	0			279.375	130.5248	2114.888	1702.122
END	Jan-2005	6.8	4.662617			550	66.69514	47.5	16.00781
END	Apr-2005	0.6	0.6			133.125	33.05121	170	56.81659
END	Jun-2005	0.8	0.374166			203.125	21.58287	10.2	6.044833

Fucus

	Date	<i>Nucella ostrina</i>		<i>Tegula funebris</i>		Limpets		Littorines	
		Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.
FKC	Jun-2004	10.6	3.668787	14.2	5.860034	57.5	19.22828	168.125	86.15257
FKC	Aug-2004	4.2	1.624808	17.4	7.775603	115	11.99772	477.5	114.932
FKC	Oct-2004	16	6.363961	21.4	5.836095	63.75	25.93185	152.5	54.97158
FKC	Jan-2005	14.8	4.340507	22.4	2.638181	18.75	7.19429	57.5	13.46291
FKC	Apr-2005	14.8	3.023243	19.4	5.04579	41.875	7.167091	192.5	85.20197
FKC	Jun-2005	10.4	6.368673	15.2	4.409082	40.625	15.21333	80	44.12341
DMN	Jun-2004	3	2.280351	0.2	0.2	41.875	9.457966	245	41.57072
DMN	Aug-2004	1.6	0.4	0	0	108.125	17.74934	662.5	242.0937
DMN	Oct-2004	8.8	2.745906	1.6	0.509902	65	9.132274	520	113.0956
DMN	Jan-2005	3.6	1.6	0.8	0.374166	41.875	8.761154	662.5	77.76166
DMN	Apr-2005	3.8	1.428286	2	1.140175	33.75	7.680129	1282.5	527.0288
DMN	Jun-2005	3.8	1.496663	5.8	2.517936	44.375	6.658524	2057.5	128.2454

Mussels

	Date	<i>Nucella ostrina</i>		<i>Tegula funebris</i>		Limpets		Littorines	
		Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.
FKC	Jun-2004	4.6	2.56125	0.2	0.2	436.875	113.3449	0	0
FKC	Aug-2004	17.4	4.43396	1	0.774597	446.25	80.53411	48.125	32.46994
FKC	Oct-2004	42.6	25.47077	0.4	0.244949	518.125	55.10466	2.5	2.5
FKC	Jan-2005	2.2	0.969536	0	0	290.625	26.38729	12.5	0
FKC	Apr-2005	3.8	2.2	0	0	244.375	29.91524	20	10.15505
FKC	Jun-2005	2.6	1.029563	0.8	0.583095	358.125	48.81006	820	499.8844
DMN	Jun-2004	2.6	2.111871	0.6	0.4	85.625	35.07247	5.6	2.869669
DMN	Aug-2004	1.2	1.2	0.6	0.4	271.875	80.81011	6.2	2.648585
DMN	Oct-2004	5.2	2.709243	0.2	0.2	132.5	32.81399	0	0
DMN	Jan-2005	0	0.4	0.6	1.16619	100.625	36.27424	2.5	2.5
DMN	Apr-2005	4	2.607681	3.8	3.8	64.375	16.19582	112.5	47.26918
DMN	Jun-2005	14.6	3.931921	2.2	1.959592	135.625	34.75079	47.5	23.84848
END	Jun-2004	51.4	18.72592			520	73.16505	63.75	43.53294
END	Aug-2004	73.4	19.4			518.75	35.78091	272.5	134.2456
END	Oct-2004	49.6	15.17432			345.625	85.27071	737.5	300.1774
END	Jan-2005	12	3.885872			438.75	25.148	92.5	39.2508
END	Apr-2005	33.6	12.74598			85	7.868549	252.5	70.42283
END	Jun-2005	60	23.47339			187.5	22.16328	165	68.8522

Pelvetiopsis

	Date	<i>Nucella ostrina</i>		<i>Tegula funebris</i>		Limpets		Littorines	
		Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.	Mean #	std. dev.
FKC	Jun-2004	6.2	5.003998			165.625	28.67517	1466.25	673.6317
FKC	Aug-2004	1	0.632456			207.5	52.76162	1390	469.0482
FKC	Oct-2004	11.8	9.845811			61.25	32.5	872.5	387.4879
FKC	Jan-2005	0.6	0.6			110	24.75268	800	256.6917
FKC	Apr-2005	18.8	14.83712			124.375	31.1467	1860	184.2383
FKC	Jun-2005	6.6	4.04475			140	37.69999	602.5	319.3842
END	Jun-2004	0	0	0	0	156.875	18.99321	365	129.1438
END	Aug-2004	0.2	0.2	1	0.632456	158.125	27.3433	622.5	139.7207
END	Oct-2004	0.6	0.4	2.2	2.2	157.5	20.45861	784.375	238.8735
END	Jan-2005	0	0	2.6	1.661325	144.375	40.01221	440	207.643
END	Apr-2005	0	0	1.6	1.363818	236.875	37.46613	502.5	135.4045
END	Jun-2005	0.8	0.8	0	0	135	26.05958	220	91.48087

Size Distribution Data

Tegula

Site	Plot Type	Date	mean	sd
DMN	<i>Fucus</i>	Jun-04	11.9	3.62
DMN	<i>Fucus</i>	Aug-04	17.0	2.89
DMN	<i>Fucus</i>	Oct-04	16.7	3.35
DMN	<i>Fucus</i>	Jan-05	14.9	3.23
DMN	<i>Fucus</i>	Apr-05	13.1	2.38
DMN	<i>Fucus</i>	Jun-05	13.6	3.34
FKC	<i>Fucus</i>	Jun-04	11.2	2.89
FKC	<i>Fucus</i>	Aug-04	10.5	3.40
FKC	<i>Fucus</i>	Oct-04	11.8	3.79
FKC	<i>Fucus</i>	Jan-05	11.7	4.20
FKC	<i>Fucus</i>	Apr-05	11.2	3.38
FKC	<i>Fucus</i>	Jun-05	11.7	3.55

Nucella ostrina

Site	Plot Type	Date	mean	sd
DMN	Barnacle	Jun-04	14.2	2.27
DMN	Barnacle	Aug-04	15.9	1.46
DMN	Barnacle	Oct-04	15.4	2.30
DMN	Barnacle	Jan-05	12.0	4.36
DMN	Barnacle	Apr-05	14.2	2.77
DMN	Barnacle	Jun-05	13.3	1.78
DMN	<i>Fucus</i>	Jun-04	13.8	3.81
DMN	<i>Fucus</i>	Aug-04	15.3	3.19
DMN	<i>Fucus</i>	Oct-04	15.6	3.54
DMN	<i>Fucus</i>	Jan-05	13.5	7.78
DMN	<i>Fucus</i>	Apr-05	10.8	2.86
DMN	<i>Fucus</i>	Jun-05	11.8	4.06
DMN	Mussel	Jun-04	12.6	2.95
DMN	Mussel	Aug-04	15.8	2.84
DMN	Mussel	Oct-04	15.6	4.59
DMN	Mussel	Jan-05	11.5	3.54
DMN	Mussel	Apr-05	11.5	2.13
DMN	Mussel	Jun-05	14.2	2.32
END	Barnacle	Jun-04	16.5	1.71
END	Barnacle	Aug-04	15.7	3.13
END	Barnacle	Oct-04	11.8	3.37
END	Barnacle	Jan-05	13.8	4.49
END	Barnacle	Apr-05	13.2	4.83
END	Barnacle	Jun-05	13.7	3.39
END	Mussel	Jun-04	15.1	1.69
END	Mussel	Aug-04	15.6	2.30
END	Mussel	Oct-04	13.2	3.42
END	Mussel	Jan-05	13.7	3.14
END	Mussel	Apr-05	14.6	2.47
END	Mussel	Jun-05	11.8	1.96
FKC	Barnacle	Jun-04	0.0	
FKC	Barnacle	Aug-04	0.0	

FKC	Barnacle	Oct-04	10.4	2.41
FKC	Barnacle	Jan-05	8.5	1.38
FKC	Barnacle	Apr-05	11.8	2.86
FKC	Barnacle	Jun-05	11.0	0.00
FKC	<i>Fucus</i>	Jun-04	13.0	3.01
FKC	<i>Fucus</i>	Aug-04	11.3	2.17
FKC	<i>Fucus</i>	Oct-04	10.2	4.57
FKC	<i>Fucus</i>	Jan-05	10.7	4.37
FKC	<i>Fucus</i>	Apr-05	11.3	3.22
FKC	<i>Fucus</i>	Jun-05	11.3	3.50
FKC	Mussel	Jun-04	11.6	2.69
FKC	Mussel	Aug-04	13.9	3.14
FKC	Mussel	Oct-04	11.2	3.60
FKC	Mussel	Jan-05	12.9	2.88
FKC	Mussel	Apr-05	10.9	2.47
FKC	Mussel	Jun-05	10.5	3.02

APPENDIX F: SAND BEACH INVENTORY LIST

Sand Beach Invertebrates

Phylum	Class	Current Scientific Name	Old Scientific Name (Boyd)	Category or common name	B&D 1977	Crescent Beach	Gold Bluffs Beach	Redwood Creek Beach
Annelida	Polychaeta	<i>Eteone dilate</i>	<i>Eteone dilate</i>	Polychaete	X			
Annelida	Polychaeta	<i>Euzonus mucronatus</i>	<i>Euzonus mucronata</i>	Blood Worm	X	A	P	
Annelida	Polychaeta	<i>Lumbrineris zonata</i>	<i>Lumbrineris zonata</i>	Polychaete	X	U		
Annelida	Polychaeta	<i>Nephtys californiensis</i>	<i>Nephtys californiensis</i>	Blood Worm	X	A	A	C
Annelida	Polychaeta	<i>Nothria conchylega</i>	<i>Nothria iridescens</i>	Polychaete	X			
Annelida	Polychaeta	<i>Orbinia johnsoni</i>	<i>Orbinia johnsoni</i>	Polychaete	X			
Annelida	Polychaeta	<i>Pygospio californica</i>	<i>Pygospio californica</i>	Polychaete	X			
Annelida	Polychaeta	<i>Scolecopsis squamata</i>	<i>Scolecopsis squamatus</i>	Polychaete	X			
Arthropoda	Crustacea	<i>Alloniscus perconvexus</i>		Isopod		P	P	R
Arthropoda	Crustacea	<i>Archaeomysis grebnitzkii</i>	<i>Archaeomysis maculata</i>	Opossum Shrimp	X	A	A	R
Arthropoda	Crustacea	<i>Atylus tridens</i>	<i>Atylus tridens</i>	Amphipod	X			
Arthropoda	Crustacea	<i>Bathycopea daltonae</i>	<i>Bathycopea daltonae</i>	Isopod	X			
Arthropoda	Crustacea	<i>Crangon nigricauda</i>	<i>Crangon nigricauda</i>	Shrimp	X	A	A	R
Arthropoda	Crustacea	<i>Emerita analoga</i>	<i>Emerita analoga</i>	Pacific Sand Crab	X	A	A	A
Arthropoda	Crustacea	<i>Eohaustorius brevicuspus</i>	<i>Eohaustorius brevicuspus</i>	Amphipod	X			
Arthropoda	Crustacea	<i>Eohaustorius sawyeri</i>	<i>Eohaustorius sawyeri</i>	Amphipod	X			
Arthropoda	Crustacea	<i>Eohaustorius washingtonianus</i>	<i>Eohaustorius washingtonianus</i>	Amphipod	X	C	C	U
Arthropoda	Crustacea	<i>Excirrolana linguifrons</i>	<i>Excirrolana linguifrons</i>	Isopod	X	C	C	C
Arthropoda	Crustacea	<i>Excirrolana spp</i>		Isopod		P	P	U
Arthropoda	Crustacea	<i>Megalorcestia benedicti</i>	<i>Orchestoidea benedicti</i>	Beach Hopper	X			
Arthropoda	Crustacea	<i>Megalorcestia californiana</i>	<i>Orchestoidea californiana</i>	California Beach Flea	X	A	C	U
Arthropoda	Crustacea	<i>Megalorcestia columbiana</i>	<i>Orchestoidea columbiana</i>	Beach Hopper	X	C	C	P
Arthropoda	Crustacea	<i>Monoculoides sp.</i>	<i>Monoculoides sp.</i>	Amphipod	X			
Arthropoda	Crustacea	<i>Paraphoxus sp.</i>	<i>Paraphoxus sp.</i>	Amphipod	X			
Arthropoda	Crustacea	<i>Probosciniotus loquax</i>	<i>Dogielinotus loquax</i>		X			
Arthropoda	Insecta	<i>Thinopinus pictus</i>		Rove beetle		U		
Cnidaria	Scyphozoa	<i>Aurelia aurita</i>		Moon Jelly		R		
Echinodermata	Echinoidea	<i>Dendraster excentricus</i>		Sand dollar		P	U	R
Mollusca	Bivalvia	<i>Siliqua patula</i>	<i>Siliqua patula</i>	Pacific Razor Clam	X			
Mollusca	Gastropoda	<i>Nassarius fossatus</i>				A	C	U
Mollusca	Gastropoda	<i>Nassarius obsoletus</i>				P	U	R
Mollusca	Gastropoda	<i>Olivella baetica</i>	<i>Olivella pycna</i>	Small Olive	X	P	U	
Mollusca	Gastropoda	<i>Olivella biplicata</i>	<i>Olivella biplicata</i>	Dwarf Purple Olive	X	C	C	R
Nemertea	Anopla	<i>Tubulanus pellucidus</i>	<i>Tubulanus pellucidus</i>	Tube Nemertean	X			

