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# Broad-Scale Non-indigenous Species Monitoring along the West Coast in National Marine Sanctuaries and National Estuarine Research Reserves

Catherine E. de Rivera
*Portland State University*, derivera@pdx.edu

Greg Ruiz
*Smithsonian Environmental Research Center*

Jeff Crooks
*National Estuarine Research Reserve System*

Kerstin Wasson
*National Estuarine Research Reserve System*

Steve Lonhart
*National Marine Sanctuary Program*

*See next page for additional authors*

Authors
Catherine E. de Rivera, Greg Ruiz, Jeff Crooks, Kerstin Wasson, Steve Lonhart, Paul Fofonoff, Brian Steves, Steven S. Rumrill, Mary Sue Brancato, Scott Pegau, Doug Bulthuis, Rikke Kvist Preisler, Carl Schoch, Ed Bowlby, Andrew DeVogelaere, Maurice Crawford, Steve Gittings, Anson Hines, Lynn Takata, Kristen Larson, Tami Huber, Anne Marie Leyman, Esther Collinetti, Tiffany Pascot, Suzanne Shull, Mary Anderson, and Sue Powell

# Broad-Scale Non-indigenous Species Monitoring along the West Coast in National Marine Sanctuaries and National Estuarine Research Reserves

**Report to National Fish & Wildlife Foundation**

Catherine E. deRivera[1*], Greg Ruiz[1], Jeff Crooks[2], Kerstin Wasson[2], Steve Lonhart[3], Paul Fofonoff[1], Brian Steves[1], Steve Rumrill[2], Mary Sue Brancato[3], Scott Pegau[2], Doug Bulthuis[2], Rikke Kvist Preisler[2], Carl Schoch[2], Ed Bowlby[3], Andrew DeVogelaere[3], Maurice Crawford[2], Steve Gittings[3], Anson Hines[1], Lynn Takata[3], Kristen Larson[1], Tami Huber[1], Anne Marie Leyman[1], Esther Collinetti[1], Tiffany Pascot[1], Suzanne Shull[2], Mary Anderson[2], Sue Powell[2]

With help from taxonomists: Linda McCann[1], Gretchen Lambert[4], Lea-Anne Henry[4], Natasha Gray Hitchcock[1], Chris Brown[1], Francis Kerckof[4], Jeff Goddard[4], Esther Collinetti[1]

1. Smithsonian Environmental Research Center
2. National Estuarine Research Reserve System
3. National Marine Sanctuary Program
4. Other institution (for taxonomists), see **Appendix A**

* Catherine E. deRivera, Aquatic Invasions Institute, Portland State University & Smithsonian Institute, deriverac@si.edu; 443 482 2401

## Table of Contents

Figures



Appendices

# Summary

Nonindigenous species have caused substantial environmental and economic damage to coastal areas. Moreover, the extent and impacts of nonindigenous species are increasing over time. To develop predictive models and to identify which areas should be targeted for impact mitigation or early detection, we need a basic foundation of knowledge about the spatial and temporal patterns of invasions. This project was developed because we lacked the necessary data to rigorously evaluate the patterns of coastal invasions. This collaborative project, between the Smithsonian Environmental Research Center, the National Estuarine Research Reserve System (NERRS) and the National Marine Sanctuary Program (NMSP), established a rigorous, large-scale monitoring and research program for invasive species in nine protected coastal areas along the US West Coast from San Diego, CA, to Kachemak Bay, AK. Our research included two components, broad-scale and site-specific projects.

The broad-scale component focused on using standardized protocols to collect data on the composition of fouling communities and nearshore fish and crabs. We collected data from 310 settling plates and 140 traps across nine NERRS Reserves and NMSP Sanctuaries. The four most common taxa on the settling plates were Bryozoa, Tunicata, Cirripedia, and Hydrozoa. We identified these four taxa and also Nudibranchia, a mobile molluscan taxa often associated with fouling organisms, to species and noted which were nonindigenous. We found 132 species in the 5 taxa under study. NIS accounted for over one quarter of the diversity in these taxa, with 31 NIS identified. Over half of tunicate species were non-native. The documented NIS included two new US west coast sitings plus 3 other range extensions. We documented two patterns in NIS, a latitudinal pattern and differences between NIS impacts in marinas versus non-marina sites; research on salinity differences is still underway. Both the number and percent of NIS decreased with increasing latitude. Tijuana River had the most, 21, NIS and Monterey Bay had the highest proportion of NIS (57%). The same pattern of decreasing NIS with increasing latitude was observed when we examined Tunicata only and Bryozoa only. Across latitudes, plates in marinas were more impacted by NIS than were plates in more natural areas. All NIS but one were found at marinas, whereas only half the NIS were found at the non-marina sites. In addition, NIS at marinas accounted for almost 80% of the NIS per site. Therefore, we were able to provide information on the relative risk of invasions for different taxonomic groups and geographic regions. The spatial and habitat patterns can be used for future predictions and will be of even more value once they are confirmed with additional taxonomic groups and hypothesis-driven studies that will continue from this initial study. Our broad-scale trapping study illustrated how recently-introduced NIS quickly can become numerically dominant. Although we only found *Carcinus maenas* at Elkhorn Slough NERR, this recently introduced nonindigenous crab was very common at this Reserve and was the most abundant crab in our traps at 3 of 7 Elkhorn sites.

The site-specific projects were conducted at each Reserve plus Olympic Coast and Monterey Bay Sanctuaries. Several are serving as the first important step in longer term research, such as examining whether a change in shipping policy in Kachemak Bay will increase NIS. Others, such as the South Slough project examining the effect of a salinity cline on the number and proportion of NIS, will be expanded to test hypotheses across several protected areas. Many of these site-specific projects still need further analyses, and analysis is underway.

# Introduction

The extent and impacts of nonindigenous species (NIS) invasions in coastal marine ecosystems have become increasingly evident in recent years (Carlton 1989, 1996a; Carlton & Geller 1993; Ruiz et al. 1997, Grosholz 2002). We know of at least 500 NIS that have invaded marine and estuarine habitats of the U.S. (Cohen & Carlton 1998, Ruiz et al. 2000). Moreover, the tempo of invasion appears to be increasing rapidly (Ruiz et al. 2000). NIS have caused substantial environmental and economic damage to coastal areas (Carlton 2001). In marine and estuarine environments, the impacts of biological invasions include dramatic changes to ecological community structure and ecosystem dynamics, parasite and pathogen interactions with native species, commercial fisheries stress, and detrimental alterations to physical habitat structure (Carlton 2001, Grosholz 2002, Levin 2002).

Understanding patterns of NIS invasions among systems is crucial to developing effective management strategies (Ruiz & Carlton 2003). Without this foundation of basic information, we cannot assess the relative risk of invasions for different taxonomic groups, geographic regions, habitat types, or vectors. Moreover, spatial patterns of invasion are key to focusing monitoring, early detection, and vector management efforts to reduce risks of new invasions. Although existing data underscore the increasing ecological and economic consequences of NIS invasions (OTA 1993; Ruiz et al. 1999; GAO 2002, Perrings et. al 2002), there are serious limitations in our present knowledge about marine invasions (Ruiz et al. 2000). Such information gaps affect critical management decisions and hamper development of invasion biology as a predictive science (Carlton 1996b; Kareiva 1996; Vermeij 1996; Ruiz et al. 1997; Ruiz & Hewitt 2002).

The rates and spatial patterns of marine invasions remain largely unresolved (Ruiz et al. 2000, Ruiz & Hewitt 2002). Although literature-based syntheses have identified many apparent patterns of invasion among coastal systems, these studies lack standardized, quantitative, and contemporary field surveys (Carlton 1979; Cohen & Carlton 1995; Reise et al. 1999, Hewitt et al. 1999, Ruiz et al. 2000). The quality and quantity of information in these reports is very uneven among sites and reflects distinct differences in sampling methods as well as differences in spatial and temporal search effort among taxonomic groups, habitats, bays, and geographic regions (Ruiz et al. 2000). For example, an extensive and on-going sampling program of soft-sediment benthic invertebrates may exist for some sites, but it may have been decades since this biota was sampled at other sites included in the same synthesis. Even where recent faunal surveys exist, the sampling designs and level of taxonomic analyses usually differ among sites and over time. Thus, spatial and temporal patterns of invasion, both within and among sites, are confounded by sampling biases present in the available data (Ruiz et al. 2000). Therefore, the Forum on Ecological Surveys (sponsored by U.S. Fish and Wildlife Service, April 1998) concluded that fundamental data for assessing such risks in coastal marine systems are lacking. The uneven and incomplete nature of existing data remains a critical information gap, limiting guidance and evaluation of management decisions.

The threats posed by current and future marine invasions are of critical concern to our nation's coastal protected areas. The National Estuarine Research Reserve System (NERRS) and the National Marine Sanctuary Program (NMSP) are two systems of protected areas charged with the conservation and stewardship of ecologically sensitive, biologically diverse areas along all coasts of the United States. Most NERRS Reserves have been affected by biological invaders (Wasson et al. 2002). Similarly, a 2001 assessment of the scientific information needs for the NMSP indicated that, for the majority of sites, the identification of marine invasive species sources was of high concern. Both NERRS and NMSP managers require scientific information to address the persistent and expanding non-indigenous species threat. They concluded substantial increases in research and monitoring activity are necessary to effectively support management (Gittings et al. 2002).

To address the information gaps about invasion patterns and the extent of invasion in these protected areas, the NERRS, NMSP, and Smithsonian Environmental Research Center (SERC) initiated a joint research program studying NIS in the west coast NERRS and NMSP protected areas. Few attempts have been made to monitor marine invasions at large spatial scales, although standardized surveys across large regions are necessary to examine hypotheses of invasion success and habitat resistance at these scales. Therefore, we set out to create a broad-scale, multi-habitat platform to study, compare, and contrast invasion patterns and their associated ecological and economic implications for protected area management nationally.

This research program had two main objectives. First, we planned to initiate and develop capacity for a broad-scale NIS monitoring network that uses standardized protocols. A quantitative baseline of standardized data could be used to identify patterns of established non-indigenous species, detect the arrival and spread of new marine invasions, and test hypotheses about the causes and impacts of invasions in coastal ecosystems. Our second goal was to develop site-specific projects of local interest that could serve as pilots for broader scale future projects. Below we address the broad-scale project followed by the site-specific projects.

## BROAD-SCALE MONITORING FOR SESSILE INVERTEBRATES AND NEARSHORE CRABS AND FISH

### Goals, Broad-Scale Project

- Provide a baseline against which the impact of future invasions may be compared.
- Contribute to the nationwide effort to track the diversity, range, and abundance of non-indigenous species.
- Delineate the current geographic range of established invaders and track their spread.
- Provide early detection of new invasion events so that rapid, focused responses may be initiated.
- Link data on invasive species in the monitoring network for shared information and large-scale analysis, as well as for inclusion in the growing national database on marine invasions established at SERC.
- Develop capacity to assess the success and performance of non-native species across sites.

- Test several hypotheses about the spatial and temporal patterns of NIS, including:

  1. Across NERRS and NMSP sites, the number of established non-indigenous species decreases with increasing latitude;
  2. Along the marine to estuarine gradient at a given latitude, the number of non-indigenous species will decrease, and the percentage of non-native species will increase, with decreasing salinity.
  3. The number of established non-indigenous species is significantly greater in estuaries and bays (i.e., NERRS sites) than more exposed marine habitats (NMSP sites);
  4. The rate of new invasions will decline with increasingly effective management efforts.
  5. The rate of spread of non-indigenous species among sites is related to life history characteristics and coast-wise transport vectors.

## Methods, Broad-Scale Project

### Reserves and Sanctuaries

Our research program employed standardized field approaches in the protected areas along the length of the U.S. West Coast from Kachemak Bay AK to San Diego CA. We sampled in and near all five west coast NERRS Reserves: Kachemak Bay AK, Padilla Bay WA, South Slough OR, Elkhorn Slough CA, Tijuana River Estuary CA, and four West Coast NMSP Sanctuaries, Olympic Coast WA, Gulf of Farallones CA, Monterey Bay CA, Channel Islands CA (**Fig 1**; see web content for map of Reserves and Sanctuaries along the west coast and of sites within and near these protected areas). The five Reserves and the Olympic Coast and Monterey Bay NMSP Sanctuaries were active participants in the project. After we began sampling, a sixth NERRS Reserve was added to the west coast, but we did not include this Reserve in our sampling regime. At multiple sites at each Reserve and Sanctuary, we sampled for fouling organisms using settling plates and, at the Reserves, for nearshore crabs and fish using traps.

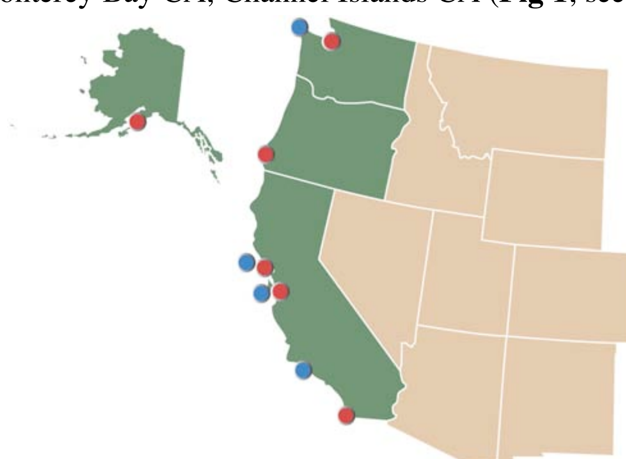

**Figure 1.** Map of the US West Coast National Estuarine Research Reserves (red) and National Marine Sanctuaries (blue) in this study.

Henceforth, we use ‘Reserves’ to refer to the participating NERRS, ‘Sanctuaries’ to refer to the NMSP sanctuaries sampled in the project, and ‘protected areas’ to refer to both.

## Settling Plate Methods

### *Site selection*

We sampled with settling plates at two marinas or piers and at several non-marina sites in or near each of the protected areas (**Table 1, Web content**). We used the two nearest marinas that were willing to participate and were not in the same harbor. There was one exception to this rule: because Elkhorn Slough opens into Monterey Bay, we used the one marina at the mouth of Elkhorn Slough, Moss Landing, midway up Monterey Bay, plus the marinas at the north and south ends of Monterey Bay. Hence, we sampled just three marinas for these two protected areas combined. We sampled both the north and south parts of the Moss Landing marina but have combined the results from the two parts for analysis because there was very little difference between them in fouling community composition.

We sampled at four to eight non-marina sites in each protected area. The non-marina areas for settling plates were selected by the actively participating sites, and were selected based on three different criteria. First, all NERRS sites participate in a system-wide water monitoring program (SWMP) and each Reserve has four to five water monitoring stations. We sampled at each of these SWMP stations to help start collecting biological data to go along with the water quality data. We deployed between one and six plates at each SWMP station, depending on feasibility of deploying multiple plates. Second, we deployed plates at additional areas that would help sample along a gradient or test a hypothesis of local interest, usually related to the SWMP station's gradient. For example, in Elkhorn Slough, the SWMP sites were selected to measure water quality at different distances from the mouth and also at different water flow regimes (high vs. low). We therefore, deployed plates at high and low flow areas at different distances from the mouth of the slough. Similarly, we sampled extra sites in South Slough to better measure the effect of salinity on recruitment.

Third, we took advantage of already-existing structure or buoys used by other sampling programs to sample deep water, and hard bottomed sites in the protected areas. For example, we deployed plates at buoys used by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) in the Channel Islands and Monterey Bay Sanctuaries. Olympic Coast maintains its own offshore buoys, which we used for settling plates. In the Gulf of Farallones area, we attached plates to buoys maintained by a graduate student in Tomales Bay.

We measured several environmental variables at each site. We measured temperature every 4 hrs with a datalogger. We also measured temperature, salinity, and dissolved oxygen at deployment and retrieval with a YSI probe. The NERRS records readings every 30 min of temperature, salinity, dissolved oxygen, and other water measurements at each of their SWMP sites. No other site variables were measured. Sites varied in flow and sediment type, and these were noted based on broad visual assessment. The marina sites tended to have low flow as did several sites in Elkhorn Slough (Azevedo Pond, Hudson Landing West, North Marsh, and Whistle Stop Lagoon) and one of the Tijuana River sites (Tidal Linkage). All other sites seemed to have moderate to high flow. The four southern NERRS, Tijuana River, Elkhorn Slough, South Slough, and Padilla Bay had soft sediment, mostly silt, at all of the sites we used. A few of the sites in these Reserves had riprap in the intertidal zone nearby (e.g., Elkhorn Slough's North Marsh, Vierra, and Whistle

Stop Lagoon). The sites we used at the edge of the Gulf of Farallones NMS, sites in Tomales Bay and Bodega Bay, were also soft bottomed. Kachemak Bay and the non-marina sites in and by the Sanctuaries had sandy or rocky substrates for the most part.

### *Plate deployment*

Following standardized protocols, we sampled the sessile invertebrate community at each site with settling plates, also called fouling panels. These plates were 13.5 cm x 13.5 cm x 0.5 cm polyvinyl chloride (PVC) squares. They served as passive collectors that accumulated organisms over time through larval recruitment and immigration. Plates were sanded on one side to facilitate attachment of recruiting invertebrates. All plates faced sanded side down to maximize invertebrate recruitment, minimize algal growth, and minimize sediment deposition on the target organisms.

Plates were suspended at least 0.25 m above the substrate so they never touched the substrate. They either were hung from a floating structure or suspended to be at least 0.5 m below MLLW; they were in water all or almost all of the time. The plates were deployed in different ways depending on available structure, sediment type, and depth at the different sites. For all deployment methods, we recorded plate depth and elevation above the substrate.

We divided each marina and pier into six equally sized parts and deployed one plate at a randomly selected spot in each part. Marina and pier plates were weighted with a brick. At marinas, each plate and brick unit was hung from a floating dock typically at 1.0 ± 0.2 m below the water surface, depth allowing. Plates suspended from shallow water floats were closer to the surface, as shallow as 0.4 m deep, so the plates would not touch the bottom when the tide was out. At piers, plates were suspended to an estimated height of 1 m below mean lower low water (MLLW).

The SWMP and in-estuary plates were attached to pilings or temporary stands in the four southern NERRS and to buoyed lines in Kachemak Bay and the deep water Padilla buoy SWMPs (see below). Plates were deployed from pilings when these were available at a site, as was the case with the South Slough SWMP sites and some Kachemak Bay plates (as indicated in **Table 1**). Piling plates were suspended 0.5 to 1.0 m below MLLW, were attached to a PVC pole, and were held at least 0.4 m away from the piling so they would be affected only minimally by anti-fouling substances on the pilings. All other Reserve sites lacked pre-existing structure. Therefore, in soft-sediment areas in Reserves (Tijuana River, Elkhorn Slough, South Slough, and most Padilla Bay sites), plates were attached to PVC pipe stands. The plates hung 0.25 to 0.5 m above the substrate and 0.5 m below MLLW. Each plate was at least 10 m from all other plates. In 2004, when we did additional sampling of South Slough for the site-specific project, we put two plates on each frame; these plates were only 7 cm from their pairs. Frames were still located at least 10 m from one another.

At the non-marina sites of the Sanctuaries, Kachemak Bay NERR, and the ‘Gong’ site of Padilla Bay NERR, plates were deployed from anchored buoys. These plates were suspended between 1 and 2.5 m below the water’s surface. We also deployed a second plate from the Reserve buoys 1 m above the substrate. The plates on buoys were held away from the line and, like the other plates, were oriented horizontally with the sanded side down.

Most plates were deployed in June and July in 2003 and 2004, and retrieved approximately 3 months (86-113 days) later. The exceptions were plates deployed from buoys in Sanctuaries in 2004. These plates were deployed in May and retrieved 128-131 days (Olympic Coast, Monterey Bay) or 182 days later (Channel Islands).

### *Retrieval, point counts, and vouchers*

We retrieved the settling plates once they had soaked for approximately 3 months. We held retrieved plates in water from each site as we processed them. We scraped away organisms growing on the top and sides of each plate, isolating the ones on the bottom side. We photographed the plates to provide an archival record and to provide pictures for web-based taxonomic guides, and we measured the amount of water they displaced to have a measure of biovolume (biomass).

We preserved plates so a small team could process all of them at once each year, for consistency. We put each plate into a nylon stocking to keep together all the mobile and sessile organisms associated with the plate, then soaked the plate for 15 to 30 min in a Magnesium Chloride (MgCl) or Magnesium Sulfate ($MgSO_4$) bath to relax the organisms for easier identification. We used 64 g MgCl or $MgSO_4$ per liter of water, and used a mixture of seawater and tap water so that the final mixture including the magnesium salt was a similar salinity to the site. The plates were then placed in a 10% Formalin bath, made with seawater, for 24 to 48 hrs, and finally into a 70% ethanol bath for 24 hrs or more. After all plates had soaked in alcohol for at least 24 hrs, they were drained and shipped overnight to SERC for further processing.

A team of four conducted point counts on the plates and collected multiple specimens of all species. We classified organisms by higher taxonomic group, numbering each morphologically different organism on a plate as a new morphotype for that group (e.g. Tunicata1, Tunicata 2, Bryozoa 1… for each plate), and noted genus or species identification when known. We identified to morphotype the organism directly attached to the plate at 50 point counts on each plate, 49 points along a 7x7 grid plus a 50$^{th}$ randomly selected point. The point counts provided a measure of community structure and dominance of sessile invertebrates.

We collected and archived multiple specimens of each morphotype on each plate. Taxonomic experts verified species identification of all collected hydroids, nudibranchs, cirripedia, bryozoa, and tunicates. These specimens provided a measure of species richness and the number and percent of NIS on each plate, at each site, and at each protected area. All vouchered specimens were stored with a unique barcode in an archive at SERC; their identifications and site-specific information were maintained in a database.

### *Data analysis*

We counted number of species from the five identified taxa in three ways. First we counted the maximum number of species in these five groups that may have been at a site and protected area.

This count included all the fully identified species plus those that have not yet been given names and had published descriptions, plus samples that were identified to a higher-level taxonomic grouping but not all the way to species (due to damaged and partially eaten specimens…). Multiple samples identified to family of that family were counted as one entry. This maximum number of species is given in Table 2 but no used in analyses. Second, we tallied a minimum number of species for each plate, site, and protected area. This included the named and not-yet-named fully identified species plus any higher-level identifications that were not represented by species in that same group. For example, a site that had a sample identified as the thecate Hydrozoa Family Campanulinidae and had no samples in this family identified to genus or species (no Campanulina, Cuspidella, and Opercularella), then we would count the family once in the minimum number of species count. Third we tallied the number of named species. This excluded the higher-level identifications and the identifications of not-yet-named species. The exception is for the tunicates; we included not-yet-named tunicate species in this count because these were well documented, well described species whose non-native status was documented in some cases. We used the minimum number of species in analyses about species diversity.

To determine the percent of the species that were non-indigenous, we divided the number of species that are documented as NIS by the number of named species. We used the number of named species as the denominator rather than the minimum number of species found because a species must be identified and named to be documented as an NIS. The exception is for the tunicates. This taxon includes NIS for identified but only partly-named species (e.g. *Didemnum sp. A*). Therefore, for the Tunicata, all organisms identified to species were included for the denominator. We excluded cryptogenic species from the list of NIS.

To allow comparison of sites with different sampling intensities, we counted the number of species on 5 randomly-selected plates at each site. Analysis on plates from previous west coast sampling showed that species accumulation tailed off after five plates at most sites (GM Ruiz, unpublished data). When a site was visited on two years, we selected all the plates from just one year (the first year with five plates). Because not all sites had five plates, we either excluded sites with fewer plates from analysis or, when possible, combined sites. We only combined sites when they were near to each other, in similar habitat, and deployed with the same method (buoys with buoys, or frames with frames). We combined the Channel Island area plates deployed from buoys into two groups, the southern three sites (Ellwood, Alegria, and Jalama) and the northern three sites (Arguello, Purisima Point, and Point Sal). Similarly, the Monterey Bay buoy-deployed plates were combined as were the Gulf of Farallones area Tomales Bay buoy plates and also the Olympic Coast buoy plates. Some Elkhorn Slough sites were combined: we grouped the two high flow sites near the mouth of the slough (Vierra and South Marsh Restoration), we grouped the low flow sites mid estuary (Whistle Stop Landing with North Marsh), and we grouped the low flow sites higher in the estuary (Azevedo Pond with Hudson Landing West). All other sites with fewer than five plates were excluded except for Cap Sante Boat Haven in Padilla Bay, which had four species-rich plates.

The point count data provided information on plate species diversity beyond the five taxa that were sent out for taxonomic identification. These point count data use morphotypes, what looks like a species rather than a verified named species, so cannot be used for site-level species accumulation curves (the identifier given to an organism on one plate was not necessarily the same identifier given to the same species on another plate). Therefore, we calculated an index of diversity, the Shannon-Weiner Index, for each plate. This index accounts for both species richness (number of species per plate) and how the individuals are apportioned across the component species (distribution of counts across morphotypes). The Shannon Index calculates the amount of information that is needed to describe (to morhpotype) every member of the community. To calculate this index, the relative abundance of each morphotype (the number of primary point counts of an invertebrate morphotype divided by the number of primary point counts of all invertebrates on the plate) was multiplied by the natural log of the relative abundance and summed across all morphotypes on a plate then multiplied by -1. Thus a plate with just one morphotype had a value of zero and the value increased with number of morphotypes and evenness of the counts across morphotypes. These data include plates from sites that do not yet have taxonomic identifications, so the sample size is somewhat larger than that used for analyses requiring species identifications.

The point count data also provided information on the proportion of each plate that was covered by invertebrates. These data were also used to calculate the proportion of points that each taxon covered.

We categorized sites as 'marina sites', plates hung from floating docks or from piers, and 'other sites', plates deployed from buoys, from frames stuck into the substrate, or from ells attached to individual pilings. **Table 2** includes small piers inside protected areas as non-marina plates, but all analyses use the aforementioned categories. The NERRS SWMP sites were all counted as in-estuary, non-marina plates.

All variables used in statistical analyses were transformed to meet the assumption of a normal distribution. Means are given with the raw data, and figures are presented with the raw data or backtransformed axis labels for ease of use.

**Crab Trapping**

We trapped for nearshore fish and crabs at the five Reserves. We selected one to seven sites at each Reserve for trapping, typically at settling plate sites (see **Table 1**). When possible, we used sites with structure, including eel grass (*Zostera marina*), cobble, and rip-rap. We trapped more than our target of three sites at Elkhorn Slough because the nonindigenous crab *Carcinus maenas* are abundant there and are under study at this Reserve. We trapped fewer than our target amount in Kachemak Bay due to a lack of accessible trapping sites and similar logistical problems.

Traps were deployed during fall low tides in 2003 and 2004, around the plate retrievals. We deployed 8 traps at each site at approximately MLLW. Some traps were not set properly or were lost; the number of traps per site we retrieved is given in **Table 1** and **Appendix B**. Two types of traps were set out at each site. We used 4 collapsible, box traps (61 x 46 x 20 cm, with two 46 cm openings and 13 mm mesh; made by Fukui) and 4 minnow traps (vinyl-coated steel tapered cylinders, 42 cm long, 23 cm diameter, with 5.0 ± 0.5 cm diameter openings on each side and ~ 1 cm mesh) interspersed between them. All traps were 20 to 30 m from their neighbors. Traps were tethered into place (tied to structure or to a temporary pole) and were weighted where currents were strong. Traps were baited with frozen fish, when available, or cat food (Kachemak Bay in 2003, Padilla Bay).

We retrieved traps after 24 hrs and identified all fish and crabs within to species. We also noted gender and injuries, and measured length (fish) or carapace width (crabs). We report traps from 2003, and we also report Kachemak Bay trap results from 2004.

## Results, Broad-Scale Project

### Settling Plates

#### *Species diversity and composition in and near the West Coast Reserves and Sanctuaries*

We found at least 132 species out of 5 taxa in our fouling plate survey, 20 hydroids, 19 nudibranchs, 11 barnacles, 26 tunicates, and 56 bryozoans (**Table 2, Fig 2a**). We found the most species in bays near Tijuana River NERR, and there was a general decrease in number of species from the southernmost to northernmost protected areas. Tijuana River NERR, however, had the most settling plates in marinas. The high number of plates as well as their habitat location could bias the trend.

Analysis of the number of species on 5 randomly-selected plates per site, which provides an estimate of alpha diversity (species richness per site) for the 5 taxa under study and also allows comparison of sites that were sampled with different intensities, yielded a coastwide average of 14.8 ± 9.2 species per 5 plates (mean ± SD, N = 39 sites). Alpha diversity ranged from 2 species on 5 Hummingbird Island plates, Elkhorn Slough NERR, and on Seldovia piling plates, Kachemak Bay NERR, to 36 species at Dana Marina, Mission Bay, near Tijuana River NERR (**Appendix C**). On the protected area level, this measure also showed a decrease in richness from southern protected areas to more polar ones (**Fig 2b**). However, the Gulf of Farallones had the highest number of species, with 25.25 ± 5.41 species per 5 plates (mean ± SE, N = 4 sites) and Elkhorn Slough had the lowest number, with 9.20 ± 1.93 species (N = 5 sites; **Fig 2b**). Tijuana River had the second highest species richness per five plates (**Fig 2b**).

Species diversity (accounting for both richness and evenness of distribution among species) on individual plates in the 76 sites also decreased from southern to northern sites but was highest at the Gulf of Farallones area plates (Shannon Index, H = 1.04 ± 0.11, mean ± SE, N = 26) and was lowest on the Padilla Bay plates (0.55 ± 0.09, N = 25; **Fig 2c**).

Invertebrates covered 64.1± 31.1% (mean ± SD, N = 310 plates) of the observed points on plates. Percent cover was highest on plates in South Slough (70.8 ± 3.8% cover, mean ± SE, N = 76 plates) and Tijuana River (70.7 ± 4.7%, N = 33) and lowest in Padilla Bay (50.6 ± 6.3%, N = 25; **Fig 2d**). Our second measure of abundance and growth of organisms on plates, biovolume, yielded an average of 167 ± 87 ml displaced (N = 295 plates). Gulf of Farallones area plates had the highest biovolume (256 ± 31 ml, mean ± SD N = 26), while Padilla Bay, again, had the lowest (111 ± 7 ml, mean ± SEN = 25; **Fig 2e**).

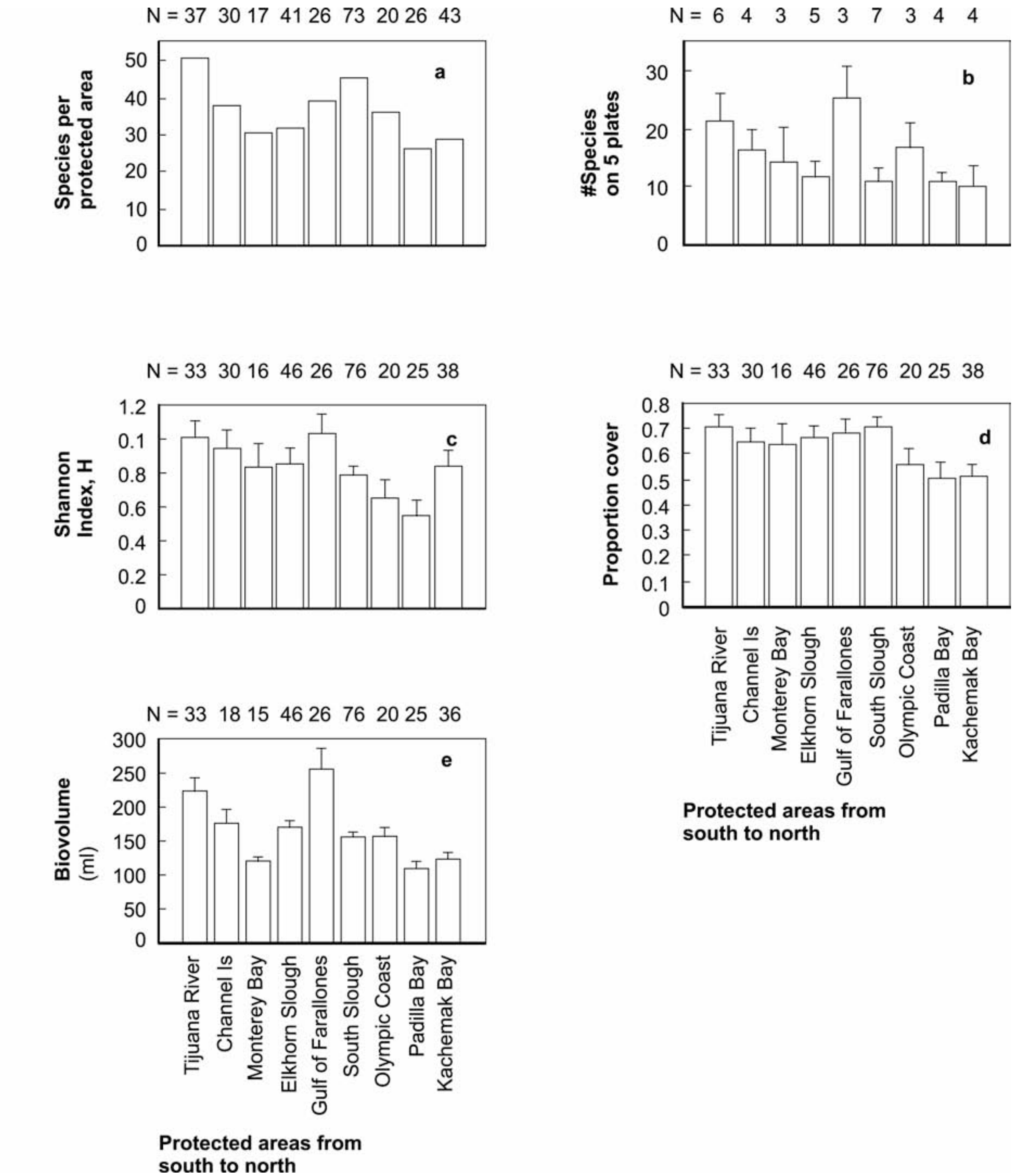


Figure 2. Species diversity and abundance on settling plates across protected areas, as measured by: a) Species richness from all plates, b) Species richness on 5 plates, c) Species diversity (Shannon diversity index) per plate, d) Proportion cover per plate, and e) Biovolume (water displaced) per plate. Bars in b-e show mean ± 1 SE; N, number of sites in b or number of plates in a, c, d, and e, is given along the top.

There were more Bryozoa species than other taxa overall and at each protected area (**Table 2**). Bryozoa also were on more plates than any other taxa: they were on 250 of the 310 plates in the study, while the second most common taxa, Tunicata, were on just 128 of the plates, Cnidaria were on 117 (Hydrozoa were on 107 of those), and Cirripedia were found on 111 plates. Other taxa were much less common. Of the plates with Bryozoa, Bryozoa also occupied more of the observed points than any other taxa (48.7 ± 1.2% of the points, mean ± SE, N = 250 plates **Fig 3**). Tunicates, hydrozoa, and barnacles also accounted for much of the percent cover on plates with these taxa, whereas other taxa were much less abundant (**Fig 3**).