A = Abundant, C = Common, P = Present, U = Uncommon, R = Rare

M. J. Boyd and J. D. DeMartini, 1977. The Intertidal and Subtidal Biota of Redwood National Park. Submitted in fulfillment of U. S. Department of the Interior, National Park Service Contract No. CX8480 - 4 -0665. 162 p.

M. J. Boyd and J. D. DeMartini, 1981. Reconnaissance Survey of Redwood Natl. Park Area of Special Biological Significance. Calif. Fish Game Report. 121 p.

APPENDIX G: RAW SAND BEACH MONITORING DATA

Sand Crabs (*Emerita Anolaga*)

Site	Date	core/m	# cores	38+ total	38+ ovig.	28+ total	28+ ovig.	18+ total	18+ ovig.	8+ total	8+ ovig.	4+ total	Megalopa	# ovig.	# non. Ovig.	Total Crabs	Crabs + meg.	Crabs /core	Crabs/m
CB	21-May-04	1	35	0	0	1	0	6	0	0	0	0	0	0	7	7	7	0.20	5
CB	21-May-04	1	34	10	8	3	2	10	1	0	0	0	0	11	23	34	34	1.00	27
CB	21-May-04	1	40	6	5	4	2	20	1	0	0	0	0	8	30	38	38	0.95	26
CB	21-May-04	1	43	2	2	5	2	5	0	0	0	0	0	4	12	16	16	0.37	10
CB	21-May-04	1	50	1	1	2	2	6	0	0	0	0	0	3	9	12	12	0.24	7
CB	17-Jul-04	2	62	3	3	1	0	28	0	4	0	0	0	3	36	39	39	0.63	17
CB	17-Jul-04	2	76	7	7	1	1	28	0	1	0	0	0	8	37	45	45	0.59	16
CB	17-Jul-04	2	81	7	6	18	0	1	0	0	0	0	0	6	26	32	32	0.40	11
CB	17-Jul-04	2	79	8	7	5	4	17	0	0	0	0	0	11	30	41	41	0.52	14
CB	17-Jul-04	2	80	12	11	8	4	44	0	0	0	0	0	15	64	79	79	0.99	27
CB	18-Aug-05	0.5	114	4	3	1	1	108	0	153	0	0	0	4	266	270	270	2.37	65
CB	18-Aug-05	0.5	130	6	6	9	8	150	0	216	0	0	0	14	381	395	395	3.04	83
CB	18-Aug-05	0.5	79	7	7	4	0	54	0	144	0	0	0	7	209	216	216	2.73	75
CB	18-Aug-05	0.5	104	3	3	1	1	155	0	357	0	2	0	4	518	522	522	5.02	138
CB	18-Aug-05	0.5	108	2	2	1	0	145	0	421	0	1	0	2	570	572	572	5.30	146
GBB	22-May-04	2	180	0	0	2	0	7	0	0	0	0	0	0	9	9	9	0.05	1
GBB	22-May-04	2	180	6	4	3	1	48	0	360	0	0	0	5	417	422	422	2.34	64
GBB	22-May-04	2	160	11	10	8	2	26	0	2	0	0	0	12	47	59	59	0.37	10
GBB	22-May-04	2	180	5	4	5	1	26	0	5	0	6	0	5	47	52	52	0.29	8
GBB	22-May-04	2	140	9	7	6	2	28	0	350	0	21	0	9	414	423	423	3.02	83
GBB	15-Jul-04	2	80	14	12	8	8	13	0	1	0	0	0	20	36	56	56	0.70	19
GBB	15-Jul-04	2	56	10	6	10	5	12	0	0	0	0	0	11	32	43	43	0.77	21
GBB	15-Jul-04	2	45	16	13	11	7	30	1	3	0	0	0	21	60	81	81	1.80	49
GBB	15-Jul-04	2	37	18	16	14	11	46	0	0	0	0	0	27	78	105	105	2.84	78
GBB	15-Jul-04	2	37	12	15	16	8	88	0	48	0	131	0	23	295	318	318	8.59	236
GBB	19-Aug-05	1	119	0	0	0	0	12	0	0	0	0	0	0	12	12	12	0.10	3
GBB	19-Aug-05	1	135	0	0	1	0	33	0	7	0	0	0	0	41	41	41	0.30	8
GBB	19-Aug-05	1	115	0	0	0	0	45	0	21	0	0	0	0	66	66	66	0.57	16
GBB	19-Aug-05	1	113	0	0	0	0	73	0	29	0	0	0	0	102	102	102	0.90	25
GBB	19-Aug-05	1	110	3	3	3	3	238	0	71	0	0	0	6	315	321	321	2.92	80
RCB	22-May-04	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
RCB	22-May-04	2	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
RCB	22-May-04	2	30	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0.03	1
RCB	22-May-04	2	35	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0.03	1
RCB	22-May-04	2	25	0	0	3	0	2	0	0	0	0	0	0	5	5	5	0.20	5
RCB	19-Jul-04	2	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
RCB	19-Jul-04	2	20	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0.05	1
RCB	19-Jul-04	2	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
RCB	19-Jul-04	2	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
RCB	19-Jul-04	2	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
RCB	20-Aug-05	4	56	0	0	0	0	3	0	14	0	0	0	0	17	17	17	0.30	8
RCB	20-Aug-05	4	45	0	0	1	1	3	0	11	0	0	0	1	15	16	16	0.36	10
RCB	20-Aug-05	4	61	0	0	0	0	13	0	114	0	0	0	0	127	127	127	2.08	57
RCB	20-Aug-05	4	71	0	0	0	0	2	0	1	0	0	0	1	3	4	4	0.06	2
RCB	20-Aug-05	4	73	0	0	0	0	13	0	0	0	0	0	0	13	13	13	0.18	5

Amphipods

Site	Date	Length (m)	# Cores/m	Total # Cores	Amphipods	Amph/Core	Amphipods/m
CB	21-May-04	25	2	50	9	5.08	139.56
CB	21-May-04	25	2	50	12	6.12	168.13
CB	21-May-04	25	2	50	19	13.12	360.44
CB	21-May-04	25	2	50	24	13.22	363.19
CB	21-May-04	25	2	50	12	7.10	195.05
CB	17-Jul-04	35	1	35	8	2.17	59.65
CB	17-Jul-04	37	1	37	3	1.05	28.96
CB	17-Jul-04	44	1	44	1	0.02	0.62
CB	17-Jul-04	52	1	52	8	2.12	58.11
CB	17-Jul-04	40	1	40	10	6.10	167.58
CB	18-Aug-05	36	2	72	148	51.36	1411.02
CB	18-Aug-05	46	2	92	35	9.28	255.02
CB	18-Aug-05	39	2	78	60	22.49	617.78
CB	18-Aug-05	43.5	2	87	44	15.33	421.25
CB	18-Aug-05	24.5	2	49	54	18.73	514.69
GBB	22-May-04	40	2	80	2	1.01	27.82
GBB	22-May-04	40	2	80	9	7.03	192.99
GBB	22-May-04	40	2	80	5	3.03	83.10
GBB	22-May-04	40	2	80	6	3.04	83.45
GBB	22-May-04	40	2	80	10	5.06	139.08
GBB	15-Jul-04	72	2	144	20	1.13	31.10
GBB	15-Jul-04	83	2	166	5	2.02	55.44
GBB	15-Jul-04	89	2	178	12	5.04	138.44
GBB	15-Jul-04	70	2	140	14	12.01	330.06
GBB	15-Jul-04	73	2	146	17	10.05	276.04
GBB	19-Aug-05	29.5	2	59	27	17.17	471.69
GBB	19-Aug-05	37.5	2	75	16	12.05	331.14
GBB	19-Aug-05	30	2	60	18	7.18	197.34
GBB	19-Aug-05	32	2	64	6	3.05	83.71
GBB	19-Aug-05	30	2	60	13	10.05	276.10
RCB	22-May-04	12	2	24	24	23.04	633.01
RCB	22-May-04	11	2	22	8	8.00	219.78
RCB	22-May-04	11.5	2	23	8	8.00	219.78
RCB	22-May-04	11	2	22	11	11.00	302.20
RCB	22-May-04	11	2	22	29	29.00	796.70
RCB	19-Jul-04	30	1	30	16	16.00	439.56
RCB	19-Jul-04	34	1	34	6	6.00	164.84
RCB	19-Jul-04	31	1	31	2	2.00	54.95
RCB	19-Jul-04	34	1	34	12	10.06	276.34
RCB	19-Jul-04	33	1	33	10	10.00	274.73
RCB	20-Aug-05	34	1	34	10	6.12	168.07
RCB	20-Aug-05	38	1	38	7	7.00	192.31
RCB	20-Aug-05	37	1	37	7	6.03	165.58
RCB	20-Aug-05	45	1	45	7	4.07	111.72
RCB	20-Aug-05	34	1	34	10	10.00	274.73

APPENDIX H: RAW FISH DATA TABLES

Fish Inventory Data

year	month	day	SITELIST	ZONE	Collection Method	Ider	Genus Species	Species Code	Size (mm)
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	138
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	127
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	91
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	92
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	112
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	97
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Clinocottus acuticeps	CACU	50
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus maculosus	OMAC	76
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus maculosus	OMAC	66
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus maculosus	OMAC	62
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus snyderi	OSNY	52
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus snyderi	OSNY	46
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus snyderi	OSNY	50
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus snyderi	OSNY	54
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus snyderi	OSNY	35
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Oligocottus snyderi	OSNY	53
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Pholis ornata	PORN	61
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Scorpaenichthys marmoratus	SMAR	47
2005	2	5	DMN	High	Bail/Dipnets	APK, DG	Sebastes melanops	SMEL	83
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Apodichthys flavidus	AFLA	89
2005	2	5	DMN	Low	Bail/Dipnets	KC	Apodichthys flavidus	AFLA	112
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Artedius lateralis	ALAT	79
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	140
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	138
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	55
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	125
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Ascelichthys rhodorus	ARHO	93
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Cebidichthys violaceus	CVIO	165
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Clinocottus globiceps	CGLO	76
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Clinocottus globiceps	CGLO	57
2005	2	5	DMN	Low	Poke poles	KC	Embiotoca lateralis	ELAT	340

2005	2	5	DMN	Low	Fishing pole/shrimpbait	KC	<i>Embiotoca lateralis</i>	ELAT	310
2005	2	5	DMN	Low	Fishing pole/shrimpbait	KC	<i>Embiotoca lateralis</i>	ELAT	315
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Embiotoca lateralis</i>	ELAT	317
2005	2	5	DMN	Low	Poke poles	KC	<i>Enophrys bison</i>	EBIS	105
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Gobiesox maeandricus</i>	GMAE	67
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Gobiesox maeandricus</i>	GMAE	70
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Gobiesox maeandricus</i>	GMAE	44
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Gobiesox maeandricus</i>	GMAE	45
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Hemilepidotus spinosus</i>	HSPI	67
2005	2	5	DMN	Low	Fishing pole/shrimpbait	KC	<i>Hexagrammos decagrammus</i>	HDEC	213
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Hexagrammos decagrammus</i>	HDEC	160
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Hexagrammos decagrammus</i>	HDEC	239
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Hexagrammos superciliosus</i>	HSUP	315
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Liparis florae</i>	LFLO	122
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus maculosus</i>	OMAC	41
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	60
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	43
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	50
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	49
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	41
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	36
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	47
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	35
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	36
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	75
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	51
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	67
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	47
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	41
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	41
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	<i>Oligocottus snyderi</i>	OSNY	38
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Oligocottus snyderi</i>	OSNY	54
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Oligocottus snyderi</i>	OSNY	55
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Oligocottus snyderi</i>	OSNY	45
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Oligocottus snyderi</i>	OSNY	43
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Oligocottus snyderi</i>	OSNY	42
2005	2	5	DMN	Low	Bail/Dipnets	KC	<i>Oligocottus snyderi</i>	OSNY	37

2005	2	5	DMN	Low	Bail/Dipnets	KC	Oligocottus snyderi	OSNY	42
2005	2	5	DMN	Low	Bail/Dipnets	KC	Oligocottus snyderi	OSNY	34
2005	2	5	DMN	Low	Bail/Dipnets	KC	Oligocottus snyderi	OSNY	37
2005	2	5	DMN	Low	Fishing pole/shrimpbait	KC	Scorpaenichthys marmoratus	SMAR	105
2005	2	5	DMN	Low	Bail/Dipnets	APK, DG	Xerperes fucorum	XFUC	175
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Artedius lateralis	ALAT	58
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Artedius lateralis	ALAT	61
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Artedius lateralis	ALAT	55
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Clinocottus globiceps	CGLO	61
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Clinocottus globiceps	CGLO	62
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Clinocottus globiceps	CGLO	51
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Clinocottus globiceps	CGLO	59
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Gobiesox maeandricus	GMAE	51
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Gobiesox maeandricus	GMAE	43
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Gobiesox maeandricus	GMAE	48
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus maculosus	OMAC	28
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	38
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	40
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	50
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	52
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	54
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	40
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	40
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	45
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	36
2005	2	5	DMN	Mid	Bail/Dipnets	BS, TM	Oligocottus snyderi	OSNY	38
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	49
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	52
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	42
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	46
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	44
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	45
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	59
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	41
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	35
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	36
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	49
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	42
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	34
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	41
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	64
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	51
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	44
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	62
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	42
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	45
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	50
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	45
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	41
2005	2	5	DMN	Mid	Bail/Dipnets	KA	Oligocottus snyderi	OSNY	42
2005	2	6	FKC	High	Bail/Dipnets	APK	Artedius spp.	Aspp	60.7
2005	2	6	FKC	High	Bail/Dipnets	APK	Artedius spp.	Aspp	57.6

2005	2	6	FKC	High	Bail/Dipnets	APK	Artedius spp.	Aspp	52.6
2005	2	6	FKC	High	Bail/Dipnets	APK	Artedius spp.	Aspp	59.8
2005	2	6	FKC	High	Bail/Dipnets	APK	Ascelichthys rhodorus	ARHO	117.2
2005	2	6	FKC	High	Bail/Dipnets	APK	Clinocottus globiceps	CGLO	37
2005	2	6	FKC	High	Bail/Dipnets	RS	Clinocottus globiceps	CGLO	48.3
2005	2	6	FKC	High	Bail/Dipnets	APK	Hemilepidotus spinosus	HSPI	98.1
2005	2	6	FKC	High	Bail/Dipnets	APK	Hexagrammos decagrammus	HDEC	146.7
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	40.2
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	81.1
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	43.4
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	32.5
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	27.9
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	33
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	32
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	31.2
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	39.2
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	47.6
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	28
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	78.9
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	60.4
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	46.8
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	78.4
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	70.6
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	72.8
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus maculosus	OMAC	36.9
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus maculosus	OMAC	35.2
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	41.8
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	55.5
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	39.9
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	39.9
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	62.6
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	33.8
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	29.5
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	38.6
2005	2	6	FKC	High	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	59
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus snyderi	OSNY	26.1
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus snyderi	OSNY	40.1
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus snyderi	OSNY	39.6
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus snyderi	OSNY	43.7
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus snyderi	OSNY	37.7
2005	2	6	FKC	High	Bail/Dipnets	RS	Oligocottus snyderi	OSNY	25.9
2005	2	6	FKC	High	Bail/Dipnets	APK	Scorpaenichthys marmoratus	SMAR	41.1
2005	2	6	FKC	High	Bail/Dipnets	APK	Scorpaenichthys marmoratus	SMAR	103.4
2005	2	6	FKC	High	Bail/Dipnets	APK	Scorpaenichthys marmoratus	SMAR	130.3
2005	2	6	FKC	High	Bail/Dipnets	APK	Scorpaenichthys marmoratus	SMAR	111.3
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	74.2
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	96.1
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	93.8
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	83.3
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	71
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	92.4
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	87.7
2005	2	6	FKC	High	Bail/Dipnets	APK	Sebastes melanops	SMEL	85

2005	2	6	FKC	High	Bail/Dipnets	APK	Xiphister atropurpureus	XATR	111.1
2005	2	6	FKC	High	Bail/Dipnets	RS	Xiphister atropurpureus	XATR	67.6
2005	2	6	FKC	High	Bail/Dipnets	RS	Xiphister atropurpureus	XATR	50.8
2005	2	6	FKC	High	Bail/Dipnets	RS	Xiphister atropurpureus	XATR	85.9
2005	2	6	FKC	Low	Bail/Dipnets	APK	Ascelichthys rhodorus	ARHO	76
2005	2	6	FKC	Low	Bail/Dipnets	APK	Gobiesox maeandricus	GMAE	117
2005	2	6	FKC	Low	Bail/Dipnets	APK	Gobiesox maeandricus	GMAE	41
2005	2	6	FKC	Low	Bail/Dipnets	APK	Gobiesox maeandricus	GMAE	44
2005	2	6	FKC	Low	Bail/Dipnets	APK	Gobiesox maeandricus	GMAE	31
2005	2	6	FKC	Low	Bail/Dipnets	APK	Hemilepidotus spinosus	HSPI	62
2005	2	6	FKC	Low	Bail/Dipnets	APK	Hemilepidotus spinosus	HSPI	98
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus maculosus	OMAC	41
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	71
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	92
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	62
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	45
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	82
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	35
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	84
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	79
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	75
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	62
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	53
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	43
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	39
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	42
2005	2	6	FKC	Low	Bail/Dipnets	APK	Oligocottus snyderi	OSNY	51
2005	2	5	DMN		Bail/Dipnets	KC	Artedius lateralis	ALAT	72
2005	2	5	DMN		Bail/Dipnets	KC	Artedius lateralis	ALAT	134
2005	2	5	DMN		Bail/Dipnets	KC	Artedius lateralis	ALAT	134
2005	2	5	DMN	Low	Poke poles	KC	Artedius lateralis	ALAT	117
2005	2	5	DMN		Bail/Dipnets	KC	Artedius lateralis	ALAT	54
2005	2	5	DMN		Bail/Dipnets	KC	Oligocottus maculosus	OMAC	71
2005	2	5	DMN		Bail/Dipnets	KC	Oligocottus maculosus	OMAC	87
2005	2	5	DMN		Bail/Dipnets	KC	Oligocottus maculosus	OMAC	37
2005	2	5	DMN		Bail/Dipnets	KC	Sebastes melanops	SMEL	86
2005	2	5	DMN		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	74
2005	2	5	DMN		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	58
2005	2	5	DMN	Low	Poke poles	KC	Enophrys bison	EBIS	179
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	111
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	73
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	67
2005	2	5	DMN	Low	Bail/Dipnets	KC	Artedius lateralis	ALAT	56
2005	2	5	DMN		Bail/Dipnets	KC	Anoplarchus purpureus	APUR	108
2005	2	5	DMN		Bail/Dipnets	KC	Cebidichthys violaceus	CVIO	81
2005	2	5	DMN		Bail/Dipnets	KC	Xerorpes fucorum	XFUC	91
2005	2	5	DMN		Bail/Dipnets	KC	Ascelichthys rhodorus	ARHO	109
2005	2	5	DMN		Bail/Dipnets	KC	Ascelichthys rhodorus	ARHO	103
2005	2	5	DMN		Bail/Dipnets	KC	Ascelichthys rhodorus	ARHO	93
2005	2	5	DMN		Bail/Dipnets	KC	Artedius lateralis	ALAT	131
2005	2	5	DMN		Bail/Dipnets	KC	Hemilepidotus spinosus	HSPI	68
2005	2	5	DMN		Bail/Dipnets	KC	Gobiesox maeandricus	GMAE	68
2005	2	5	DMN		Bail/Dipnets	KC	Liparis florum	LFLO	114

2005	2	5	DMN		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	54
2005	2	5	DMN		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	48
2005	2	5	DMN		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	59
2005	2	6	FKC		Bail/Dipnets	KC	Cebidichthys violaceus	CVIO	88
2005	2	6	FKC		Bail/Dipnets	KC	Xiphister atropurpureus	XATR	117
2005	2	6	FKC		Bail/Dipnets	KC	Xiphister atropurpureus	XATR	66
2005	2	6	FKC		Bail/Dipnets	KC	Gobiesox maeandricus	GMAE	119
2005	2	6	FKC		Bail/Dipnets	KC	Gobiesox maeandricus	GMAE	153
2005	2	6	FKC		Bail/Dipnets	KC	Ascelichthys rhodorus	ARHO	155
2005	2	6	FKC		Bail/Dipnets	KC	Ascelichthys rhodorus	ARHO	150
2005	2	6	FKC		Bail/Dipnets	KC	Hemilepidotus spinosus	HSPI	95
2005	2	6	FKC		Bail/Dipnets	KC	Hemilepidotus spinosus	HSPI	96
2005	2	6	FKC		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	47
2005	2	5	DMN	Mid	Bail/Dipnets	KC	Bothragonus swanii	BSWA	73
2005	2	6	FKC		Bail/Dipnets	KC	Clinocottus globiceps	CGLO	38

Fish Beach Seining Data

Date	Site	Species Code	Species Code	Avg Of Total Length	Total No.
5 /20/2004	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	127.44	126
5 /20/2004	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	134.24	17
5 /21/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	157.50	4
5 /21/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	142.80	5
5 /21/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	136.00	1
5 /21/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	130.40	5
5 /21/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	149.60	5
5 /21/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	133.67	3
5 /21/2004	Crescent Beach	CSTI	Citharichthys stigmaeus	40.00	2
7 /15/2004	Gold Bluffs Beach	ACAL	Atherinopsis californiensis	101.67	9
7 /15/2004	Gold Bluffs Beach	ACAL	Atherinopsis californiensis	83.50	2
7 /15/2004	Gold Bluffs Beach	ACAL	Atherinopsis californiensis	158.50	8
7 /15/2004	Gold Bluffs Beach	ACAL	Atherinopsis californiensis	173.94	16
7 /15/2004	Gold Bluffs Beach	ACAL	Atherinopsis californiensis	173.94	32
7 /15/2004	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	71.00	1
7 /15/2004	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	72.00	1
7 /15/2004	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	74.00	1