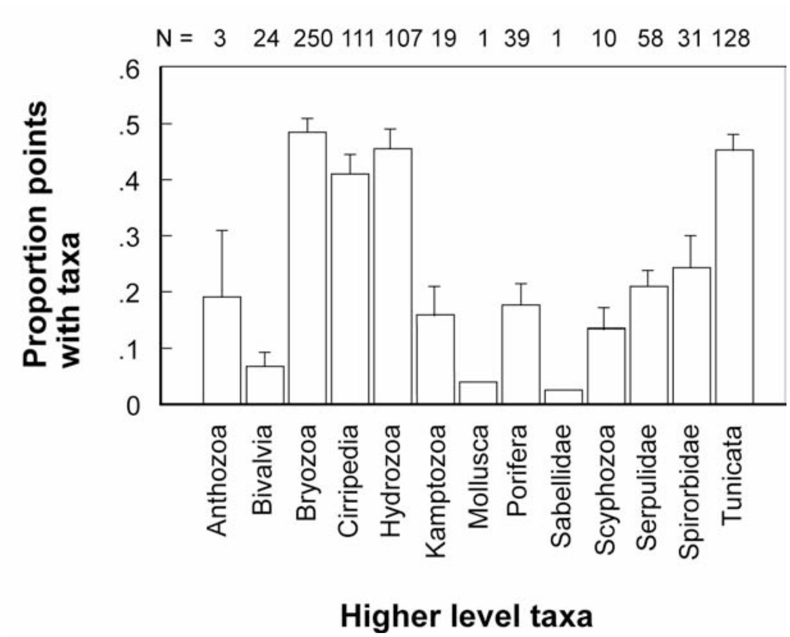


Figure 3. Species dominance on settling plates as measured by proportion cover on plates. Bars show mean ± SE; N, number of plates with each taxon, given along the top.

### *NIS diversity and abundance*

Nonindigenous species (NIS) accounted for over one fourth of the diversity of the more common taxonomic groups in protected areas along the US west coast (**Table 2**). We found 31 NIS on the plates, one each of Hydrozoa, Serpulidae, and Nudibranchia, plus 3 Cirripedia, 11 Bryozoa, and 14 Tunicata NIS (**Tables 2, 3**). NIS represent 27% of the species richness of these taxa excluding the Serpulidae, which are not yet fully documented in our samples: 7.7% of the fully-identified, described hydroid species were NIS, as were 5.9% of the nudibranchs, 27.3% of the barnacles, 27.0% of the bryozoans, and 53.8% of the tunicate species (**Table 2**).

The most common nonindigenous taxa were Tunicata (on 346 plates at 114 sites in 8 protected areas, all but Kachemak Bay) followed by Bryozoa (on 303 plates at 86 sites in 7 protected areas, all but Kachemak Bay and Olympic Coast). NIS Cirripedia were on only 42 plates at 20 sites in 5 protected areas, Hydrozoa were on 4 plates at 2 sites in 2 protected areas (Tijuana River, South Slough), and a Nudibranchia was on just one plate (Elkhorn Slough). The most common nonindigenous species included three Tunicata, *Botryllus schlosseri* (on 56 plates at 22 sites in 8 protected areas), its congener *Boltrylloides violaceus* (on 67 plates at 20 sites in 8 protected areas), and another colonial tunicate *Diplosoma listerianum* (on 65 plates at 16 sites in 5 protected areas), plus 3 Bryozoa, the encrusting *Watersipora subtorquata* (on 66 plates at 14 sites in 6 protected areas) and *Cryptosula pallasiana* (50 plates at 14 sites in 7 protected areas), and the erect *Bugula neritina* (58 plates at 14 sites in 5 protected areas).

***NIS ranges and range extensions***

The nonindigenous fouling species on our plates came to the west coast from both sides of the Atlantic, the Indo-Pacific, and the NW Pacific through shipping vectors (hull fouling and ballast water) and, for 10 of the species, also along with oysters brought for mariculture (**Table 3**).

**Appendix D** lists the sites in which each NIS was found. The ranges of NIS found in our survey are given in the web-accessible database and the associated fact sheets. The most widespread species we found was *Obelia longissima*, which was found at all protected areas. The most widespread NIS were *Botryllus schlosseri* and its congener *Boltrylloides violaceus*, both of which were found at all 8 protected areas from Tijuana River, CA, to Padilla Bay, WA. Also extending from Tijuana River to Padilla Bay but at fewer of the protected areas were *Cryptosula pallasiana*, which was missing from Olympic Coast, and *Balanus improvisus*, which was missing from the Channel Islands up through the Gulf of Farallones area sites.

This study documents range extensions for five of the 31 NIS we found on plates, including new records for the US west coast. Our documentation of *Balanus reticulatus* in a Tijuana River NERR area marina, Sunroad Marina in San Diego Bay, is a new record for the US West Coast. It was previously documented much further south in Mazatlan Mexico (Laguna 1985). The Atlantic bryozoan *Bugula fulva,* which we found in Monterey Marina, seems to be a first west coast record as well, although it may be the same species as Cohen et al.'s (1998) *Bugula sp. 2* in Puget Sound. The marinas we sampled near Channel Islands (Oxnard's Vintage Marina) and the Gulf of Farallones (Bodega Bay's Mason's Marina) also had a bryozoan that was either *B. fulva or B. flabellate*, a similar-looking NIS (**Appendix D**). Other species had more minor range extensions. *Balanus improvisus* was found in many of our plate sampling sites. It was previously known from San Francisco Bay, Elkhorn Slough, Coos Bay, the Columbia River, and Vancouver Island, mostly in low or variable-salinity sites, but there have been scattered single records from harbors in San Diego and Los Angeles (Carlton 1979, Wasson et al. 2002). We found *B. improvisus* in Tijuana River's Oneonta Slough; in South Slough's Charleston Boat Basin, Empire Pier, Coos Citrus Docks, Sengstacken Arm and YSI, Valino Island, and Winchester YSI sites; in Olympic Coast's La Push Marina, and in Padilla Bay's Bayview Channel. The tunicate *Styela plicata* had a documented range extending from Mexico north to Santa Barbara (Lambert & Lambert 1998, 2003, Cohen et al. 2002). We found it in the two marinas in Mission Bay (near Tijuana River), and both marinas that we sampled near the Channel Islands, but also in the marina at the mouth of Elkhorn Slough (Moss Landing), a northward range extension. This tunicate also has recently colonized San Francisco Bay (1st record 2000, Ruiz et al. unpublished). Finally, the bryozoan *Victorella pavida* was found at multiple sites in two protected areas, in Elkhorn Slough's Hudson Landing, Kirby Park, and Moss Landing marina, and in Tijuana River's Model Marsh and Main Channel (**Appendix D**). This species, which prefers brackish water, formerly had only been known on the west coast in Merritt Lagoon, San Francisco Bay (Carlton 1979, Cohen & Carlton 1995).

### *NIS across protected areas and latitudes*

On the protected area level, Monterey Bay had the greatest proportion of NIS; well over half (57%) of the identified species in Monterey Bay NMS were introduced (**Table 2, Appendix D).** Elkhorn Slough (53.6% NIS) and Tijuana River (51.2%) also had many NIS relative to native and cryptogenic species richness (Table 2). Kachemak Bay, of course, had the lowest proportion of NIS (0%), and Olympic Coast had the second lowest proportion (0.14, **Table 2, Appendix D**).

The number of documented NIS per protected area (**Fig 4a**) and per site (**Fig 4b)** decreased with increasing latitude (per site: $Y = 11.02 - 2.83 X$, $r^2 = 0.18$; $F = 15.89$, $N = 73$ sites within the 9 protected areas, $P = 0.0002$). Tijuana River had the most NIS, 21 known nonindigenous species, in the five identified taxa on the settling plates, and Kachemak Bay had the least, 0 NIS (**Table 2**). Although the zeros at the Kachemak Bay sites influenced the regression line, the pattern was still significant when Kachemak's sites were excluded from analysis ($F = 4.89$, $N = 65$, $P = 0.0306$). Similarly, the percent of species that were nonindigenous decreased with increasing latitude (**Fig 4c**, $Y = 4.24 – 1.03 X$, $r^2 = 0.22$; $F = 19.85$, $N = 73$ sites, $P < 0.0001$; without Kachemak sites, $F = 7.68$, $P = 0.0073$).

Similarly, both the number and percent of nonindigenous Bryozoan species decreased with increasing latitude (**Fig 4d,e** # NIS bryozoa, ln, excluding sites with no bryozoa: $Y = 8.23 – 2.19 X$, $r^2 = 0.16$; $F = 10.79$, $t = -3.29$, $N = 61$ sites, $P = 0.0017$; proportion NIS bryozoa, ASSR: $Y = 3.77 – 0.92 X$, $r^2 = 0.15$; $F = 10.59$, $t = -3.25$, $N = 61$ sites, $P = 0.0019$). The number and percent of nonindigenous tunicate species per site also decreased with increasing latitude (**Fig 4d,e**; # NIS tunicates, ln, excluding sites with no tunicates: $Y = 19.62 – 5.06 X$, $r^2 = 0.65$; $F = 63.24$, $t = -7.95$, $N = 36$ sites, $P < 0.0001$; proportion NIS tunicates, ASSR: $Y = 8.40 - 2.04 X$, $r^2 = 0.37$; $F = 19.83$, $t = -4.45$, $N = 36$ sites within the 9 protected areas, $P < 0.0001$). The other taxa did not have enough NIS or species across sites to support similar analyses.

The 30 NIS found in or near each protected area by this study plus 24 nonindigenous fouling organisms from other studies are listed in **Appendix D** along with information on the waterways in which they were found, whether they are considered established, and references to relevant literature. Comparison of results from this study with this tabulation of all documented nonindigenous fouling species from the areas in and around these same protected areas shows that this decrease in NIS with increasing latitude is also apparent when a broader range of taxa are included (**Fig. 4a**). **Appendix E** lists 58 NIS from Elkhorn Slough Reserve. It also provides 37 known NIS associated with wetlands from Tijuana River NERR and 87 marine NIS (fouling organisms and also other invertebrates, algae, and plants) known in the broader San Diego area.

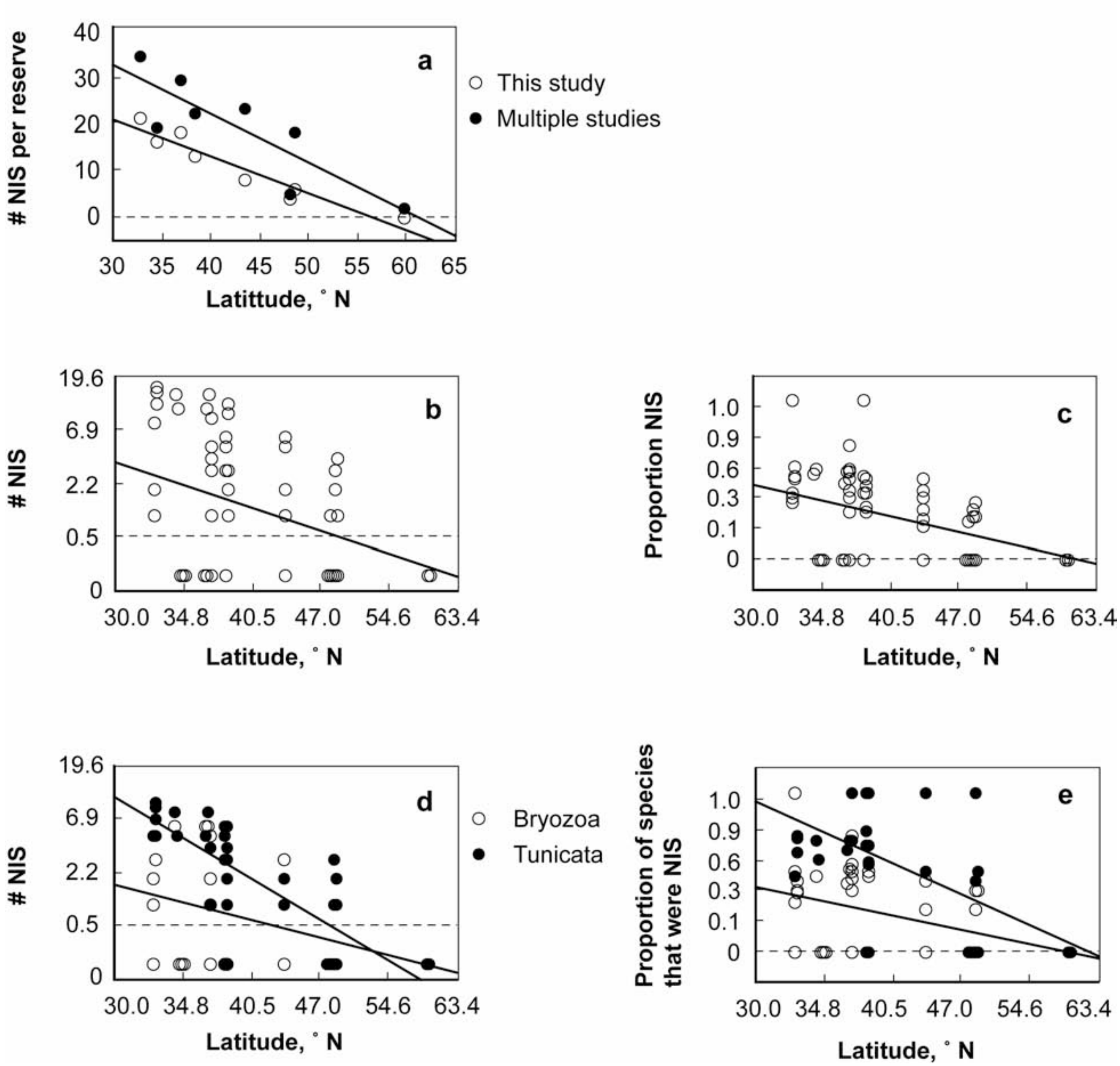


Figure 4. NIS across latitude for a) total number of NIS per protected area, b) number of NIS per site (ln), c) proportion of NIS per site (arcsine square-root transformed), d) number of nonindigenous bryozoan and tunicate species, and e) proportion of bryozoan and tunicate species that were nonindigenous. Equations for lines in text.

The decrease in NIS with increasing latitude is a strong enough pattern and NIS represent such a large proportion of the species at many of the protected areas that NIS are partly driving the pattern of a decrease in species richness from southern to more northern protected areas observed in **Figure 2**. When we removed the NIS from the total number of species and examined the native and cryptogenic species only, we no longer found a decrease in species richness from south to north (**Fig 5 a,b**).

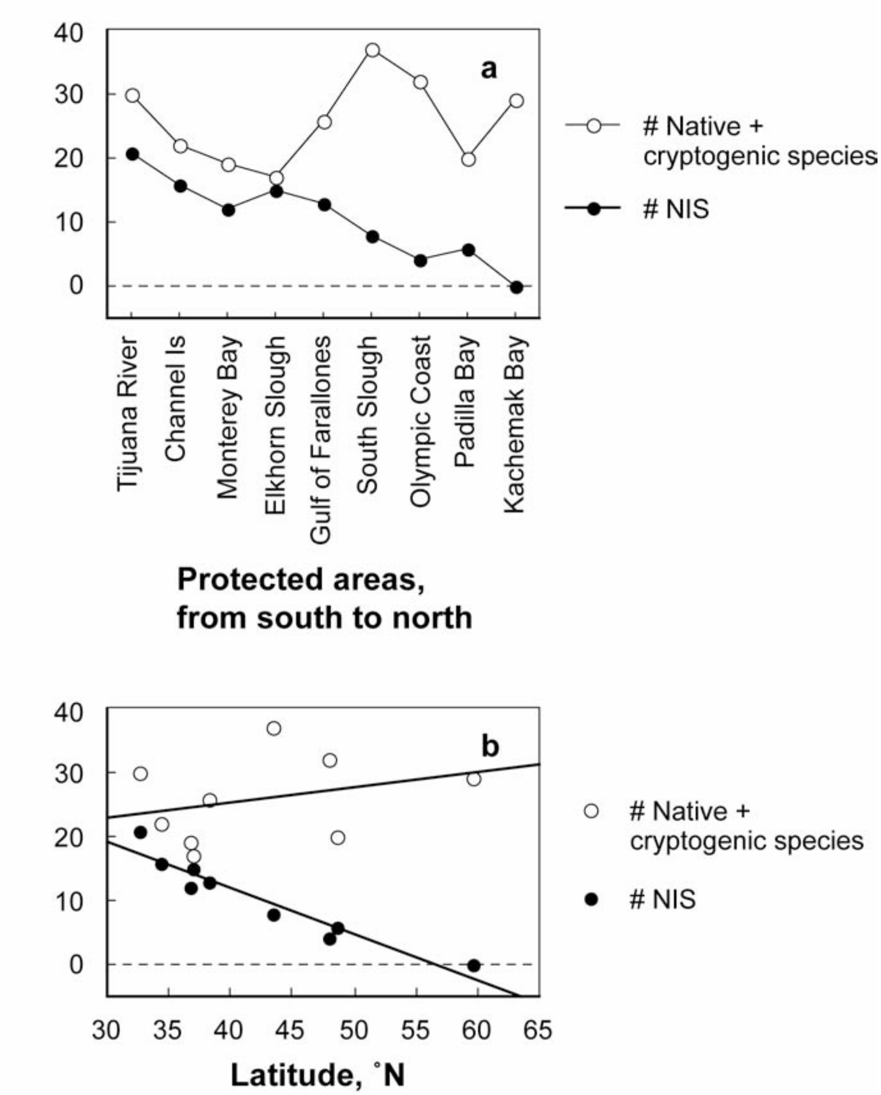


Figure 5. Number of NIS and native plus cryptogenic species across protected areas and latitudes.

### *Diversity between habitats*

Only a fraction of the species overlapped between marinas and natural estuarine and offshore habitats (**Table 4**). For example, in Padilla Bay, where the number of species found in marinas was similar to the number found in the Reserve on plates suspended from frames and buoys, less than a third (29.6%) of the species were found in both types of habitats (marina versus in the Reserve). Plates in Olympic Coast marinas and offshore buoys also had similar numbers of species (22 versus 20) but only one sixth (16.7%) of these species were found in both habitats. In Elkhorn Slough and the Gulf of Farallones area, NIS represented 60% of the overlapping species (**Table 4**). However, NIS did not substantially increase the homogeny between habitats in the other protected areas. Nonindigenous Bryozoa, Cirripedia, and Tunicata species were found in marinas as well as other sites.

More species were found at marina sites than at the more natural sites, those requiring buoys or frames for plate deployment. Species richness was three times higher in marinas (18.9 ± 1.6 species per site, N = 20 sites) than in natural sites (6.3 ± 0.5, N = 51 sites) overall. Across protected areas, this pattern was found everywhere except the Olympic Coast (**Fig 6**). Similarly, marinas had higher species richness (21.2 ± 1.9 species per site, N = 20 sites) on 5 plates than natural sites (9.7 ± 1.1 species per site, N = 19). The highest species richness per 5 plates in marinas was found in Tijuana River area marinas, with 28.5 ± 2.8 species per site (N = 4 sites), whereas Tijuana River's in-estuary plates had just 7 ± 2 species on 5 plates per site (N = 2). The lowest marina diversity was found in the Padilla Bay marinas (12.0 ± 4.0 species per site, N = 2) and Padilla's non-marina sites were slightly less diverse (9.5 ± 1.5, N = 2; **Fig 6**). In contrast, the Olympic Coast had higher species richness on 5 plates deployed from offshore buoys with 22 species than on its marina plates (14 ± 6, N = 2). Monterey Bay buoys had the lowest number, 6 species on 5 plates. Of the non-marina sites, the in-estuary frame-deployed plates had the lowest number of species on 5 plates (8.2 ± 1.0 species per site, N = 13 sites). The offshore buoy sites averaged 12.5 ± 3.4 species on 5 plates (N = 4), and the one in-bay buoy-deployed set (Tomales Bay) had 18 species.

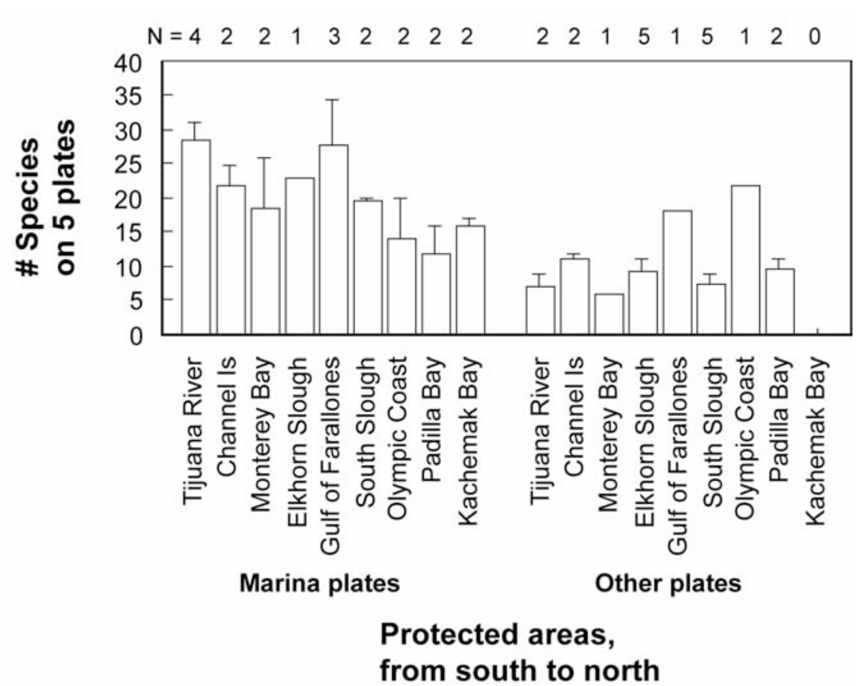


Figure 6. The number of species on 5 plates in marina sites versus frame or buoy sites across protected areas. Bars show mean ± 1 SE; N, number of sites in given along the top.

Species diversity was almost twice as high on the marina plates (H = 1.07 ± 0.04, N = 158) than other plates (0.59 ± 0.04, N = 151) at all the protected areas. The marina at the mouth of Elkhorn Slough had the highest diversity (1.57 ± 0.06, N = 12 plates), as measured by the Shannon Index, despite moderate species richness, while the Olympic Coast marinas had the lowest diversity (0.67 ± 0.14, N = 12). South Slough marina plates had high species richness but relatively low diversity once evenness was considered (0.87 ± 0.09, N = 30). South Slough's plates deployed from frames had much higher evenness than plates in the nearby marinas. Tomales Bay buoys

(Gulf of Farallones) had the highest diversity of non-marina plates (0.78 ± 0.23, N = 7), but this was still low diversity compared to marina plates. Kachemak Bay had the lowest diversity for non-marina plates (0.37 ± 0.11, N = 14). Biovolume was also higher for marina plates (188.0 ± 6.6 ml, N = 204) than non-marina ones (146.3 ± 4.4 ml, N = 200), but not as different as diversity or richness were between the types of sites. The biovolume was high in Elkhorn Slough marina given the relatively low species richness, indicating large colonies or individuals.

***NIS differences between habitats***

The difference in species richness between marina and natural sites was even greater for NIS. The occurrence of NIS in marinas (7.8 ± 1.2 NIS per site, N = 20 sites) was 7 times higher than the occurrence of NIS in other sites (1.1 ± 0.2 NIS per site, N = 51 sites). **Figure 7** shows that, averaged across protected areas, almost 80% of NIS per site were found at marinas only, and most of the remaining 20% of NIS were found at both marinas and other sites. There was only one occurrence of an NIS found only at a non-marina site, the sites with buoys or frames. The native plus cryptogenic species also had higher species richness per site at marinas only, but had a much larger proportion of species per site at non-marina areas than did the NIS.

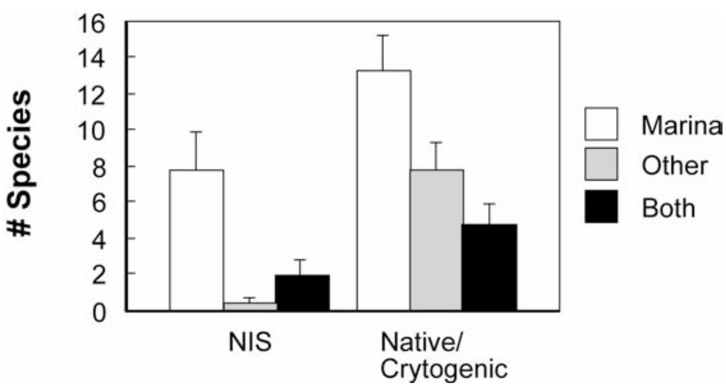


Figure 7. Number of NIS versus native plus cryptogenic species at marinas only, at frames and buoys only, or at all types of sites. Bars show mean ± 1 SE; N, N = 9 protected areas for all bars.

This ratio of NIS at marinas compared to other sites was less skewed towards marinas only when we examine number of species per habitat instead of per site. We found 14 NIS in marinas only (plus 2 NIS Hydrozoa, shown in Table 2, at a port from South Slough's site-specific study that is not yet completely analyzed and so was not included in these analyses). 14 NIS colonized plates both at marinas and other sites. Just 1 NIS was only in other sites.

We found more nonindigenous Tunicata species in marinas only than other NIS taxa, whereas more nonindigenous Bryozoa species than other taxa overlapped between marinas and the frames, buoys, and other in-estuary monitoring sites (the SWMP YSI sites of the NERRS). One nonindigenous Nudibranchia was found at non-marina sites only. The NIS at marinas only included 9 nonindigenous Tunicata species, 4 NIS Bryozoa, and 1 NIS Cirripedea. In contrast, the NIS at both marinas and other sites included 5 Tunicates , 7 Bryozoa , and 2 Cirripedia. Therefore, around 1/3 of the Tunicate and 2/3 of the Bryozoan and Cirripedia NIS dispersed to non-marina sites.

Further subdividing the non-marina plates into in-estuary frames (the lower four NERRS; Kachemak was excluded from the analysis as it had no NIS at any type of site), in-bay buoys (Gulf of Farallones area buoy sites), and offshore buoys (other three Sanctuaries) shows the non-marina plates differ in NIS by habitat or deployment method. No NIS were found on offshore buoys (N = 15 sites), 1.5 ± 0.28 NIS per site were found on in-estuary frame-deployed plates (N = 24 sites), and 3.0 ± 0.9 NIS per site were found on the in-estuary buoy-deployed plates (N = 6 sites).

## Trapping

We trapped the invasive green crab, *Carcinus maenas* (henceforth *Carcinus*) in Elkhorn Slough. *Carcinus* were only found in Elkhorn Slough although they were previously found near our South Slough trapping sites and they have been found as far north as British Columbia. These crabs were common in Elkhorn Slough. They represented from 10 to 99% of the crab catch at 6 of the 7 sites we trapped, at all sites but the one at the mouth of the slough (**Fig 8**). They were the numerically dominant crab in the Hummingbird Is, North Marsh, and Azevedo Pond sites. The carapace width of these *Carcinus* averaged 51.4 ± 8.4 mm (mean ± SD, N = 904), and ranged from 28 to 86 mm wide. *Carcinus* was the only verified nonindigenous species in our traps. We trapped 3 fish in Tijuana River that may have been *Tridentiger trigonocephalus*, but we did not verify the field identification; this non-native goby is already documented in this area.

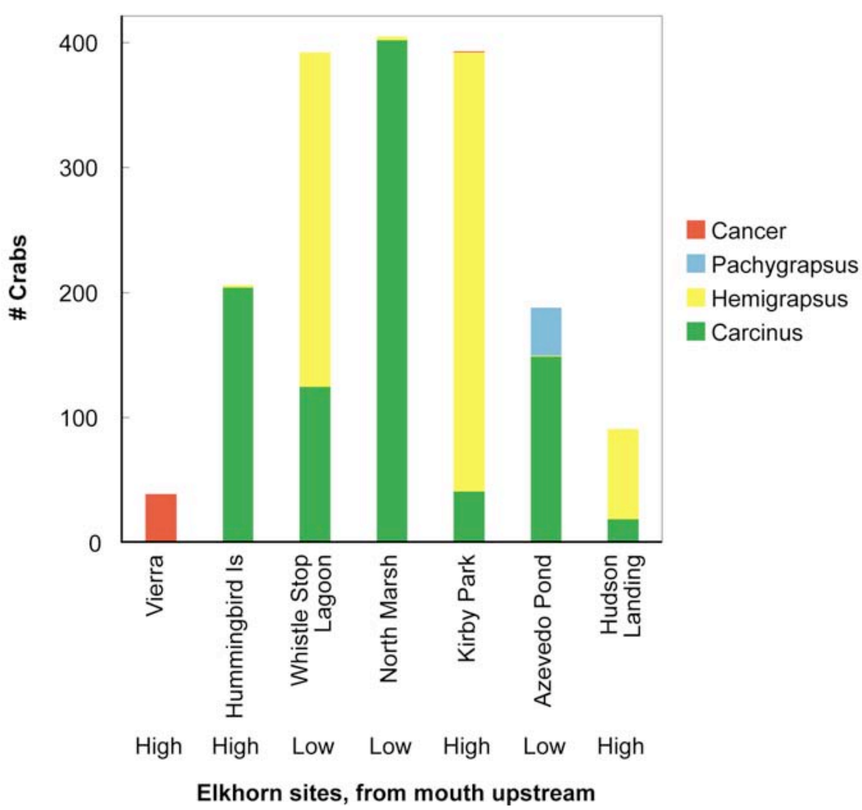


Figure 8. The number of trapped nonindigenous *Carcinus maenas* and native crabs across 7 sites in Elkhorn Slough NERR.

Across the protected areas, we caught 7 crab and 10 fish species in our traps (**Table 5**, **Appendix B**). The native shore crab *Hemigrapsus oregonensis* was most abundant in the Tijuana River traps. Both *H. oregonensis* and *Carcinus* were abundant in the Elkhorn Slough traps. These crabs were absent and *Cancer magister* was abundant in the South Slough traps. Fewer crabs were caught at the trapping sites in the more northern protected areas. The most common fish we caught were *Gillichthys mirabilis* and *Leptocottus armatus*. We caught more crabs and fish per trap in Elkhorn Slough than in the other protected areas.

## Discussion, Broad-Scale Project

To determine the impact and spatial patterns of nonindigenous species (NIS), we identified to species the four most common fouling community taxa, Bryozoa, Cirripedia, Hydrozoa, and Tunicata, plus Nudibranchia, from settling plates in and around nine US west coast protected areas. NIS accounted for more than one quarter of species richness in the 5 taxa under study at these protected areas. Tunicate species richness was especially influenced by NIS: 53.8% of the tunicate species found on our settling plates were introduced. Bryozoa, which represented the highest number of NIS in a taxa, and Cirripedia also had high proportions of NIS. Hydrozoa and Nudibranchia had just one NIS each. The most common NIS were Tunicate and Bryozoa species. These findings of many NIS Tunicates and Bryozoa deviates from the literature review finding (Ruiz et al. 2000) that most NIS identified in previous studies were crustaceans or mollusks. In fact, the mollusc order we identified, Nudibranchia, had the lowest percent NIS (5.9%) out of the five taxa under study. This difference illustrates why it is imperative to conduct broad geographic surveys using uniform protocols rather than relying on literature reviews. As more of the taxa on our fouling plates are identified, we will be able to evaluate the relative risk of invasions for a number of taxonomic groups.

The species richness at many of the protected areas was highly influenced by NIS. For example, Tijuana River Reserve had 21 NIS (51.2% of species). Even larger proportions of species were introduced in Monterey Bay Sanctuary (57.1%, from 12 NIS) and adjacent Elkhorn Slough Reserve (53.6%, from 15 NIS). Due to facilitation of new NIS by already established NIS, these protected areas have an especially high risk of new invasions as well as ecological or economic impacts from the NIS already established. Kachemak Bay Reserve is at the other extreme, with no NIS found in this study, yet is not free of NIS and is also vulnerable to new introductions. While no NIS in the five taxa under study were found in Kachemak Bay, Alaska, our previous studies identified two NIS in Kachemak, and two additional NIS in nearby Prince William Sound.

Our results supported the hypothesis that NIS decrease with increasing latitude and that they serve to drive a similar pattern apparent in overall species richness across latitudes. We found a strong pattern of decreasing species diversity and abundance along the US west coast from Tijuana River in the south to Kachemak Bay in the north. Gulf of Farallones and Olympic Coast sites had high diversity and abundance given their relative latitudes. The pattern of decreasing species richness with increasing latitude was largely driven by nonindigenous species. NIS showed this same pattern of decreasing species richness across increasing latitudes. However, when NIS were subtracted from the total species count, the latitudinal pattern was no longer evident for the native plus crypotgenic species.

These results combined with data from SERC's additional studies of NIS in the fouling community of ports and marinas in 24 US bays will be used to identify whether the strong latitudinal pattern identified here exists across coasts. We have already compared NIS across latitudes from this study with NIS from this plus other studies (Appendix D). This comparison showed the points were less clustered about the regression line for the combination tally, perhaps because methods varied across the studies used in this compilation and taxonomic group may have been studied unequally. Moreover, the latitudinal pattern of all studies combined would have been less apparent without the datapoints from this study.

Ships serve as transport vectors for many NIS, especially ones in the fouling community (Carlton 1986, Ruiz et al. 2000). Therefore, commercial ports and also marinas likely serve as a point of entry for many NIS, including several tunicates and the kelp *Undaria* (Lambert & Lambert 1998, Thornber et al. 2004). We found the marinas in and near the west coast protected areas were highly impacted by NIS. While half the NIS found in this study lived only in marinas, all the NIS in non-marina areas were also found in marinas except one Nudibranch species. This further supports the idea that marinas and ports are the entry point for NIS into more natural habitats in estuaries, bays, and offshore. However, this study found little overlap between the occurrence of NIS in marinas and their occurrence further in the estuaries or, especially offshore, where no NIS were found. This lack of overlap could be due to the fact that marinas provided hard substrate near the plates whereas very few of the plates in more natural areas were set near hard substrate. Areas with natural hard substrate may have a much higher overlap in community structure with marinas. A large proportion of the NIS in marinas were tunicates (9/14 NIS species), which have brief, local larval dispersal. Clearly, the question of dispersal of tunicate and other NIS from marinas, and more importantly from commercial ports, to nearby natural areas needs to be studied further.

This study already identified five new range expansions, including two new US West Coast introductions. Four of these species were found at marinas only and the fifth was found at both marina and non-marina sites.

The *Carcinus maenas* data from our trapping illustrate the impact and high abundance NIS can reach after a short timespan. This species is dominant in the crab community in Elkhorn Slough. Similarly, *Carcinus* have impacted native crabs at other west coast sites. Other studies have shown reciprocal abundance from native crabs due to *Carcinus's* impacts on small native crabs and also to large native *Cancer* crabs impacting *Carcinus* (Grosholz et al. 2000, Hunt & Behrens Yamada 2003). The absence of *Carcinus* in South Slough during this study may be due to the large number of *Cancer* crabs caught there.

## SITE-SPECIFIC PROJECTS

The Research Coordinators at the Reserves and Sanctuaries support a variety of research projects on NIS (**Appendix F**) and have expert knowledge about their protected areas. Therefore, we planned to capitalize on the local expertise and interests of these participants through site-specific projects in all the 5 Reserves and Monterey Bay and Olympic Coast Sanctuaries. Many of these projects will be expanded upon; they served as pilot studies that can be conducted at multiple protected areas in the future or at the same one over time.