7 /15/2004	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	56.50	2
7 /15/2004	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	60.00	3
7 /15/2004	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	57.00	1
7 /15/2004	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	59.04	23
7 /15/2004	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	59.00	2
7 /15/2004	Gold Bluffs Beach	PMEL	Psettichthys melanostictus	132.00	1
7 /18/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	103.50	2
7 /18/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	63.59	301
7 /18/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	103.00	2
7 /18/2004	Crescent Beach	ARHO	Amphistichus rhodoterus	118.00	3
7 /18/2004	Crescent Beach	LARM	Leptocottus armatus	1360.00	1
7 /18/2004	Crescent Beach	OTSH	Oncorhynchus tshawytscha	104.00	1
7 /18/2004	Crescent Beach	PMEL	Psettichthys melanostictus	109.00	2
8 /18/2005	Crescent Beach	ARHO	Amphistichus rhodoterus	136.67	3
8 /18/2005	Crescent Beach	ARHO	Amphistichus rhodoterus	181.37	19
8 /18/2005	Crescent Beach	ARHO	Amphistichus rhodoterus	260.91	11
8 /18/2005	Crescent Beach	ARHO	Amphistichus rhodoterus	287.33	3
8 /18/2005	Crescent Beach	ARHO	Amphistichus rhodoterus	209.78	9
8 /18/2005	Crescent Beach	HARG	Hyperprosopon argenteum	120.14	21
8 /18/2005	Crescent Beach	HARG	Hyperprosopon argenteum	104.75	76
8 /18/2005	Crescent Beach	HARG	Hyperprosopon argenteum	99.00	7
8 /18/2005	Crescent Beach	HARG	Hyperprosopon argenteum	135.00	5
8 /19/2005	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	143.00	1
8 /19/2005	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	173.00	1
8 /19/2005	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	75.00	1
8 /19/2005	Gold Bluffs Beach	ARHO	Amphistichus rhodoterus	128.57	14
8 /19/2005	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	67.81	16
8 /19/2005	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	84.76	41

8 /19/2005	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	74.30	73
8 /19/2005	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	106.90	11
8 /19/2005	Gold Bluffs Beach	HARG	Hyperprosopon argenteum	71.50	2
8 /19/2005	Gold Bluffs Beach	OTSH	Oncorhynchus tshawytscha	93.00	1

APPENDIX I: TEMPERATURE DATA

Mean daily temperature (degrees Celsius) data for False Klamath Cove (FKC), Damnation Creek (DMN) and Enderts Beach (END) from 4 July 2004 to 15 November 2005. Temperature was recorded with ONSET tidbit temperature loggers on a 15 minute intervals. # of temp readings is the number of readings that were used to calculate the daily mean. SE1 is one standard deviation. ND = no data. Temperatures have been corrected for low tides by removing all data recorded when Mean Low Low water levels were less than +3.0 feet.

DATE	Site	Mean_ IP_PST	SE1_ pPST	#_Temp lings	Site	Mean_ IP_PST	SE1_ pPST	#_Temp lings	Site	Mean_ IP_PST	SE1_ pPST	#_Temp lings
7/4/2004	FKC	ND	ND	ND	DMN	12.81	0.12	43	END	12.97	0.09	85
7/5/2004	FKC	ND	ND	ND	DMN	12.32	0.11	42	END	12.69	0.12	84
7/6/2004	FKC	ND	ND	ND	DMN	11.77	0.14	42	END	11.91	0.16	84
7/7/2004	FKC	ND	ND	ND	DMN	10.55	0.13	41	END	11.11	0.12	82
7/8/2004	FKC	ND	ND	ND	DMN	10.36	0.21	44	END	10.72	0.15	89
7/9/2004	FKC	ND	ND	ND	DMN	11.47	0.07	44	END	12.87	0.13	87
7/10/2004	FKC	ND	ND	ND	DMN	11.65	0.14	44	END	12.56	0.13	88
7/11/2004	FKC	ND	ND	ND	DMN	12.86	0.11	47	END	12.87	0.10	95
7/12/2004	FKC	ND	ND	ND	DMN	13.02	0.06	53	END	13.87	0.06	105
7/13/2004	FKC	ND	ND	ND	DMN	13.67	0.11	50	END	14.26	0.07	100
7/14/2004	FKC	ND	ND	ND	DMN	13.76	0.08	50	END	14.51	0.05	99
7/15/2004	FKC	ND	ND	ND	DMN	13.65	0.12	50	END	14.99	0.09	99
7/16/2004	FKC	ND	ND	ND	DMN	13.43	0.06	50	END	13.94	0.08	100
7/17/2004	FKC	ND	ND	ND	DMN	15.11	0.16	50	END	14.57	0.09	100
7/18/2004	FKC	ND	ND	ND	DMN	15.41	0.11	50	END	16.30	0.03	101
7/19/2004	FKC	ND	ND	ND	DMN	14.66	0.10	51	END	16.23	0.08	101
7/20/2004	FKC	ND	ND	ND	DMN	14.09	0.10	47	END	15.33	0.09	93
7/21/2004	FKC	ND	ND	ND	DMN	14.45	0.14	45	END	14.83	0.04	90
7/22/2004	FKC	ND	ND	ND	DMN	14.86	0.05	43	END	15.49	0.01	86
7/23/2004	FKC	ND	ND	ND	DMN	14.99	0.06	43	END	15.71	0.04	85
7/24/2004	FKC	ND	ND	ND	DMN	14.71	0.03	45	END	15.76	0.02	89
7/25/2004	FKC	ND	ND	ND	DMN	14.85	0.03	46	END	15.36	0.04	90
7/26/2004	FKC	ND	ND	ND	DMN	14.62	0.03	46	END	15.12	0.02	94
7/27/2004	FKC	ND	ND	ND	DMN	14.38	0.04	53	END	15.13	0.03	106
7/28/2004	FKC	ND	ND	ND	DMN	14.25	0.03	52	END	14.99	0.02	104
7/29/2004	FKC	ND	ND	ND	DMN	13.68	0.04	49	END	14.28	0.04	98
7/30/2004	FKC	ND	ND	ND	DMN	13.33	0.05	47	END	13.94	0.04	95
7/31/2004	FKC	13.52	0.03	78	DMN	13.60	0.06	45	END	14.14	0.04	89
8/1/2004	FKC	13.85	0.06	85	DMN	13.52	0.03	43	END	14.41	0.06	85
8/2/2004	FKC	13.72	0.04	83	DMN	13.49	0.05	42	END	14.38	0.04	83
8/3/2004	FKC	14.47	0.17	81	DMN	13.18	0.08	41	END	14.77	0.08	81
8/4/2004	FKC	14.61	0.09	81	DMN	13.50	0.09	40	END	14.42	0.06	81
8/5/2004	FKC	14.05	0.10	81	DMN	14.04	0.12	41	END	14.43	0.09	81
8/6/2004	FKC	14.22	0.06	90	DMN	14.64	0.02	45	END	14.90	0.01	90
8/7/2004	FKC	13.37	0.06	94	DMN	13.61	0.07	47	END	14.64	0.08	94
8/8/2004	FKC	14.19	0.05	106	DMN	14.93	0.15	53	END	15.18	0.05	106
8/9/2004	FKC	14.65	0.04	108	DMN	14.95	0.03	54	END	15.48	0.04	108

8/10/2004	FKC	14.26	0.05	106	DMN	14.18	0.07	53	END	14.92	0.07	106
8/11/2004	FKC	14.54	0.03	104	DMN	14.49	0.02	52	END	15.11	0.03	104
8/12/2004	FKC	14.77	0.03	101	DMN	14.64	0.03	51	END	15.16	0.02	101
8/13/2004	FKC	14.88	0.02	101	DMN	14.67	0.03	51	END	15.20	0.02	101
8/14/2004	FKC	14.98	0.02	102	DMN	14.81	0.04	51	END	15.13	0.02	102
8/15/2004	FKC	15.53	0.07	92	DMN	15.02	0.06	46	END	15.36	0.04	92
8/16/2004	FKC	15.32	0.06	88	DMN	14.75	0.04	44	END	16.14	0.07	88
8/17/2004	FKC	14.83	0.03	85	DMN	14.17	0.08	42	END	15.36	0.09	85
8/18/2004	FKC	13.97	0.05	84	DMN	13.83	0.04	41	END	14.89	0.05	84
8/19/2004	FKC	14.37	0.04	83	DMN	14.52	0.07	42	END	14.83	0.05	83
8/20/2004	FKC	14.18	0.05	81	DMN	14.36	0.03	40	END	14.91	0.02	81
8/21/2004	FKC	13.89	0.03	87	DMN	14.04	0.02	43	END	14.83	0.03	87
8/22/2004	FKC	13.61	0.02	93	DMN	13.50	0.02	47	END	14.50	0.02	93
8/23/2004	FKC	13.96	0.02	104	DMN	13.57	0.02	53	END	14.29	0.02	104
8/24/2004	FKC	14.05	0.04	107	DMN	13.92	0.05	54	END	14.61	0.04	107
8/25/2004	FKC	13.78	0.02	106	DMN	13.81	0.03	53	END	14.50	0.02	106
8/26/2004	FKC	13.72	0.05	105	DMN	13.34	0.09	53	END	14.40	0.08	105
8/27/2004	FKC	13.27	0.07	101	DMN	13.00	0.10	50	END	13.51	0.08	101
8/28/2004	FKC	12.37	0.06	87	DMN	12.48	0.07	44	END	12.56	0.06	87
8/29/2004	FKC	12.50	0.06	83	DMN	13.00	0.12	42	END	12.86	0.07	83
8/30/2004	FKC	13.01	0.03	81	DMN	13.09	0.07	40	END	13.58	0.03	81
8/31/2004	FKC	13.85	0.05	80	DMN	13.73	0.13	40	END	14.01	0.05	80
9/1/2004	FKC	13.87	0.05	80	DMN	13.58	0.06	40	END	14.13	0.04	80
9/2/2004	FKC	12.76	0.04	81	DMN	12.05	0.06	41	END	12.85	0.05	81
9/3/2004	FKC	11.07	0.03	83	DMN	10.66	0.05	42	END	10.92	0.06	83
9/4/2004	FKC	10.77	0.07	94	DMN	10.54	0.07	47	END	10.35	0.08	94
9/5/2004	FKC	10.19	0.02	112	DMN	10.34	0.07	56	END	10.59	0.02	112
9/6/2004	FKC	10.77	0.02	110	DMN	11.19	0.08	55	END	11.48	0.06	110
9/7/2004	FKC	11.77	0.05	108	DMN	12.07	0.08	54	END	12.38	0.07	108
9/8/2004	FKC	12.29	0.06	107	DMN	11.72	0.07	54	END	12.73	0.04	107
9/9/2004	FKC	12.50	0.06	107	DMN	12.14	0.09	53	END	12.83	0.08	107
9/10/2004	FKC	12.87	0.05	105	DMN	13.51	0.09	52	END	14.07	0.08	105
9/11/2004	FKC	12.50	0.06	98	DMN	12.29	0.08	49	END	13.71	0.08	98
9/12/2004	FKC	12.42	0.15	89	DMN	11.88	0.06	45	END	12.86	0.05	89
9/13/2004	FKC	13.49	0.08	85	DMN	13.00	0.10	43	END	14.20	0.05	85
9/14/2004	FKC	11.05	0.05	83	DMN	10.46	0.09	42	END	11.05	0.08	83
9/15/2004	FKC	10.08	0.02	80	DMN	9.63	0.05	40	END	9.84	0.02	80
9/16/2004	FKC	10.55	0.06	80	DMN	10.56	0.11	41	END	10.56	0.06	80
9/17/2004	FKC	11.41	0.05	81	DMN	11.61	0.05	41	END	11.69	0.06	81
9/18/2004	FKC	11.04	0.05	83	DMN	11.42	0.04	42	END	12.12	0.03	83
9/19/2004	FKC	11.24	0.06	92	DMN	11.56	0.04	46	END	12.42	0.03	92
9/20/2004	FKC	11.97	0.05	109	DMN	11.47	0.06	55	END	12.74	0.02	109
9/21/2004	FKC	11.61	0.07	108	DMN	11.28	0.11	54	END	11.99	0.08	108
9/22/2004	FKC	11.84	0.07	107	DMN	11.79	0.09	54	END	12.57	0.08	107
9/23/2004	FKC	12.35	0.08	107	DMN	12.23	0.11	53	END	12.93	0.07	107
9/24/2004	FKC	12.11	0.04	108	DMN	12.42	0.06	54	END	13.39	0.02	108
9/25/2004	FKC	12.26	0.03	88	DMN	12.19	0.05	44	END	13.46	0.02	88
9/26/2004	FKC	12.48	0.07	82	DMN	11.75	0.05	41	END	13.15	0.05	82
9/27/2004	FKC	12.51	0.07	80	DMN	12.24	0.07	40	END	13.44	0.02	80
9/28/2004	FKC	12.39	0.05	80	DMN	12.64	0.04	39	END	13.35	0.01	80

9/29/2004	FKC	12.25	0.07	80	DMN	12.54	0.04	40	END	13.35	0.02	80
9/30/2004	FKC	12.07	0.04	81	DMN	12.16	0.05	40	END	13.25	0.01	81
10/1/2004	FKC	12.29	0.05	85	DMN	12.27	0.05	42	END	13.36	0.02	85
10/2/2004	FKC	12.60	0.03	89	DMN	12.46	0.04	45	END	13.37	0.03	89
10/3/2004	FKC	12.76	0.04	107	DMN	12.26	0.05	54	END	13.00	0.05	107
10/4/2004	FKC	12.61	0.03	109	DMN	12.62	0.03	55	END	13.19	0.02	109
10/5/2004	FKC	12.64	0.01	108	DMN	12.05	0.02	54	END	12.92	0.04	108
10/6/2004	FKC	12.84	0.03	109	DMN	12.46	0.05	54	END	12.74	0.03	109
10/7/2004	FKC	12.03	0.03	108	DMN	12.12	0.03	54	END	12.96	0.03	108
10/8/2004	FKC	12.02	0.03	109	DMN	12.02	0.03	54	END	13.11	0.02	109
10/9/2004	FKC	11.94	0.02	110	DMN	11.86	0.03	55	END	13.08	0.02	110
10/10/2004	FKC	11.74	0.02	89	DMN	11.35	0.04	44	END	12.45	0.03	89
10/11/2004	FKC	11.33	0.05	85	DMN	11.26	0.08	43	END	11.46	0.06	85
10/12/2004	FKC	11.22	0.04	82	DMN	11.53	0.05	41	END	11.87	0.06	82
10/13/2004	FKC	11.44	0.06	82	DMN	11.37	0.06	42	END	11.34	0.06	82
10/14/2004	FKC	11.88	0.04	81	DMN	11.60	0.04	41	END	12.09	0.04	81
10/15/2004	FKC	11.72	0.04	83	DMN	11.92	0.04	42	END	12.32	0.03	83
10/16/2004	FKC	11.81	0.01	86	DMN	12.01	0.00	43	END	12.42	0.01	86
10/17/2004	FKC	11.79	0.02	91	DMN	11.84	0.02	46	END	12.29	0.01	91
10/18/2004	FKC	11.75	0.01	106	DMN	11.36	0.02	53	END	11.86	0.01	106
10/19/2004	FKC	11.98	0.00	106	DMN	11.48	0.02	53	END	11.94	0.01	106
10/20/2004	FKC	11.85	0.01	106	DMN	11.58	0.02	53	END	11.99	0.02	106
10/21/2004	FKC	11.89	0.02	108	DMN	11.70	0.03	54	END	11.84	0.01	108
10/22/2004	FKC	11.79	0.01	109	DMN	11.44	0.01	54	END	11.92	0.01	109
10/23/2004	FKC	11.88	0.02	95	DMN	11.56	0.03	48	END	12.14	0.03	95
10/24/2004	FKC	11.63	0.02	86	DMN	11.35	0.03	43	END	12.01	0.03	86
10/25/2004	FKC	11.53	0.00	82	DMN	11.15	0.00	41	END	11.72	0.01	82
10/26/2004	FKC	11.60	0.01	81	DMN	11.15	0.00	41	END	11.57	0.01	81
10/27/2004	FKC	11.61	0.01	83	DMN	11.13	0.02	41	END	11.47	0.02	83
10/28/2004	FKC	11.69	0.02	85	DMN	11.23	0.02	42	END	11.72	0.01	85
10/29/2004	FKC	11.83	0.01	90	DMN	11.36	0.03	45	END	11.89	0.01	90
10/30/2004	FKC	11.84	0.03	97	DMN	11.54	0.03	49	END	12.05	0.01	97
10/31/2004	FKC	11.69	0.01	102	DMN	11.27	0.02	54	END	11.66	0.02	102
11/1/2004	FKC	11.70	0.02	103	DMN	11.46	0.03	52	END	11.71	0.02	103
11/2/2004	FKC	11.63	0.01	106	DMN	11.52	0.02	53	END	11.85	0.01	106
11/3/2004	FKC	11.59	0.01	107	DMN	11.32	0.02	53	END	11.74	0.01	107
11/4/2004	FKC	10.70	0.01	108	DMN	10.42	0.02	54	END	10.38	0.01	108
11/5/2004	FKC	10.75	0.01	109	DMN	10.52	0.03	54	END	10.78	0.02	109
11/6/2004	FKC	10.78	0.02	112	DMN	10.63	0.02	56	END	11.08	0.03	112
11/7/2004	FKC	10.55	0.01	101	DMN	10.61	0.02	51	END	10.94	0.01	101
11/8/2004	FKC	10.71	0.01	92	DMN	10.57	0.00	46	END	10.88	0.00	92
11/9/2004	FKC	10.77	0.01	84	DMN	10.58	0.01	42	END	10.98	0.01	84
11/10/2004	FKC	10.83	0.02	84	DMN	10.61	0.02	42	END	11.07	0.01	84
11/11/2004	FKC	10.82	0.02	84	DMN	10.56	0.03	42	END	10.86	0.01	84
11/12/2004	FKC	10.72	0.01	87	DMN	10.43	0.02	44	END	10.89	0.01	87
11/13/2004	FKC	10.67	0.01	91	DMN	10.52	0.02	45	END	10.96	0.01	91
11/14/2004	FKC	10.64	0.01	101	DMN	10.39	0.02	50	END	10.98	0.01	101
11/15/2004	FKC	10.68	0.01	100	DMN	10.57	0.00	50	END	11.08	0.01	100
11/16/2004	FKC	10.54	0.02	105	DMN	10.57	0.00	53	END	11.07	0.01	105
11/17/2004	FKC	10.34	0.02	107	DMN	10.41	0.02	54	END	10.91	0.01	107

11/18/2004	FKC	10.41	0.01	107	DMN	10.38	0.02	54	END	10.82	0.02	107
11/19/2004	FKC	10.31	0.01	111	DMN	10.05	0.02	56	END	10.33	0.02	111
11/20/2004	FKC	10.11	0.01	99	DMN	9.62	0.03	49	END	9.89	0.04	99
11/21/2004	FKC	10.13	0.01	92	DMN	9.54	0.03	46	END	9.99	0.02	92
11/22/2004	FKC	10.14	0.01	88	DMN	9.68	0.02	44	END	10.09	0.03	88
11/23/2004	FKC	10.13	0.01	84	DMN	9.88	0.02	42	END	10.24	0.01	84
11/24/2004	FKC	10.08	0.01	87	DMN	10.03	0.03	43	END	10.27	0.01	87
11/25/2004	FKC	10.18	0.01	94	DMN	10.15	0.02	47	END	10.46	0.01	94
11/26/2004	FKC	10.17	0.01	103	DMN	10.00	0.00	51	END	10.40	0.01	103
11/27/2004	FKC	10.02	0.01	103	DMN	9.87	0.02	51	END	10.16	0.01	103
11/28/2004	FKC	9.75	0.01	102	DMN	9.51	0.02	51	END	9.56	0.01	102
11/29/2004	FKC	9.45	0.01	102	DMN	9.14	0.03	51	END	9.52	0.02	102
11/30/2004	FKC	9.32	0.01	102	DMN	9.15	0.03	51	END	9.59	0.01	102
12/1/2004	FKC	9.40	0.01	105	DMN	9.26	0.02	53	END	9.36	0.02	105
12/2/2004	FKC	9.25	0.01	107	DMN	8.99	0.02	53	END	9.31	0.02	107
12/3/2004	FKC	9.22	0.01	109	DMN	8.86	0.02	55	END	9.16	0.01	109
12/4/2004	FKC	9.18	0.01	111	DMN	8.81	0.01	56	END	9.17	0.00	111
12/5/2004	FKC	9.42	0.01	115	DMN	9.02	0.02	57	END	9.22	0.01	115
12/6/2004	FKC	9.30	0.01	100	DMN	8.96	0.02	50	END	9.24	0.02	100
12/7/2004	FKC	9.51	0.00	95	DMN	9.32	0.02	48	END	9.57	0.01	95
12/8/2004	FKC	9.77	0.02	89	DMN	9.56	0.03	44	END	9.89	0.01	89
12/9/2004	FKC	10.33	0.01	92	DMN	10.02	0.01	45	END	10.34	0.01	92
12/10/2004	FKC	10.49	0.01	98	DMN	10.14	0.02	49	END	10.37	0.01	98
12/11/2004	FKC	10.65	0.01	102	DMN	10.38	0.02	51	END	10.56	0.01	102
12/12/2004	FKC	10.75	0.00	88	DMN	10.53	0.01	50	END	10.64	0.01	101
12/13/2004	FKC	10.84	0.01	101	DMN	10.70	0.02	51	END	10.99	0.01	101
12/14/2004	FKC	10.99	0.01	101	DMN	10.86	0.00	50	END	11.09	0.01	101
12/15/2004	FKC	11.00	0.01	104	DMN	10.75	0.02	52	END	10.97	0.01	104
12/16/2004	FKC	10.81	0.01	108	DMN	10.38	0.04	54	END	10.59	0.02	108
12/17/2004	FKC	10.76	0.00	110	DMN	10.57	0.00	55	END	10.84	0.01	110
12/18/2004	FKC	10.79	0.01	102	DMN	10.69	0.02	51	END	10.97	0.01	102
12/19/2004	FKC	10.67	0.03	96	DMN	10.56	0.02	49	END	10.82	0.01	96
12/20/2004	FKC	10.72	0.01	96	DMN	10.48	0.02	48	END	10.74	0.01	96
12/21/2004	FKC	10.69	0.01	93	DMN	10.51	0.02	46	END	10.50	0.02	93
12/22/2004	FKC	10.79	0.01	106	DMN	10.33	0.02	53	END	10.38	0.02	106
12/23/2004	FKC	10.63	0.01	104	DMN	10.11	0.02	52	END	10.41	0.01	104
12/24/2004	FKC	10.52	0.01	103	DMN	10.00	0.03	52	END	10.08	0.03	103
12/25/2004	FKC	10.40	0.01	103	DMN	10.12	0.02	52	END	10.42	0.00	103
12/26/2004	FKC	10.47	0.01	102	DMN	10.26	0.01	51	END	10.35	0.01	102
12/27/2004	FKC	10.43	0.01	103	DMN	10.25	0.01	51	END	10.40	0.00	103
12/28/2004	FKC	10.39	0.01	103	DMN	9.92	0.02	52	END	10.20	0.01	103
12/29/2004	FKC	10.27	0.02	104	DMN	9.90	0.04	52	END	10.17	0.01	104
12/30/2004	FKC	10.35	0.01	105	DMN	10.07	0.02	53	END	10.13	0.02	105
12/31/2004	FKC	10.18	0.01	107	DMN	9.80	0.02	54	END	10.10	0.00	107
1/1/2005	FKC	10.14	0.01	111	DMN	9.80	0.02	55	END	9.88	0.02	111
1/2/2005	FKC	10.56	0.02	115	DMN	10.01	0.04	57	END	10.00	0.02	115
1/3/2005	FKC	10.53	0.01	103	DMN	9.74	0.05	51	END	9.92	0.03	103
1/4/2005	FKC	10.15	0.02	102	DMN	9.58	0.05	51	END	9.61	0.04	102
1/5/2005	FKC	10.40	0.01	103	DMN	9.87	0.02	51	END	9.80	0.02	103
1/6/2005	FKC	10.34	0.01	104	DMN	9.77	0.02	52	END	9.89	0.02	104