**List of Site-Specific Projects (alphabetical, by protected area)**

- Elkhorn Slough NERR:
  - Habitat correlates of invasive green crabs; native to invasive crab ratios across sites
- Kachemak Bay NERR
  - Inter-annual variability of NIS recruitment at System Wide Monitoring stations
  - Effects of shipping policy change on NIS
  - Seasonal patterns of NIS recruitment
  - Educational programs for NIS on settling plates
- Monterey Bay NMS
  - Monitoring of NIS in more exposed, deeper areas; NIS impact to natural hard substrate
  - Identification of organisms attached to hard substrate in the harbor
- Olympic Coast NMS
  - Rapid assessment for invasive species in the southern third of the sanctuary (rest done)
- Padilla Bay NERR
  - Distribution, rate of spread, and impacts of NIS eelgrass, *Zostera japonica* in Padilla Bay
  - Patterns of barnacle larval dispersal
- South Slough NERR
  - NIS impacts along a salinity cline
  - NIS impacts in a Reserve versus an adjacent commercial bay
- Tijuana River NERR
  - Community composition of sessile invertebrates in artificially warmed water (power plant) versus cooler water nearby and in local marinas
  - Fouling organisms on natural hard substrate in TRNERR
  - Monitoring for Japanese Oyster, *Crassostrea gigas*
  - Effects of tamarisk, *Tamarix ramosissima*, invasion and eradication on salt marsh habitat

## Site-Specific Project Reports

### *Elkhorn Slough NERR, Kerstin Wasson*

#### Invasion Monitoring Report, June 2005

Prepared by R. Kvist Preisler

Invertebrate monitoring is among the many important monitoring programs in Elkhorn Slough. During the past 5 years of crab monitoring we have qualitatively noticed what seems to be an increasing abundance of the invasive European green crab in the slough. Traditionally, the crab monitoring has consisted of 10 days per year of sampling using minnow traps and settlement trays. To complement the monitoring by SERC and to compare whether there is a difference in green crab abundance and distribution among habitats we set out minnow traps and collapsible traps during two 4-day periods of low tides in June and July 2004 at 3 different locations: Kirby Park (KP), Whistlestop Lagoon (WL), North Marsh (NM). We set 6 traps (depending on the specific site) every day and checked the traps the following day. For each individual green crab caught we measured carapace width, claw size, and determined sex. In order to investigate whether green crabs exhibited depth or tidal flow rate preference, within each site (KP, WL, NM) we set traps at all of the following locations within each site: Tidal height: Intertidal, subtidal; Tidal flow: Full tidal flow, muted tidal flow. We found that green crab abundances were higher at sites with full, rather than with muted tidal flow ($p = 0.009$). We also found that green crab abundance was not related to depth: intertidal (0 ft) vs. subtidal (–2 ft) ($p = 0.53$).

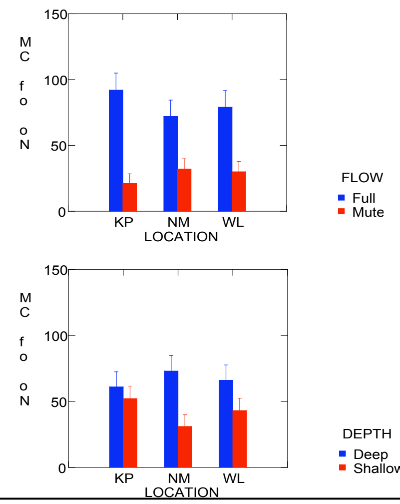


**Figure 1. Above:** Green crab abundances at full and muted flow within the same site. **Below:** Green crab abundances at 0 ft and – 2ft within the same site.

Because the European green crabs seem to have rapidly increased in abundance and distribution within Elkhorn Slough we wished to increase the effort of crab monitoring across many sites. In order to investigate whether there are certain trends in as to where green crabs are found we set 9 crab traps at 1 or 2 sites during two low tide series of 8 and 9 consecutive days during the month of April 2005 (**Fig ES-2**). We found that, in general European green crabs are found at the sites in the slough located along the main channel, rather than in smaller tidal creeks or diked areas with limited tidal flow. We detected large spatial and temporal variation in crab abundance. Quantifying this variation is useful as a basis for power analysis to inform the design of future long-term monitoring programs.

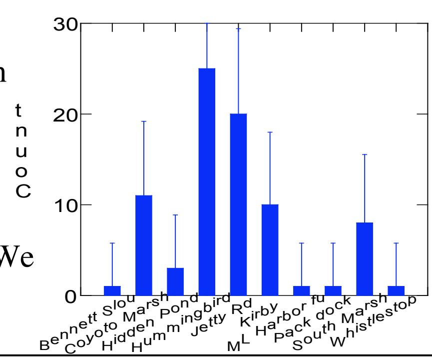


**Figure 2**. Number of green crabs found at 10 different sites

We also looked at whether ratios of native crabs to invasive crabs varied at different sites within Elkhorn Slough. We found that invasive crabs dominate more than half of the surveyed sites (**Fig ES-3**). These data were also obtained from the 17 days of sampling described above.

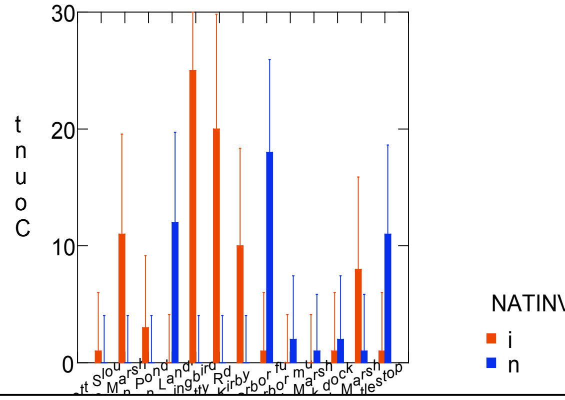


**Figure 3**. Number of green crabs relative to native crabs at 13 different sites

Furthermore, the traps we used also captured various fishes, i.e. sculpins, long jaw mudsuckers, sticklebacks and top smelt. The numbers of fishes that we caught are insufficient for any statistical analyses but identifying all fishes allows us to compile a species list for sites that have never before been sampled for fishes.

In addition to the work we originally proposed, we also seined for crabs and fish at each site sampled during the 17 days mentioned above. Again, we found that green crabs are found in the main channel of Elkhorn Slough, rather than in areas that are diked and/or have muted tidal flow. (The fish data from this work are part of a larger, unrelated study and are being presented elsewhere.)

To sum up, we found that green crabs appear to prefer full tidal flow over muted tidal flow, and are absent from sites with minimal tidal flow. We did not find any significant patterns with regard to depth (intertidal or subtidal). We did find significant differences among sites between ratios of native to invasive crabs.

### *Kachemak Bay Research Reserve, Scott Pegau*

The KBNERR has been working with SERC to examine the interannual and seasonal variation in species on settling plates. Documenting patterns of temporal variation will help identify optimal timing of plate deployment and soak duration. In addition, we will use seasonal information to contrast recruitment times of different taxa in Alaska and to determine whether non-native species have different peak recruitment time from native ones. Interannual variation data will allow us to know how representative any year’s data are. More importantly, multiple years of surveying will help identify what factors are correlated with peak recruitment of non-native and of native organisms.

Settling plates were placed on floating docks within the Homer harbor in 2003-2005. Between June 2004 and March 2005 we replaced the plates every three months. The last of these seasonal plates were pulled from the water at the end of June 2005. The plates from 2005 have not been analyzed yet.

A quick look at the plates showed relatively heavy loading for plates out from July 2004 to September 2004. The communities appeared to be different at each of the locations monitored.

There was no visible fouling of plates deployed from September 2004 to December 2004. One plate was checked on a monthly basis; it appears that organisms had settled by the end of October, but they were no longer present in December. We also found many larval organisms in the water column as late as November 2004. There were extremely few organisms present on plates deployed between December 2004 and March 2005. There were also relatively few organisms found on the plates deployed between March and June 2005. Interestingly, in June 2005 at a nearby site where we monitor temperature the probe had the heaviest biofouling of barnacles we had ever experienced. Yet there were very few barnacles present on the plates within the nearby harbor.

We are presently completing a set of protocols designed to allow school children to monitor for the presence of non-indigenous crabs. We expect that the education group will provide these protocols to schools in the surrounding villages. By working with the schools we can greatly expand our monitoring scope.

### *Monterey Bay NMS, Steve Lonhart & Andrew DeVogelaere*

Prepared by Steve Lonhart

Invasive marine species are found in a wide variety of habitats, but harbors and ports are particularly invaded. This is in part due to vessel traffic that serves as an important vector, spreading invaders from one port to another. Monterey Harbor is a relatively small harbor, serving mostly recreational sailing vessels. However, even this small harbor is currently the home of at least a dozen marine invaders. Studies on invasive species within the harbor have been limited to one-time surveys or single-species projects. Long-term monitoring and extensive species identifications are lacking.

Our program involves two primary components. First, we will use a digital camera in an underwater housing to take photo quadrats. These images, covering a fixed area (a 10 by 10 cm square), will be taken at a variety of sites within the harbor. Our purpose is to collect high-resolution digital images of sessile invertebrates attached to the docks, pier pilings, and sea walls at fixed locations. These images can then be used to track changes through time at regular intervals (extending this work beyond the NFWF grant, but supported by MBNMS). In addition, taxonomic experts will use these images for identification.

The second component involves collecting specimens for identification by taxonomic experts. In conjunction with taking digital images, we will collect invertebrate specimens from selected locations. One group that is particularly hard to identify is the tunicates. We will collect all tunicate species, preserve them, and ship them to Dr. Gretchen Lambert for identification.

These in situ photographs and verified identifications will be placed on the Sanctuary Integrated Monitoring Network (SIMoN) website as part of our species database. This will be a vital reference tool for other agency and academic researchers working within the MBNMS. One key to effective management of invasive species is early detection. Having high-quality photos of these cryptic species is essential for distinguishing natives from invaders, tracking their spread, and rapidly responding to new invasions.

## *Olympic Coast National Marine Sanctuary, Mary Sue Brancato & Ed Bowlby*

### A Rapid Assessment Survey for Non-Indigenous Species in the Intertidal and Nearshore Area of Olympic Coast National Marine Sanctuary

Prepared by Mary Sue Brancato, Katie Brenkman, Helen Berry, John Chapman, Jeff Goddard Leslie Harris, Kathy Ann Miller, Claudia Mills, Brian Bingham, Betty Bookheim, Allen Fukuyama, Ben Miner, Bruno Pernet, Paul Scott, Dave Secord, and Melissa Wilson

### Introduction

In 2001 and 2002, Olympic Coast National Marine Sanctuary (OCNMS) organized a team of invertebrate and algae taxonomists to conduct qualitative rapid assessment surveys for invasive species in the intertidal area of the sanctuary. The sanctuary chose to undertake this project due to concerns over the recent establishment of the European green crab *Carcinus maenas* to the south of the sanctuary in Willapa Bay and Grays Harbor. In addition, changes in ballast water exchange regulations and vessel traffic routing, changes in commercial fishing regulations, recent control mechanisms introduced for injurious invasive species outside of the Sanctuary, and the introduction of aquaculture activities in the area around the Sanctuary have been or soon will be implemented that could influence the opportunities for invasive species to establish in the Sanctuary.

The primary objective was to identify invasive species in different habitats along the 135 miles of shoreline within the sanctuary and Neah Bay, to establish baseline conditions for that point in time. To the best of our knowledge, no such open coast surveys have been conducted to date to determine the extent of introductions in an open coast area such as OCNMS.

A second objective was to compile an inventory of native species in the intertidal area of the sanctuary to contribute to the species inventory and voucher collection of invertebrate and algae species within the Sanctuary. A third objective was to compare the information from the outer coast to that available for Puget Sound (Cohen et al. 1998), Hoods Canal and Willapa Bay, a coastal estuary to the south of the sanctuary (Cohen et al. 2001).

Had injurious invasive species been found, another objective of the surveys was to provide insight and prioritization for future monitoring, prevention and control. It is our goal to conduct these surveys periodically in order to detect new invasions and should injurious species be found, to determine the effectiveness of any control measures undertaken. In addition, over the long term, the results of these surveys can be reviewed along with information obtained from the nearshore buoy array that OCNMS has established from April through October each year. The oceanographic information from these buoys can be used to determine if any trends exist and if the data correlate with any changes observed in invasive species introductions.

Due to tidal constraints, the two rapid assessment surveys conducted in 2001-2002 were insufficient to cover the geographic expanse of the sanctuary; therefore, an additional survey is planned for 2006 to fill in some of the geographic and habitat gaps. The funds with the from the National Fish and Wildlife Foundation have been used by OCNMS to both aid with the amphipod taxonomy from the 2001-2002 surveys and to support taxonomists involvement in the development and implementation of the 2006 rapid assessment to fill in the data gaps.

The qualitative rapid assessment survey methods complement the quantitative Smithsonian Environmental Research Center (SERC) panel studies conducted with OCNMS because some of the same areas were studied with each program providing somewhat different information. The rapid assessment surveys provide qualitative data on both mobile and sessile species and the occurrence of both native and non-native invertebrate and algal species along an expansive geographic range. Our first year of the SERC panels (2003) covered two of the sites (marinas) sampled during the rapid assessment, and the 2004 panels were co-located with our oceanographic moorings in the nearshore, providing information on larval recruitment and settlement of sessile invertebrate species.

**Methods**

The procedures for the rapid assessment surveys were adapted from those first used in the San Francisco Bay, using non-quantitative census methods.

<u>Survey Schedule</u>
Survey dates for intertidal sampling were selected based on the low tide schedule for the summer months and the availability of taxonomic expertise. Intertidal and marina dock surveys were conducted daily during six days in August 2001 (18-23 August) and seven days in August 2002 (6-12 August). In addition, since a key amphipod taxonomist, Dr. John Chapman, was unable to participate in the full duration of the 2001 assessment, he and a team from OCNMS surveyed the two sites he missed in 2001 during two days in July 2002 (23-24 July).

Nearshore samples were collected on 27 June 2002 from the OCNMS *RV Tatoosh* using a plankton net for surface tows and dip bucket for jellies. The intent of the sampling was to focus on jellies and copepods. The schedule for this sampling was not tide dependent but was based on the months when jellies were expected off the coast and the availability of the key taxonomist, Dr. Claudia Mills.

<u>Survey Participants</u>
The survey participants, their expertise and the dates they participated are provided in **Appendix OC-A**.

<u>Site Access</u>
Unlike other rapid assessment surveys conducted in Washington to date, the sites on the Olympic Coast could not be sampled by boat or by surveying dock fauna. Only two docks are located in the study area, both of which were sampled. The open coast and surf zone are also not conducive to sampling by boat, thus all intertidal sites were sampled by driving and then hiking to the location in time to be on site one hour before the low tide. In 2001 the sites selected could be

accessed via day hike to the location. In 2002 the sites required backpacking into more remote sites and overnight stays.

Site Selection

The sites sampled and sampling logistics were arranged by Mary Sue Brancato (OCNMS). Each survey year the sites selected shared some of the following characteristics.

1. At least two of the areas selected included coastal tribal lands because subsistence harvest and protection of natives species is critical to the tribes,
2. All areas included sites that have been studied previously as part of the Olympic National Park/Washington coast monitoring program (initiated by Megan Dethier),
3. All areas included multiple habitat types, such as a cobble or rocky intertidal areas, adjacent to sand, or gravel beach habitats so that more than one location could be sampled within the tide window
4. All included areas with freshwater input

Because of the remote nature of the outer coast of Washington, sites were also selected based on 1) accessibility, 2) availability of floating docks, and 3) proximity to a site suitable for a field laboratory. Although Neah Bay is not located in the Sanctuary, the Makah Tribe expressed interest and OCNMS had considerable interest in sampling the site for several reasons: 1) its proximity to the sanctuary; 2) the only protected bay with saline water directly adjacent to the sanctuary; 3) the fact that as a marina environment the influence of boats (primarily commercial fishing and recreational) was apparent; 4) the presence of aquaculture in the area; 5) its proximity to the Strait of Juan de Fuca shipping channel; and 6) the historic use of Makah Bay, just outside of Neah Bay as a ship moorage location prior to entrance to the Strait.

The intertidal sites selected, dates sampled and site characteristics are identified in **Table OC-1** and **Figure OC-1**. The latitude and longitude for the nearshore sampling sites are provided in **Appendix OC-B** and illustrated in **Figure OC-2**. The area that will be the focus for the 2006 sampling effort is identified in **Figure OC-3**.

Survey Methods

Intertidal sampling occurred for approximately one hour bracketing the low tide. Docks were also sampled for approximately one hour but sampling these was independent of tide. The focus of the sampling was on the low and mid tide zones; however, information was gathered from the high zone as well, as time permitted. Site sampling focused on the rocky intertidal habitat, moving to an adjacent sand habitat after surveying the rock habitat.

For each site, one person was designated to describe the site, another to take salinity and temperature readings, and the rest were paired so that each individual with taxonomic expertise was paired with a note taker, who recorded all the of the native and non-native species called out by the taxonomist. Samples were collected by all parties, particularly of those species that could not be identified in the field, needed confirmation in the laboratory, required further processing or were desired for vouchers.

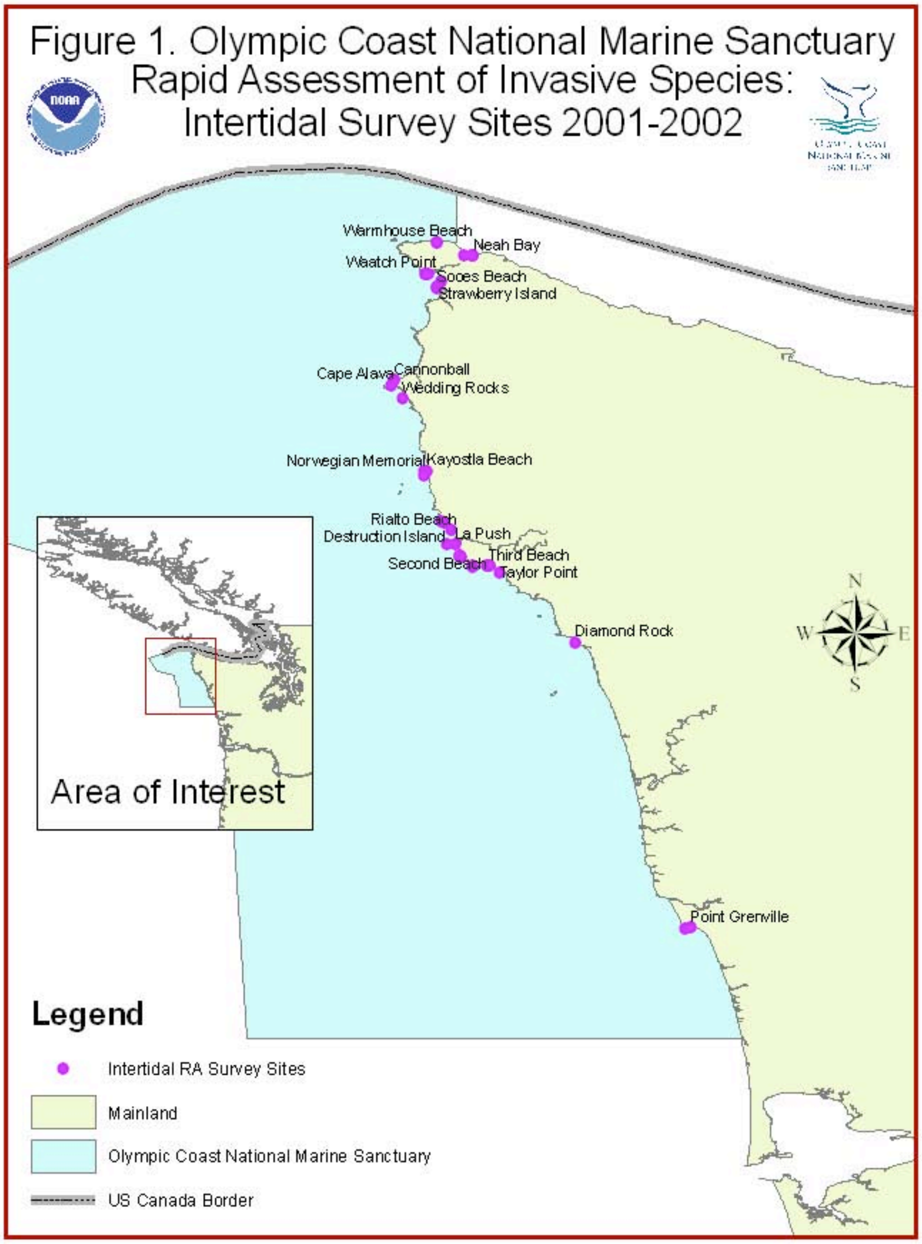
Figure 1. Olympic Coast National Marine Sanctuary
Rapid Assessment of Invasive Species:
Intertidal Survey Sites 2001-2002
Warmhouse Beach
Neah Bay
Waatch Point
Sooes Beach
Strawberry Island
Cape Alava
Cannonball
Wedding Rocks
Norwegian Memorial
Kayostla Beach
Rialto Beach
Destruction Island
La Push
Second Beach
Third Beach
Taylor Point
Diamond Rock
Point Grenville
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Area of Interest
Legend
Intertidal RA Survey Sites
Mainland
Olympic Coast National Marine Sanctuary
US Canada Border

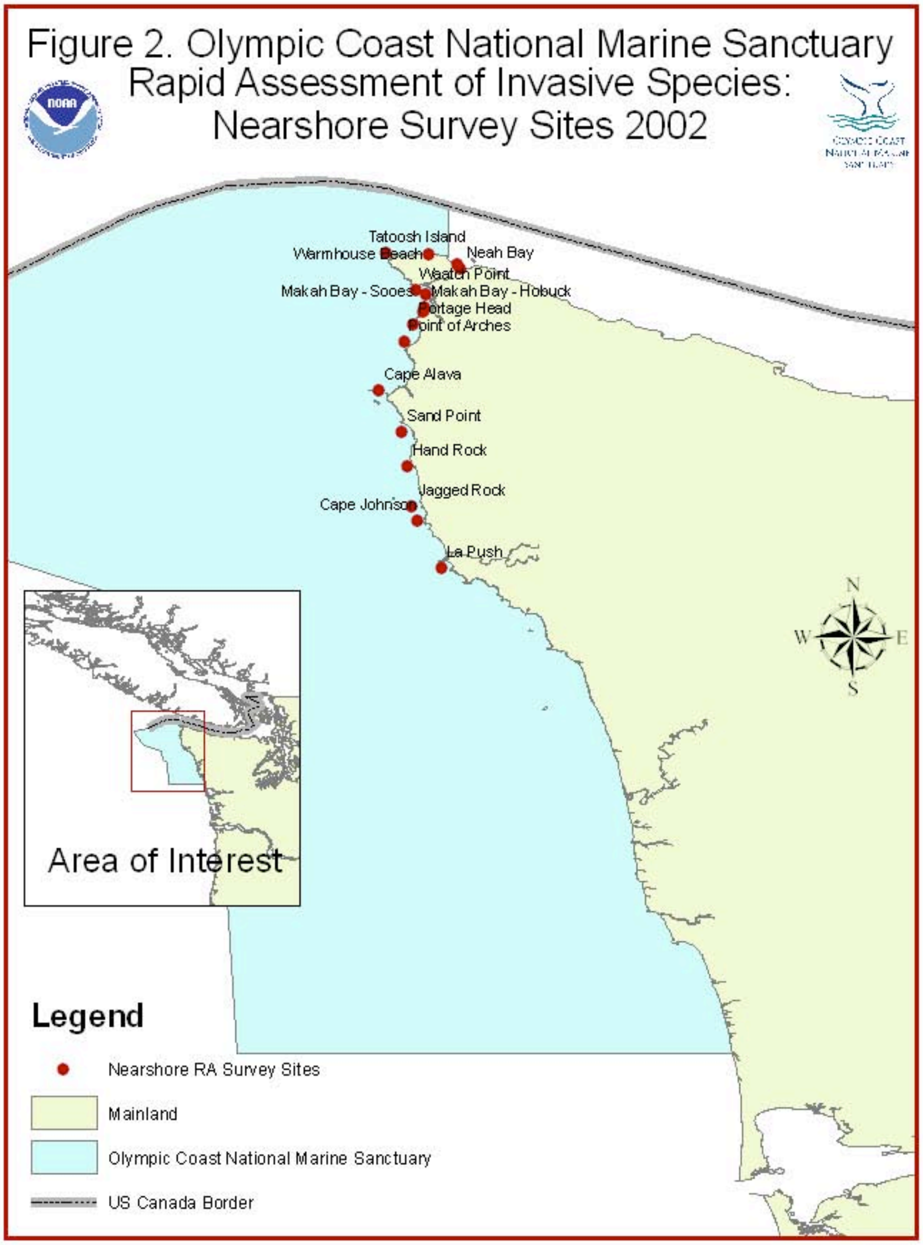
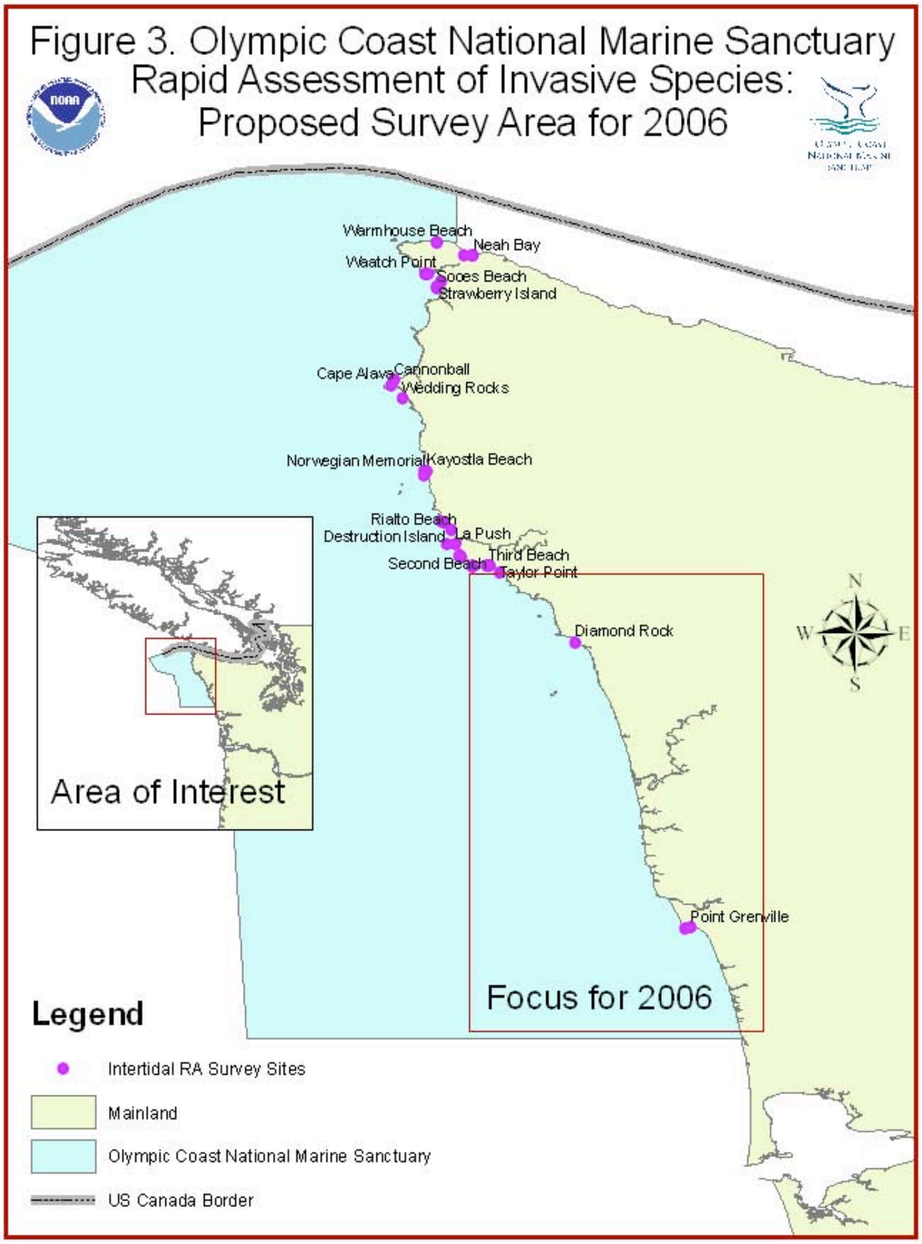



Figure 2. Olympic Coast National Marine Sanctuary Rapid Assessment of Invasive Species: Nearshore Survey Sites 2002




Species Identifications

During both years, mobile field laboratories equipped with microscopes, fixatives and sample jars were used to identify organisms during the survey whenever possible. From the experience of previous rapid assessments, OCNMS tried to get as much of the identifications completed in the field or field laboratories. The tides were all morning tides; thus the afternoons were spent identifying organisms. Still, despite considerable field laboratory time, it was still necessary to send samples to taxonomists for additional identification work, which still continues today.

To date analyses are not yet complete for the nearshore samples (primarily copepods). The majority of the intertidal sample analyses have been completed except for the amphipod samples and a few miscellaneous taxa.

Both field and laboratory identifications were recorded along with the participants that made the identifications. Laboratory identifications were considered more accurate than field observations when selecting between the two.

**Results/Conclusions**

Thus far, 11 invasive and 13 cryptogenic species have been identified in the intertidal area of the sanctuary from the 2001-2002 survey efforts (**Tables OC-2** and **OC-3**, respectively). Taxonomists are still analyzing some of the samples collected from these surveys, in particular the amphipods, so the number may yet increase. The 11 nonindigenous species were distributed through six taxa; we found one alga, two polychaetes, one amphipod, one bryozoan, four bivalves and two ascidians. Likewise, the 13 cryptogenic species were also from several taxa, including eight polychaetes, one amphipod, one copepod, two isopods and one ascidian. Range expansion has been identified for three native species (**Table OC-4**). In addition, one never before described species of amphipod has been identified to date (J. Chapman draft report). In addition to the rapid assessment surveys, OCNMS has been conducting European green crab (*Carcinus maenas*) monitoring monthly from at least April through September of each year from 2001 to 2005, primarily in Neah Bay and occasionally near Waatch River near its entrance to Makah Bay. To date, no European green crab have been found in these traps.

## *Padilla Bay NERR, Doug Bulthuis*

**Distribution of the non-indigenous eelgrass, *Zostera japonica*, in Padilla Bay Washington in 2004**
and
**Establishment of a barnacle settlement monitoring program in Padilla Bay National Estuarine Research Reserve**

Prepared by Douglas A. Bulthuis, Suzanne Shull, and Mary Anderson

**Background**

The Estuarine Reserves Division (NOAA/OCRM), SERC, five west coast National Estuarine Research Reserves (NERRS), and four west coast National Marine Sanctuaries cooperated in a joint National Fish and Wildlife Foundation project entitled “Broad-scale Non-indigenous Species Monitoring along the West Coast in National Marine Sanctuaries and National Estuarine Research Reserves”. The project addressed the issue of non-indigenous species monitoring across the broad geographic range of protected sites along the west coast of the U.S. with two approaches (tiers). The first approach involved standardized and uniform methods at all sites based on organisms settling on fouling plates deployed for about three months during the summer. The second approach (tier) involved a variety of location-based methods and location-based non-indigenous species issues. SERC took primary responsibility for the first approach with some on-site assistance at each reserve or sanctuary. The reserves and sanctuaries took primary responsibility for the second approach and used a variety of techniques. Padilla Bay NERR submitted a proposal to SERC to provide planning and field support to SERC in implementing the first approach at Padilla Bay NERR (Task 1) and to support the second, site specific, approach at Padilla Bay NERR (Tasks 2-4). A summary of the four tasks in the proposal (titled *Monitoring for Non-indigenous Species in Padilla Bay NERR during 2003 and 2004 as part of the SERC Project: "Broad-scale Non-indigenous Species Monitoring along the West Coast in National Marine Sanctuaries and National Estuarine Research Reserves"*) is provided below:

Task 1: Provide support to SERC in implementing the first approach (tier) at Padilla Bay.
Task 2: Establish a barnacle settlement monitoring program in Padilla Bay NERR to indicate patterns of larval dispersal to Padilla Bay (and seasonal fluctuations) based on the barnacle settling plates used by Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO).
Task 3: Monitor the distribution of the non-indigenous eelgrass, *Zostera japonica* in Padilla Bay in 2004.
Task 4: Improve the capacity of Padilla Bay NERR to participate in non-indigenous species monitoring programs by the purchase of a suitable scope and compatible digital camera.

The present report is the final report for the proposal submitted by Padilla Bay National Estuarine Research Reserve, and divided into two parts: the first addressing Task 2, monitoring of barnacles; and the second addressing Task 3, distribution of *Zostera japonica*.

**Establishment of a barnacle settlement monitoring program in Padilla Bay.**

Monitoring of barnacle settlement at the water quality monitoring sites in Padilla Bay was established to indicate seasonal patterns of larval dispersal to the bay. Padilla Bay NERR maintains three sites as part of the NERRS System-wide Monitoring Program at which basic physical water quality parameters are measured every 30 minutes and at which dissolved inorganic nitrogen and phosphorus are measured semi-monthly. Two sites are located in Padilla Bay, one in the southern part of the bay (Bay View Channel), and the other site in the northern part of the bay (Ploeg Channel). The third site (Gong) is located east of Padilla Bay and the Ploeg Channel site in the strait between Samish and Guemes Islands. This area is a source of water to the northern part of Padilla Bay (**Fig PB-1**).

The settlement plates for barnacles were based on those used by Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO). Pieces of Safety Walk were cut to 2 x 2 inch squares and attached to rigid plastic plates. The plates were attached to a floating frame of PVC pipes with cable ties through pre-cut holes in the plates and pipes. The plates were installed with the safety walk facing down because preliminary trials indicated barnacles settled primarily on the underside of the plates. Four replicate plates are set out on each floating apparatus for each deployment.

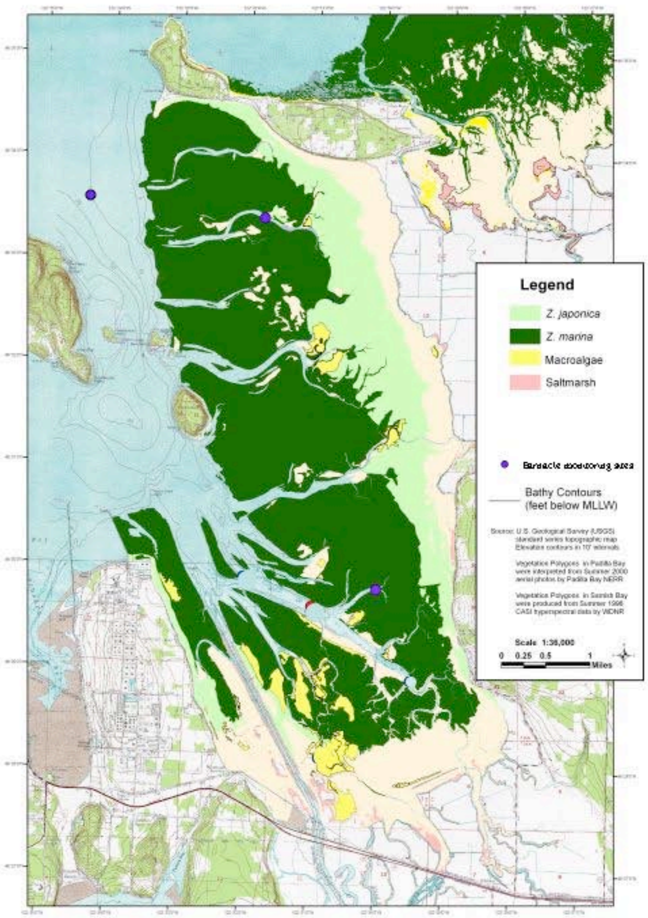



Figure PB-1. Location of water quality monitoring sites in Padilla Bay, Washington at which barnacle settlement is being monitored.