1/7/2005	FKC	10.35	0.03	102	DMN	9.75	0.03	51	END	9.76	0.01	102
1/8/2005	FKC	9.84	0.01	101	DMN	9.50	0.02	50	END	9.61	0.01	101
1/9/2005	FKC	9.87	0.01	101	DMN	9.62	0.03	51	END	9.58	0.01	101
1/10/2005	FKC	10.10	0.01	101	DMN	9.92	0.02	50	END	9.80	0.01	101
1/11/2005	FKC	10.04	0.02	102	DMN	9.79	0.04	51	END	9.87	0.02	102
1/12/2005	FKC	10.03	0.03	101	DMN	9.57	0.05	51	END	10.41	0.02	101
1/13/2005	FKC	9.82	0.02	96	DMN	9.57	0.15	2	END	9.40	0.04	96
1/14/2005	FKC	9.86	0.03	93	DMN	ND	ND	0	END	9.56	0.02	93
1/15/2005	FKC	10.06	0.02	93	DMN	ND	ND	0	END	9.92	0.01	93
1/16/2005	FKC	10.62	0.02	95	DMN	ND	ND	0	END	10.21	0.02	95
1/17/2005	FKC	10.70	0.01	98	DMN	ND	ND	0	END	10.44	0.01	98
1/18/2005	FKC	10.80	0.01	107	DMN	ND	ND	0	END	10.76	0.01	107
1/19/2005	FKC	10.83	0.01	105	DMN	ND	ND	0	END	10.75	0.01	105
1/20/2005	FKC	10.89	0.00	103	DMN	ND	ND	0	END	10.88	0.00	103
1/21/2005	FKC	10.65	0.02	103	DMN	ND	ND	0	END	10.49	0.03	103
1/22/2005	FKC	10.73	0.01	102	DMN	ND	ND	0	END	10.61	0.01	102
1/23/2005	FKC	11.09	0.01	103	DMN	ND	ND	0	END	10.92	0.01	103
1/24/2005	FKC	11.21	0.01	104	DMN	ND	ND	0	END	11.22	0.01	104
1/25/2005	FKC	11.22	0.00	104	DMN	ND	ND	0	END	11.04	0.03	104
1/26/2005	FKC	11.27	0.01	106	DMN	ND	ND	0	END	11.13	0.01	106
1/27/2005	FKC	11.41	0.01	106	DMN	ND	ND	0	END	11.19	0.01	106
1/28/2005	FKC	11.45	0.01	108	DMN	ND	ND	0	END	11.21	0.01	108
1/29/2005	FKC	11.44	0.01	99	DMN	ND	ND	0	END	11.20	0.01	99
1/30/2005	FKC	11.24	0.03	97	DMN	ND	ND	0	END	11.42	0.01	97
1/31/2005	FKC	11.39	0.01	95	DMN	ND	ND	0	END	11.36	0.02	95
2/1/2005	FKC	11.32	0.01	99	DMN	ND	ND	0	END	11.59	0.03	99
2/2/2005	FKC	11.20	0.00	108	DMN	ND	ND	0	END	11.57	0.01	108
2/3/2005	FKC	11.09	0.01	103	DMN	ND	ND	0	END	11.15	0.01	103
2/4/2005	FKC	11.11	0.01	101	DMN	ND	ND	0	END	11.04	0.00	101
2/5/2005	FKC	11.33	0.01	101	DMN	10.94	0.03	15	END	11.26	0.02	101
2/6/2005	FKC	10.98	0.03	101	DMN	10.72	0.04	51	END	11.19	0.02	101
2/7/2005	FKC	10.96	0.02	102	DMN	10.89	0.04	51	END	11.02	0.02	102
2/8/2005	FKC	10.99	0.01	96	DMN	10.75	0.03	49	END	10.85	0.02	96
2/9/2005	FKC	10.90	0.02	89	DMN	10.73	0.02	44	END	10.75	0.02	89
2/10/2005	FKC	11.03	0.01	86	DMN	10.74	0.04	44	END	10.90	0.02	86
2/11/2005	FKC	10.89	0.01	86	DMN	10.83	0.04	43	END	10.87	0.02	86
2/12/2005	FKC	11.05	0.00	86	DMN	11.02	0.02	44	END	11.11	0.01	86
2/13/2005	FKC	11.06	0.01	88	DMN	11.15	0.00	44	END	11.17	0.01	88
2/14/2005	FKC	10.89	0.02	93	DMN	10.91	0.02	46	END	11.18	0.02	93
2/15/2005	FKC	10.87	0.01	108	DMN	10.73	0.03	54	END	10.94	0.01	108
2/16/2005	FKC	10.88	0.02	104	DMN	10.76	0.03	52	END	10.82	0.02	104
2/17/2005	FKC	11.10	0.02	102	DMN	10.93	0.04	51	END	11.06	0.04	102
2/18/2005	FKC	11.20	0.01	102	DMN	11.23	0.02	51	END	11.28	0.01	102
2/19/2005	FKC	11.26	0.02	103	DMN	11.32	0.03	51	END	11.38	0.02	103
2/20/2005	FKC	11.23	0.01	103	DMN	11.33	0.02	51	END	11.43	0.01	103
2/21/2005	FKC	11.29	0.01	104	DMN	11.32	0.03	52	END	11.38	0.02	104
2/22/2005	FKC	11.49	0.02	106	DMN	11.47	0.03	53	END	11.54	0.02	106
2/23/2005	FKC	11.47	0.01	95	DMN	11.58	0.02	47	END	11.66	0.01	95
2/24/2005	FKC	11.44	0.01	90	DMN	11.48	0.02	45	END	11.63	0.01	90
2/25/2005	FKC	11.49	0.01	88	DMN	11.49	0.02	44	END	11.61	0.01	88

2/26/2005	FKC	11.59	0.02	86	DMN	11.33	0.03	43	END	11.49	0.01	86
2/27/2005	FKC	11.62	0.01	87	DMN	11.67	0.02	43	END	11.61	0.01	87
2/28/2005	FKC	11.83	0.02	88	DMN	11.83	0.02	44	END	11.76	0.02	88
3/1/2005	FKC	11.81	0.01	91	DMN	11.72	0.00	45	END	11.71	0.01	91
3/2/2005	FKC	11.97	0.01	105	DMN	11.91	0.02	52	END	11.88	0.02	105
3/3/2005	FKC	11.99	0.02	101	DMN	12.05	0.03	50	END	12.00	0.02	101
3/4/2005	FKC	11.91	0.01	99	DMN	12.02	0.00	49	END	12.13	0.02	99
3/5/2005	FKC	11.88	0.01	99	DMN	11.98	0.01	50	END	11.89	0.02	99
3/6/2005	FKC	11.92	0.01	100	DMN	12.02	0.00	50	END	12.05	0.03	100
3/7/2005	FKC	12.05	0.01	102	DMN	12.18	0.04	51	END	12.11	0.01	102
3/8/2005	FKC	12.05	0.01	91	DMN	12.32	0.04	46	END	12.30	0.02	91
3/9/2005	FKC	12.14	0.02	85	DMN	12.34	0.04	42	END	12.49	0.02	85
3/10/2005	FKC	12.19	0.01	81	DMN	12.53	0.04	40	END	12.63	0.01	81
3/11/2005	FKC	12.16	0.01	81	DMN	12.60	0.03	41	END	12.65	0.02	81
3/12/2005	FKC	12.17	0.01	81	DMN	12.79	0.03	41	END	12.81	0.02	81
3/13/2005	FKC	12.37	0.02	83	DMN	13.06	0.05	42	END	13.02	0.02	83
3/14/2005	FKC	12.69	0.06	86	DMN	13.10	0.08	43	END	12.93	0.03	86
3/15/2005	FKC	12.24	0.03	97	DMN	12.69	0.03	49	END	13.11	0.02	97
3/16/2005	FKC	12.00	0.01	102	DMN	12.41	0.04	51	END	12.65	0.02	102
3/17/2005	FKC	11.97	0.02	100	DMN	12.46	0.06	50	END	12.53	0.03	100
3/18/2005	FKC	12.35	0.04	100	DMN	12.78	0.04	50	END	12.79	0.04	100
3/19/2005	FKC	12.30	0.01	100	DMN	12.50	0.03	50	END	12.54	0.02	100
3/20/2005	FKC	12.39	0.01	102	DMN	12.03	0.00	51	END	12.29	0.00	102
3/21/2005	FKC	12.16	0.01	103	DMN	12.03	0.00	51	END	12.20	0.01	103
3/22/2005	FKC	12.22	0.01	93	DMN	12.03	0.00	46	END	12.16	0.01	93
3/23/2005	FKC	12.01	0.01	87	DMN	12.02	0.01	43	END	12.22	0.01	87
3/24/2005	FKC	11.91	0.03	84	DMN	11.65	0.05	42	END	11.72	0.03	84
3/25/2005	FKC	11.95	0.01	82	DMN	11.71	0.04	41	END	11.69	0.02	82
3/26/2005	FKC	11.66	0.02	82	DMN	11.69	0.02	41	END	11.75	0.01	82
3/27/2005	FKC	11.68	0.01	80	DMN	11.73	0.01	40	END	11.85	0.01	80
3/28/2005	FKC	11.92	0.02	82	DMN	11.86	0.02	41	END	11.87	0.01	82
3/29/2005	FKC	11.91	0.02	86	DMN	11.90	0.02	43	END	12.01	0.02	86
3/30/2005	FKC	11.94	0.01	95	DMN	11.82	0.02	47	END	12.07	0.01	95
3/31/2005	FKC	12.00 ND		53	DMN	12.36	0.09	49	END	12.37	0.03	98
4/1/2005	FKC	12.11	0.04	16	DMN	12.20	0.04	48	END	12.29	0.01	96
4/2/2005	FKC	11.93	0.06	16	DMN	12.19	0.04	48	END	12.08	0.01	97
4/3/2005	FKC	11.73	0.04	15	DMN	11.81	0.03	46	END	11.80	0.01	99
4/4/2005	FKC	11.81	0.07	17	DMN	11.62	0.05	51	END	11.75	0.03	102
4/5/2005	FKC	12.07	0.06	13	DMN	12.03	0.05	43	END	12.07	0.03	85
4/6/2005	FKC	12.09	0.05	14	DMN	12.22	0.04	41	END	12.29	0.02	81
4/7/2005	FKC	12.10	0.05	12	DMN	12.06	0.02	39	END	12.32	0.01	78
4/8/2005	FKC	12.03	0.03	13	DMN	11.97	0.02	40	END	11.98	0.01	78
4/9/2005	FKC	12.14	0.04	12	DMN	12.09	0.03	39	END	12.13	0.02	78
4/10/2005	FKC	11.99	0.03	14	DMN	12.12	0.03	40	END	12.19	0.02	81
4/11/2005	FKC	12.05	0.05	14	DMN	12.27	0.05	41	END	12.27	0.03	19
4/12/2005	FKC	12.03	0.04	15	DMN	12.19	0.04	45	END	12.32	0.05	30
4/13/2005	FKC	11.67	0.04	17	DMN	11.80	0.02	50	END	11.90	0.03	33
4/14/2005	FKC	11.55	0.07	17	DMN	11.74	0.03	49	END	11.91	0.04	33
4/15/2005	FKC	12.08	0.12	16	DMN	12.05	0.09	48	END	12.11	0.06	32
4/16/2005	FKC	11.80	0.03	17	DMN	12.01	0.01	48	END	12.21	0.02	33

4/17/2005	FKC	11.76	0.09	17	DMN	11.94	0.05	49	END	12.15	0.08	33
4/18/2005	FKC	11.41	0.05	17	DMN	11.65	0.03	51	END	11.69	0.05	34
4/19/2005	FKC	10.68	0.10	15	DMN	11.14	0.05	45	END	11.09	0.12	29
4/20/2005	FKC	10.75	0.24	13	DMN	11.06	0.13	42	END	10.84	0.16	27
4/21/2005	FKC	10.98	0.07	13	DMN	11.43	0.05	39	END	11.41	0.14	27
4/22/2005	FKC	11.19	0.12	13	DMN	11.68	0.05	39	END	11.57	0.09	26
4/23/2005	FKC	11.11	0.10	12	DMN	11.55	0.04	39	END	11.86	0.03	25
4/24/2005	FKC	11.29	0.07	14	DMN	12.09	0.10	40	END	11.80	0.07	27
4/25/2005	FKC	12.29	0.30	14	DMN	12.95	0.16	39	END	12.73	0.17	27
4/26/2005	FKC	12.20	0.16	15	DMN	12.58	0.13	42	END	12.49	0.13	28
4/27/2005	FKC	11.44	0.06	16	DMN	11.86	0.06	45	END	12.17	0.04	31
4/28/2005	FKC	11.78	0.13	16	DMN	12.39	0.06	49	END	12.39	0.12	32
4/29/2005	FKC	12.03	0.15	16	DMN	12.82	0.07	48	END	12.98	0.08	32
4/30/2005	FKC	11.73	0.08	16	DMN	12.33	0.05	49	END	12.52	0.07	32
5/1/2005	FKC	12.74	0.24	16	DMN	13.09	0.03	67	END	12.26	0.07	31
5/2/2005	FKC	12.13	0.14	15	DMN	12.24	0.04	91	END	12.54	0.11	31
5/3/2005	FKC	11.84	0.11	14	DMN	12.28	0.10	82	END	12.23	0.12	28
5/4/2005	FKC	12.57	0.11	13	DMN	12.75	0.07	78	END	13.16	0.03	27
5/5/2005	FKC	12.56	0.06	13	DMN	12.16	0.02	77	END	12.66	0.07	27
5/6/2005	FKC	12.89	0.15	13	DMN	12.83	0.08	77	END	12.46	0.11	26
5/7/2005	FKC	12.69	0.09	13	DMN	13.30	0.04	78	END	13.06	0.08	26
5/8/2005	FKC	13.01	0.09	14	DMN	13.14	0.08	81	END	13.62	0.07	28
5/9/2005	FKC	13.20	0.07	13	DMN	13.39	0.01	86	END	13.52	0.05	28
5/10/2005	FKC	13.42	0.09	16	DMN	13.44	0.02	92	END	13.35	0.04	31
5/11/2005	FKC	14.45	0.30	16	DMN	13.91	0.07	97	END	14.23	0.14	32
5/12/2005	FKC	14.87	0.24	16	DMN	14.41	0.12	97	END	14.43	0.09	33
5/13/2005	FKC	14.97	0.31	16	DMN	14.60	0.09	96	END	14.59	0.12	32
5/14/2005	FKC	15.03	0.19	16	DMN	15.22	0.05	96	END	15.20	0.13	32
5/15/2005	FKC	14.28	0.07	17	DMN	14.79	0.05	98	END	14.96	0.03	33
5/16/2005	FKC	13.97	0.06	17	DMN	14.22	0.03	100	END	14.54	0.06	34
5/17/2005	FKC	13.48	0.10	16	DMN	14.05	0.03	92	END	14.25	0.06	31
5/18/2005	FKC	13.38	0.10	14	DMN	13.68	0.02	82	END	13.77	0.02	28
5/19/2005	FKC	14.22	0.08	13	DMN	14.24	0.05	79	END	14.26	0.09	26
5/20/2005	FKC	14.31	0.09	14	DMN	14.35	0.02	78	END	14.15	0.03	27
5/21/2005	FKC	14.22	0.07	13	DMN	14.80	0.04	79	END	14.59	0.11	27
5/22/2005	FKC	14.23	0.03	14	DMN	14.29	0.04	81	END	14.66	0.08	27
5/23/2005	FKC	13.97	0.09	13	DMN	14.13	0.04	83	END	14.03	0.08	27
5/24/2005	FKC	13.48	0.13	15	DMN	13.82	0.06	87	END	13.50	0.08	30
5/25/2005	FKC	13.34	0.21	16	DMN	14.94	0.17	91	END	14.47	0.25	31
5/26/2005	FKC	14.80	0.20	16	DMN	15.24	0.06	96	END	15.74	0.09	32
5/27/2005	FKC	14.13	0.24	16	DMN	14.20	0.04	96	END	15.11	0.04	32
5/28/2005	FKC	13.77	0.14	16	DMN	14.57	0.12	97	END	14.41	0.12	33
5/29/2005	FKC	13.53	0.21	14	DMN	13.32	0.09	91	END	14.81	0.22	29
5/30/2005	FKC	13.15	0.18	16	DMN	12.81	0.06	91	END	13.00	0.13	31
5/31/2005	FKC	12.10	0.10	13	DMN	12.46	0.05	85	END	12.46	0.10	28
6/1/2005	FKC	11.20	0.15	13	DMN	11.11	0.06	78	END	11.03	0.18	26
6/2/2005	FKC	10.08	0.12	13	DMN	10.25	0.06	76	END	10.01	0.19	26
6/3/2005	FKC	10.44	0.29	13	DMN	10.23	0.06	78	END	9.85	0.12	26
6/4/2005	FKC	10.87	0.27	14	DMN	10.76	0.11	82	END	10.31	0.12	28
6/5/2005	FKC	11.10	0.20	15	DMN	11.66	0.10	88	END	11.00	0.16	29

6/6/2005	FKC	10.67	0.12	16	DMN	11.67	0.04	98	END	11.65	0.03	33
6/7/2005	FKC	11.86	0.20	16	DMN	12.50	0.08	97	END	12.34	0.10	32
6/8/2005	FKC	12.11	0.27	16	DMN	12.87	0.09	97	END	13.58	0.14	32
6/9/2005	FKC	12.85	0.25	16	DMN	13.72	0.11	97	END	14.63	0.14	33
6/10/2005	FKC	12.95	0.24	17	DMN	12.48	0.07	98	END	12.45	0.11	33
6/11/2005	FKC	11.10	0.15	16	DMN	11.09	0.07	98	END	10.46	0.13	32
6/12/2005	FKC	10.14	0.26	16	DMN	10.07	0.09	99	END	9.55	0.12	33
6/13/2005	FKC	10.01	0.30	17	DMN	10.15	0.09	100	END	9.28	0.12	33
6/14/2005	FKC	9.50	0.24	16	DMN	9.74	0.08	98	END	9.54	0.15	31
6/15/2005	FKC	10.57	0.51	15	DMN	10.96	0.19	87	END	10.70	0.23	29
6/16/2005	FKC	10.99	0.15	14	DMN	11.70	0.09	84	END	11.87	0.04	27
6/17/2005	FKC	10.62	0.08	14	DMN	10.84	0.04	82	END	10.45	0.02	28
6/18/2005	FKC	11.12	0.03	14	DMN	11.31	0.03	84	END	11.08	0.09	29
6/19/2005	FKC	11.81	0.18	14	DMN	11.81	0.05	89	END	11.72	0.07	29
6/20/2005	FKC	13.02	0.31	16	DMN	12.99	0.07	93	END	12.45	0.13	32
6/21/2005	FKC	13.03	0.23	17	DMN	13.72	0.05	98	END	13.39	0.13	33
6/22/2005	FKC	13.33	0.23	17	DMN	13.41	0.10	96	END	13.57	0.07	33
6/23/2005	FKC	13.04	0.22	15	DMN	13.80	0.13	90	END	13.28	0.13	30
6/24/2005	FKC	12.71	0.12	15	DMN	13.73	0.02	88	END	13.59	0.07	30
6/25/2005	FKC	13.01	0.06	15	DMN	13.69	0.08	87	END	13.83	0.04	30
6/26/2005	FKC	13.23	0.10	14	DMN	13.68	0.03	82	END	13.98	0.04	27
6/27/2005	FKC	13.40	0.29	14	DMN	13.43	0.09	89	END	14.13	0.13	28
6/28/2005	FKC	12.82	0.30	15	DMN	12.77	0.06	87	END	12.64	0.10	28
6/29/2005	FKC	12.35	0.23	14	DMN	13.01	0.06	84	END	12.53	0.17	28
6/30/2005	FKC	12.81	0.25	13	DMN	14.25	0.09	85	END	13.76	0.08	28
7/1/2005	FKC	12.29	0.06	15	DMN	13.91	0.09	86	END	13.11	0.06	30
7/2/2005	FKC	12.70	0.17	17	DMN	12.82	0.10	100	END	12.44	0.12	34
7/3/2005	FKC	12.95	0.18	17	DMN	12.94	0.07	99	END	13.14	0.16	33
7/4/2005	FKC	13.54	0.20	16	DMN	13.84	0.04	99	END	13.70	0.09	33
7/5/2005	FKC	13.44	0.20	16	DMN	13.06	0.10	99	END	14.07	0.09	33
7/6/2005	FKC	13.12	0.30	17	DMN	12.08	0.10	98	END	12.97	0.20	33
7/7/2005	FKC	12.18	0.37	16	DMN	11.72	0.12	99	END	13.18	0.20	33
7/8/2005	FKC	11.94	0.38	17	DMN	12.84	0.18	100	END	12.85	0.19	33
7/9/2005	FKC	13.28	0.47	16	DMN	14.25	0.09	100	END	14.36	0.05	33
7/10/2005	FKC	12.48	0.21	17	DMN	14.43	0.05	102	END	14.61	0.06	34
7/11/2005	FKC	14.36	0.36	17	DMN	15.15	0.09	93	END	15.74	0.21	32
7/12/2005	FKC	13.52	0.15	14	DMN	12.98	0.08	91	END	14.07	0.24	28
7/13/2005	FKC	11.47	0.22	15	DMN	11.69	0.11	92	END	11.56	0.09	30
7/14/2005	FKC	11.18	0.29	15	DMN	13.43	0.17	90	END	11.89	0.31	30
7/15/2005	FKC	12.85	0.21	16	DMN	14.37	0.11	90	END	13.62	0.18	31
7/16/2005	FKC	13.01	0.06	17	DMN	14.55	0.10	97	END	13.16	0.12	33
7/17/2005	FKC	13.63	0.16	17	DMN	15.55	0.18	101	END	14.26	0.18	34
7/18/2005	FKC	14.18	0.26	16	DMN	17.38	0.14	98	END	16.40	0.26	33
7/19/2005	FKC	14.93	0.14	17	DMN	16.33	0.05	98	END	15.53	0.08	33
7/20/2005	FKC	15.05	0.09	17	DMN	16.15	0.05	99	END	15.73	0.13	33
7/21/2005	FKC	14.59	0.15	15	DMN	15.87	0.04	89	END	15.82	0.08	30
7/22/2005	FKC	13.36	0.18	23	DMN	15.24	0.04	86	END	15.08	0.06	29
7/23/2005	FKC	11.84	0.08	27	DMN	14.90	0.02	83	END	15.50	0.38	35
7/24/2005	FKC	12.20	0.11	27	DMN	14.56	0.12	54	END	14.59	0.14	27
7/25/2005	FKC	12.25	0.07	26	DMN	14.57	0.10	80	END	14.02	0.11	26