Frames and settlement plates were set out at the BayView Channel, Ploeg Channel, and Gong water quality sites in Padilla Bay (**Fig PB-1**). However, the Gong water quality site was out of commission for most of 2005 because of the loss of buoys, anchors, and datasondes. When a new apparatus is deployed at the Gong site during late summer of 2005, barnacle settlement plates will be deployed again at the Gong site.

Settlement plates are collected semi-monthly when water quality datasondes are exchanged. In the laboratory, each plate is examined and the total number of barnacles counted on each plate.

This barnacle settlement program has now been established at Padilla Bay NERR completing Task 2 of the Padilla Bay NERR proposal.

**Distribution of non-indigenous *Zostera japonica* in Padilla Bay, Washington in 2004**

Introduction

*Zostera japonica* (Japanese eelgrass) is a non-indigenous eelgrass to the west coast of North America (Den Hartog 1970, Harrison and Bigley 1982) Its native range on the Pacific coast of east Asia extends from the Kamchatka Peninsula, Russia, to Vietnam (Den Hartog 1970). *Z. japonica* was probably introduced to the west coast of North America, accidentally, with the introduction of the Pacific or Japanese oyster, *Crassostrea gigas*, for oyster culture for aquaculture production. *Z. japonica* is presently distributed from Vancouver Island, British Columbia to Humboldt Bay, California (Harrison and Bigley 1982, Phillips and Menez 1988, McBride 2002). *C. gigas* was introduced to Padilla Bay from Japan in the 1930's to establish oyster culture in the bay (Dinnel 2000). Oyster culture flourished briefly in Padilla Bay but growth of oysters in the bay were poor due to environmental conditions and pollution from pulp mills (Dinnel 2000). In 1932 *C. gigas* seed was imported from Japan and first planted in Padilla Bay. Presumably, *Z. japonica* was used as packing material and introduced accidentally to Padilla Bay and other commercial oyster growing areas at that time (Harrison and Bigely 1982, Dinnel 2000).

In Padilla Bay, *Z. japonica* generally occurs higher in the intertidal than the native eelgrass, *Zostera marina* L (Bulthuis 1991, 1995). *Z. japonica* generally seems to be occupying intertidal flats that had been devoid of macrophytes prior to the introduction of *Z. japonica*. Field and laboratory studies in Fraser River delta area (about 100 km north of Padilla Bay) indicated that *Z. marina* out competes *Z. japonica* when the two species overlap (Harrison 1982a, 1982b). However, anecdotal observations in Padilla Bay indicated that *Z. japonica* may be extending its range into areas that had been covered by *Z. marina* (Bulthuis, pers. obs.).

The distribution of eelgrasses and macroalgae in Padilla Bay has been mapped with a variety of methods, including satellite imagery, color and infra-red aerial photography, compact airborne spectral imagery, and videography (Webber et al. 1987, Bulthuis 1995, Shull 2000, Bulthuis and Shull 2002, Berry et al. 2003) In the satellite and aerial photography studies the boundary between *Z. marina* and *Z. japonica* has not always been clear. Sometimes intermixed areas of both species can be identified on the aerial photos. At other places in the bay, there is no clear demarcation although the vegetated "meadow" may begin with *Z. japonica* on the upper edge and be 100% cover of *Z. marina* in the lower intertidal areas of the meadow. The objectives of this study were to determine the boundary between *Z. marina* and *Z. japonica* in Padilla Bay in the summer of 2004 and to compare the distribution with previous attempts to map these two seagrasses in Padilla Bay.

Methods

The distribution of *Zostera marina* and *Z. japonica* in Padilla Bay (and the location of the interface between these two species where possible) were mapped with a combination of color aerial photography, ground truth investigations of percent cover, orthorectification of the aerial photographs, and photointerpretation and digitizing on screen with ArcGIS 9.0. See Shull and Bulthuis (2002) for a more detailed description of the steps involved in the delineation.

True color aerial photographs were obtained on June 3, 2004 at scales of 1:12,000 and 1:40,000 during a –3.9 ft low tide, the lowest tide of the year. The 1:12,000 scale aerial photos were scanned, orthorectified, and mosaicked into a single digital file and imported into ArcGIS 9.

Ground truth points were obtained during June, July, and August, 2004 at about 1300 locations. Ground truth teams often walked from the shoreline, out through the meadows of *Z. japonica*, and toward the lower intertidal, until the vegetation coverage was 100% *Z. marina*. Ground truth data collected at each point included: geographic coordinates; estimated percent cover of vegetation in an area of about 0.01 hectare (10m x 10m); and, within the vegetated area: the percent cover of three species of eelgrass, of green algae, of brown algae, and of red algae. (Frequently the genera of the most abundant algae were determined.) Herbarium specimens were collected for the eelgrass and algae at various ground truth sites. Digital photos of the vegetation were taken at most ground truth sites. The subtidal edge of the eelgrass was determined with vessel, depth sounder, and visual confirmation of the edge at more than 50 sites along the western border of the eelgrass beds in Padilla Bay. All of the ground truth data were entered in an Excel spreadsheet that was imported into ArcGIS database and then linked to the GPS data collected at each site. The digital photos were 'hot-linked' with point and click display to the ground truth GPS locations in ArcGIS to aid in interpretation.

Delineation of the vegetation was conducted on screen using ArcGIS 9. A geodatabase schema was used for the various vegetation categories. The vegetation boundaries and categories were delineated on the scanned orthorectified mosaic, with frequent reference and comparison to the color prints, ground truth database, and digital photos.

Results

The ground truth data indicated that *Z. japonica* is widely distributed close to the shoreline (**Fig PB-2**). *Z. japonica* also occurred in some areas in the central part of Padilla Bay (**Fig PB-2)**. Most of these areas were raised and slightly higher in elevation than the surrounding intertidal flats. *Z. japonica* was not distributed in the lower intertidal in Padilla Bay (apparently not below 0.0, chart datum).

Photointerpretation of the aerial photographs could clearly delineate vegetated intertidal flats from those lacking macrophytes. However, distinguishing *Z. japonica* from *Z. marina* was more difficult. Delineation between the species relied heavily on ground truth investigations. In some areas, with extensive ground truth data, the demarcation between the species could be seen on the aerial photos, especially where the boundary between the species coincided with a change in depth or type of substrate. In other areas, the ground truth data indicated changes between the species that could not be seen on the aerial photos. Thus, the aerial photos could not consistently be used to delineate *Z. japonica* from *Z. marina*.


Figure PB-2. True color aerial photomosaic of Padilla Bay, Washington June 3, 2004, with ground truth sites plotted. Sites marked in red are those at which *Zostera japonica* was the most common macrophyte. The northeast study area is outlined.

The northeastern study area of Padilla Bay was chosen as a selected area in which to compare results of mapping efforts from 2004 with previous mapping efforts in 1989 and 2000 (Bulthuis 1991, 1995; Bulthuis and Shull 2002, see area outlined in **Fig PB-2**). In 1989, much of the northeast study area had less than 10% cover of macrophytes (**Fig PB-3, Table PB-1**). In the summer of 2000 more than 100 hectares that had been bare in 1989, was mapped as *Z. japonica* or *Z. marina* with greater than 10% cover (**Fig PB-4, Table PB-1**). In 2004 the total area covered by vegetation was similar to 2000, but the mapped distribution of *Z. japonica* and *Z. marina* had changed (**Fig PB-5, Table PB-1**). The area covered by eelgrasses in the northeastern study area increased more than 100 hectares from 1989 to 2000 followed by little change from 2000 to 2004 (**Table PB-1**).

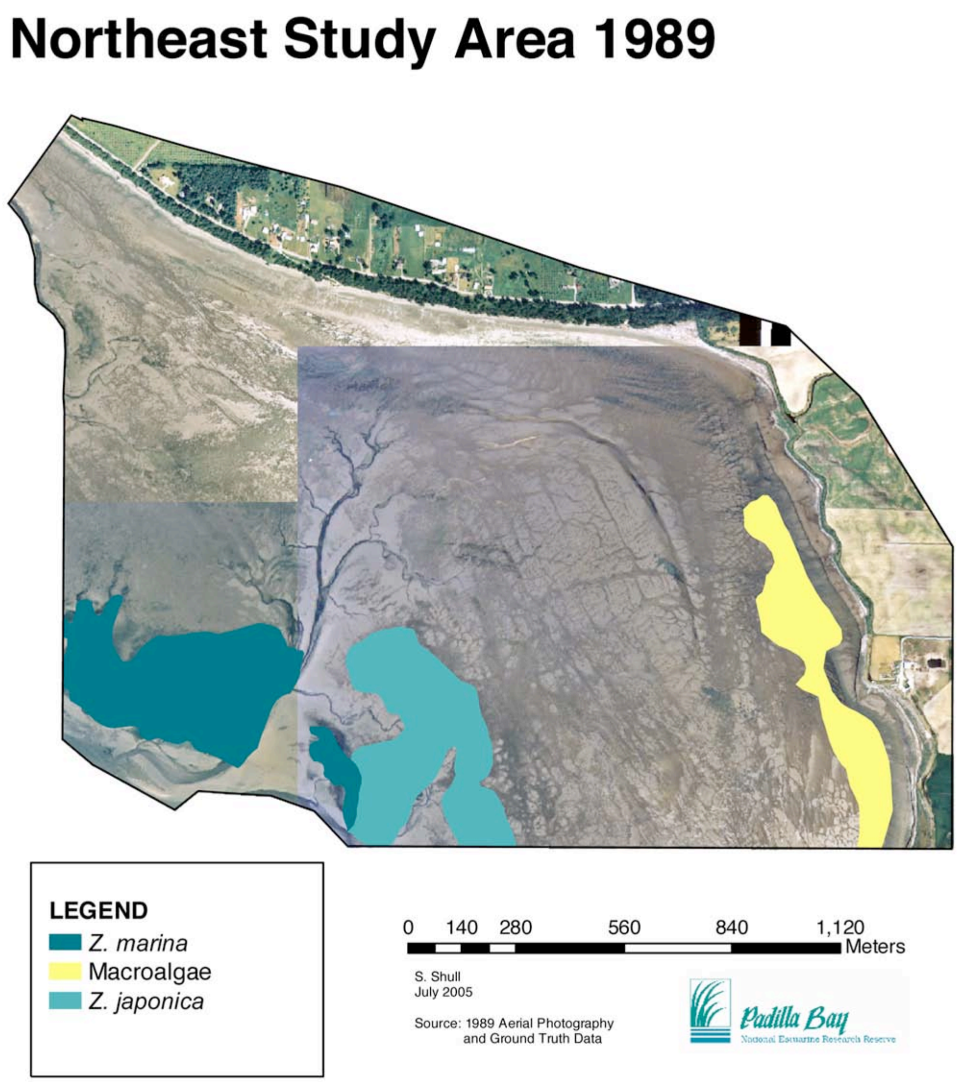



Figure PB-3. Distribution of macrophytes in 1989 in the northeast study area of Padilla Bay, Washington as mapped by Bulthuis 1991.

# Northeast Study Area 2000

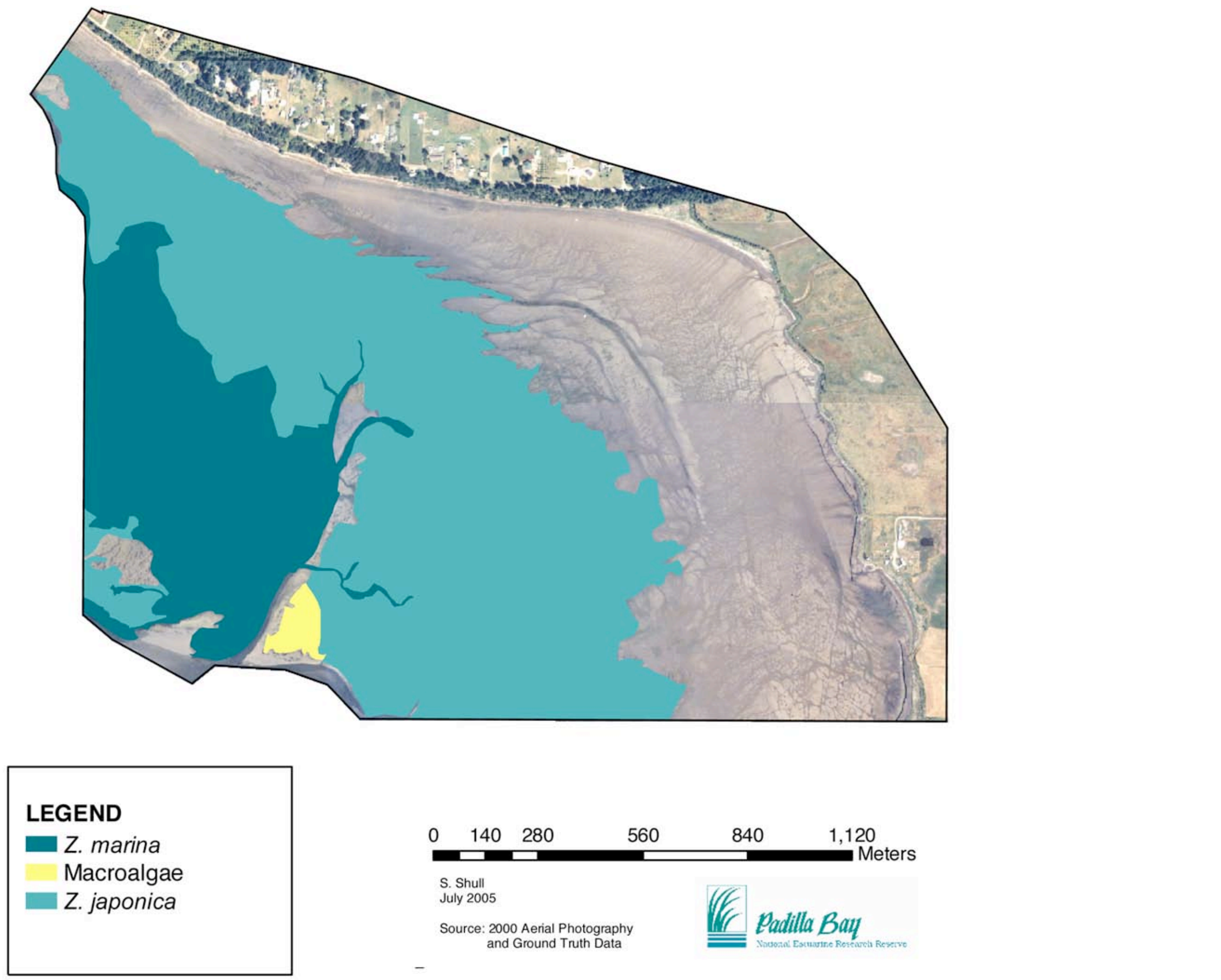



Figure PB-4. Distribution of macrophytes in 2000 in the northeast study area of Padilla Bay, Washington as mapped by Bulthuis and Shull 2002.

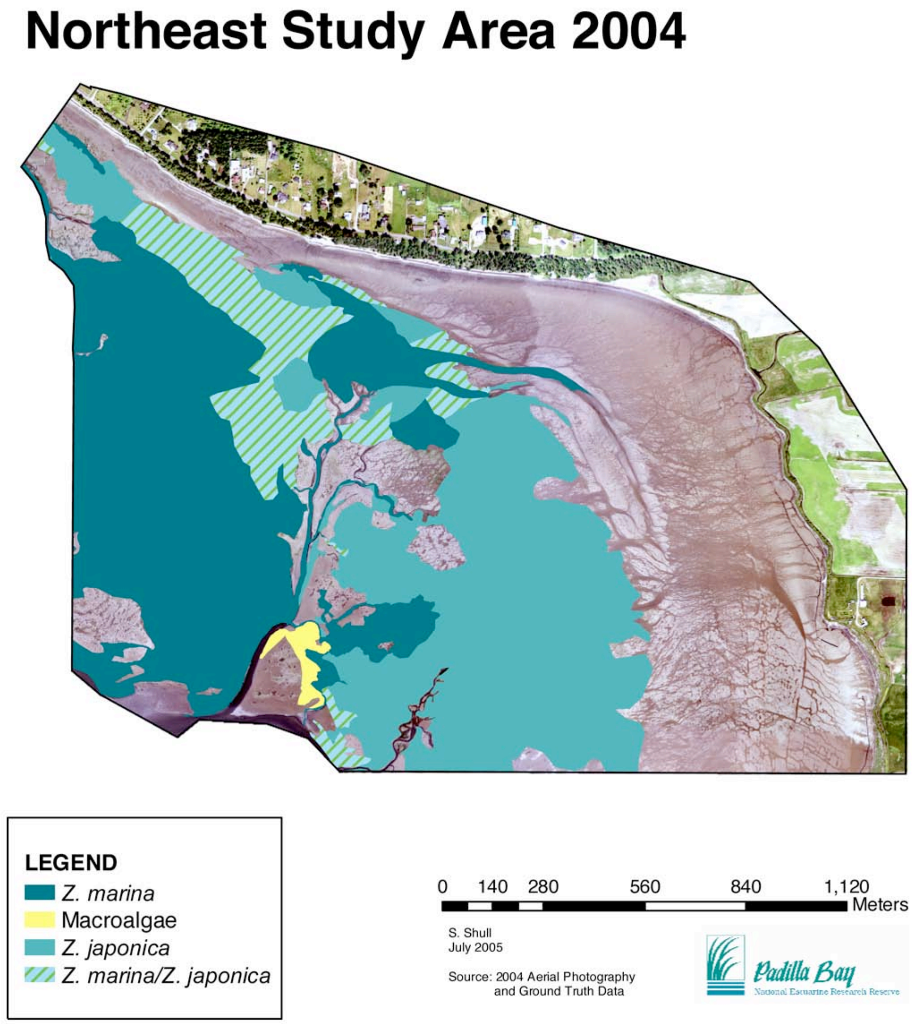



Figure PB-5. Distribution of macrophytes in 2004 in the northeast study area of Padilla Bay, Washington as mapped in the present study.

Table PB-1. Area of macrophytes (hectares) in northeast study area of Padilla Bay based on photointerpretation of true color aerial photographs and ground truth investigations.

| | 1989[1] | 2000[2] | 2004[3] |
|---|---|---|---|
| *Z. japonica* | | 119 | 68 |
| *Z. japonica* and *Z. marina* | 15 | | 19 |
| *Z. marina* | 18 | 48 | |
| *Z. marina* intertidal | | | 69 |
| *Z. marina* subtidal | | | 4 |
| **Total eelgrass** | **32** | **167** | **161** |
| | | | |
| macroalgal mats | 10 | 2 | 2 |
| saltmarsh | 2 | 1 | 1 |
| bare of macrophytes | 247 | 122 | 128 |
| | | | |
| **Total in northeast study area** | **291** | **292** | **292** |

[1] Data from Bulthuis 1991
[2] Data from Bulthuis and Shull 2002
[3] Data from present study

Discussion

This study documents the widespread distribution of the non-indigenous eelgrass, *Zostera japonica* in Padilla Bay in 2004. *Z. japonica* is distributed both in large mono-specific meadows and in extensive areas in which *Zostera marina* and *Z. japonica* are intermixed. *Z. japonica* is generally distributed closer to the shore and higher in the intertidal than *Z. marina*. In the northeastern study area, the area covered by *Z. japonica* appeared to decrease from 2000 to 2004 (Table 1). However, in 2000 there were few ground truth sites in the part of the northeast study area which appears to have changed. The aerial photos do not indicate a clear difference among years. Therefore the apparent decrease in *Z. japonica* coverage and increase in *Z. marina* coverage in the northeast study area may be a result of misinterpretation of the aerial photos in 2000.

This study also demonstrated the need for extensive ground truth investigations in order to delineate between *Z. japonica* and *Z. marina*. The ground truth investigations were much more extensive in 2004 than in previous mapping efforts. Because of these differences in the extent of ground truth investigations among years, the 2004 study does not provide unequivocal evidence whether *Z. japonica* is extending its range in Padilla Bay into areas that had been covered by *Z. marina*, or whether *Z. japonica* distribution is decreasing in Padilla Bay.

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## *South Slough NERR, Steve Rumrill*

### Differences in Susceptibility to Invasion by Aquatic Non-indigenous Species along the Estuarine Gradients of the South Slough and Coos Bay, Oregon

Introduction: Biological invasions by aquatic non-indigenous species (NIS) pose a considerable threat to the ecological integrity of the South Slough and Coos estuary. The South Slough tidal basin, including the South Slough National Estuarine Research Reserve (NERR), is currently inhabited by over 50 species of aquatic non-indigenous organisms, and over 100 aquatic nonindigenous species have been identified within the adjacent waters of Coos Bay. Coos Bay and the South Slough are both susceptible to introductions of new aquatic non-indigenous species, and recent evidence suggests that release of ballast water associated with international shipping, interstate commerce of living marine organisms, inter-basin movements of commercial and recreational vessels, commercial shellfish mariculture, and recreational uses of the estuaries, are most likely the primary vectors that contribute to continued introductions and accelerated rates of invasion. As an integral sub-unit of the greater Coos estuary, the South Slough is directly linked to Coos Bay by the daily ebb and flood of the tides. This hydrodynamic process ensures the physical and biotic continuity between Coos Bay, where the incidence of aquatic NIS infestation is high, with the South Slough where the current levels of NIS are lower. The direct hydrodynamic link between these two tidal basins also suggests that South Slough is at considerable risk for colonization by new introductions on non-indigenous species.

Project Description: Staff members from the South Slough National Estuarine Research Reserve worked in collaboration with the Smithsonian Environmental Research Center (SERC) to investigate any similarities and/or differences in the spatial pattern of non-indigenous species along the estuarine gradients of the South Slough and Coos estuaries. This component of the project carried out along the southern Oregon coast focused on development of empirical data to understand differences in the susceptibility of estuarine habitats to invasion by aquatic non-indigenous species in relation to variability in physical water parameters (i.e., temperature, salinity, specific conductivity) and differences in habitat availability (i.e., location of docks, marinas, and pilings) along the shorelines of the South Slough and Coos Bay.

Field work was carried out during 2003 and 2004 to deploy, recover, and process a series of 140 replicated PVC fouling plates from a series of fourteen study sites (**Table SS-1**): (A) Coos Bay entrance / Coast Guard Beach, (B) Charleston Marina / Inner Boat Basin, (C) Charleston Marina / Outer Boat Basin, (D) Charleston Distant Water Fleet Dock, (E) Valino Island, (F) Long Island Peninsula / West, (G) Winchester Creek, (H) Empire Dock, (I) North Bend Airport Runway Extension, (J) North Bend Dock, (K) Port of Coos Bay / Citris Dock, (L) Coos Bay City Dock, (M) Shinglehouse Slough, and (N) Haynes Inlet. These study sites were selected to span a wide range of salinity conditions within the Coos Bay and South Slough estuaries, and representative sites were placed within the marine, marine-dominated, mesohaline, and riverine regions of the estuary (**Table SS-1**). A total of ten replicate plates were deployed at each study site, and the plates were either attached to masonry bricks that were hung from fixed or floating docks, attached to PVC pipe that was extended horizontally from vertical log piling, or suspended above the substratum affixed to a PVC frame. In all cases the PVC panels were oriented horizontally with regard to the substratum and water surface. All 140 fouling plates were recovered after a period of 100-110 days of immersion in the estuarine tidal channels. At the end of the deployment period, the panels were returned to the South Slough NERR / Estuarine and Coastal Science Laboratory, photographed, preserved, and then shipped to SERC for taxonomic identification of the epifouling invertebrates. Taxonomists from SERC are still working to analyze the fouling plate samples collected from the surveys conducted within South Slough and Coos Bay.

In another part of the project, baited crab traps were deployed to monitor the abundance and distribution of European Green Crab (*Carcinus maenas*) and several native crabs (*Cancer* *magister, C. productus, C. oregonensis*) at four study sites within the South Slough estuary. The South Slough NERR / SERC team also deployed and recovered a series of 10 shell rubble traps to gauge the abundance of non-indigenous Atlantic mud crabs (*Rhithropanopeus harrisii*) within riverine regions of the Coos estuary (Coos River and Catching Slough).

Table SS-1. Description of NIS assessment deployment sites and types within the South Slough and Coos estuary, Oregon

| Study Site | Tidal Basin | Hydrodynamic Regime | No. Plates | Deployment Type |
|---|---|---|---|---|
| Coos Bay Entrance | Coos Bay | marine | 10 | vertical log piling |
| Charleston Marina - inner | South Slough | marine | 10 | floating dock |
| Charleston Marina - outer | South Slough | marine | 10 | floating dock |
| Distant Fleet Facility | South Slough | marine dominated | 10 | floating dock |
| Valino Island | South Slough | marine dominated | 10 | vertical log piling |
| Long Island Peninsula | South Slough | mesohaline | 10 | PVC frame |
| Winchester Creek | South Slough | riverine | 10 | vertical log piling |
| Empire Dock | Coos Bay | marine dominated | 10 | fixed dock |
| North Bend Airport | Coos Bay | marine dominated | 10 | PVC frame |
| North Bend Dock | Coos Bay | mesohaline | 10 | fixed dock |
| Citris Dock | Coos Bay | mesohaline | 10 | fixed dock |
| Coos Bay City Dock | Coos Bay | mesohaline | 10 | floating dock |
| Shinglehouse Slough | Coos Bay | riverine | 10 | PVC frame |
| Haynes Inlet | Coos Bay | mesohaline | 10 | PVC frame |

Results from this investigation are timely and important because Oregon's shallow estuaries and protected embayments are particularly susceptible to invasion by aquatic non-indigenous species. Long-term commercial oyster mariculture operations have resulted in numerous deliberate and inadvertent introductions of exotic species into the tidal channels and tideflat communities of South Slough and Coos Bay. Moreover, intensive human settlement and industrial shoreline development in Coos Bay has been coupled with a long legacy of commercial deep-draft ship traffic and chronic introductions of non-native species via ballast water. The increased frequency of non-native introductions associated with oyster mariculture and ballast water transport has created many opportunities for exotic species to invade new ecological niches, including the relatively undisturbed habitats located within the protected administrative boundaries of the South Slough NERR.

## *Tijuana River National Estuarine Research Reserve, Jeff Crooks*

The funding provided by the National Fish and Wildlife Foundation have facilitated coast-wide collaborative efforts and site-based projects aimed at better understanding patterns of marine invasion. At the Tijuana River National Estuarine Research Reserve, a portion of these resources have been used for travel to a meeting (sponsored by the California State Lands Commission) that addressed managing invasions via ship fouling. In addition, the funds were used to support interns that have helped with the regional monitoring effort as well as our local projects. The latter include a number of continuing studies, including invasion assessment in a power plant effluent, documenting the distribution of the Pacific oyster in San Diego County, and augmenting ongoing work on the impact of salt cedar invasion (*Tamarisk* sp.) in Tijuana Estuary salt marshes.

<u>Invasions in a warm-water effluent in San Diego Bay</u>

San Diego Bay, immediately north of the Tijuana River National Estuarine Research Reserve, is marked by heavy commercial, military, and recreational uses. In the south bay, one of the principal factors driving environmental signatures is the warm water discharged from a power plant. These warm water effluents have some well-known effects, such as facilitating resident populations of green sea turtles and sea horses. Much less is known about impacts to fouling communities or how this warm water might change invasion patterns. The potential effect of the warm water on invasions is particularly relevant given that the Port of San Diego has recently begun an effort to increase commercial use of the harbor. To this end, Dole Fruits has now made San Diego its home port, and its ships, which often come from warm climates, now frequently call on San Diego.

To address this issue, we are building off the coast-wide project and have deployed fouling panels at three sites in the bay. These include the power plant's discharge channel, the plant's intake channel (where water is much cooler), and an adjacent marina. The latter was one of the sites sampled as part of the larger project last summer. The plates were deployed on 21 January 2005, with six plates at each site. The panels will be retrieved in the late summer, after seven months (some of the sites are adjacent to endangered species breeding habitat and access is prohibited for much of the spring and summer).

Upon retrieval, plates will be photographed and processed in a manner consistent with our other plate protocols. We will generate species lists for the different sites, as well as assess community information such as percent cover and diversity patterns.

**The Pacific oyster in San Diego County**

The oyster *Crassostrea gigas*, which is native to Asia, is an interesting invader on the west coast of the United States. In the decades proceeding and following turn of the last century, much effort was expended in trying to get this commercially important species to establish itself in North America. "Success" was met with in some locales, such as in the Pacific Northwest, where the oyster can now be found in the wild. In many other places, such as San Francisco Bay, however, the oyster failed to establish despite many attempts (although many "tag-along" species did invade). In other locations, such as southern California, there were only limited attempts at oyster introduction, as the water was thought to be too warm to allow for establishment of self-sustaining populations. There are grow-out facilities for sterile adults, however, such as in Tomales Bay, California, and San Quintin, Baja California, Mexico.

In San Diego County, there have been occasional reports of the oyster over the years, but there have been no reports of established populations. Recently, however, a colleague (C. Gramlich, San Diego State University) had reported populations in Mission Bay, San Diego. Those populations, which occur in the northeast portion of the bay, have since been confirmed. Our subsequent field work has also identified populations in the south part of Mission Bay. Additional searching in other county lagoons has revealed populations in the Tijuana River Estuary and Oceanside Harbor. There are also recent accounts of the mussel in Agua Hedionda Lagoon.

This project will continue by additional searches to determine presence in other county bays and estuaries. In addition, we will assess size structure of populations to determine if recruitment events appear rare or common. We are also collecting samples for detailed taxonomic (and perhaps genetic) analysis. When completed, this study will offer a better picture of the invasion of this unexpected species in southern California.

**The impacts of Tamarisk on high marsh communities in the Tijuana River Estuary**

Until recently, it has appeared that the salt marshes of southern California have been relatively free from plant invaders. This contrasts with the situation in estuaries in northern California and the Pacific Northwest, which have been plagued with invasion of exotic cordgrass. Unfortunately, our reprieve is now over. In the Tijuana River Estuary, there are now large stands of salt cedar (*Tamarisk* spp.) growing in the high intertidal salt marsh. Although the plant is a well-known and often-cursed invader of freshwater and terrestrial systems, its presence in marine systems has not raised much concern. At the TR NERR, however, many acres of formerly low-lying succulent (pickleweed) marsh have been converted to tamarisk forests. The impacts of the tree invasion, as well as recovery of the system after tamarisk removal, are the focus of a large research project funded by California Sea Grant.

The NFWF funding has allowed us to expand the scope of this work and address some additional problems not originally part of the larger project. In particular, we are focusing on the effects of the marsh conversion to forest for terrestrial invertebrates, such as insects and spiders (marine invertebrates are being sampled as part of the Sea Grant project). We have developed methodologies to assess insect communities in the invaded and uninvaded habitats, and preliminary analysis suggests major differences in the arthropod assemblages in the tamarisk and pickleweed zones. We are also performing follow-up analysis to assess the degree to which such responses are due to food resources or to the dramatic structural change in the system. When placed in the larger context of our studies, we will have key information on shifts in biotic assemblages due to the tree invasion.

**Future work**

As most of the work described above is ongoing, we will continue with our sampling and analysis plans. This information, coupled with coast-wide study and other invasions work, will give much-needed information on the extent, impact, and implications of coastal invasions in San Diego. We are currently developing a database of local invaders, which will interface with the larger database being developed as part of this project. In addition, our core mission relates to translating science into education and outreach. As such, we are actively working with our education staff to incorporate invasion-related themes into our K-12 program, and are planning workshops for local resource managers and decision-makers about the prevention and control of invaders.

# Overall Conclusions

The NERRS, NMSP, and SERC together developed a large-scale monitoring program for invasive species in marine protected areas along the west coast. The long-term intent of this program was to expand geographically to link all of NERRS and NMSP sites as well other US marine protected areas in order to support a national network of coordinated invasive species monitoring and research in coastal ecosystems. We are now ready to expand our sampling to include interannual sampling and to include these other protected coastal areas. We plan to adapt and increase sampling coverage over time and space to address both management and larger research questions, including measuring responses to changes in transport vectors (e.g., shipping patterns, ballast water treatment, fishery stock management and aquaculture) and large ecosystem changes (e.g., weather and oceanographic patterns, and human-mediated disturbance, such as freshwater usage, pollution, dredging).

While we have laid the groundwork for future studies, we have also already produced results useful for habitat managers and for testing research hypotheses. This study already identified five new range expansions, including two new US West Coast introductions. We found a strong pattern of decreasing number and percent of NIS with increasing latitude. A high number and proportion of Tunicata and Bryozoan species were nonindigenous, and both these taxa separately followed the same latitduinal pattern seen for all NIS together. We also found that NIS in non-marina sites, estuaries and bay sites in more natural habitats, almost entirely overlapped with those in marina sites but not vice versa, and marinas were more heavily invaded than these other sites. Offshore buoys had no NIS. We also collected samples that will allow us to test the pattern of NIS across a salinity gradient, interannual variation in NIS, and the role of flow and distance into an estuary.

While it was essential to use uniform protocols in order to gather quantitative data to determine spatial, temporal, and taxonomic patterns of invasion, the Olympic Coast Sanctuary site-specific project highlighted the importance of using multiple survey methods to create complete species lists of NIS. Olympic Coast rapid assessment study produced a list of NIS that barely overlapped with the list from this study. The list of overlapping species should increase from 2 when more taxonomic identifications are conducted on our settling plates. Nonetheless, both studies will still have noted species missing from the other.

The information from the broad-scale project is available to the managers and research coordinators of these protected areas via a web-accessible database. This information will be updated and available as more taxa are identified to species. Hence, mangers of the protected areas can know which sites in and near their reserves harbor NIS and which NIS are widespread. In addition, the data on where NIS were present and missing will enable us to track the range limits and, given future sampling, the spread of NIS.

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## Appendices

A. Taxonomists who provided or will provide species identifications
B. Trapping data from all NERRS sites
C. Species found on settling plates at each Reserve or Sanctuary site
D. Nonindigenous fouling species found in this and other surveys
E. Wetland and marine NIS found in Elkhorn Slough and TRNERR and its surrounding bays.
F. NIS work at US West Coast National Estuarine Research Reserves and Marine Sanctuaries
OC-A. Survey and Taxonomy Participants
OC-B. Nearshore survey sites sampled 27 June 2002 (north to south).

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Table 1. Sites in west coast Reserves and Sanctuaries, from south to north, and how we sampled them (geographic coordinates, year, # plates retrieved, # traps retrieved).