7/26/2005	FKC	12.41	0.08	29	DMN	14.51	0.04	84	END	14.80	0.18	29
7/27/2005	FKC	13.04	0.06	30	DMN	14.78	0.04	88	END	14.84	0.06	30
7/28/2005	FKC	12.79	0.09	30	DMN	14.86	0.10	90	END	14.35	0.13	30
7/29/2005	FKC	13.06	0.03	33	DMN	15.30	0.04	100	END	14.78	0.07	33
7/30/2005	FKC	13.36	0.07	36	DMN	15.32	0.03	106	END	15.08	0.07	36
7/31/2005	FKC	13.47	0.04	34	DMN	15.50	0.03	104	END	15.30	0.07	34
8/1/2005	FKC	13.19	0.07	33	DMN	15.11	0.05	100	END	15.36	0.08	33
8/2/2005	FKC	13.11	0.07	34	DMN	15.68	0.05	101	END	15.09	0.06	34
8/3/2005	FKC	13.45	0.13	33	DMN	15.79	0.06	101	END	16.50	0.14	33
8/4/2005	FKC	13.61	0.08	34	DMN	15.50	0.05	102	END	16.16	0.05	34
8/5/2005	FKC	13.24	0.05	32	DMN	15.24	0.08	94	END	15.05	0.09	32
8/6/2005	FKC	13.31	0.03	31	DMN	15.32	0.03	91	END	15.00	0.10	31
8/7/2005	FKC	13.30	0.06	30	DMN	14.93	0.03	88	END	14.81	0.07	30
8/8/2005	FKC	12.74	0.04	28	DMN	14.97	0.05	85	END	14.79	0.07	28
8/9/2005	FKC	13.11	0.09	28	DMN	14.47	0.02	85	END	14.70	0.06	28
8/10/2005	FKC	12.59	0.06	28	DMN	14.31	0.02	83	END	14.34	0.06	28
8/11/2005	FKC	12.60	0.17	30	DMN	14.70	0.12	90	END	14.43	0.12	30
8/12/2005	FKC	12.82	0.06	31	DMN	14.82	0.04	95	END	14.51	0.06	31
8/13/2005	FKC	12.89	0.03	37	DMN	14.45	0.01	111	END	14.30	0.02	37
8/14/2005	FKC	12.35	0.08	36	DMN	14.07	0.01	106	END	13.92	0.02	36
8/15/2005	FKC	11.97	0.02	35	DMN	13.87	0.02	105	END	13.95	0.03	35
8/16/2005	FKC	12.44	0.05	34	DMN	13.89	0.03	104	END	13.45	0.05	34
8/17/2005	FKC	12.52	0.09	34	DMN	13.72	0.04	100	END	14.35	0.08	34
8/18/2005	FKC	12.78	0.06	28	DMN	14.19	0.05	87	END	14.23	0.07	28
8/19/2005	FKC	12.31	0.07	27	DMN	14.14	0.01	83	END	14.17	0.03	27
8/20/2005	FKC	12.68	0.07	27	DMN	14.41	0.06	81	END	14.54	0.05	27
8/21/2005	FKC	12.45	0.10	25	DMN	14.10	0.05	79	END	14.02	0.07	25
8/22/2005	FKC	12.39	0.06	26	DMN	13.87	0.06	78	END	14.11	0.05	26
8/23/2005	FKC	12.04	0.07	27	DMN	14.04	0.02	79	END	13.87	0.09	27
8/24/2005	FKC	12.01	0.00	29	DMN	13.53	0.04	85	END	13.15	0.12	29
8/25/2005	FKC	12.19	0.08	31	DMN	13.67	0.01	92	END	13.25	0.06	31
8/26/2005	FKC	11.90	0.02	37	DMN	13.08	0.01	111	END	13.15	0.04	37
8/27/2005	FKC	11.73	0.03	36	DMN	13.40	0.03	108	END	13.50	0.12	36
8/28/2005	FKC	12.13	0.14	36	DMN	13.52	0.03	107	END	14.01	0.10	36
8/29/2005	FKC	11.25	0.05	36	DMN	12.89	0.04	106	END	12.82	0.08	36
8/30/2005	FKC	10.66	0.16	34	DMN	12.19	0.05	104	END	12.00	0.08	34
8/31/2005	FKC	10.27	0.13	34	DMN	12.15	0.07	103	END	11.13	0.10	34
9/1/2005	FKC	10.23	0.07	31	DMN	12.47	0.08	94	END	11.61	0.09	31
9/2/2005	FKC	11.12	0.10	29	DMN	12.43	0.03	89	END	12.47	0.05	29
9/3/2005	FKC	10.97	0.06	29	DMN	12.20	0.02	86	END	12.16	0.04	29
9/4/2005	FKC	11.49	0.08	27	DMN	13.14	0.03	84	END	12.98	0.09	27
9/5/2005	FKC	11.78	0.06	28	DMN	13.52	0.03	83	END	13.92	0.12	28
9/6/2005	FKC	11.92	0.03	28	DMN	13.89	0.02	83	END	13.56	0.06	28
9/7/2005	FKC	11.92	0.04	28	DMN	13.52	0.02	84	END	13.29	0.05	28
9/8/2005	FKC	12.04	0.05	28	DMN	13.59	0.01	85	END	13.39	0.02	28
9/9/2005	FKC	12.03	0.04	33	DMN	13.50	0.03	97	END	13.31	0.05	33
9/10/2005	FKC	11.05	0.09	36	DMN	12.31	0.06	110	END	12.12	0.14	36
9/11/2005	FKC	11.50	0.11	36	DMN	13.46	0.04	108	END	13.22	0.07	36
9/12/2005	FKC	11.44	0.04	36	DMN	13.17	0.05	107	END	13.48	0.05	36
9/13/2005	FKC	11.47	0.06	35	DMN	13.31	0.02	106	END	13.64	0.03	35

9/14/2005	FKC	11.19	0.07	36	DMN	13.09	0.03	107	END	13.49	0.02	36
9/15/2005	FKC	10.96	0.03	29	DMN	13.13	0.03	88	END	13.43	0.02	29
9/16/2005	FKC	11.17	0.06	28	DMN	12.86	0.02	82	END	13.35	0.03	28
9/17/2005	FKC	11.59	0.03	27	DMN	12.91	0.02	79	END	13.13	0.04	27
9/18/2005	FKC	11.82	0.03	26	DMN	12.89	0.02	79	END	13.15	0.03	26
9/19/2005	FKC	11.78	0.03	26	DMN	13.05	0.03	78	END	13.10	0.05	26
9/20/2005	FKC	11.24	0.04	27	DMN	13.21	0.02	80	END	13.36	0.03	27
9/21/2005	FKC	11.20	0.05	28	DMN	13.14	0.01	83	END	13.18	0.05	28
9/22/2005	FKC	11.18	0.03	31	DMN	12.86	0.02	92	END	12.82	0.07	31
9/23/2005	FKC	11.48	0.05	36	DMN	13.04	0.02	109	END	13.08	0.04	36
9/24/2005	FKC	10.25	0.09	36	DMN	11.77	0.03	108	END	11.55	0.04	36
9/25/2005	FKC	9.82	0.10	36	DMN	11.49	0.07	108	END	11.15	0.14	36
9/26/2005	FKC	10.16	0.07	36	DMN	11.65	0.03	108	END	11.34	0.04	36
9/27/2005	FKC	9.94	0.05	37	DMN	11.53	0.01	109	END	11.63	0.05	37
9/28/2005	FKC	9.91	0.03	36	DMN	11.55	0.03	110	END	11.64	0.08	36
9/29/2005	FKC	10.36	0.06	31	DMN	11.92	0.05	92	END	12.07	0.09	31
9/30/2005	FKC	10.26	0.06	29	DMN	12.18	0.02	87	END	12.44	0.04	29
10/1/2005	FKC	10.45	0.05	28	DMN	12.36	0.04	85	END	12.26	0.04	28
10/2/2005	FKC	10.40	0.06	28	DMN	11.91	0.03	83	END	12.08	0.02	28
10/3/2005	FKC	10.58	0.08	27	DMN	12.02	0.02	82	END	12.04	0.02	27
10/4/2005	FKC	10.59	0.05	27	DMN	12.06	0.02	83	END	12.04	0.04	27
10/5/2005	FKC	10.70	0.08	28	DMN	12.06	0.04	84	END	12.19	0.06	28
10/6/2005	FKC	10.59	0.06	30	DMN	12.05	0.03	88	END	11.94	0.03	30
10/7/2005	FKC	10.48	0.06	33	DMN	12.13	0.01	96	END	11.99	0.03	33
10/8/2005	FKC	10.10	0.05	36	DMN	12.00	0.02	108	END	12.03	0.04	36
10/9/2005	FKC	10.38	0.10	35	DMN	12.20	0.02	107	END	12.39	0.06	35
10/10/2005	FKC	10.29	0.12	36	DMN	11.66	0.03	107	END	11.83	0.06	36
10/11/2005	FKC	10.31	0.03	36	DMN	11.81	0.02	107	END	12.03	0.06	36
10/12/2005	FKC	10.28	0.04	36	DMN	11.92	0.03	108	END	11.88	0.05	36
10/13/2005	FKC	10.02	0.07	32	DMN	11.83	0.03	96	END	12.22	0.09	32
10/14/2005	FKC	10.46	0.08	28	DMN	12.28	0.04	85	END	12.13	0.06	28
10/15/2005	FKC	10.44	0.04	27	DMN	11.85	0.02	81	END	12.27	0.03	27
10/16/2005	FKC	10.55	0.04	25	DMN	11.76	0.02	79	END	12.13	0.04	25
10/17/2005	FKC	10.49	0.04	26	DMN	11.84	0.04	80	END	11.54	0.06	26
10/18/2005	FKC	10.48	0.03	27	DMN	12.25	0.01	82	END	12.03	0.02	27
10/19/2005	FKC	10.81	0.04	28	DMN	12.37	0.01	85	END	12.34	0.02	28
10/20/2005	FKC	10.72	0.03	31	DMN	12.20	0.02	94	END	12.14	0.02	31
10/21/2005	FKC	10.88	0.03	35	DMN	12.09	0.02	103	END	11.83	0.03	35
10/22/2005	FKC	10.82	0.02	35	DMN	12.08	0.02	106	END	12.27	0.02	35
10/23/2005	FKC	10.55	0.01	35	DMN	11.97	0.01	107	END	12.41	0.03	35
10/24/2005	FKC	10.49	0.03	36	DMN	11.92	0.01	108	END	12.31	0.03	36
10/25/2005	FKC	10.66	0.03	36	DMN	12.05	0.02	109	END	12.06	0.02	36
10/26/2005	FKC	10.51	0.03	37	DMN	11.78	0.01	111	END	11.80	0.02	37
10/27/2005	FKC	10.25	0.02	35	DMN	11.59	0.01	105	END	11.63	0.01	35
10/28/2005	FKC	10.59	0.01	31	DMN	11.74	0.01	92	END	11.78	0.01	31
10/29/2005	FKC	10.81	0.05	29	DMN	11.81	0.01	86	END	11.69	0.02	29
10/30/2005	FKC	10.97	0.08	26	DMN	12.06	0.04	78	END	11.80	0.04	26
10/31/2005	FKC	11.32	0.06	28	DMN	12.47	0.04	84	END	12.51	0.05	28
11/1/2005	FKC	11.29	0.04	22	DMN	12.69	0.01	86	END	12.70	0.01	28
11/2/2005	FKC	ND	ND	ND	DMN	12.55	0.02	89	END	12.57	0.02	30

11/3/2005	FKC	ND	ND	ND	DMN	12.30	0.02	94	END	12.34	0.02	31
11/4/2005	FKC	ND	ND	ND	DMN	12.57	0.00	101	END	12.52	0.01	33
11/5/2005	FKC	ND	ND	ND	DMN	12.37	0.01	100	END	12.36	0.00	34
11/6/2005	FKC	ND	ND	ND	DMN	12.42	0.00	106	END	12.36	0.00	36
11/7/2005	FKC	ND	ND	ND	DMN	12.25	0.01	106	END	12.31	0.01	36
11/8/2005	FKC	ND	ND	ND	DMN	11.95	0.03	107	END	12.14	0.04	36
11/9/2005	FKC	ND	ND	ND	DMN	11.91	0.03	110	END	11.85	0.05	36
11/10/2005	FKC	ND	ND	ND	DMN	12.07	0.02	100	END	12.18	0.02	34
11/11/2005	FKC	ND	ND	ND	DMN	12.18	0.01	92	END	12.27	0.02	31
11/12/2005	FKC	ND	ND	ND	DMN	12.04	0.01	85	END	12.25	0.04	28
11/13/2005	FKC	ND	ND	ND	DMN	12.21	0.01	82	END	12.18	0.03	28
11/14/2005	FKC	ND	ND	ND	DMN	12.24	0.02	84	END	13.58	0.37	28
11/15/2005	FKC	ND	ND	ND	DMN	11.73	0.02	89	END	ND	ND	ND
11/16/2005	FKC	ND	ND	ND	DMN	11.63	0.03	80	END	ND	ND	ND