SWMP = System-wide water monitoring program stations of the NERRS (WM = other in-estuary regular water monitoring).

| Waterway | Site type | Site | Latitude (°N) | Longitude (°W) | Year | # Plates | # Traps |
|---|---|---|---|---|---|---|---|
| **Tijuana River NERR** | SWMP | Model Marsh | 32.55972 | 117.10655 | 2003 | 6 | 7 |
| | SWMP | Oneonta Slough | 32.56780 | 117.13153 | | 6 | 7 |
| | SWMP | Tidal Linkage | 32.57420 | 117.12695 | | 1 | 7 |
| | SWMP | Tijuana R. Main Channel | 32.55972 | 117.10655 | | 1 | 8 |
| | Marina | Mission Bay, Dana Point | 32.76753 | 117.23647 | | 6 | |
| | Marina | Mission Bay, Seaforth | 32.76302 | 117.23726 | | 6 | |
| | Marina | SD Bay, Sunroad | 32.72625 | 117.19217 | | 5 | |
| | Marina | SD Bay, Chula Vista | 32.62439 | 117.10376 | | 6 | |
| **Channel Is NMS** | Buoy | Alegria (PISCO) | 34.46175 | 120.29003 | 2004 | 2 | |
| | Buoy | Arguello (PISCO) | 34.54685 | 120.60883 | | 2 | |
| | Buoy | Ellwood (PISCO) | 34.42485 | 119.93163 | | 2 | |
| | Buoy | Jalama (PISCO) | 34.47385 | 120.48605 | | 2 | |
| | Buoy | Point Sal (PISCO) | 34.86982 | 120.63535 | | 2 | |
| | Buoy | Purisima Point (PISCO) | 34.72648 | 120.62680 | | 2 | |
| | Marina | Oxnard, Vintage | 34.17153 | 119.22884 | | 9 | |
| | Marina | Ventura West Harbor | 34.24638 | 119.26110 | | 9 | |
| **Monterey Bay NMS** | Buoy | Pt Sur (PISCO) | 36.27563 | 121.87194 | 2003 | 1 | |
| | Buoy | Sandhill Bluff (PISCO) | 36.97292 | 122.15773 | 2003 | 1 | |
| | Buoy | Soquel Pt (PISCO) | 36.93867 | 121.97547 | 2003 | 1 | |
| | Buoy | Stillwater Beach (PISCO) | 36.55905 | 121.94479 | 2003 | 1 | |
| | Buoy | Stillwater Cove (PISCO) | 36.55893 | 121.94477 | 2004 | 1 | |
| | Buoy | Terrace Pt (PISCO) | 36.94417 | 122.13293 | 2003 | 1 | |
| | Marina | Monterey | 36.60915 | 121.89203 | 2003 | 5 | |
| | Marina | Santa Cruz | 36.96580 | 122.00163 | 2003 | 6 | |
| **Elkhorn Slough NERR** | SWMP | Azevedo Pond | 36.84573 | 121.75358 | 2003 | 3 | 8 |
| | SWMP | North Marsh | 36.83463 | 121.73843 | | 3 | 8 |
| | SWMP | South Marsh Restoration | 36.81808 | 121.73963 | | 1 | |
| | SWMP | Vierra | 36.81110 | 121.77827 | | 4 | 8 |
| | WM | Hudson Landing West | 36.85673 | 121.75495 | | 3 | 8 |
| | In estuary | Hummingbird Island | 36.82372 | 121.74278 | | 6 | 8 |
| | In estuary | Kirby Park | 36.84103 | 121.74630 | | 6 | 7 |
| | In estuary | Whistle Stop Lagoon | 36.82397 | 121.73938 | | 3 | 8 |
| | Marina | Moss Landing | 36.80022 | 121.78719 | | 12 | |
| **Gulf of Farallones NMS** | Buoy, in bay | Tomales Bay, Clark | 38.18101 | 122.91047 | 2004 | 1 | |
| | Buoy, in bay | Tomales Bay, Duck Cove | 38.14000 | 122.89000 | | 1 | |
| | Buoy, in bay | Tomales Bay, Marshall | 38.14969 | 122.88853 | | 1 | |
| | Buoy, in bay | Tomales Bay, Nick's Cove | 38.20103 | 122.92281 | | 1 | |
| | Buoy, in bay | Tomales Bay, Shell Beach | 38.11473 | 122.86944 | | 1 | |
| | Buoy, in bay | Tomales Bay, Thomas Stn | 38.12865 | 122.86539 | | 1 | |
| | Buoy, in bay | Tomales Bay, Tomales Beach | 38.17558 | 122.92336 | | 1 | |
| | Float & Pier | Tomales Bay, Miller Park | 38.19956 | 122.92168 | | 4 | |
| | Float & Pier | Tomales Bay, Sacramento Landing | 38.15035 | 122.90575 | | 4 | |
| | Marina | Bodega Bay, Mason's | 38.33207 | 123.05880 | | 5 | |
| | Marina | Bodega Bay, Porto Bodega | 38.33440 | 123.05263 | | 6 | |

| Waterway (cont'd) | Site type | Site | Latitude (°N) | Longitude (°W) | Year | # Plates | # Traps |
|---|---|---|---|---|---|---|---|
| **South Slough NERR** | SWMP, Pier, Float | Charleston Bridge | 43.33768 | 124.32055 | 2003 | 1 | |
| | | | | | 2004 | 7 | |
| | SWMP, Piling | Coast Guard Beach | 43.34932 | 124.32477 | 2004 | 10 | |
| | SWMP, Piling | Sengstacken | 43.31738 | 124.32173 | 2003 | 1 | |
| | SWMP, Piling, Frame | Valino Island/Crown Point | 43.31665 | 124.32135 | 2003 | 1 | 7 |
| | | | | | 2004 | 10 | |
| | SWMP, Piling, Frame | Winchester | 43.31738 | 124.32173 | 2003 | 1 | |
| | | | | | 2004 | 10 | |
| | In estuary | Brown's Cove | 43.32692 | 124.32513 | 2003 | 0 | 7 |
| | In estuary | Sengstacken Arm | 43.30135 | 124.31583 | 2003 | 5 | 7 |
| | In estuary | Winchester arm | 43.30190 | 124.31945 | 2003 | 5 | 6 |
| | Marina | Charleston Boat Basin | 43.34650 | 124.32665 | 2003 | 5 | |
| | Pier | Empire boat ramp | 43.39330 | 124.28117 | 2003 | 6 | |
| | | | | | 2004 | 5(10) | |
| | Pier | Port of Coos Bay Citrus | 43.38225 | 124.21927 | 2004 | 6 | |
| **Olympic Coast NMS** | Buoy | Outer Coast, Cape Alava | 48.16613 | 124.80405 | 2004 | 2 | |
| | Buoy | Outer Coast, Kalalock | 47.59418 | 124.49460 | 2004 | 2 | |
| | Buoy | Outer Coast, Makah Bay | 48.32305 | 124.73953 | 2004 | 2 | |
| | Buoy | Outer Coast, Teawhit Head | 47.84603 | 124.62870 | 2004 | 2 | |
| | Marina | La Push, Quileute River | 47.91112 | 124.63698 | 2003 | 6 | |
| | Marina | Neah Bay, Makah | 48.36770 | 124.61157 | 2003 | 6 | |
| **Padilla Bay NERR** | 2 SWMP, buoy | Gong (high + low) | 48.55895 | 122.57300 | | 2 | |
| | SWMP, Piling | Joe Leary, Fresh | 48.51802 | 122.47443 | | 1 | |
| | SWMP | Joe Leary, Marine | 48.51808 | 122.47117 | | 1 | |
| | In estuary | Bayview Channel | 48.49607 | 122.50083 | 2003 | 6 | 8 |
| | In estuary | Middle Channel | 48.53332 | 122.52907 | | 0 | 6 |
| | In estuary | Ploug Channel | 48.55483 | 122.52712 | | 6 | 7 |
| | Marina | Anacortes, Cap Sante | 48.51097 | 122.60940 | | 4 | |
| | Marina | La Conner | 48.39943 | 122.49403 | | 6 | |
| **Kachemak Bay NERR** | SWMP, buoy | Bear Point | 59.42348 | 151.06611 | 2003 | 2 | |
| | SWMP, buoy | Homer Dolphin | 59.36213 | 151.40892 | 2003 | 2 | |
| | | | | | 2004 | 1 | |
| | SWMP, buoy | Port Graham | 59.22770 | 151.53834 | 2003 | 2 | |
| | SWMP, buoy | Seldovia Pier | 59.44071 | 151.72101 | 2003 | 2 | |
| | | | | | 2004 | 1 | |
| | In estuary | Halibut Cove | 59.59478 | 115.24695 | 2004 | 1 | |
| | Harbor piling | Homer pilings | 59.60294 | 151.41728 | 2003 | 5 | 8 |
| | Harbor piling | Seldovia pilings | 59.43695 | 151.71367 | 2003 | 6 | |
| | Marina | Homer Harbor | 59.60605 | 151.93063 | 2003 | 5 | |
| | | | | | 2004 | 5 | |
| | Marina | Seldovia Harbor | 59.43718 | 151.71671 | 2003 | 6 | |
| | | | | | 2004 | 5 | |

Table 2. Species found on plates in each Reserve or Sanctuary. Species are listed alphabetically within each class, and confirmed nonindigenous species are noted.

| **TAXA** | | **Sites (from south to north)[1]** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cnidaria, Hydrozoa** | | | | | | | | | | |
| Aequorea sp. | | | | | | | *SS* | *OC* | | |
| Aglaophenia sp. | | TR | | | | | | | | |
| Aglaophenia struthionides | | TR | | | | | | | | |
| Athecata | | | | | | | | | | KB |
| Bougainvillia sp. | | TR | | | | | | | | |
| Bougainvilliidae | | | | | ES | GF | | | | |
| Calycella syringa | | | **CI** | | | | *SS* | OC | | KB |
| Campanulariidae | | *TR* | *CI* | *MB* | *ES* | *GF* | *SS* | *OC* | *PB* | *KB* |
| Campanulinidae | | | | *MB* | *ES* | GF | *SS* | OC | | KB |
| Clytia hemisphaerica | | | | | | | *SS* | | *PB* | |
| Clytia sp. | | *TR* | | | *ES* | | *SS* | *OC* | *PB* | KB |
| Corynidae | | | *CI* | *MB* | | | | | | KB |
| Cuspidella sp. | | | | | | | | | | KB |
| Ectopleura crocea **NIS** | | | | | | | **SS** | | | |
| Ectopleura dumortierii | | | | | | | SS | | | |
| Endothecium sp. | | TR | | | | | | | | |
| Eudendrium sp. | | | | | | | | OC | *PB* | |
| Gonothyraea clarki | | | | | | | | | | KB |
| Gonothyraea sp. | | | | | | | | | PB | KB |
| Laomedea sp. | | | | | | | *SS* | | PB | |
| Obelia dichotoma | | | | | | | *SS* | OC | | *KB* |
| Obelia longissima | | *TR* | *CI* | *MB* | *ES* | *GF* | *SS* | *OC* | *PB* | *KB* |
| Obelia sp. | | *TR* | *CI* | | *ES* | *GF* | *SS* | *OC* | *PB* | KB |
| Opercularella lacerata | | | | | *ES* | | *SS* | | | KB |
| Opercularella sp. | | | | | | GF | *SS* | | | |
| Perigonimus repens | | | | | | | *SS* | OC | | |
| Plumularia lagenifera | | | CI | | | | | *OC* | | |
| Plumularia sp. | | | | | | | | *OC* | | |
| Sarsia eximia | | | *CI* | | | | | | | |
| Sarsia tubulosa | | | | | | | | | | *KB* |
| Thecata | | *TR* | | | | | *SS* | | | |
| Tubularia sp. | | | | | | | SS | | | |
| Tubulariidae | | | | | | GF | SS | | | |
| **Totals** | Coast | TR | CI | MB | ES | GF | SS | OC | PB | KB |
| Max # species[2] | 33 | 9 | 7 | 4 | 7 | 7 | 18 | 12 | 8 | 14 |
| Min # species[3] | 20 | 5 | 4 | 2 | 4 | 4 | 11 | 9 | 5 | 8 |
| # Named species[4] | 13 | 2 | 4 | 1 | 2 | 1 | 8 | 5 | 2 | 6 |
| # NIS[5] | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| % NIS[6] | 7.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.5 | 0.0 | 0.0 | 0.0 |

| **Mollusca, Gastropoda Nudibranchia** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cumanotus sp. | | | | | | | | | *PB* | |
| Cuthona albocrusta | | *TR* | | | | | | | | |
| Cuthona concinna | | | | | | | | | | *KB* |
| Cuthona pustulata | | | | | | | | | | *KB* |
| Dendronotus frondosus | | | | *MB* | | *GF* | *SS* | OC | *PB* | *KB* |
| Dirona picta | | | | | ES | GF | | | | |
| Doto form A | | | *CI* | | | | | | | |
| Doto kya | | | | | | | | OC | | |
| Doto sp. | | | | *MB* | | | | | | |
| Eubranchus rupium | | | | | | | | | *PB* | *KB* |
| Eubranchus rustyus | | | *CI* | | | | | OC | | |
| Flabellina japonica | | | | | | | | | | *KB* |
| Flabellina trilineata | | | *CI* | | | | | | | |
| Hermissenda crassicornis | | TR | *CI* | | | GF | *SS* | OC | *PB* | |
| Janolus fuscus | | | | | | | *SS* | | | |
| Onchidoris bilamellata | | | | | | | *SS* | | | |
| Palio zosterae | | | | | | | *SS* | | | |
| Stiliger sp. | | | | | | | *SS* | | | |
| Tenellia adspersa **NIS** | | | | | ***ES*** | | | | | |
| Triopha catalinae | | | | MB | | | | | | |
| **Totals** | Coast | TR | CI | MB | ES | GF | SS | OC | PB | KB |
| Max # species | 20 | 2 | 4 | 3 | 2 | 3 | 6 | 4 | 4 | 5 |
| Min # species | 19 | 2 | 4 | 3 | 2 | 3 | 6 | 4 | 4 | 5 |
| # Named species | 17 | 2 | 4 | 2 | 2 | 3 | 5 | 4 | 3 | 5 |
| # NIS | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| % NIS | 5.9 | 0.0 | 0.0 | 0.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| **Crustacea, Cirripedia** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Balanidae | | | | | | | | | | *KB* |
| Balanus amphitrite **NIS** | | ***TR*** | **CI** | | | | | | | |
| Balanus balanus | | | | | | GF | *SS* | *OC* | | |
| Balanus crenatus | | | *CI* | *MB* | *ES* | GF | *SS* | *OC* | *PB* | *KB* |
| Balanus glandula | | *TR* | | | | | *SS* | OC | PB | *KB* |
| Balanus improvisus **NIS, R.E.**[7] | | ***TR*** | | | | | ***SS*** | **OC** | ***PB*** | |
| Balanus reticulatus **NIS, R.E.*** | | **TR** | | | | | | | | |
| Balanus sp. | | | *CI* | | | GF | *SS* | *OC* | | |
| Balanus trigonus | | *TR* | | | | | | | | |
| Chthamalus dalli | | | | | | GF | | | | |
| Chthamalus sp. | | TR | | | | | | | | |
| Lepas antifera | | | | *MB* | | | | | | |
| Lepas pectinata pacifica | | | | *MB* | | | | | | |
| Lepas sp. | | | | *MB* | | | | | | |
| Megabalanus californicus | | | *CI* | | | | | | | |
| Megabalanus sp. | | | CI | | | | | | | |
| **Totals** | Coast | TR | CI | MB | ES | GF | SS | OC | PB | KB |
| Max # species | 16 | 6 | 5 | 4 | 1 | 4 | 5 | 5 | 3 | 3 |
| Min # species | 11 | 6 | 3 | 3 | 1 | 3 | 4 | 4 | 3 | 2 |
| # Named species | 11 | 5 | 3 | 3 | 1 | 3 | 4 | 4 | 3 | 2 |
| # NIS | 3 | 3 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| % NIS | 27.3 | 60.0 | 33.3 | 0.0 | 0.0 | 0.0 | 25.0 | 25.0 | 33.3 | 0.0 |

| **Urochordata, Ascidiacea** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Aplidium californicum | TR | | | | | | | | |
| Aplidium sp. | | CI | | | | | | | |
| Aplidium sp.A | | CI | | | | | | | |
| Aplousobranchia | | | | | *GF* | | | | |
| Ascidia ceratodes | TR | CI | | | *GF* | | | | |
| Ascidia sp. | TR | CI | MB | | *GF* | | | | KB |
| Ascidia sp. B | | CI | | | *GF* | | | | |
| Ascidia zara **NIS** | **TR** | **CI** | | **ES** | **GF** | | | | |
| Botryllidae | | CI | | | *GF* | | | | |
| Botrylloides diegensis | TR | | | ES | | | | | |
| Botrylloides perspicuum **NIS** | **TR** | | | | | | | | |
| Botrylloides sp. | | CI | | | GF | | | PB | |
| Botrylloides violaceus **NIS** | **TR** | **CI** | **MB** | **ES** | ***GF*** | ***SS*** | **OC** | **PB** | |
| Botryllus schlosseri **NIS** | **TR** | **CI** | **MB** | ***ES*** | ***GF*** | **SS** | **OC** | **PB** | |
| Ciona intestinalis **NIS** | **TR** | **CI** | **MB** | | ***GF*** | | | | |
| Ciona savignyi **NIS** | **TR** | **CI** | **MB** | **ES** | | | | | |
| Ciona sp. | | | | ES | *GF* | | | | |
| Corella inflata | | | | | | | OC | PB | |
| Corella sp. | | | | | | | OC | | |
| Corella willmeriana | | | | | | | OC | PB | |
| Didemnum sp. A **NIS** | | | | **ES** | ***GF*** | | | | |
| Diplosoma listerianum **NIS** | **TR** | **CI** | **MB** | **ES** | ***GF*** | | **OC** | | |
| Distaplia occidentalis | TR | CI | | ES | *GF* | SS | OC | | KB |
| Distaplia sp. | TR | | | | | | | | KB |
| Molgula manhattensis **NIS** | | **CI** | **MB** | | **GF** | | | **PB** | |
| Molgula pugetiensis | | | | | | SS | | | KB |
| Molgula sp. | TR | | | | | SS | | | KB |
| Molgula sp. A **NIS** | **TR** | | | | | | | | |
| Perophora annectens | TR | | | | GF | | OC | | |
| Polyandrocarpa zorritensis **NIS** | **TR** | | | | | | | | |
| Stolidobranchia | | CI | | | | | *OC* | | |
| Styela clava **NIS** | **TR** | **CI** | | | | | | | |
| Styela plicata **NIS, R.E.** | **TR** | **CI** | | **ES** | | | | | |
| Styela sp. | TR | CI | MB | | GF | | *OC* | *PB* | |
| Styela truncata | | | | | GF | | | | |
| Styelidae | TR | | | ES | | | | | |
| Symplegma reptans **NIS** | **TR** | | | | | | | | |

| **Totals** | Coast | TR | CI | MB | ES | GF | SS | OC | PB | KB |
|---|---|---|---|---|---|---|---|---|---|---|
| Max # species | 37 | 22 | 19 | 8 | 11 | 18 | 5 | 10 | 7 | 5 |
| Min # species | 26 | 17 | 13 | 8 | 10 | 12 | 4 | 8 | 6 | 3 |
| # Named species | 26 | 17 | 13 | 6 | 10 | 12 | 4 | 7 | 5 | 2 |
| # NIS | 14 | 12 | 9 | 6 | 7 | 7 | 2 | 3 | 3 | 0 |
| % NIS | 53.8 | 70.6 | 69.2 | 100.0 | 70.0 | 58.3 | 50.0 | 42.9 | 60.0 | 0.0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Bryozoa** | | | | | | | | | |
| Alcyonidium sp. | | | MB | | GF | *SS* | *OC* | | KB |
| Amathia sp. | TR | | | *ES* | | | | | |
| Amathia vidovici | | | | *ES* | | | | | |
| Bowerbankia aggregata | | CI? | MB | *ES* | | *SS* | | | |
| Bowerbankia sp. | *TR* | CI | MB | *ES* | GF | *SS* | *OC* | *PB* | *KB* |
| Bugula californica | | CI | | | GF | | | | |
| Bugula fulva **NIS, R.E.*** | | **CI** | **MB** | | | | | | |
| Bugula longirostrata | | | | ES | | | | | |
| Bugula neritina **NIS** | **TR** | **CI** | **MB** | ***ES*** | **GF** | | | | |
| Bugula pacifica | | | | | GF | *SS* | OC | *PB* | KB |
| Bugula sp. | TR | CI | MB | *ES* | GF | SS | OC | PB | |
| Bugula sp. 1 | | | | ES | GF | | | | |
| Bugula sp. X | | | MB | *ES* | | | | | |
| Bugula sp. Y | TR | CI | | | GF | | | | |
| Bugula stolonifera **NIS** | | **CI** | **MB** | ***ES*** | **GF** | | | | |
| Buskia seriata | | | | *ES* | | | | | |
| Callopora craticula | | | | | | | | | *KB* |
| Callopora sp. | | | | | | SS | | | KB |
| Callopora sp. 1 | | | | | | | *OC* | | |
| Caulibugula ciliata | | | | | | SS | | | |
| Celleporaria brunnea | TR | CI | MB | | GF | | | | |
| Celleporaria sp. | | CI | | | GF | | | | |
| Celleporella hyalina | | | MB | | GF | *SS* | *OC* | *PB* | *KB* |
| Celleporina robertsoniae | TR | CI | | | | | | | |
| Celleporina sp. | TR | CI | | | | | | | |
| Cheilopora praelonga | | | | | | SS | | | |
| Cheilostomata | | | | | | SS | | | |
| Conopeum osburni | | | | *ES* | GF | SS | | | |
| Conopeum seurati **NIS** | | | | ***ES*** | **GF** | **SS** | | | |
| Conopeum tenuissimum **NIS** | | | | | | **SS** | | | |
| Cribrilina annulata | | | | | | | | | KB |
| Cribrilina corbicula | | | | | | | OC | *PB* | KB |
| Cribrilina sp. | | | | | | SS | | | |
| Cribrilina sp. 1 | | | | | | SS | | | |
| Crisia occidentalis | | | | | | | *OC* | | |
| Crisia sp. | | CI | MB | | | SS | OC | | |
| Crisulipora occidentalis | TR | CI | | | | | | | |
| Crisulipora sp. | TR | | | | | | | | |
| Cryptosula pallasiana **NIS** | **TR** | **CI** | **MB** | ***ES*** | **GF** | **SS** | | **PB** | |
| Ctenostomata | *TR* | | | | | | | | |
| Cyclostomata | TR | | | | | | | | |
| Dendrobeania lichenoides | | | | | | SS | | | |
| Disporella sp. | TR | | | | | | | | |
| Electra crustulenta | | | | | | *SS* | | | |
| Filicrisia franciscana | | | | | | | *OC* | | |
| Filicrisia sp. | | | MB | | | | | | |
| Hippopodina feegeensis | TR | | | | GF | | | | |
| Lichenopora sp. 1 | TR | | | | | | | | |

| **Bryozoa, continued** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lichenopora verrucaria | | | | | | | | | | *KB* |
| Membranipora sp.? | | | | MB | | | | | | |
| Membranipora villosa | | | | | | | | | *PB* | |
| Microporella californica | | | | | | | SS | | | |
| Parasmittina sp. | | | | | | | SS | | | |
| Parasmittina trispinosa | | | | | | | SS? | *OC* | | |
| Reteporidae sp. | | | | | | | | | | *KB* |
| Schizoporella sp. | | | | | | GF? | | | *PB* | |
| Schizoporella sp. A | | TR | | | | | | | | |
| Schizoporella unicornis **NIS** | | | | **MB** | **ES** | **GF** | ***SS*** | | ***PB*** | |
| Scruparia sp. | | | | | | | SS | | | |
| Scrupocellaria bertholetti tenuirostris | | TR | | | | | | | | |
| Smittinidae sp. | | | | | | GF | | | | |
| Smittoidea prolifica | | TR | | | *ES* | | *SS* | | | |
| Tegella aquilirostris | | | | | | | | | | *KB* |
| Tegella armifera | | | | | | | | | | *KB* |
| Thalamoporella californica | | TR | CI | | | | | | | |
| Thalamoporella sp. | | TR | | | | | | | | |
| Tricellaria occidentalis | | | | | | | | *OC* | | |
| Tricellaria ternata | | | | | | | | *OC* | | |
| Tubulipora pacifica | | TR | | | | | | | | |
| Tubulipora sp. | | TR | | MB | | | | | | |
| Tubulipora tuba | | TR | | | | | | | *PB* | |
| Victorella pavida **NIS, R.E.** | | ***TR*** | | | ***ES*** | | | | | |
| Watersipora arcuata **NIS** | | **TR** | **CI** | | | | | | | |
| Watersipora subtorquata **NIS** | | **TR** | **CI** | **MB** | ***ES*** | **GF** | | | | |
| Zoobotryon verticillatum **NIS** | | **TR** | | | | | | | | |

| **Totals** | Coast | TR | CI | MB | ES | GF | SS | OC | PB | KB |
|---|---|---|---|---|---|---|---|---|---|---|
| Max # species | 75 | 28 | 18 | 17 | 18 | 20 | 25 | 13 | 10 | 12 |
| Min # species | 56 | 21 | 14 | 15 | 15 | 17 | 20 | 11 | 8 | 11 |
| # Named species | 43 | 15 | 12 | 9 | 13 | 12 | 15 | 8 | 7 | 8 |
| # NIS | 11 | 6 | 6 | 6 | 7 | 6 | 4 | 0 | 2 | 0 |
| % NIS | 25.0 | 40.0 | 50.0 | 66.7 | 53.8 | 50.0 | 28.6 | 0.0 | 28.6 | 0.0 |

**All Taxa Combined**

| **Totals** | Coast | TR | CI | MB | ES | GF | SS | OC | PB | KB |
|---|---|---|---|---|---|---|---|---|---|---|
| Max # species | 181 | 67 | 53 | 36 | 39 | 52 | 59 | 44 | 32 | 39 |
| Min # species | 132 | 51 | 38 | 31 | 32 | 39 | 45 | 36 | 26 | 29 |
| # Named species | 110 | 41 | 36 | 21 | 28 | 31 | 36 | 28 | 20 | 23 |
| # NIS | 30 | 21 | 16 | 12 | 15 | 13 | 8 | 4 | 6 | 0 |
| % NIS | 27.0 | 51.2 | 44.4 | 57.1 | 53.6 | 41.9 | 22.9 | 14.3 | 30.0 | 0.0 |
| # plates retrieved | 313 | 37 | 30 | 17 | 41 | 26 | 73 | 20 | 26 | 43 |
| # plates with these taxa | 298 | 37 | 29 | 16 | 37 | 26 | 69 | 20 | 26 | 38 |
| # non-marina plates | 157 | 14 | 12 | 6 | 29 | 7 | 54 | 8 | 16 | 22 |

Notes:

1: **TR** = Tijuana River NERR; **CI** = Channel Islands NMS; **MB** = Monterey Bay NMS; **ES** = Elkhorn Slough NERR; **GF** = Gulf of Farallones NMS; **SS** = South Slough NERR; **OC** = Olympic Coast NMS; **PB** = Padilla Bay NERR; **KB** = Kachemak Bay NER

When a species was found on plates at NERRS YSI Datasondes and other in-reserve sites that were not marinas, the Reserves and Sanctuaries are in *italix* in the table; when the species is an NIS, the Reserve/Sanctuary initials are **bolded**.

2. Maximum number of speices per Reserve or Sanctuary on the plates

3: Minimum number of different species per Reserve or Sanctuary on the plates

4: Number of named, described (recorded?) species identified to the species level in this study

5: Minimum number of nonindigenous species per Reserve or Sanctuary

6: Percent nonindigenous species, as calculated by (minimum # NIS ÷ # named species * 100)

7: R.E. = Range extension; R.E.* = New record for US West Coast

Table 3. The origin and arrival of the NIS found in our survey.

| Taxonomy | Species | Origin | 1st West Coast date | 1st West Coast location | Probable vector to West Coast |
|---|---|---|---|---|---|
| Hydrozoa | *Ectopleura crocea* | NW Atlantic? | 1865 | CA/ San Diego Bay | Shipping (Hull Fouling) |
| Serpulidae | *Ficopomatus enigmaticus* | Unknown | 1921 | CA/San Francisco Bay | Shipping (Hull Fouling; Ballast Water) |
| Nudibranchia | *Tenellia adspersa* | Amphi-Atlantic | 1953 | CA/San Francisco Bay | Shipping (Hull Fouling; Ballast Water) |
| Cirripedia | *Balanus amphitrite* | Indo-Pacific | 1921 | La Jolla/CA/Pacific Ocean | Shipping (Hull Fouling; Ballast Water) |
| Cirripedia | *Balanus improvisus* | NW Atlantic | 1853 | CA/San Francisco Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Cirripedia | *Balanus reticulatus* | Indo-Pacific | 1985 | Mazatlan/Mexico/Pacific Ocean | Shipping (Hull Fouling; Ballast Water) |
| Bryozoa | *Bugula fulva* | Amphi-Atlantic | 2003 | CA/Monterey Bay | Shipping (Hull Fouling) |
| Bryozoa | *Bugula neritina* | Unknown | 1905 | CA/Monterey Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Bryozoa | *Bugula stolonifera* | NW Atlantic? | 1985 | CA/Monterey Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Bryozoa | *Conopeum seurati* | NE Atlantic? | Unknown | Unknown | Shipping (Hull Fouling; Ballast Water) |
| Bryozoa | *Conopeum tenuissimum* | NW Atlantic | 1951 | CA/San Francisco Bay | Shipping (Hull Fouling; Ballast Water) |
| Bryozoa | *Cryptosula pallasiana* | Amphi-Atlantic | 1947 | CA/San Francisco Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Bryozoa | *Schizoporella unicornis* | NE Atlantic? | 1927 | WA/Puget Sound | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Bryozoa | *Victorella pavida* | Unknown | 1967 | CA/San Francisco Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Bryozoa | *Watersipora arcuata* | Unknown | 1959 | Mexico/Scammon's Lagoon (Gulf of California) | Shipping (Hull Fouling) |
| Bryozoa | *Watersipora subtorquata* | Unknown | 1989 | CA/Drakes Estero | Shipping (Hull Fouling) |
| Bryozoa | *Zoobotryon verticillatum* | Unknown | 1900 | CA/ San Diego Bay | Shipping (Hull Fouling) |

| | | | | | |
|---|---|---|---|---|---|
| Tunicata | *Ascidia zara* | NW Pacific | 1982 | CA/Long Beach Harbor | Shipping (Hull Fouling) |
| Tunicata | *Botrylloides perspicuum* | Indo-Pacific | 1997 | CA/ San Diego Bay | Shipping (Hull Fouling) |
| Tunicata | *Botrylloides violaceus* | NW Pacific | 1973 | CA/San Francisco Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Tunicata | *Botryllus schlosseri* | NE Atlantic? | 1947 | CA/San Francisco Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Tunicata | *Ciona intestinalis* | Amphi-Atlantic | 1897 | CA/San Diego Bay | Shipping (Hull Fouling) |
| Tunicata | *Ciona savignyi* | NW Pacific | 1985 | CA/Long Beach Harbor | Shipping (Hull Fouling; Ballast Water) |
| Tunicata | *Didemnum sp. A.* | Unknown | 1993 | CA/San Francisco Bay | Shipping (Hull Fouling) |
| Tunicata | *Diplosoma listerianum* | NE Atlantic? | 1917 | CA/ San Diego Bay | Shipping (Hull Fouling) |
| Tunicata | *Molgula manhattensis* | Amphi-Atlantic | 1949 | CA/Tomales Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Tunicata | *Molgula sp. A.* | Unknown | Unknown | southern CA | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Tunicata | *Polyandrocarpa zorritensis* | SE Pacific? | 1994 | CA/Oceanside Harbor | Shipping (Hull Fouling) |
| Tunicata | *Styela clava* | NW Pacific | 1933 | CA/Newport Bay | Shipping (Hull Fouling); Fisheries (Oysters-Accidental) |
| Tunicata | *Styela plicata* | Unknown | 1915 | CA/ San Diego Bay | Shipping (Hull Fouling) |
| Tunicata | *Symplegma reptans* | Indo-Pacific | 1997 | CA/Mission Bay | Shipping (Hull Fouling) |

Table 4. Species overlap and beta diversity between marinas and other sites, for all species and NIS.

| Reserve | # Species in marinas (#plates) | # Species in reserve, buoy or frame (# plates) | # Species in both habitats (% overlap) | # Non-overlapping species (%) | # NIS in marinas | # NIS in reserve (buoy or frame) | # NIS in both habitats (%) | # Non-overlapping NIS (%) |
|---|---|---|---|---|---|---|---|---|
| Tijuana River | 44 (23) | 10 (14 frame) | 3 (5.9) | 48 (94.1) | 19 | 3 | 1 (4.8) | 20 (95.2) |
| Channel Islands | 31 (18) | 9 (12 buoy) | 1 (2.6) | 38 (97.4) | 16 | 0 | 0 (0) | 16 (N/A) |
| Monterey Bay | 25 (11) | 8 (5 buoy) | 1 (3.1) | 31 (96.9) | 12 | 0 | 0 (0) | 12 (N/A) |
| Elkhorn Slough | 23 (12) | 18 (29 frame) | 10 (32.3) | 21 (67.7) | 13 | 8 | 6 (40.0) | 9 (60.0) |
| Gulf of Farallones | 38 (15) | 11 (6 buoy) | 10 (25.6) | 29 (74.4) | 13 | 6 | 6 (46.3) | 7 (53.8) |
| South Slough | 29 (11) | 26 (41 frame) | 12 (27.9) | 31 (72.1) | 7 | 3 | 3 (42.9) | 4 (57.1) |
| Olympic Coast | 22 (12) | 20 (8 buoy) | 6 (16.7) | 30 (83.3) | 4 | 0 | 0 (0) | 4 (N/A) |
| Padilla Bay | 18 (10) | 17 (16 frame, buoy) | 8 (29.6) | 19 (70.4) | 5 | 2 | 2 (28.6) | 5 (71.4) |
| Kachemak Bay | 22 (11) | 17 (8 buoy) | 10 (34.5) | 19 (65.5) | 0 | 0 | N/A | N/A |

Table 5. Average number individuals per trap per species at each Reserve.

| Species | Site | | | | |
|---|---|---|---|---|---|
| NERR: | TR (29) | ES (55) | SS (27) | PB (21) | KB* (8) |
| Crabs | | | | | |
| *Hemigrapsus oregonensis* (Hairy shore crab) | 8.45 | 12.5 | 0 | 0 | 0 |
| *Pachygrapsus crassipes* (Striped shore crab) | 1.38 | .69 | 0 | 0 | 0 |
| *Telmessus cheiragonus* (Helmet crab) | 0 | 0 | 0 | 0 | 1.13 |
| *Cancer gracilis* (Graceful crab) | 0 | 0 | 0 | .10 | 0 |
| *Cancer magister* (Dungeness crab) | 0 | 0 | 7.48 | 0 | 0.25 |
| *Cancer productus* (Red rock crab) | 0 | 0.71 | 1.78 | .10 | 0 |
| *Carcinus maenas* (Green crab) NIS | 0 | 17.09 | 0 | 0 | 0 |
| Fish | | | | | |
| *Fundulus parvipinnis* (California killifish) | 0.07 | 0 | 0 | 0 | 0 |
| *Scorpaenichthys marmoratus* (Cabezon sculpin) | 0 | 0.02 | 0 | 0 | 0 |
| *Leptocottus armatus* (Staghorn sculpin) | 0 | 0.20 | 0.26 | .24 | 0 |
| *Paralabrax clathratus* (Kelp bass) | 0 | 0.02 | 0 | 0 | 0 |
| *Cymatogaster aggregata* (Shiner surfperch) | 0 | 0 | 0 | .05 | 0 |
| *Pholis ornata* (Saddleback gunnel) | 0 | 0 | 0 | .05 | 0 |
| *Tridentiger trigonocephalus* ** (Chameleon goby) NIS | 0.10 | 0 | 0 | 0 | 0 |
| *Gillichthys mirabilis* (Longjaw mudsucker) | 0.28 | 0.55 | 0 | 0 | 0 |
| *Clevelandia ios* (Arrow goby) | 0.03 | 0 | 0 | 0 | 0 |

NERR: TR = Tijuana River; ES = Elkhorn Slough; SS = South Slough; PB = Padilla Bay; KB = Kachemak Bay. Number of traps in parentheses (N).

* All results are from 2003 except the Kachemak Bay NERR results, which are from 2004. No organisms were caught in traps at Kachemak in 2003.
** = ID not verified

| Table OC-1. Site Location Characteristics and Survey Schedule | | | | | | | |
|---|---|---|---|---|---|---|---|
| Site Code | Site Name | Habitat | Sample Date | Start Time | End Time | Surf Temp (°C) | Surf Salinity (ppt) |
| BP | Strawberry Island (Bahobohosh Point) | Rock Shelf | 8/19/01 | 700 | 800 | 13 | 31.6 |
| | Strawberry Island (Bahobohosh Point) | Rock Shelf | 7/24/02 | | | | |
| CARS | Cape Alava Rock Shelf | Rock Shelf | 8/7/02 | 620 | 720 | 14.9 | 32.7 |
| CAWR | Wedding Rocks | Rock Shelf | 8/7/02 | 550 | 650 | 13.3 | 32.6 |
| CB | Cannonball | Rock Shelf | 8/7/02 | 830 | 937 | 14 | 34 |
| CBM | Cannonball Mud | Mud Flat | 8/7/02 | 950 | 1005 | 16.5 | 32 |
| CME | Chilean Memorial Exposed | Rock Shelf | 8/20/01 | 800 | 900 | 11 | 34 |
| CMP | Chilean Memorial Protected | Rock Shelf | 8/20/01 | 930 | 1030 | 12 | 32.8 |
| DI | Destruction Island | Boulders with rock outcrops | 8/11/02 | 945 | 1115 | 11 | 32.8 |
| HRC | Diamond Rock (Hoh River) | Cobble Beach | 8/22/01 | 845 | 945 | 12.5 | 25.1 |
| KBS | Kayostla Beach Sand | Sandy Beach | 8/9/02 | 955 | 1030 | | |
| LP | La Push Marina | Dock | 8/20/01 | 1400 | 1445 | 12.5 | 31.2 |
| NB1 | Neah Bay Marina | Dock | 8/12/02 | | | | |
| | Neah Bay Marina | Dock | 7/23/02 | | | | |
| | Neah Bay Marina | Dock | 8/18/01 | 1345 | 1445 | 12 | 30.2 |
| NB2 | Neah Bay School Creek | Rock Shelf | 8/18/01 | 1010 | 1100 | 15 | 30 |
| NMM | Norwegian Memorial Middle | Rock Shelf | 8/9/02 | 845 | 945 | 13.1 | 32.7 |
| NPRS | Norwegian Point Rock Shelf | Rock Shelf | 8/9/02 | 702 | 830 | 11.5 | 32.7 |
| PG | Point Grenville Rock | Rock Shelf | 8/10/02 | 840 | 945 | 10.9 | 32.2 |
| PGS | Point Grenville Sand | Sandy Beach | 8/10/02 | 1025 | 1120 | 12 | 32.2 |
| QR | Quillayute River | Salt Water Wedge | 8/21/01 | | | | |
| RB | Rialto Beach | Gravel Beach | 8/20/01 | 1130 | 1200 | 13.5 | 32 |
| SB | Sooes Beach | Sandy Beach | 8/19/01 | 820 | 920 | 13 | 31.9 |
| SB1 | Second Beach Rock Shelf | Rock Shelf | 8/6/02 | 624 | 730 | 12 | 32.4 |

**Table OC-2. Invasive Invertebrate and Algae Species Found To Date in OCNMS Rapid Assessment Surveys 2001-2002**

| Category | Species_Name | BP | CARS | CAWR | CME | CMP | DI | HRC | LP | NB1 | NB2 | NMM | NPRS | PG | SB1 | SB2 | TBR | WP | WR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Algae: Phaeophyta | *Sargassum muticum* | | X | X | | | X | | | | | X | X | | | | X | | |
| Annelida: Polychaeta | *Proceraea kiiensis* | | | | | | | X | | | | | | | | | | X | |
| Annelida: Polychaeta | *Proceraea okadi* | | | | | | | | | | | | | | | | X | | |
| Arthropoda: Crustacea: Amphipoda | *Caprella penantis* | | | | | | | | | | | | | X | | | | | |
| Bryozoa: Cheilostomata | *Schizoporella unicornis* | | | | | | | | | X | X | | | | | | | | |
| Mollusca: Bivalvia: Heterodonta | *Mya arenaria* | | | | | | | | | | X | | | | | | | | X |
| Mollusca: Bivalvia: Heterodonta | *Nuttallia obscurata* | | | | | | | | | | X | | | | | | | | X |
| Mollusca: Bivalvia: Heterodonta | *Venerupis philippinarum* | | | | | | | | | | X | X | | | | | | | X |
| Mollusca: Bivalvia: Pteriomorpha | *Crassostrea gigas* | X | | X | | | | | | | X | | X | | | | | | X |
| Urochordata: Ascidiacea | *Botrylloides violaceus* | | | | | | | | | X | | | | | | | | | |
| Urochordata: Ascidiacea | *Styela clava* | | | | | | | | | X | | | | | | | | | |

| Category | Species_Name | BP | CARS | CAWR | CME | CMP | DI | HRC | LP | NB1 | NB2 | NMM | NPRS | PG | SB1 | SB2 | TBR | WP | WR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Annelida: Polychaeta | Arabella iricolor | | | | | | | | | | | | | | | | X | X | |
| Annelida: Polychaeta | Capitella capitata complex | | | | X | X | | | | X | | | | | | | | | |
| Annelida: Polychaeta | Exogone lourei | | | | X | | | | | X | | | | | | | | | |
| Annelida: Polychaeta | Lumbrineris japonica | | | | | | | | | | | | | | | | | X | |
| Annelida: Polychaeta | Myxicola sp UI | | | | | | | | | X | | | | | | | | | |
| Annelida: Polychaeta | Neanthes virens/brandti | | | | | | | | | | X | | | | | | | | |
| Annelida: Polychaeta | Nepthys longosetosa? | | | | | | | | X | | | | | | | | | | |
| Annelida: Polychaeta | Scolelepis "squamata" | | | | | | | | X | | | | | | | | | | |
| Arthropoda: Crustacea: Amphipoda | Microjassa sp. | | X | | | | | | | | | | | | | | | | |
| Arthropoda: Crustacea: Copepoda | unidentified species | | X | | | | | | | | | | | | | | | | |
| Arthropoda: Crustacea: Isopoda | ?Synidotea sp. | | X | | | | | | | | | | | | | | | | |
| Arthropoda: Crustacea: Isopoda | Dynamenopsis cf. dianae | | | | | | | | | | | | | X | | | | | |
| Urochordata: Ascidiacea | Diplosoma listerianum | | | | | | | | | X | | | | | | | | | |

**Table 4. Native Invertebrate Species with Range Expansions in OCNMS 2001-2002**

| Category | Species_Name | BP | CARS | CAWR | CME | CMP | DI | HRC | LP | NB1 | NB2 | NMM | NPRS | PG | SB1 | SB2 | TBR | WP | WR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mollusca: Bivalvia: Pteriomorpha | Adula diegensis | | | | | | | X | | | | | | | X | X | X | | |
| Arthropoda: Crustacea: Isopoda | Idotea (Pentidotea) recta | | | | | | | X | | | | | | | X | | | X | |
| Arthropoda: Crustacea: Isopoda | Joeropsis dubia dubia | | | | | | | | | | | | | | X | | | | |

**Appendix A. Taxonomists who provided or will provide identifications to taxa in study**

**ANNELIDA**
**Serpulids**
Linda McCann (Smithsonian Environmental Research Center, MD)
Rolando Bastida-Zavala, Universidad del Mar (Oaxaca, Mexico)

**BRYOZOA**
Linda McCann (Smithsonian Environmental Research Center, MD)
Natasha Gray Hitchcock (Smithsonian Environmental Research Center, MD)
Judy Winston (Virginia Museum of Natural History, VA)
Scott Santagata (Smithsonian Marine Station at Fort Pierce, FL)
Matthew H. Dick (Hokkaido University, Sapporo, Japan)
Josh Mackie (SUNY Stony Brook, NY)

**CIRRIPEDIA**
Chris W. Brown (Smithsonian Environmental Research Center, CA)
Francis Kerckhof (Royal Belgian Institute of Natural Sciences, Oostende, Belgium)

**HYDROZOA**
Lea-Anne Henry (Argyll, UK)

**MOLLUSCA**
**Bivalvia**
Nora Foster (University of Alaska Museum of the North, AK)

**Nudibranchia**
Jeff Goddard (Marine Science Institute UCSB, CA)

**PORIFERA**
Chris W. Brown (Smithsonian Environmental Research Center, CA)

**TUNICATA**
Gretchen and Charlie Lambert (UC Fullerton, CA)

Appendix B. Number of each species caught in traps at west coast NERRS sites in fall 2003.

| | | Crabs | | | | | | | Fish | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Site** | **# Traps** | **H.o** | **Pac** | **T.c** | **C.g** | **Can** | **C.p** | **Car** | **F.p** | **S.m** | **L.a** | **Par** | **C.a** | **P.o** | **T.t*** | **G.m** | **C.i** |
| **Tijuana River** | 29 (13,16) | 245 | 40 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 8 | 1 |
| Main Channel | 8 (4,4) | 18 | 4 | | | | | | | | | | | | | | |
| Model Marsh | 7 (3,4) | 2 | 16 | | | | | | | | | | | | | 7 | |
| Oneonta Slough | 7 (3,4) | 201 | 6 | | | | | | | | | | | | | 1 | |
| Tidal Linkage | 7 (3,4) | 24 | 14 | | | | | | 2 | | | | | | 3 | | 1 |
| **Elkhorn Slough** | 55 (28,27) | 693 | 38 | 0 | 0 | 0 | 39 | 940 | 0 | 1 | 11 | 1 | 0 | 0 | 0 | 30 | 0 |
| Azevedo Pond | 8 (4,4) | 1 | 38 | | | | | 149 | | | 1 | | | | | | |
| Hudson Landing | 8 (4,4) | 72 | | | | | | 19 | | | | | | | | 1 | |
| Hummingbird Is | 8 (4,4) | 2 | | | | | | 204 | | | 7 | | | | | | |
| Kirby Park | 7 (4,3) | 351 | | | | | 1 | 41 | | | | | | | | | |
| North Marsh | 8 (4,4) | 3 | | | | | | 402 | | | | | | | | 27 | |
| Vierra's | 8 (4,4) | 1 | | | | | 38 | 0 | | 1 | | 1 | | | | | |
| Whistle Stop Lgn | 8 (4,4) | 267 | | | | | | 125 | | | 3 | | | | | 2 | |
| **South Slough** | 27 (16,11) | 0 | 0 | 0 | 0 | 202 | 48 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| Brown's Cove | 7 (4,3) | | | | | 33 | 38 | | | | 5 | | | | | | |
| Sengstaken arm | 7 (4,3) | | | | | 73 | | | | | 2 | | | | | | |
| Valino Is | 7 (4,3) | | | | | 41 | 10 | | | | | | | | | | |
| Winchester arm | 6 (4,2) | | | | | 55 | | | | | | | | | | | |
| **Padilla Bay** | 21 (12,9) | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 5 | 0 | 1 | 1 | 0 | 0 | 0 |
| Bayview Channel | 8 (4,4) | | | | 1 | | | | | | 2 | | | | | | |
| Middle Channel | 6 (4,2) | | | | | | 2 | | | | | | 1 | | | | |
| Ploug Channel | 7 (4,3) | | | | 1 | | | | | | 3 | | | 1 | | | |
| **Kachemak Bay** | 16 (8,8) | 0 | 0 | 9 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Homer pilings 2003 | 8 (4,4) | | | | | | | | | | | | | | | | |
| Homer pilings 2004 | 8 (4,4) | | | 9 | | 2 | | | | | | | | | | | |

# Traps retrieved (# Collapsible traps, # Minnow traps)

Crabs: H.o: *Hemigrapsus oregonensis* (Hairy shore crab); Pac: *Pachygrapsus crassipes* (Striped shore crab); T.c: *Telmessus cheiragonus* (Helmet crab); C.g: *Cancer gracilis* (Graceful crab); Can: *Cancer magister* (Dungeness crab); C.p: *Cancer productus* (Red rock crab); Car: *Carcinus maenas* (Green crab);
Fish: F.p: *Fundulus parvipinnis* (California killifish); S.m: *Scorpaenichthys marmoratus* (Cabezon sculpin); L.a: *Leptocottus armatus* (Staghorn sculpin); Par: *Paralabrax clathratus* (Kelp bass); C.a: *Cymatogaster aggregata* (Shiner surfperch); O,i: *Pholis ornata* (Saddleback gunnel); T.t: *Tridentiger trigonocephalus* (Chameleon goby – ID not verified); G.m: *Gillichthys mirabilis* (Longjaw mudsucker); C.i: *Clevelandia ios* (Arrow goby)

*ID not verified

**ng plates at each Reserve or Sanctuary site.**

| Year | Reserve | Site | ModTaxa | Genus | Species | #Plates at site with taxa | Notes | NIS? |
|---|---|---|---|---|---|---|---|---|
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Bowerbankia | sp. | 3 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Bugula | neritina | 2 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Bugula | sp. Y | 2 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Celleporaria | brunnea | 6 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Celleporina | robertsoniae | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Crisulipora | occidentalis | 6 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Crisulipora | sp. | 4 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Cryptosula | pallasiana | 1 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Cyclostomata | | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Hippopodina | feegeensis | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Schizoporella | sp. A | 4 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Smittoidea | prolifica | 4 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Thalamoporella | californica | 6 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Tubulipora | pacifica | 2 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Tubulipora | sp. | 2 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Tubulipora | tuba | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Watersipora | arcuata | 5 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Watersipora | subtorquata | 6 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Bryozoa | Zoobotryon | verticillatum | 4 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Cirripedia | Balanus | amphitrite | 1 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Cirripedia | Balanus | trigonus | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Hydrozoa | Aglaophenia | sp. | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Hydrozoa | Aglaophenia | struthionides | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Aplidium | californicum | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Ascidia | sp. | 1 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Ascidia | zara | 4 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Botrylloides | perspicuum | 5 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Botryllus | schlosseri | 6 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Ciona | intestinalis | 4 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Ciona | savignyi | 2 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Diplosoma | listerianum | 3 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Perophora | annectens | 2 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Polyandrocarpa | zorritensis | 2 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Styela | clava | 1 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Styela | plicata | 3 | | yes |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Styela | sp. | 3 | | no |
| 2003 | Tijuana River | Mission Bay, Dana Point Marina | Tunicata | Symplegma | reptans | 4 | | yes |

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|---|---|---|---|---|---|---|---|
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Bugula | neritina | 1 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Bugula | sp. | 2 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Bugula | sp. Y | 3 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Celleporaria | brunnea | 6 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Celleporina | robertsoniae | 1 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Celleporina | sp. | 1 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Crisulipora | occidentalis | 3 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Cryptosula | pallasiana | 1 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Schizoporella | sp. A | 1 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Thalamoporella | californica | 6 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Tubulipora | sp. | 2 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Tubulipora | tuba | 5 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Watersipora | arcuata | 4 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Watersipora | subtorquata | 6 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Bryozoa | Zoobotryon | verticillatum | 1 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Cirripedia | Balanus | amphitrite | 3 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Aplidium | californicum | 2 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Ascidia | sp. | 1 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Ascidia | zara | 2 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Botrylloides | perspicuum | 5 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Botrylloides | violaceus | 1 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Botryllus | schlosseri | 6 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Ciona | intestinalis | 4 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Ciona | savignyi | 6 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Diplosoma | listerianum | 4 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Distaplia | occidentalis | 4 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Polyandrocarpa | zorritensis | 1 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Styela | plicata | 1 | yes |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Styela | sp. | 1 | no |
| 2003 | Tijuana River | Mission Bay, Seaforth Marina | Tunicata | Styelidae | | 1 | no |
| 2003 | Tijuana River | Model Marsh | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | Tijuana River | Model Marsh | Bryozoa | Victorella | pavida | 4 | yes |
| 2003 | Tijuana River | Model Marsh | Cirripedia | Balanus | amphitrite | 5 | yes |
| 2003 | Tijuana River | Model Marsh | Cirripedia | Balanus | glandula | 1 | no |
| 2003 | Tijuana River | Model Marsh | Cirripedia | Chthamalus | sp. | 3 | no |
| 2003 | Tijuana River | Model Marsh | Hydrozoa | Thecata | | 1 | no |
| 2003 | Tijuana River | Oneonta Slough | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | Tijuana River | Oneonta Slough | Cirripedia | Balanus | amphitrite | 4 | yes |
| 2003 | Tijuana River | Oneonta Slough | Cirripedia | Balanus | improvisus | 1 | yes |
| 2003 | Tijuana River | Oneonta Slough | Cirripedia | Balanus | trigonus | 1 | no |
| 2003 | Tijuana River | Oneonta Slough | Hydrozoa | Campanulariidae | | 3 | no |
| 2003 | Tijuana River | Oneonta Slough | Hydrozoa | Clytia | sp. | 2 | no |
| 2003 | Tijuana River | Oneonta Slough | Hydrozoa | Obelia | longissima | 1 | no |

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|---|---|---|---|---|---|---|---|---|
| 2003 | Tijuana River | Oneonta Slough | Hydrozoa | Obelia | sp. | 2 | | no |
| 2003 | Tijuana River | Oneonta Slough | Nudibranchia | Cuthona | albocrusta | 2 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Amathia | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Celleporaria | brunnea | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Disporella | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Hippopodina | feegeensis | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Lichenopora | sp. 1 | 2 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Scrupocellaria | bertholetti tenuirostris | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Thalamoporella | californica | 4 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Thalamoporella | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Watersipora | subtorquata | 1 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Bryozoa | Zoobotryon | verticillatum | 6 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Cirripedia | Balanus | amphitrite | 2 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Hydrozoa | Endothecium | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Aplidium | californicum | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Ascidia | zara | 3 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Botrylloides | diegensis | 2 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Botrylloides | perspicuum | 1 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Ciona | savignyi | 1 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Diplosoma | listerianum | 4 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Distaplia | occidentalis | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Distaplia | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Molgula | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Perophora | annectens | 3 | | no |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Polyandrocarpa | zorritensis | 3 | | yes |
| 2003 | Tijuana River | SD Bay, Chula Vista Marina | Tunicata | Styela | sp. | 4 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Bugula | sp. Y | 1 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Celleporaria | brunnea | 2 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Celleporina | robertsoniae | 2 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Crisulipora | occidentalis | 2 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Cyclostomata | | 1 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Thalamoporella | californica | 1 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Tubulipora | sp. | 2 | ? | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Tubulipora | tuba | 1 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Watersipora | arcuata | 4 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Watersipora | subtorquata | 3 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Bryozoa | Zoobotryon | verticillatum | 4 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Cirripedia | Balanus | amphitrite | 1 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Cirripedia | Balanus | reticulatus | 1 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Hydrozoa | Bougainvillia | sp. | 2 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Ascidia | ceratodes | 1 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Ascidia | zara | 2 | | yes |

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|---|---|---|---|---|---|---|---|---|
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Botrylloides | violaceus | 3 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Botryllus | schlosseri | 4 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Ciona | intestinalis | 2 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Ciona | savignyi | 4 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Diplosoma | listerianum | 5 | | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Distaplia | occidentalis | 3 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Molgula | sp. | 1 | | no |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Molgula | sp. A | 1 | was verrucifera, GL changed | yes |
| 2003 | Tijuana River | SD Bay, Sunroad Marina | Tunicata | Perophora | annectens | 4 | | no |
| 2003 | Tijuana River | Tidal Linkage | Bryozoa | Ctenostomata | | 1 | | no |
| 2003 | Tijuana River | Tidal Linkage | Cirripedia | Balanus | amphitrite | 1 | | yes |
| 2003 | Tijuana River | Tidal Linkage | Hydrozoa | Campanulariidae | | 1 | | no |
| 2003 | Tijuana River | Tijuana River Main Channel | Bryozoa | Victorella | pavida | 1 | | yes |
| 2004 | Channel Is | Alegria (PISCO) | Bryozoa | Alcyonidium | | | ID not verified | no |
| 2004 | Channel Is | Alegria (PISCO) | Bryozoa | Bryo sp. | | | ID not verified | |
| 2004 | Channel Is | Alegria (PISCO) | Hydrozoa | Obelia | longissima | 2 | | no |
| 2004 | Channel Is | Alegria (PISCO) | Nudibranchia | Eubranchus | rustyus | 1 | | no |
| 2004 | Channel Is | Arguello (PISCO) | Bryozoa | Bryo sp. | | | ID not verified | |
| 2004 | Channel Is | Arguello (PISCO) | Bryozoa | Membraniporidae | | | ID not verified | no |
| 2004 | Channel Is | Arguello (PISCO) | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Channel Is | Arguello (PISCO) | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Channel Is | Ellwood (PISCO) | Bryozoa | Alcyonidium | | | ID not verified | no |
| 2004 | Channel Is | Ellwood (PISCO) | Bryozoa | Bryozoa | | | ID not verified | |
| 2004 | Channel Is | Ellwood (PISCO) | Bryozoa | Victorellidae | | | ID not verified | |
| 2004 | Channel Is | Ellwood (PISCO) | Cirripedia | Megabalanus | californicus | 1 | | no |
| 2004 | Channel Is | Ellwood (PISCO) | Cirripedia | Megabalanus | sp. | 1 | | no |
| 2004 | Channel Is | Ellwood (PISCO) | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Channel Is | Ellwood (PISCO) | Hydrozoa | Obelia | longissima | 1 | | no |
| 2004 | Channel Is | Ellwood (PISCO) | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Channel Is | Jalama (PISCO) | Bryozoa | Alcyonidium | | | ID not verified | no |
| 2004 | Channel Is | Jalama (PISCO) | Bryozoa | Bryozoa | | | ID not verified | |
| 2004 | Channel Is | Jalama (PISCO) | Bryozoa | Conopeum | | | ID not verified | |
| 2004 | Channel Is | Jalama (PISCO) | Bryozoa | Victorellidae | | | ID not verified | |
| 2004 | Channel Is | Jalama (PISCO) | Cirripedia | Balanus | sp. | 1 | | no |
| 2004 | Channel Is | Jalama (PISCO) | Cirripedia | Megabalanus | californicus | 1 | | no |
| 2004 | Channel Is | Jalama (PISCO) | Hydrozoa | Calycella | syringa | 1 | | no |
| 2004 | Channel Is | Jalama (PISCO) | Hydrozoa | Campanulariidae | | 2 | | no |
| 2004 | Channel Is | Jalama (PISCO) | Hydrozoa | Sarsia | eximia | 1 | | no |
| 2004 | Channel Is | Jalama (PISCO) | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Bugula | californica | 1 | | no |

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|---|---|---|---|---|---|---|---|---|
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Bugula | fulva | 1 | flabellata, as original ID | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Bugula | neritina | 6 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Bugula | sp. | 2 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Bugula | stolonifera | 1 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Celleporaria | brunnea | 4 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Celleporaria | sp. | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Celleporina | robertsoniae | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Celleporina | sp. | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Crisia | sp. | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Crisulipora | occidentalis | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Cryptosula | pallasiana | 5 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Thalamoporella | californica | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Watersipora | arcuata | 3 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Bryozoa | Watersipora | subtorquata | 6 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Hydrozoa | Plumularia | lagenifera | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Ascidia | ceratodes | 8 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Ascidia | sp. | 2 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Ascidia | zara | 1 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Botryllidae | | 3 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Botrylloides | sp. | 1 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Botrylloides | violaceus | 5 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Botryllus | schlosseri | 7 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Ciona | intestinalis | 8 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Ciona | savignyi | 1 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Diplosoma | listerianum | 5 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Distaplia | occidentalis | 4 | | no |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Styela | clava | 2 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Styela | plicata | 6 | | yes |
| 2004 | Channel Is | Oxnard, Vintage Marina | Tunicata | Styela | sp. | 2 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Bryozoa | Bryo sp. | | | ID not verified | |
| 2004 | Channel Is | Point Sal (PISCO) | Bryozoa | Victorellidae | | | ID not verified | |
| 2004 | Channel Is | Point Sal (PISCO) | Hydrozoa | Calycella | syringa | 1 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Hydrozoa | Campanulariidae | | 2 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Hydrozoa | Corynidae | | 1 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Hydrozoa | Obelia | longissima | 1 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Hydrozoa | Sarsia | eximia | 2 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Nudibranchia | Doto | form A of Goddard | 1 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Nudibranchia | Eubranchus | rustyus | 2 | | no |
| 2004 | Channel Is | Point Sal (PISCO) | Nudibranchia | Flabellina | trilineata | 1 | | no |

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|---|---|---|---|---|---|---|---|---|
| 2004 | Channel Is | Point Sal (PISCO) | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Bryozoa | Bowerbankia | | | ID not verified | |
| 2004 | Channel Is | Purisima Point (PISCO) | Bryozoa | Membraniporidae | | | ID not verified | |
| 2004 | Channel Is | Purisima Point (PISCO) | Cirripedia | Balanus | crenatus | 1 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Cirripedia | Megabalanus | californicus | 2 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Hydrozoa | Obelia | sp. | 2 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Hydrozoa | Sarsia | eximia | 2 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Nudibranchia | Doto | form A of Goddard | 1 | | no |
| 2004 | Channel Is | Purisima Point (PISCO) | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Bowerbankia | aggregata | 1 | ? | no |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Bugula | neritina | 7 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Bugula | sp. | 2 | | no |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Bugula | sp. Y | 2 | | no |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Bugula | stolonifera | 5 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Cryptosula | pallasiana | 6 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Watersipora | arcuata | 5 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Bryozoa | Watersipora | subtorquata | 6 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Cirripedia | Balanus | amphitrite | 3 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Hydrozoa | Corynidae | | 1 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Aplidium | sp. | 2 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Aplidium | sp. A | 3 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Ascidia | ceratodes | 3 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Ascidia | sp. | 3 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Ascidia | sp. B | 1 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Ciona | intestinalis | 9 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Diplosoma | listerianum | 4 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Molgula | manhattensis | 3 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Stolidobranchia | | 1 | | no |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Styela | plicata | 3 | | yes |
| 2004 | Channel Is | Ventura West Harbor | Tunicata | Styela | sp. | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Alcyonidium | sp. | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bowerbankia | aggregata | 2 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bugula | fulva | 1 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bugula | neritina | 4 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bugula | sp. | 2 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bugula | sp. X | 2 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Bugula | stolonifera | 1 | ? | yes |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Celleporaria | brunnea | 5 | | no |

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|---|---|---|---|---|---|---|---|---|
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Celleporella | hyalina | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Crisia | sp. | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Cryptosula | pallasiana | 4 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Filicrisia | sp. | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Membranipora | sp. | 1 | ? | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Schizoporella | unicornis | 2 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Tubulipora | sp. | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Bryozoa | Watersipora | subtorquata | 5 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Cirripedia | Balanus | crenatus | 2 | | no |
| 2003 | Monterey Bay | Monterey Marina | Nudibranchia | Triopha | catalinae | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Ascidia | sp. | 1 | | no |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Botrylloides | violaceus | 3 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Botryllus | schlosseri | 3 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Ciona | intestinalis | 3 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Ciona | savignyi | 2 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Diplosoma | listerianum | 3 | | yes |
| 2003 | Monterey Bay | Monterey Marina | Tunicata | Styela | sp. | 1 | | no |
| 2003 | Monterey Bay | Pt Sur (PISCO) | Cirripedia | Lepas | antifera | 1 | | no |
| 2003 | Monterey Bay | Pt Sur (PISCO) | Cirripedia | Lepas | pectinata pacifica | 1 | | no |
| 2003 | Monterey Bay | Pt Sur (PISCO) | Hydrozoa | Obelia | longissima | 1 | | no |
| 2003 | Monterey Bay | Pt Sur (PISCO) | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2003 | Monterey Bay | Sandhill Bluff (PISCO) | Cirripedia | Balanus | crenatus | 1 | | no |
| 2003 | Monterey Bay | Santa Cruz Harbor | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2003 | Monterey Bay | Santa Cruz Harbor | Bryozoa | Bugula | neritina | 2 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Bryozoa | Bugula | stolonifera | 4 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Bryozoa | Cryptosula | pallasiana | 4 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Bryozoa | Schizoporella | unicornis | 4 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Bryozoa | Watersipora | subtorquata | 6 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Tunicata | Ascidia | sp. | 1 | was sp. A, GL changed | no |
| 2003 | Monterey Bay | Santa Cruz Harbor | Tunicata | Botrylloides | violaceus | 1 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Tunicata | Botryllus | schlosseri | 5 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Tunicata | Diplosoma | listerianum | 3 | | yes |
| 2003 | Monterey Bay | Santa Cruz Harbor | Tunicata | Molgula | manhattensis | 3 | | yes |
| 2003 | Monterey Bay | Stillwater Beach (PISCO) | Cirripedia | Lepas | antifera | 1 | | no |
| 2003 | Monterey Bay | Stillwater Beach (PISCO) | Cirripedia | Lepas | pectinata pacifica | 1 | | no |
| 2003 | Monterey Bay | Stillwater Beach (PISCO) | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Monterey Bay | Stillwater Cove (PISCO) | Cirripedia | Lepas | sp. | 1 | | no |
| 2004 | Monterey Bay | Stillwater Cove (PISCO) | Hydrozoa | Campanulinidae | | 1 | | no |
| 2004 | Monterey Bay | Stillwater Cove (PISCO) | Hydrozoa | Corynidae | | 1 | | no |
| 2004 | Monterey Bay | Stillwater Cove (PISCO) | Nudibranchia | Dendronotus | frondosus | 1 | | no |

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|---|---|---|---|---|---|---|---|---|
| 2004 | Monterey Bay | Stillwater Cove (PISCO) | Nudibranchia | Doto | sp. | 1 | | no |
| 2003 | Monterey Bay | Terrace Pt (PISCO) | Cirripedia | Balanus | crenatus | 1 | ? | no |
| 2003 | Monterey Bay | Terrace Pt (PISCO) | Cirripedia | Lepas | antifera | 1 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Amathia | sp. | 1 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Amathia | vidovici | 2 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Bowerbankia | aggregata | 2 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Bowerbankia | sp. | 3 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Bugula | neritina | 2 | | yes |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Bugula | stolonifera | 1 | ? | yes |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Buskia | seriata | 2 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Conopeum | seurati | 2 | | yes |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Cryptosula | pallasiana | 3 | | yes |
| 2003 | Elkhorn Slough | Azevedo Pond | Bryozoa | Smittoidea | prolifica | 1 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Hydrozoa | Obelia | longissima | 1 | | no |
| 2003 | Elkhorn Slough | Azevedo Pond | Nudibranchia | Tenellia | adspersa | 1 | | yes |
| 2003 | Elkhorn Slough | Hudson Landing West | Bryozoa | Amathia | vidovici | 1 | | no |
| 2003 | Elkhorn Slough | Hudson Landing West | Bryozoa | Bowerbankia | aggregata | 1 | ? | no |
| 2003 | Elkhorn Slough | Hudson Landing West | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2003 | Elkhorn Slough | Hudson Landing West | Bryozoa | Conopeum | seurati | 3 | | yes |
| 2003 | Elkhorn Slough | Hudson Landing West | Bryozoa | victorella | pavida | 1 | | yes |
| 2003 | Elkhorn Slough | Hudson Landing West | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2003 | Elkhorn Slough | Hummingbird Island | Bryozoa | Amathia | vidovici | 2 | | no |
| 2003 | Elkhorn Slough | Hummingbird Island | Bryozoa | Buskia | seriata | 1 | | no |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Amathia | sp. | 4 | | no |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Amathia | vidovici | 6 | | no |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Bowerbankia | sp. | 1 | | no |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Bugula | neritina | 6 | | yes |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Bugula | sp. | 2 | | no |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Conopeum | osburni | 5 | ? | no |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Cryptosula | pallasiana | 5 | | yes |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | victorella | pavida | 1 | | yes |
| 2003 | Elkhorn Slough | Kirby Park | Bryozoa | Watersipora | subtorquata | 3 | | yes |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Amathia | sp. | 1 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Amathia | vidovici | 2 | ? | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Bowerbankia | aggregata | 1 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Bowerbankia | sp. | 1 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Bugula | neritina | 6 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Bugula | sp. X | 3 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Bugula | stolonifera | 6 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Cryptosula | pallasiana | 2 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Schizoporella | unicornis | 1 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | victorella | pavida | 1 | | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Bryozoa | Watersipora | subtorquata | 6 | | no |

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|---|---|---|---|---|---|---|---|
| 2003 | Elkhorn Slough | Moss Landing, North | Hydrozoa | Obelia | sp. | 2 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Nudibranchia | Dirona | picta | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Ascidia | zara | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Botrylloides | diegensis | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Botrylloides | violaceus | 4 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Botryllus | schlosseri | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Didemnum | sp. A | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Diplosoma | listerianum | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Distaplia | occidentalis | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Styela | plicata | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, North | Tunicata | Styelidae | | 2 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Amathia | vidovici | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bowerbankia | aggregata | 2 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bugula | longirostrata | 2 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bugula | neritina | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bugula | sp. | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bugula | sp. 1 | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Bugula | stolonifera | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Cryptosula | pallasiana | 5 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Schizoporella | unicornis | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Bryozoa | Watersipora | subtorquata | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Cirripedia | Balanus | crenatus | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Hydrozoa | Bougainvilliidae | | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Hydrozoa | Campanulariidae | | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Nudibranchia | Dirona | picta | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Ascidia | zara | 4 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Botrylloides | violaceus | 3 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Botryllus | schlosseri | 4 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Ciona | savignyi | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Ciona | sp. | 1 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Didemnum | sp. A | 4 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Diplosoma | listerianum | 6 | no |
| 2003 | Elkhorn Slough | Moss Landing, South | Tunicata | Distaplia | occidentalis | 5 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Amathia | sp. | 1 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Amathia | vidovici | 3 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Bowerbankia | sp. | 2 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Bugula | neritina | 3 | yes |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Bugula | sp. | 2 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Bugula | sp. X | 1 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Bugula | stolonifera | 3 | yes |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Buskia | seriata | 3 | no |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Conopeum | osburni | 1 | no |

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|---|---|---|---|---|---|---|---|---|---|
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Cryptosula | pallasiana | 2 | | | yes |
| 2003 | Elkhorn Slough | North Marsh | Bryozoa | Watersipora | subtorquata | 1 | ? | | yes |
| 2003 | Elkhorn Slough | North Marsh | Hydrozoa | Campanulariidae | | 2 | | | no |
| 2003 | Elkhorn Slough | South Marsh Restoration | Bryozoa | Amathia | vidovici | 1 | | | no |
| 2003 | Elkhorn Slough | South Marsh Restoration | Bryozoa | Bugula | neritina | 1 | | | yes |
| 2003 | Elkhorn Slough | South Marsh Restoration | Bryozoa | Bugula | sp. | 1 | | | no |
| 2003 | Elkhorn Slough | South Marsh Restoration | Bryozoa | Smittoidea | prolifica | 1 | | | no |
| 2003 | Elkhorn Slough | Vierra | Bryozoa | Bugula | sp. | 1 | | | no |
| 2003 | Elkhorn Slough | Vierra | Bryozoa | Watersipora | subtorquata | 1 | | | yes |
| 2003 | Elkhorn Slough | Vierra | Cirripedia | Balanus | crenatus | 3 | | | no |
| 2003 | Elkhorn Slough | Vierra | Hydrozoa | Campanulariidae | | 1 | | | no |
| 2003 | Elkhorn Slough | Vierra | Hydrozoa | Campanulinidae | | 1 | | | no |
| 2003 | Elkhorn Slough | Vierra | Hydrozoa | Clytia | sp. | 2 | | | no |
| 2003 | Elkhorn Slough | Vierra | Hydrozoa | Opercularella | lacerata | 1 | | | no |
| 2003 | Elkhorn Slough | Whistle Stop Lagoon | Bryozoa | Bugula | neritina | 3 | | | yes |
| 2003 | Elkhorn Slough | Whistle Stop Lagoon | Hydrozoa | Campanulariidae | | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Alcyonidium | sp. | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bowerbankia | sp. | 5 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bugula | californica | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bugula | neritina | 5 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bugula | sp. | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bugula | sp. 1 | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bugula | sp. Y | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Bugula | stolonifera | 5 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Celleporaria | sp. | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Conopeum | seurati | 1 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Cryptosula | pallasiana | 3 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Schizoporella | sp. | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Schizoporella | unicornis | 5 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Bryozoa | Watersipora | subtorquata | 5 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Cirripedia | Balanus | balanus | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Cirripedia | Balanus | crenatus | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Hydrozoa | Bougainvilliidae | | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Hydrozoa | Obelia | longissima | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Hydrozoa | Obelia | sp. | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Nudibranchia | Hermissenda | crassicornis | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Ascidia | ceratodes | 3 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Ascidia | sp. | 2 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Ascidia | sp. B | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Ascidia | zara | 3 | | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Botryllidae | | 1 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Botrylloides | sp. | 2 | | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Botrylloides | violaceus | 5 | | | yes |

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|---|---|---|---|---|---|---|---|---|
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Botryllus | schlosseri | 4 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Ciona | intestinalis | 2 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Didemnum | sp. A | 5 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Diplosoma | listerianum | 5 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Distaplia | occidentalis | 5 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Mason's Marina | Tunicata | Styela | sp. | 2 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Bowerbankia | sp. | 5 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Bugula | neritina | 4 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Bugula | pacifica | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Bugula | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Bugula | stolonifera | 5 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Celleporaria | brunnea | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Celleporella | hyalina | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Conopeum | osburni | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Conopeum | seurati | 1 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Cryptosula | pallasiana | 4 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Hippopodina | feegeensis | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Schizoporella | unicornis | 5 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Smittinidae | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Bryozoa | Watersipora | subtorquata | 5 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Cirripedia | Balanus | balanus | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Cirripedia | Balanus | crenatus | 3 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Cirripedia | Balanus | sp. | 3 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Hydrozoa | Bougainvilliidae | | 2 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Hydrozoa | Campanulinidae | | 2 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Hydrozoa | Opercularella | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Nudibranchia | Dendronotus | frondosus | 2 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Nudibranchia | Dirona | picta | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Ascidia | ceratodes | 4 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Ascidia | sp. | 3 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Botryllidae | | 1 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Botrylloides | sp. | 2 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Botrylloides | violaceus | 6 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Botryllus | schlosseri | 4 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Didemnum | sp. A | 5 | alt. listed as D sp. | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Diplosoma | listerianum | 6 | | yes |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Distaplia | occidentalis | 5 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Styela | sp. | 5 | | no |
| 2004 | Gulf of Farallones | Bodega Bay, Porto Bodega Marina | Tunicata | Styela | truncata | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Bryozoa | Bryo sp | | | ID not verified | |

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|---|---|---|---|---|---|---|---|---|
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Bryozoa | Bugula sp | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Tunicata | Ascidia | ceratodes | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Tunicata | Botrylloides | violaceus | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Tunicata | Ciona | intestinalis | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Tunicata | Didemnum | sp. A | 1 | alt. listed as D sp. | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Clark | Tunicata | Diplosoma | listerianum | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Duck Cove | Bryozoa | Bugula sp | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Duck Cove | Tunicata | Ascidia | ceratodes | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Duck Cove | Tunicata | Botryllidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Bryozoa | Bryo sp | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Bryozoa | Bugula | neritina | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Bryozoa | Bugula | sp | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Hydrozoa | Tubulariidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Ascidia | ceratodes | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Ascidia | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Botrylloides | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Botrylloides | violaceus | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Ciona | intestinalis | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Ciona | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Didemnum | sp. A | 1 | alt. listed as D sp. | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Diplosoma | listerianum | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Marshall | Tunicata | Molgula | manhattensis | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Bryozoa | Bryo sp | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Bryozoa | Cryptosula | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Bryozoa | Victorellidae | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Bryozoa | Watersipora | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Cirripedia | Chthamalus | dalli | 2 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Hydrozoa | Bougainvilliidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Hydrozoa | Campanulinidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Tunicata | Botryllidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Tunicata | Botrylloides | violaceus | 4 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Miller Park | Tunicata | Didemnum | sp. A | 2 | alt. listed as D sp. | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Hydrozoa | Obelia | longissima | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Hydrozoa | Obelia | sp. | 1 | | no |

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|---|---|---|---|---|---|---|---|---|
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Tunicata | Aplousobranchia | | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Tunicata | Botrylloides | violaceus | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Tunicata | Distaplia | occidentalis | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Nick's Cove | Tunicata | Molgula | manhattensis | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Bryozoa | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Bugula | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Bugula | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Conopeum | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Cryptosula | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Schizoporella | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Victorellidae | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Bryozoa | Watersipora | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Ascidia | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Ascidia | sp. B | 2 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Botryllidae | | 4 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Botrylloides | sp. | 2 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Botrylloides | violaceus | 2 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Botryllus | schlosseri | 2 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Ciona | intestinalis | 3 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Ciona | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Didemnum | sp. A | 4 | alt. listed as D sp. | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Diplosoma | listerianum | 2 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Distaplia | occidentalis | 3 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Molgula | manhattensis | 3 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Sacramento Landing | Tunicata | Perophora | annectens | 3 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Bryozoa | Bryo sp | | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Bryozoa | Bugula | neritina | | | |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Bryozoa | Bugula | sp | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Hydrozoa | Obelia | longissima | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Tunicata | Botrylloides | violaceus | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Tunicata | Ciona | sp. | 1 | | no |
| 2004 | Gulf of Farallones | Tomales Bay, Shell Beach | Tunicata | Molgula | manhattensis | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Bryozoa | Bugula | neritina | | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Bryozoa | Bugula | sp | | ID not verified | |
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Tunicata | Botrylloides | violaceus | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Tunicata | Ciona | intestinalis | 1 | | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Tunicata | Didemnum | sp. A | 1 | alt. listed as D sp. | yes |

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|---|---|---|---|---|---|---|---|
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Tunicata | Diplosoma | listerianum | 1 | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Thomas Station | Tunicata | Molgula | manhattensis | 1 | yes |
| 2004 | Gulf of Farallones | Tomales Bay, Tomales Beach | Tunicata | Botrylloides | violaceus | 1 | yes |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Alcyonidium | sp. | 2 | no |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Bowerbankia | aggregata | 1 | no |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Bowerbankia | sp. | 4 | no |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Bugula | pacifica | 2 | no |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Bugula | sp. | 1 | no |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Celleporella | hyalina | 1 | no |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Conopeum | seurati | 1 | yes |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Cryptosula | pallasiana | 3 | yes |
| 2003 | South Slough | Charleston Boat Basin | Bryozoa | Schizoporella | unicornis | 4 | yes |
| 2003 | South Slough | Charleston Boat Basin | Cirripedia | Balanus | crenatus | 3 | no |
| 2003 | South Slough | Charleston Boat Basin | Cirripedia | Balanus | glandula | 3 | no |
| 2003 | South Slough | Charleston Boat Basin | Cirripedia | Balanus | improvisus | 1 | yes |
| 2003 | South Slough | Charleston Boat Basin | Hydrozoa | Campanulariidae | | 1 | no |
| 2003 | South Slough | Charleston Boat Basin | Hydrozoa | Obelia | longissima | 2 | no |
| 2003 | South Slough | Charleston Boat Basin | Tunicata | Botrylloides | violaceus | 4 | yes |
| 2003 | South Slough | Charleston Boat Basin | Tunicata | Botryllus | schlosseri | 3 | yes |
| 2003 | South Slough | Charleston Boat Basin | Tunicata | Distaplia | occidentalis | 5 | no |
| 2003 | South Slough | Charleston Boat Basin | Tunicata | Molgula | pugetiensis | 1 | no |
| 2003 | South Slough | Charleston Boat Basin | Tunicata | Molgula | sp. | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Cirripedia | Balanus | balanus | 2 | no |
| 2004 | South Slough | Charleston Bridge, float | Cirripedia | Balanus | crenatus | 7 | no |
| 2004 | South Slough | Charleston Bridge, float | Cirripedia | Balanus | sp. | 2 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Aequorea | sp. | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Calycella | syringa | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Campanulariidae | | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Campanulinidae | | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Obelia | dichotoma | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Obelia | longissima | 4 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Obelia | sp. | 1 | no |
| 2004 | South Slough | Charleston Bridge, float | Hydrozoa | Opercularella | lacerata | 2 | no |
| 2004 | South Slough | Charleston Bridge, float | Nudibranchia | Dendronotus | frondosus | 3 | no |
| 2003 | South Slough | Charleston Bridge, pier | Bryozoa | Alcyonidium | sp. | 1 | no |
| 2003 | South Slough | Charleston Bridge, pier | Bryozoa | Bowerbankia | aggregata | 1 | no |
| 2003 | South Slough | Charleston Bridge, pier | Bryozoa | Celleporella | hyalina | 1 | no |
| 2003 | South Slough | Charleston Bridge, pier | Cirripedia | Balanus | crenatus | 1 | no |
| 2003 | South Slough | Charleston Bridge, pier | Hydrozoa | Obelia | longissima | 1 | no |
| 2003 | South Slough | Charleston Bridge, pier | Hydrozoa | Obelia | sp. | 1 | no |
| 2003 | South Slough | Charleston Bridge, pier | Nudibranchia | Hermissenda | crassicornis | 1 | no |
| 2004 | South Slough | Coast Guard Beach | Cirripedia | Balanus | crenatus | 9 | no |
| 2004 | South Slough | Coast Guard Beach | Cirripedia | Balanus | sp. | 7 | no |

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|---|---|---|---|---|---|---|---|---|
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Campanulariidae | | 4 | | no |
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Campanulinidae | | 2 | | no |
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Clytia | hemisphaerica | 3 | | no |
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Clytia | sp. | 2 | | no |
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Obelia | longissima | 1 | | no |
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Obelia | sp. | 3 | | no |
| 2004 | South Slough | Coast Guard Beach | Hydrozoa | Thecata | | 1 | | no |
| 2004 | South Slough | Coast Guard Beach | Nudibranchia | Dendronotus | frondosus | 4 | | no |
| 2004 | South Slough | Coast Guard Beach | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2004 | South Slough | Coast Guard Beach | Nudibranchia | Janolus | fuscus | 1 | | no |
| 2004 | South Slough | Coast Guard Beach | Nudibranchia | Onchidoris | bilamellata | 4 | | no |
| 2004 | South Slough | Coast Guard Beach | Nudibranchia | Palio | zosterae | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Alcyonidium | sp. | 4 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Bowerbankia | aggregata | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Bowerbankia | sp. | 4 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Callopora | sp. | 2 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Caulibugula | ciliata | 4 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Celleporella | hyalina | 6 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Cheilopora | praelonga | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Cheilostomata | | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Conopeum | osburni | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Conopeum | seurati | 4 | | yes |
| 2003 | South Slough | Empire Pier | Bryozoa | Conopeum | tenuissimum | 1 | | yes |
| 2003 | South Slough | Empire Pier | Bryozoa | Cribrilina | sp. | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Cribrilina | sp. 1 | 3 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Crisia | sp. | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Dendrobeania | lichenoides | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Electra | sp. A | 1 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Microporella | californica | 5 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Parasmittina | sp. | 2 | | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Parasmittina | trispinosa | 1 | ? | no |
| 2003 | South Slough | Empire Pier | Bryozoa | Schizoporella | unicornis | 1 | | yes |
| 2003 | South Slough | Empire Pier | Bryozoa | Scruparia | sp. | 1 | | no |
| 2004 | South Slough | Empire Pier | Cirripedia | Balanus | crenatus | 2 | | no |
| 2003 | South Slough | Empire Pier | Cirripedia | Balanus | crenatus | 5 | | no |
| 2003 | South Slough | Empire Pier | Cirripedia | Balanus | glandula | 2 | ? | no |
| 2003 | South Slough | Empire Pier | Cirripedia | Balanus | improvisus | 1 | | yes |
| 2004 | South Slough | Empire Pier | Hydrozoa | Clytia | hemisphaerica | 2 | | no |
| 2004 | South Slough | Empire Pier | Hydrozoa | Clytia | sp. | 1 | | no |
| 2004 | South Slough | Empire Pier | Hydrozoa | Obelia | longissima | 2 | | no |
| 2004 | South Slough | Empire Pier | Hydrozoa | Opercularella | lacerata | 1 | | no |
| 2004 | South Slough | Empire Pier | Hydrozoa | Thecata | | 1 | | no |
| 2003 | South Slough | Empire Pier | Hydrozoa | Tubulariidae | | 2 | | no |

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|---|---|---|---|---|---|---|---|
| 2004 | South Slough | Empire Pier | Nudibranchia | Hermissenda | crassicornis | 1 | no |
| 2003 | South Slough | Empire Pier | Tunicata | Botrylloides | violaceus | 1 | yes |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Cirripedia | Balanus | improvisus | 5 | yes |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Cirripedia | Balanus | sp. | 1 | no |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Hydrozoa | Campanulariidae | | 1 | no |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Hydrozoa | Ectopleura | crocea | 2 | yes |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Hydrozoa | Ectopleura | dumortierii | 2 | yes |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Hydrozoa | Tubularia | sp. | 1 | no |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Hydrozoa | Tubulariidae | | 1 | no |
| 2004 | South Slough | Port of Coos Bay Citrus Dock | Tunicata | Botrylloides | violaceus | 1 | yes |
| 2003 | South Slough | Sengstacken Arm | Bryozoa | Bowerbankia | aggregata | 4 | no |
| 2003 | South Slough | Sengstacken Arm | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | South Slough | Sengstacken Arm | Cirripedia | Balanus | crenatus | 5 | no |
| 2003 | South Slough | Sengstacken Arm | Cirripedia | Balanus | glandula | 5 | no |
| 2003 | South Slough | Sengstacken Arm | Cirripedia | Balanus | improvisus | 2 | yes |
| 2003 | South Slough | Sengstacken Arm | Hydrozoa | Clytia | hemisphaerica | 1 | no |
| 2003 | South Slough | Sengstacken Arm | Hydrozoa | Laomedea | sp. | 1 | no |
| 2003 | South Slough | Sengstacken Arm | Hydrozoa | Obelia | longissima | 1 | no |
| 2003 | South Slough | Sengstacken Arm | Hydrozoa | Opercularella | sp. | 1 | no |
| 2003 | South Slough | Sengstacken Arm | Nudibranchia | Stiliger | sp. | 1 | no |
| 2003 | South Slough | Sengstacken YSI | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | South Slough | Sengstacken YSI | Cirripedia | Balanus | glandula | 1 | no |
| 2003 | South Slough | Sengstacken YSI | Cirripedia | Balanus | improvisus | 1 | yes |
| 2003 | South Slough | Valino Is YSI | Bryozoa | Alcyonidium | sp. | 1 | no |
| 2003 | South Slough | Valino Is YSI | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | South Slough | Valino Is YSI | Bryozoa | Bugula | pacifica | 1 | no |
| 2003 | South Slough | Valino Is YSI | Bryozoa | Celleporella | hyalina | 1 | no |
| 2003 | South Slough | Valino Is YSI | Bryozoa | Schizoporella | unicornis | 1 | yes |
| 2003 | South Slough | Valino Is YSI | Bryozoa | Smittoidea | prolifica | 1 | no |
| 2004 | South Slough | Valino Is/ Crown Pt | Cirripedia | Balanus | crenatus | 7 | no |
| 2003 | South Slough | Valino Is YSI | Cirripedia | Balanus | glandula | 1 | no |
| 2004 | South Slough | Valino Is/ Crown Pt | Cirripedia | Balanus | improvisus | 1 | yes |
| 2004 | South Slough | Valino Is/ Crown Pt | Cirripedia | Balanus | sp. | 4 | no |
| 2003 | South Slough | Valino Is YSI | Hydrozoa | Obelia | longissima | 1 | no |
| 2003 | South Slough | Valino Is YSI | Tunicata | Botrylloides | violaceus | 1 | yes |
| 2003 | South Slough | Winchester Arm | Bryozoa | Bowerbankia | aggregata | 4 | no |
| 2003 | South Slough | Winchester Arm | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | South Slough | Winchester Arm | Bryozoa | Celleporella | hyalina | 1 | no |
| 2003 | South Slough | Winchester Arm | Bryozoa | Electra | sp. A | 1 | no |
| 2003 | South Slough | Winchester Arm | Cirripedia | Balanus | crenatus | 5 | no |
| 2003 | South Slough | Winchester Arm | Cirripedia | Balanus | glandula | 5 | no |
| 2003 | South Slough | Winchester Arm | Hydrozoa | Campanulariidae | | 1 | no |
| 2003 | South Slough | Winchester Arm | Hydrozoa | Obelia | longissima | 4 | no |

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|---|---|---|---|---|---|---|---|---|
| 2003 | South Slough | Winchester Arm | Nudibranchia | Dendronotus | frondosus | 3 | | no |
| 2003 | South Slough | Winchester Arm | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2003 | South Slough | Winchester YSI | Bryozoa | Bowerbankia | aggregata | 1 | | no |
| 2004 | South Slough | Winchester YSI | Cirripedia | Balanus | crenatus | 4 | | no |
| 2003 | South Slough | Winchester YSI | Cirripedia | Balanus | glandula | 1 | | no |
| 2004 | South Slough | Winchester YSI | Cirripedia | Balanus | improvisus | 6 | | yes |
| 2003 | South Slough | Winchester YSI | Cirripedia | Balanus | improvisus | 1 | | yes |
| 2004 | South Slough | Winchester YSI | Cirripedia | Balanus | sp. | 2 | | no |
| 2003 | South Slough | Winchester YSI | Hydrozoa | Campanulariidae | | 1 | | no |
| 2004 | South Slough | Winchester YSI | Hydrozoa | Perigonimus | repens | 10 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Cirripedia | Balanus | crenatus | 6 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Cirripedia | Balanus | glandula | 6 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Cirripedia | Balanus | improvisus | 1 | | yes |
| 2003 | Olympic Coast | La Push, Quileute River | Hydrozoa | Campanulariidae | | 5 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Hydrozoa | Eudendrium | sp. | 2 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Hydrozoa | Obelia | sp. | 1 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Hydrozoa | Perigonimus | repens | 2 | | no |
| 2003 | Olympic Coast | La Push, Quileute River | Tunicata | Perophora | annectens | 1 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Bryozoa | Alcyonidium | sp. | 2 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Bryozoa | Bugula | pacifica | 6 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Bryozoa | Bugula | sp. | 2 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Bryozoa | Celleporella | hyalina | 6 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Bryozoa | Cribrilina | corbicula | 4 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Cirripedia | Balanus | crenatus | 3 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Hydrozoa | Calycella | syringa | 1 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Hydrozoa | Campanulariidae | | 2 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Hydrozoa | Campanulinidae | | 1 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Hydrozoa | Obelia | dichotoma | 1 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Hydrozoa | Obelia | longissima | 2 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Botrylloides | violaceus | 3 | | yes |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Botryllus | schlosseri | 2 | | yes |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Corella | inflata | 3 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Corella | sp. | 1 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Corella | willmeriana | 2 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Diplosoma | listerianum | 6 | | yes |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Distaplia | occidentalis | 5 | | no |
| 2003 | Olympic Coast | Neah Bay, Makah Marina | Tunicata | Styela | sp. | 1 | | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Bryozoa | Bowerbankia | sp. | 1 | | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Bryozoa | Callopora | sp. 1 | 1 | | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Bryozoa | Celleporella | hyalina | 1 | | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Bryozoa | Crisia | occidentalis | 1 | | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Bryozoa | Tricellaria | occidentalis | 1 | | no |

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|---|---|---|---|---|---|---|---|
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Cirripedia | Balanus | balanus | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Cirripedia | Balanus | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Hydrozoa | Aequorea | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Hydrozoa | Campanulariidae | | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Hydrozoa | Clytia | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Hydrozoa | Plumularia | lagenifera | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Hydrozoa | Plumularia | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Nudibranchia | Dendronotus | frondosus | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Nudibranchia | Doto | kya | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Nudibranchia | Eubranchus | rustyus | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Nudibranchia | Hermissenda | crassicornis | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Tunicata | Stolidobranchia | | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Cape Alava | Tunicata | Styela | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Cirripedia | Balanus | crenatus | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Cirripedia | Balanus | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Hydrozoa | Obelia | longissima | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Hydrozoa | Obelia | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Nudibranchia | Dendronotus | frondosus | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Nudibranchia | Hermissenda | crassicornis | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Kalalock | Tunicata | Styela | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Bryozoa | Callopora | sp. 1 | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Bryozoa | Celleporella | hyalina | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Bryozoa | Crisia | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Cirripedia | Balanus | balanus | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Cirripedia | Balanus | crenatus | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Hydrozoa | Campanulariidae | | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Hydrozoa | Clytia | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Hydrozoa | Plumularia | lagenifera | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Nudibranchia | Dendronotus | frondosus | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Nudibranchia | Doto | kya | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Nudibranchia | Eubranchus | rustyus | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Nudibranchia | Hermissenda | crassicornis | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Makah Bay | Tunicata | Styela | sp. | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Bryozoa | Alcyonidium | sp. | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Bryozoa | Celleporella | hyalina | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Bryozoa | Crisia | occidentalis | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Bryozoa | Filicrisia | franciscana | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Bryozoa | Parasmittina | trispinosa | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Bryozoa | Tricellaria | ternata | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Cirripedia | Balanus | crenatus | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Hydrozoa | Obelia | sp. | 2 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Hydrozoa | Plumularia | lagenifera | 1 | no |
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Nudibranchia | Hermissenda | crassicornis | 1 | no |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2004 | Olympic Coast | Outer Coast, Teawhit Head | Tunicata | Styela | sp. | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Bowerbankia | sp. | 2 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Bugula | pacifica | 3 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Bugula | sp. | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Cribrilina | corbicula | 4 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Cryptosula | pallasiana | 2 | | yes |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Membranipora | villosa | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Bryozoa | Schizoporella | unicornis | 3 | | yes |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Cirripedia | Balanus | crenatus | 4 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Cirripedia | Balanus | glandula | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Hydrozoa | Clytia | sp. | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Hydrozoa | Obelia | longissima | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Tunicata | Botrylloides | sp. | 1 | was labeled diegensis | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Tunicata | Botrylloides | violaceus | 3 | | yes |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Tunicata | Botryllus | schlosseri | 1 | | yes |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Tunicata | Corella | inflata | 1 | | no |
| 2003 | Padilla Bay | Anacortes, Cap Sante | Tunicata | Corella | willmeriana | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Bryozoa | Bugula | pacifica | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Bryozoa | Celleporella | hyalina | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Bryozoa | Cribrilina | corbicula | 2 | | no |
| 2003 | Padilla Bay | Bayview Channel | Bryozoa | Schizoporella | sp. | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Bryozoa | Schizoporella | unicornis | 1 | | yes |
| 2003 | Padilla Bay | Bayview Channel | Bryozoa | Tubulipora | tuba | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Cirripedia | Balanus | crenatus | 3 | | no |
| 2003 | Padilla Bay | Bayview Channel | Cirripedia | Balanus | improvisus | 1 | | yes |
| 2003 | Padilla Bay | Bayview Channel | Hydrozoa | Campanulariidae | | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Hydrozoa | Clytia | hemisphaerica | 2 | | no |
| 2003 | Padilla Bay | Bayview Channel | Hydrozoa | Obelia | longissima | 4 | | no |
| 2003 | Padilla Bay | Bayview Channel | Hydrozoa | Obelia | sp. | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Nudibranchia | Hermissenda | crassicornis | 1 | | no |
| 2003 | Padilla Bay | Bayview Channel | Tunicata | Styela | sp. | 1 | | no |
| 2003 | Padilla Bay | Gong | Bryozoa | Membranipora | villosa | 1 | | no |
| 2003 | Padilla Bay | Gong | Cirripedia | Balanus | crenatus | 1 | | no |
| 2003 | Padilla Bay | Gong | Hydrozoa | Campanulariidae | | 1 | | no |
| 2003 | Padilla Bay | Gong | Hydrozoa | Clytia | hemisphaerica | 1 | | no |
| 2003 | Padilla Bay | Gong | Hydrozoa | Obelia | longissima | 2 | | no |
| 2003 | Padilla Bay | Gong | Nudibranchia | Cumanotus | sp. | 1 | | no |
| 2003 | Padilla Bay | Gong | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2003 | Padilla Bay | Gong | Nudibranchia | Eubranchus | rupium | 1 | | no |
| 2003 | Padilla Bay | Joe Leary, Fresh | Hydrozoa | Eudendrium | sp. | 1 | | no |
| 2003 | Padilla Bay | Joe Leary, Marine | Bryozoa | Bowerbankia | sp. | 1 | | no |
| 2003 | Padilla Bay | Joe Leary, Marine | Hydrozoa | Eudendrium | sp. | 1 | | no |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2003 | Padilla Bay | La Conner Marina | Bryozoa | Bowerbankia | sp. | 6 | no |
| 2003 | Padilla Bay | La Conner Marina | Bryozoa | Celleporella | hyalina | 5 | no |
| 2003 | Padilla Bay | La Conner Marina | Bryozoa | Schizoporella | unicornis | 1 | yes |
| 2003 | Padilla Bay | La Conner Marina | Cirripedia | Balanus | crenatus | 6 | no |
| 2003 | Padilla Bay | La Conner Marina | Cirripedia | Balanus | glandula | 2 | no |
| 2003 | Padilla Bay | La Conner Marina | Hydrozoa | Campanulariidae | | 4 | no |
| 2003 | Padilla Bay | La Conner Marina | Hydrozoa | Gonothyraea | sp. | 1 | no |
| 2003 | Padilla Bay | La Conner Marina | Hydrozoa | Laomedea | sp. | 1 | no |
| 2003 | Padilla Bay | La Conner Marina | Hydrozoa | Obelia | longissima | 1 | no |
| 2003 | Padilla Bay | La Conner Marina | Tunicata | Molgula | manhattensis | 2 | yes |
| 2003 | Padilla Bay | Ploug Channel | Bryozoa | Cribrilina | corbicula | 2 | no |
| 2003 | Padilla Bay | Ploug Channel | Bryozoa | Schizoporella | unicornis | 4 | yes |
| 2003 | Padilla Bay | Ploug Channel | Cirripedia | Balanus | crenatus | 6 | no |
| 2003 | Padilla Bay | Ploug Channel | Hydrozoa | Clytia | hemisphaerica | 1 | no |
| 2003 | Padilla Bay | Ploug Channel | Hydrozoa | Clytia | sp. | 2 | no |
| 2003 | Padilla Bay | Ploug Channel | Hydrozoa | Obelia | longissima | 5 | no |
| 2003 | Padilla Bay | Ploug Channel | Hydrozoa | Obelia | sp. | 1 | no |
| 2003 | Padilla Bay | Ploug Channel | Nudibranchia | Eubranchus | rupium | 2 | no |
| 2003 | Kachemak Bay | Bear Point | Cirripedia | Balanus | crenatus | 1 | no |
| 2003 | Kachemak Bay | Bear Point | Cirripedia | Balanus | glandula | 1 | no |
| 2003 | Kachemak Bay | Bear Point | Hydrozoa | Obelia | longissima | 2 | no |
| 2003 | Kachemak Bay | Bear Point | Nudibranchia | Dendronotus | frondosus | 1 | no |
| 2003 | Kachemak Bay | Bear Point | Nudibranchia | Eubranchus | rupium | 1 | no |
| 2003 | Kachemak Bay | Bear Point | Nudibranchia | Flabellina | japonica | 1 | no |
| 2003 | Kachemak Bay | Homer Dolphin | Bryozoa | Bowerbankia | sp. | 1 | no |
| 2003 | Kachemak Bay | Homer Dolphin | Bryozoa | Callopora | craticula | 1 | no |
| 2003 | Kachemak Bay | Homer Dolphin | Bryozoa | Tegella | armifera | 1 | no |
| 2004 | Kachemak Bay | Homer Dolphin | Cirripedia | Balanidae | | 1 | no |
| 2004 | Kachemak Bay | Homer Dolphin | Cirripedia | Balanus | crenatus | 1 | no |
| 2003 | Kachemak Bay | Homer Dolphin | Cirripedia | Balanus | crenatus | 1 | no |
| 2003 | Kachemak Bay | Homer Dolphin | Cirripedia | Balanus | glandula | 1 | no |
| 2004 | Kachemak Bay | Homer Dolphin | Hydrozoa | Campanulariidae | | 1 | no |
| 2003 | Kachemak Bay | Homer Dolphin | Hydrozoa | Obelia | dichotoma | 1 | no |
| 2004 | Kachemak Bay | Homer Dolphin | Hydrozoa | Obelia | longissima | 1 | no |
| 2004 | Kachemak Bay | Homer Dolphin | Hydrozoa | Sarsia | tubulosa | 1 | no |
| 2004 | Kachemak Bay | Homer Dolphin | Nudibranchia | Cuthona | concinna | 1 | no |
| 2003 | Kachemak Bay | Homer Harbor | Bryozoa | Bowerbankia | sp. | 3 | no |
| 2003 | Kachemak Bay | Homer Harbor | Bryozoa | Bugula | pacifica | 1 | no |
| 2003 | Kachemak Bay | Homer Harbor | Bryozoa | Celleporella | hyalina | 5 | no |
| 2003 | Kachemak Bay | Homer Harbor | Bryozoa | Cribrilina | annulata | 1 | no |
| 2003 | Kachemak Bay | Homer Harbor | Bryozoa | Tegella | aquilirostris | 3 | no |
| 2003 | Kachemak Bay | Homer Harbor | Bryozoa | Tegella | armifera | 1 | no |
| 2004 | Kachemak Bay | Homer Harbor | Cirripedia | Balanus | crenatus | 3 | no |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2003 | Kachemak Bay | Homer Harbor | Cirripedia | Balanus | crenatus | 1 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Cirripedia | Balanus | glandula | 3 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Hydrozoa | Calycella | syringa | 1 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Hydrozoa | Campanulariidae | | 1 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Hydrozoa | Clytia | sp. | 1 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Hydrozoa | Corynidae | | 1 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Hydrozoa | Cuspidella | sp. | 1 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Hydrozoa | Gonothyraea | clarki | 3 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Hydrozoa | Gonothyraea | sp. | 2 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Hydrozoa | Obelia | longissima | 3 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Hydrozoa | Obelia | longissima | 2 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Hydrozoa | Obelia | sp. | 2 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Hydrozoa | Opercularella | lacerata | 1 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Nudibranchia | Cuthona | concinna | 1 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Nudibranchia | Cuthona | pustulata | 1 | | no |
| 2004 | Kachemak Bay | Homer Harbor | Tunicata | Distaplia | occidentalis | 5 | ID not verified | no |
| 2003 | Kachemak Bay | Homer Harbor | Tunicata | Distaplia | occidentalis | 4 | | no |
| 2003 | Kachemak Bay | Homer Harbor | Tunicata | Molgula | sp. | 1 | | no |
| 2003 | Kachemak Bay | Homer piling | Bryozoa | Alcyonidium | sp. | 2 | | no |
| 2003 | Kachemak Bay | Homer piling | Bryozoa | Callopora | sp. | 1 | | no |
| 2003 | Kachemak Bay | Homer piling | Bryozoa | Celleporella | hyalina | 2 | | no |
| 2003 | Kachemak Bay | Homer piling | Bryozoa | Cribrilina | corbicula | 1 | | no |
| 2003 | Kachemak Bay | Homer piling | Cirripedia | Balanus | crenatus | 2 | | no |
| 2003 | Kachemak Bay | Homer piling | Cirripedia | Balanus | glandula | 1 | | no |
| 2003 | Kachemak Bay | Homer piling | Hydrozoa | Gonothyraea | clarki | 3 | | no |
| 2003 | Kachemak Bay | Port Graham | Bryozoa | Celleporella | hyalina | 1 | | no |
| 2003 | Kachemak Bay | Port Graham | Hydrozoa | Campanulariidae | | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Bryozoa | Bowerbankia | sp. | 5 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Bryozoa | Bugula | pacifica | 3 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Bryozoa | Celleporella | hyalina | 6 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Bryozoa | Cribrilina | corbicula | 2 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Bryozoa | Tegella | aquilirostris | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Bryozoa | Tegella | armifera | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Cirripedia | Balanidae | | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Cirripedia | Balanus | crenatus | 4 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Cirripedia | Balanus | crenatus | 4 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Athecata | | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Calycella | syringa | 2 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Campanulariidae | | 2 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Campanulariidae | | 2 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Campanulinidae | | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Clytia | sp. | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Obelia | longissima | 5 | | no |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2003 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Obelia | longissima | 6 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Obelia | sp. | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Hydrozoa | Opercularella | lacerata | 4 | | no |
| 2004 | Kachemak Bay | Seldovia Harbor | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Tunicata | Ascidia | sp. | 2 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Tunicata | Distaplia | occidentalis | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Tunicata | Distaplia | sp. | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Tunicata | Molgula | pugetiensis | 2 | | no |
| 2003 | Kachemak Bay | Seldovia Harbor | Tunicata | Molgula | sp. | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Bryozoa | Callopora | craticula | 2 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Bryozoa | Celleporella | hyalina | 2 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Bryozoa | Lichenopora | verrucaria | 1 | ID not verified | no |
| 2004 | Kachemak Bay | Seldovia Pier | Bryozoa | Reterporidae | sp. | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Bryozoa | Tegella | aquilirostris | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Bryozoa | Tegella | armifera | 2 | | no |
| 2004 | Kachemak Bay | Seldovia Pier | Cirripedia | Balanidae | | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Pier | Cirripedia | Balanus | crenatus | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Cirripedia | Balanus | crenatus | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Hydrozoa | Obelia | dichotoma | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Pier | Hydrozoa | Obelia | longissima | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Hydrozoa | Obelia | longissima | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Pier | Nudibranchia | Cuthona | pustulata | 1 | | no |
| 2004 | Kachemak Bay | Seldovia Pier | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2003 | Kachemak Bay | Seldovia Pier | Nudibranchia | Dendronotus | frondosus | 1 | | no |
| 2003 | Kachemak Bay | Seldovia piling | Cirripedia | Balanus | crenatus | 2 | | no |
| 2003 | Kachemak Bay | Seldovia piling | Cirripedia | Balanus | glandula | 1 | | no |

**Appendix D. Nonindigenous fouling species found in this and other surveys. Note, NIS are listed for all sites combined and per site.**
**Overall Species List**

| Broad Taxa Group | Phylum | Species | Common Name | In or Near | Seen in SERC NERRS Survey? | Notes |
|---|---|---|---|---|---|---|
| Invertebrate | Chordata (Urochordata) | *Ascidia sp.A* | solitary tunicate | Tijuana River, Channel Islands | Yes | |
| Invertebrate | Chordata (Urochordata) | *Ascidia zara* | solitary tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay | Yes | |
| Invertebrate | Mollusca (Gastropoda) | *Babakina festiva* | nudibranch | Tijuana River | No | |
| Invertebrate | Crustacea (Cirripedia) | *Balanus amphitrite* | Striped Barnacle | Tijuana River, Channel Islands | Yes | |
| Invertebrate | Crustacea (Cirripedia) | *Balanus improvisus* | Bay Barnacle | Tijuana River, Elkhorn Slough/Monterey Bay; South Slough; Olympic Coast; Padilla Bay | Yes | |
| Invertebrate | Crustacea (Cirripedia) | *Balanus reticulatus* | barnacle | Tijuana River | Yes | |
| Invertebrate | Entoprocta (Kamptozoa) | *Barentsia benedeni* | kamptozoan | Elkhorn Slough/Monterey Bay; South Slough; Padilla Bay | No | |
| Invertebrate | Cnidaria (Hydrozoa) | *Blackfordia virginica* | hydroid and medusa | South Slough | No | |
| Invertebrate | Chordata (Urochordata) | *Botrylloides perspicuum* | colonial tunicate | Tijuana River | Yes | |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Olympic Coast; Padilla Bay; Kachemak Bay | Yes | |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Olympic Coast; Padilla Bay | Yes | |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula "neritina"* | bryozoan | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough | Yes | |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula fulva (flabellata?)* | bryozoan | Channel Islands; Elkhorn Slough/Monterey Bay | Yes | |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula sp. 1* | bryozoan | Padilla Bay | No | |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula sp. 2* | bryozoan | Padilla Bay | No | |

| | | | | | |
|---|---|---|---|---|---|
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula stolonifera* | bryozoan | Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; Padilla Bay | Yes |
| Invertebrate | Crustacea (Decapoda) | *Carcinus maenas* | Green Crab | Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough | Yes |
| Invertebrate | Mollusca (Gastropoda) | *Catriona rickettsi* | nudibranch | Tijuana River, | No |
| Invertebrate | Chordata (Urochordata) | *Ciona intestinalis* | solitary tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon | Yes |
| Invertebrate | Chordata (Urochordata) | *Ciona savignyi* | solitary tunicate | Elkhorn Slough/Monterey Bay; Gulf of Farallon; Padilla Bay | Yes |
| Invertebrate | Porifera | *Cliona sp.* | Boring sponge | Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Padilla Bay; Kachemak Bay | No |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum seurati?* | bryozoan | Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough | Yes |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum tenuissimum* | bryozoan | Elkhorn Slough/Monterey Bay; South Slough | Yes |
| Invertebrate | Cnidaria (Hydrozoa) | *Cordylophora caspia* | Freshwater Hydroid | South Slough; Padilla Bay | No |
| Invertebrate | Ectoprocta (Bryozoa) | *Cryptosula pallasiana* | bryozoan | Tijuana River, Elkhorn Slough/Monterey Bay; South Slough; Padilla Bay | Yes |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene franciscana* | San Francisco Anemone | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon | No |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene leucolena* | Ghost Anemone | Elkhorn Slough; South Slough | No |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene lineata* | Striped Anemone | Tijuana River, Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Padilla Bay | No |
| Invertebrate | Chordata (Urochordata) | *Didemnum sp. A* | colonial tunicate | Elkhorn Slough/Monterey Bay; Gulf of Farallon; Padilla Bay | Yes |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Olympic Coast; Padilla Bay | Yes |
| Invertebrate | Cnidaria (Hydrozoa) | *Ectopleura crocea* | hydroid | Tijuana River, Elkhorn Slough/Monterey Bay;South Slough | Yes |
| Invertebrate | Annelida (Polychaeta) | *Ficopomatus enigmaticus* | tubeworm | , Elkhorn Slough/Monterey Bay | Yes |
| Invertebrate | Cnidaria (Hydrozoa) | *Garveia franciscana* | hydroid | Tijuana River; Kachemak Bay | No |
| Invertebrate | Porifera | *Halichondria bowerbankii* | sponge | Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; | No |

| | | | | | |
|---|---|---|---|---|---|
| Invertebrate | Porifera | *Haliclona loosanoffi* | sponge | Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Padilla Bay | No |
| Invertebrate | Annelida (Polychaeta) | *Hydroides diramphus* | tubewrom | Tijuana River | No |
| Invertebrate | Annelida (Polychaeta) | *Hydroides elegans* | tubeworm | Tijuana River, Channel Islands | Yes |
| Invertebrate | Porifera | *Hymeniacidon sp.* | sponge | Elkhorn Slough | No |
| Invertebrate | Chordata (Urochordata) | *Microcosmus squamiger* | colonial tunicate | Tijuana River, Channel Islands | Yes |
| Invertebrate | Chordata (Urochordata) | *Molgula manhattensis* | solitary tunicate | Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Padilla Bay | Yes |
| Invertebrate | Chordata (Urochordata) | *Molgula sp. A* | colonial tunicate | Tijuana River | Yes |
| Invertebrate | Cnidaria (Scyphozoa) | *Phyllorhiza punctata* | Australian Spotted Jellyfish and polyp | Tijuana River | No |
| Invertebrate | Chordata (Urochordata) | *Polyandrocarpa zorritensis* | colonial tunicate | Tijuana River | Yes |
| Invertebrate | Ectoprocta (Bryozoa) | *Schizoporella unicornis?* | bryozoan | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Padilla Bay; Kachemak Bay | Yes |
| Invertebrate | Chordata (Urochordata) | *Styela canopus* | solitary tunicate | Tijuana River | No |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough; Padilla Bay | Yes |
| Invertebrate | Chordata (Urochordata) | *Styela plicata* | solitary tunicate | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay | Yes |
| Invertebrate | Chordata (Urochordata) | *Symplegma reptans* | solitary tunicate | Elkhorn Slough/Monterey Bay; South Slough | Yes |
| Invertebrate | Mollusca (Gastropoda) | *Tenellia adspersa* | nudibranch | Elkhorn Slough; Monterey Bay | Yes |
| Invertebrate | Ectoprocta (Bryozoa) | *Victorella "pavida"* | | Tijuana River, Elkhorn Slough/Monterey Bay | Yes |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora arcuata* | bryozoan | Tijuana River, Channel Islands | Yes |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora subtorquata* | bryozoan | Tijuana River, Channel Islands; Elkhorn Slough/Monterey Bay; Gulf of Farallon; South Slough | Yes |

| | | | | | | |
|---|---|---|---|---|---|---|
| Invertebrate | Cnidaria (Hydrozoa) | *Zanclea costata* | hydroid & medusa | Gulf of Farallon | No | in Carlton 1979, could change to cryptogenic, regarded as "circumglobal" but hydroid found on bivalves |
| Invertebrate | Ectoprocta (Bryozoa) | *Zoobotryon verticillatum* | bryozoan | Tijuana River | Yes | |

**Appendix D continued, Tijuana River**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge proper? |
|---|---|---|---|---|
| Invertebrate | Ectoprocta (Bryozoa) | *Victorella "pavida"* | | Yes (Tijuana River, Model Marsh) |
| Invertebrate | Chordata (Urochordata) | *Ascidia sp.A* | solitary tunicate | No |
| Invertebrate | Chordata (Urochordata) | *Ascidia zara* | solitary tunicate | No |
| Invertebrate | Mollusca (Gastropoda) | *Babakina festiva* | nudibranch | ? |
| Invertebrate | Crustacea (Cirripedia) | *Balanus amphitrite* | Striped Barnacle | Yes (Model Marsh; Oneonta Slough) |
| Invertebrate | Crustacea (Cirripedia) | *Balanus improvisus* | Bay Barnacle | Yes (Oneonta Slough) |
| Invertebrate | Crustacea (Cirripedia) | *Balanus reticulatus* | | No |
| Invertebrate | Chordata (Urochordata) | *Botrylloides perspicuum* | colonial tunicate | |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | No |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | No |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula "neritina"* | bryozoan | No |
| Invertebrate | Mollusca (Gastropoda) | *Catriona rickettsi* | nudibranch | ? |
| Invertebrate | Chordata (Urochordata) | *Ciona intestinalis* | solitary tunicate | No |
| Invertebrate | Chordata (Urochordata) | *Ciona savignyi* | solitary tunicate | No |
| Invertebrate | Ectoprocta (Bryozoa) | *Cryptosula pallasiana* | bryozoan | ? |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene franciscana* | San Francisco Anemone | ? |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene lineata* | Striped Anemone | ? |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | ? |
| Invertebrate | Cnidaria (Hydrozoa) | *Ectopleura crocea* | hydroid | ? |
| Invertebrate | Cnidaria (Hydrozoa) | *Garveia franciscana* | hydroid | ? |

| | | | | |
|---|---|---|---|---|
| Invertebrate | Annelida (Polychaeta) | *Hydroides diramphus* | tubewrom | ? |
| Invertebrate | Annelida (Polychaeta) | *Hydroides elegans* | tubeworm | ? |
| Invertebrate | Chordata (Urochordata) | *Microcosmus squamiger* | colonial tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Molgula sp. A* | colonial tunicate | ? |
| Invertebrate | Cnidaria (Scyphozoa) | *Phyllorhiza punctata* | Australian Spotted Jellyfish & polyp | ? |
| Invertebrate | Chordata (Urochordata) | *Poly&rocarpa zorritensis* | colonial tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Styela canopus* | solitary tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Styela plicata* | solitary tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Symplegma reptans* | solitary tunicate | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora arcuata* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora subtorquata* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Zoobotryon verticillatum* | bryozoan | ? |
| Invertebrate | Cnidaria (Anthozoa) | *Bunodeopsis sp.* | anemone | San Diego/Mission Bays |

| In Adjacent Area | Established? | References | Notes |
|---|---|---|---|
| No? | Yes | SERC | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| La Jolla/CA/Pacfic Ocean | Yes | Carlton 1979 | |
| La Jolla/CA/Pacific Ocean; San Diego/CA/San Diego Bay; San Diego/CA/Mission Bay | Yes | Carlton et al. 1969; Carlton 1979; Cohen & Carlton 1995; Cohen et al. 2002; SERC | |
| Yes- 1939, on buoy, San Diego Bay, single record | Unknown | Carlton 1979; SERC | |
| Sunroad Marina/CA/San Diego Bay | Unknown | SERC | |
| Yes | | | |
| San Diego-Mission Bays | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; Cohen et al. 2002; SERC | |
| La Jolla/CA/Pacfic Ocean | Yes | Cohen & Carlton 1995 | |
| San Diego-Mission Bays | Yes | Carlton 1979; Cohen et al. 2002; Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; Cohen et al. 2002; Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; Cohen & Carlton 1995; Cohen et al. 2000 | |
| San Diego-Mission Bays | Yes | Crooks 1998 | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; Crooks 1998; Ruiz et al., unpublished data | |
| San Diego Bay | Unknown | Ruiz et al., unpublished data | (1st records for San Diego Bay?. This is an unusual habitat for this low-salinity form. |

| | | | |
|---|---|---|---|
| San Diego-Mission Bays | Yes | Cohen et al. 2002; Ruiz et al., unpublished data | |
| San Diego-Mission Bays | Yes | Carlton 1979; Crooks 1998 | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003 | |
| San Diego-Mission Bays | Yes | SERC, Lambert, pers. comm. | |
| San Diego-Mission Bays | Yes | Larson & Arneson 1990 | |
| | | | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003 | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Lambert & Lambert 2003; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; SERC | |
| San Diego-Mission Bays | Yes | Crooks 1998; Cohen et al. 2002; SERC | |
| San Diego-Mission Bays | Yes | Carlton 1979; Crooks 1998; SERC | |
| Yes | Yes | Crooks 1998; Crooks, personal communication | Introduced or cryptogenic? |

**Appendix D continued, Channel Islands**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge? |
|---|---|---|---|---|
| Invertebrate | Chordata (Urochordata) | *Ascidia sp.A* | solitary tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Ascidia zara* | solitary tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Crustacea (Cirripedia) | *Balanus amphitrite* | Striped Barnacle | ? |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula "neritina"* | bryozoan | ? |
| | Ectoprocta (Bryozoa) | *Bugula fulva?* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula stolonifera* | bryozoan | ? |
| Invertebrate | Chordata (Urochordata) | *Ciona intestinalis* | solitary tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Chordata (Urochordata) | *Ciona savignyi* | solitary tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene franciscana* | San Francisco Anemone | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor) |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | ? |
| Invertebrate | Annelida (Polychaeta) | *Hydroides elegans* | tubeworm | ? |
| Invertebrate | Chordata (Urochordata) | *Microcosmus squamiger* | colonial tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Chordata (Urochordata) | *Molgula manhattensis* | solitary tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Chordata (Urochordata) | *Styela plicata* | solitary tunicate | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Chordata (Urochordata) | *Watersipora arcuata* | bryozoan | Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora subtorquata* | bryozoan | ? |

| In Adjacent Area | Established? | References |
|---|---|---|
| Ventura/CA, Port Hueneme/CA | Yes | Lambert & Lambert 2003; |
| Ventura/CA, Port Hueneme/CA; | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC |
| 'Ventura West harbor; | Yes | SERC |
| Ventura/CA, Port Hueneme/CA; Anacapa Island (Channel Islands)/CA/Anacapa Islands Harbor | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC |
| Ventura/CA, Port Hueneme/CA; | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC |
| Ventura West harbor; Vintage Marina, Oxnard Vintage Marina, Oxnard | Yes | SERC |
| Ventura West harbor; Vintage Marina, Oxnard | Yes | SERC |
| Ventura West harbor; Vintage Marina, Oxnard | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC |
| Vintage Marina, Oxnard | Yes | Cohen et al. 2002; Lambert & Lambert 2003; SERC |
| ? | Yes | Carlton 1979; Cohen & Carlton 1995; Cohen et al. 2000 |
| Ventura West harbor; Vintage Marina, Oxnard | Yes | SERC |
| 'Ventura West harbor; | Yes | Carlton 1979; SERC |
| Ventura/CA, Port Hueneme/CA; | | Lambert & Lambert 2003 |
| Ventura/CA | Yes | Lambert & Lambert 2003; SERC |
| Ventura West harbor; Vintage Marina, Oxnard; Port Hueneme/CA; | Yes | Lambert & Lambert 2003; SERC |
| Ventura West harbor; Vintage Marina, Oxnard; Port Hueneme/CA; | Yes | Lambert & Lambert 2003; SERC |
| Ventura West harbor; Vintage Marina, Oxnard; Port Hueneme/CA; | | Cohen et al. 2000; SERC |
| 'Ventura West harbor; Vintage Marina, Oxnard; | Yes | SERC |

**Appendix D continued, Elkhorn Slough and Monterey Bay**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge proper? |
|---|---|---|---|---|
| Invertebrate | Ectoprocta (Bryozoa) | *Victorella pavida* | bryozoan | Yes(Elkhorn Slough- Moss Landing, North; Kirby Park) |
| Invertebrate | Chordata | *Ascidia zara* | solitary tunicate | Elkhorn Slough |
| Invertebrate | Crustacea (Cirripedia) | *Balanus improvisus* | Bay Barnacle | Elkhorn Slough |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Monterey Bay, Elkhorn Slough; Monterey Marina/CA/Monterey Bay; Santa Cruz Harbor/CA/Monterey Bay |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | Elkhorn Slough; Monterey Marina/CA/Monterey Bay; Santa Cruz Harbor/CA/Monterey Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula "neritina"* | bryozoan | Elkhorn Slough; Monterey Marina/CA/Monterey Bay; Santa Cruz Harbor/CA/Monterey Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula fulva* | bryozoan | Monterey Marina/CA/Monterey Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula stolonifera* | bryozoan | Elkhorn Slough; Monterey Marina/CA/Monterey Bay; Santa Cruz Harbor/CA/Monterey Bay |
| Invertebrate | Crustacea (Decapoda) | *Carcinus maenas* | Green Crab | Monterey Bay, Elkhorn Slough |
| Invertebrate | Porifera | *Cliona sp.* | Boring sponge | Elkhorn Slough |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum seurati?* | bryozoan | Azevedo Pond; Hudson Landing West |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum tenuissimum* | bryozoan | Elkhorn Slough |
| Invertebrate | Ectoprocta (Bryozoa) | *Cryptosula pallasiana* | bryozoan | Elkhorn Slough; Monterey Bay |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene franciscana* | San Francisco Anemone | Elkhorn Slough |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene leucolena* | Ghost Anemone | Elkhorn Slough |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene lineata* | Striped Anemone | Elkhorn Slough |
| Invertebrate | Chordata (Urochordata) | *Didemnum sp.* | colonial tunicate | Elkhorn Slough |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | Elkhorn Slough; Monterey Bay |
| Invertebrate | Cnidaria (Hydrozoa) | *Ectopleura crocea* | hydroid | Elkhorn Slough |
| Invertebrate | Annelida (Polychaeta) | *Ficopomatus enigmaticus* | tubeworm | Elkhorn Slough |
| Invertebrate | Porifera | *Halichondria bowerbankii* | sponge | Elkhorn Slough |
| Invertebrate | Porifera | *Haliclona loosanoffi* | sponge | Elkhorn Slough; Monterey Bay |
| Invertebrate | Porifera | *Hymeniacidon sp.* | sponge | Elkhorn Slough |
| Invertebrate | Chordata (Urochordata) | *Molgula manhattensis* | solitary tunicate | Elkhorn Slough; Monterey Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Schizoporella unicornis?* | bryozoan | Elkhorn Slough; Monterey Bay |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | Elkhorn Slough; Monterey Bay |
| Invertebrate | Chordata (Urochordata) | *Styela plicata* | solitary tunicate | Elkhorn Slough |
| Invertebrate | Mollusca (Gastropoda) | *Tenellia adspersa* | nudibranch | Elkhorn Slough; Monterey Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora subtorquata* | bryozoan | Elkhorn Slough; Monterey Bay |

| In Adjacent Area | Established | References | Notes |
|---|---|---|---|
| ? | Yes | SERC | |
| ? | Yes | SERC | |
| Yes | Yes | Wasson et al. 2001; SERC | |
| ? | Yes | Wasson et al. 2001; SERC | |
| ? | Yes | Wasson et al. 2001; SERC | |
| | Yes | Wasson et al. 2001; SERC | |
| ? | Unknown | SERC | Uncertain ID- could be *flabellata?* |
| | | Wasson et al. 2001; SERC | |
| Yes | Yes | Grosholz & Ruiz 1995; Miller 1996; Ruiz et al. 1998 | |
| | Yes | Wasson et al. 2001 | |
| ? | Yes | SERC | Taxonomically difficult, but apparently introduced |
| ? | Yes | Wasson et al. 2001 | |
| Yes | Yes | Wasson et al. 2001; SERC | |
| ? | Yes | Wasson et al. 2001 | |
| ? | Yes | Wasson et al. 2001 | |
| ? | Yes | Carlton 1979; Wasson et al. 2001 | |
| ? | Yes | Lambert, pers. comm.; SERC | |
| Yes | Yes | SERC | |
| Yes | Yes | Carlton 1979; Wasson et al. 2001 | |
| ? | Yes | Wasson et al. 2001; SERC | |
| ? | Yes | Wasson et al. 2001 | |
| ? | Yes | Wasson et al. 2001 | |
| ? | Yes | Wasson et al. 2001 | |
| | Yes | Wasson et al. 2001; SERC | |
| Yes | Yes | Wasson et al. 2001; SERC | Identity of this species is unclear. |
| ? | Yes | Carlton 1979; Wasson et al. 2001; SERC | |
| ? | Yes | SERC | |
| ? | Yes | Carlton 1979; Wasson et al. 2001; SERC | |
| ? | Yes | Wasson et al. 2001; SERC | |

**Appendix D continued, Gulf of Farallones**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge? |
|---|---|---|---|---|
| Invertebrate | Chordata (Urochordata) | *Ascidia zara* | solitary tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula "neritina"* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula flabellata* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula stolonifera* | bryozoan | ? |
| Invertebrate | Crustacea (Decapoda) | *Carcinus maenas* | Green Crab | ? |
| Invertebrate | Chordata (Urochordata) | *Ciona intestinalis* | solitary tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Ciona savignyi* | solitary tunicate | ? |
| Invertebrate | Porifera | *Cliona sp.* | Boring sponge | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum seurati?* | bryozoan | ? |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene franciscana* | San Francisco Anemone | ? |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene lineata* | Striped Anemone | ? |
| Invertebrate | Chordata (Urochordata) | *Didemnum sp.* | colonial tunicate | ? |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | ? |
| Invertebrate | Porifera | *Halichondria bowerbankii* | sponge | ? |
| Invertebrate | Porifera | *Haliclona loosanoffi* | sponge | ? |
| Invertebrate | Chordata (Urochordata) | *Molgula manhattensis* | solitary tunicate | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Schizoporella unicornis?* | bryozoan | ? |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora subtorquata* | bryozoan | ? |
| Invertebrate | Cnidaria (Hydrozoa) | *Zanclea costata* | hydroid & medusa | ? |

| In Adjacent Area | Established | References | Notes |
|---|---|---|---|
| Tomales Bay; Bodega Bay; Mason's Marina/CA/Bodega Bay | Yes | Fairey et al. 2002; SERC | |
| Tomales Bay; Bodega Bay | Yes | Fairey et al. 2002; SERC | |
| Tomales Bay; Bodega Bay | Yes | Fairey et al. 2002; SERC | |
| Tomales Bay; Bodega Bay | Yes | Fairey et al. 2002; SERC | |
| | Yes | SERC | |
| Mason's marina/CA/Bodega Bay; Porto Bodega marina/CA/Bodega Bay | Yes | SERC | |
| Tomales Bay; Bodega Bay | Yes | Grosholz & Ruiz 1995; Miller 1996; Ruiz et al. 1998 | |
| Tomales Bay; Bodega Bay | Yes | Fairey et al. 2002; SERC | |
| Tomales Bay | Yes | Fairey et al. 2002; SERC | CHECK |
| Tomales Bay | Yes | Carlton 1979; Cohen & Carlton 1995 | |
| Mason's marina/CA/Bodega Bay; Porto Bodega marina/CA/Bodega Bay | Yes | SERC | Taxonomically difficult, but apparently introduced |
| Tomales Bay | Yes | Cohen & Carlton 1995 | |
| Tomales Bay; Bodega Bay | Yes | Carlton 1979; Wasson et al. 2001 | |
| Tomales Bay; Bodega Bay | Yes | Ruiz et al. unpublished; Lambert, pers. comm., SERC | |
| Tomales Bay; Bodega Bay | Yes | SERC | |
| Tomales Bay | Yes | Fairey et al. 2002 | |
| Tomales Bay | Yes | Fairey et al. 2002 | |
| Tomales Bay; Bodega Bay | Yes | SERC | |
| Tomales Bay; Bodega Bay | Yes | Carlton 1979; Fairey et al. 2002; SERC | Identity of this species is unclear. |
| Bodega Bay | Yes | Fairey et al. 2002 | |
| Tomales Bay; Bodega Bay | Yes | Cohen & Carlton 1995; SERC | |
| Bodega Bay | Yes | Carlton 1979 | |

**Appendix D continued, South Slough**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge? |
|---|---|---|---|---|
| Invertebrate | Crustacea (Cirripedia) | *Balanus improvisus* | Bay Barnacle | Coos Bay/OR/South Slough; Sengstocken Arm; Empire Boat Ramp; Charleston Boat Basin; Winchester; Port of Coos Bay; Citrus Dock; Valino Is; Crown Pt |
| Invertebrate | Entoprocta (Kamptozoa) | *Barentsia benedeni* | kamptozoan | ? |
| Invertebrate | Cnidaria (Hydrozoa) | *Blackfordia virginica* | hydroid and medusa | |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Coos Bay; Coos Bay/OR/South Slough; Empire Boat Ramp; Charleston Boat Basin/OR/South Slough; Valino Is/-Crown Pt |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | Coos Bay; Charleston Boat Basin/OR/South Slough |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula "neritina"* | bryozoan | ? |
| Invertebrate | Crustacea (Decapoda) | *Carcinus maenas* | Green Crab | Coos Bay |
| Invertebrate | Porifera | *Cliona sp.* | Boring sponge | Coos Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum seurati?* | bryozoan | Empire Boat Ramp; Charleston Boat Basin |
| Invertebrate | Ectoprocta (Bryozoa) | *Conopeum tenuissimum* | bryozoan | Coos Bay; 'Empire Boat Ramp |
| Invertebrate | Cnidaria (Hydrozoa) | *Cordylophora caspia* | Freshwater Hydroid | |
| Invertebrate | Ectoprocta (Bryozoa) | *Cryptosula pallasiana* | bryozoan | Charleston Boat Basin |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene leucolena* | Ghost Anemone | Coos Bay |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene lineata* | Striped Anemone | Coos Bay |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | Isthmus Slough (Coos Bay) |
| Invertebrate | Cnidaria (Hydrozoa) | *Ectopleura crocea* | hydroid | Coos Bay |
| Invertebrate | Porifera | *Halichondria bowerbankii* | sponge | Coos Bay |
| Invertebrate | Porifera | *Haliclona loosanoffi* | sponge | Coos Bay |
| Invertebrate | Chordata (Urochordata) | *Molgula manhattensis* | solitary tunicate | Isthmus Slough (Coos Bay) |
| Invertebrate | Ectoprocta (Bryozoa) | *Schizoporella unicornis?* | bryozoan | Coos Bay/OR/Charlestown Boat Basin |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | Coos Bay/OR/Inner Boat Basin |
| Invertebrate | Mollusca (Gastropoda) | *Tenellia adspersa* | nudibranch | Coos Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Watersipora subtorquata* | bryozoan | Coos Bay |

| In Adjacent Area | Established | References | Notes |
|---|---|---|---|
| Yes, OR/Coos Bay | Yes | Carlton 1979; Carlton 1989; Cohen & Carlton 1995; Wonham et al. 2005; SERC | |
| Yes, Coos Bay/OR/Isthmus Slough | Yes | Carlton 1989; Wasson 1997 | |
| Yes, Coos Bay/ OR/Isthmus Slough | Yes | Ruiz et al. 2000; Wonham et al. 2005 | |
| Yes | Yes | | |
| | | Hewitt et al. 1993; Ruiz et al. 2000, SERC; Carlton, unpublished data; | |
| Yes | Yes | Hewitt et al. 1993; Ruiz et al. 2000, SERC; Carlton, unpublished data; | |
| Coos Bay | Yes | Cohen & Carlton 1995; Carlton 1989; Carlton unpublished data | |
| Yes | Yes | Ruiz et al. 1998 | |
| Yes | | Carlton 1979; Cohen et al. 1998 | |
| ? | Yes | SERC | Taxonomically difficult, but apparently introduced |
| ? | Yes | Wasson et al. 2001 | |
| Coos Bay/OR/ Coos River | Yes | Ruiz et al. 2000; Carlton unpublished data | |
| Coos Bay | Yes | Ruiz et al. 2000; Carlton unpublished data; SERC | |
| ? | Yes | Carlton 1979; Cohen & Carlton 1995 | |
| ? | Yes | Carlton 1979; Cohen & Carlton 1995 | |
| Yes | Yes | Hewitt 1993 | |
| Yes | Yes | Carlton 1979; Wonham et al. 2005 | |
| ? | Yes | Carlton 1979; Wonham et al. 2005 | |
| ? | Yes | Carlton 1979; Wonham et al. 2005 | |
| ? | Yes | Carlton 1979; Wonham et al. 2005 | |
| ? | Yes | Carlton 1989; Cohen & Carlton 1995; Wonham et al. 2005 | Identity of this species is unclear. |
| ? | Yes | Cohen & Carlton 1995; Wonham et al. 2005 | |
| ? | Yes | Wonham et al. 2005 | |
| ? | Yes | Wonham et al. 2005 | |

**Appendix D continued, Olympic Coast**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge? | In Adjacent Area | Established? | References | Notes |
|---|---|---|---|---|---|---|---|---|
| Invertebrate | Crustacea (Cirripedia) | *Balanus improvisus* | Bay Barnacle | La PushWA/La Push Harbor | No? | Unknown | SERC | |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Neah Bay | Willapa Bay | Yes | Cohen et al. 2000; SERC | |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | Neah Bay | Willapa Bay | Yes | Cohen et al. 2000; SERC | |
| Invertebrate | Crustacea (Decapoda) | *Carcinus maenas* | Green Crab | ? | Grays Harbor; Willapa Bay | Unknown | Cohen et al. 2000 | |
| Invertebrate | Chordata (Urochordata) | *Diplosoma listerianum* | colonial tunicate | Neah Bay | Willapa Bay | Yes | SERC | |

**Appendix D continued, Padilla Bay**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge? |
|---|---|---|---|---|
| Invertebrate | Crustacea (Cirripedia) | *Balanus improvisus* | Bay Barnacle | Bayview Channel |
| Invertebrate | Entoprocta (Kamptozoa) | *Barentsia benedeni* | kamptozoan | ? |
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Anacortes/WA/ Padilla Bay |
| Invertebrate | Chordata (Urochordata) | *Botryllus schlosseri* | colonial tunicate | Anacortes/WA/ Padilla Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula sp. 1* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula sp. 2* | bryozoan | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Bugula stolonifera* | bryozoan | ? |
| Invertebrate | Chordata (Urochordata) | *Ciona savignyi* | solitary tunicate | ? |
| Invertebrate | Cnidaria (Hydrozoa) | *Cladonema radiatum* | hydroid & medusa | WA/Padilla Bay |
| Invertebrate | Porifera | *Cliona sp.* | Boring sponge | ? |
| Invertebrate | Cnidaria (Hydrozoa) | *Cordylophora caspia* | Freshwater Hydroid | ? |
| Invertebrate | Ectoprocta (Bryozoa) | *Cryptosula pallasiana* | bryozoan | WA/Padilla Bay |
| Invertebrate | Cnidaria (Anthozoa) | *Diadumene lineata* | Striped Anemone | WA/Padilla Bay |
| Invertebrate | Chordata (Urochordata) | *Didemnum sp. A* | colonial tunicate | ? |
| Invertebrate | Porifera | *Haliclona loosanoffi* | sponge | ? |
| Invertebrate | Chordata (Urochordata) | *Molgula manhattensis* | solitary tunicate | WA/Padilla Bay |
| Invertebrate | Ectoprocta (Bryozoa) | *Schizoporella unicornis?* | bryozoan | WA/Padilla Bay |
| Invertebrate | Chordata (Urochordata) | *Styela clava* | solitary tunicate | Anacortes/WA/ Puget Sound |

| In Adjacent Area | Established in refuge | References | Notes |
|---|---|---|---|
| No? | Unknown | SERC | |
| Yes, WA/Puget Sound | Yes | Cohen et al. 1998 | |
| Puget Sound | Yes | Cohen et al. 1998; Cohen et al. 2000; Lambert 2003 | |
| Puget Sound | Yes | Cohen et al. 1998; Cohen et al. 2000; Lambert 2003 | |
| Puget Sound | Yes | Cohen et al. 1998 | Resembles *B. turrita.* |
| Puget Sound | Yes | Cohen et al. 1998 | Resembles *B. fulva* |
| Puget Sound | Yes | Cohen et al. 1998 | |
| Puget Sound | Yes | Fairey et al. 2002; SERC | CHECK |
| ? | Yes | Cohen et al. 1998 | |
| Puget Sound | | Carlton 1979; Cohen et al. 1998 | |
| Edison/WA/Samish River; Seattle/ WA/Elliott Bay | Yes | Ruiz et al. 2000; Carlton unpublished data | |
| Puget Sound | Yes | Cohen et al. 1998; SERC | |
| Puget Sound | Yes | Carlton 1979; Cohen et al. 1998 | |
| Puget Sound | Yes | Woods Hole Marine Science Center 2005 | |
| Puget Sound | Yes | Carlton 1979; Cohen et al. 1998; Wonham et al. 2005 | |
| Puget Sound | Yes | Cohen et al. 1998; Wonham et al. 2005; SERC | |
| Puget Sound | Yes | Cohen et al. 1998; Wonham et al. 2005; SERC | Identity of this species is unclear. |
| Puget Sound | Yes | Cohen et al. 1998; Wonham et al. 2005 | |

**Appendix D continued, Kachemak Bay**

| Broad Taxa Group | Phylum | Species | Common Name | In Refuge? | In Adjacent Area | Established | References | Notes |
|---|---|---|---|---|---|---|---|---|
| Invertebrate | Chordata (Urochordata) | *Botrylloides violaceus* | colonial tunicate | Kachemak Bay | Prince William Sound | Yes | Ruiz et al., unpublished data; SERC | |
| Invertebrate | Porifera | *Cliona sp.* | Boring sponge | ? | Prince William Sound | Yes | Hines & Ruiz 2000 | |
| Invertebrate | Cnidaria (Hydrozoa) | *Garveia franciscana* | hydroid | Kachemak Bay | | Unknown | Hines & Ruiz 2001 | This record seems puzzling for this warm-water species. |
| Invertebrate | Ectoprocta (Bryozoa) | *Schizoporella unicornis?* | bryozoan | ? | Prince William Sound | Yes | Hines & Ruiz 2000 | Identity of this species is unclear. |

# EXOTICS IN ELKHORN SLOUGH ESTUARINE HABITATS

*A list of documented non-native species compiled by Kerstin Wasson*
*Elkhorn Slough National Estuarine Research Reserve*

## INVERTEBRATES

**PORIFERA**
**Cliona ?celata/lobata*
**Halichondria bowerbanki*
*Haliclona loosanoffi*
**Hymeniacidon sinapium*

**ANNELIDA**: POLYCHAETA
*Ficopomatus enigmaticus*
*Heteromastus filiformis*
*Polydora ligni*
*Pseudopolydora paucibranchiata*
*Streblospio benedicti*

**ARTHROPODA**:CRUSTACEA
CIRRIPEDIA
*Balanus improvisus*
COPEPODA
*Mytilicola orientalis*
MALACOSTRACA
ISOPODA
*Iais californica*
*Limnoria quadripunctata*
*Sphaeroma quoyanum*
TANAIDA
*Sinelobus* sp.
AMPHIPODA
*Ampithoe valida*
*Caprella mutica*
*Grandidierella japonica*
*Jassa marmorata*
*Melita nitida*
*Monocorophium acherusicum*
*Monocorophium insidiosum*
*Monocorophium uenoi*
*Parapleustes derzhavini*
DECAPODA
*Carcinus maenas*
*Palaemon macrodactylus*

**PLATYHELMINTHES**
*Cercaria batillariae*

**CNIDARIA**
*Cordylophora caspia*
*Diadumene franciscana*
*Diadumene leucolena*
*Diadumene lineata*
*Ectopleura crocea*
*Sarsia tubulosa*

**BRYOZOA**
*Amathia vidovici*
*Bowerbankia gracilis*
**Bugula neritina*
*Bugula stolonifera*
*Conopeum tenuissimum*
**Cryptosula pallasiana*
**Schizoporella unicornis*
*Watersipora subtorquata*

**KAMPTOZOA**
*Barentsia benedeni*

**MOLLUSCA**
BIVALVIA
*Gemma gemma*
*Lyrodus pedicellatus*
*Musculista senhousia*
*Mya arenaria*
**Mytilus galloprovincialis*
*Nuttallia obscurata*
*Venerupis philippinarum*
GASTROPODA
*Batillaria attramentaria*
*Myosotella myosotis*
*Okenia plana*
*Philine ?auriformis*
*Tenellia adspersa*
*Urosalpinx cinerea*

**CHORDATA**: UROCHORDATA
*Botrylloides violaceus*
**Molgula manhattensis*
*Styela clava*

## FISH

Yellowfin Goby *Acanthogobius flavimanus*
American Shad *Alosa sapioissima*
Striped Bass *Morone saxafilis*

## ALGAE

*Caulacanthus ustulatus*
*Sargassum muticum*

## PLANTS

*Ammophila arenaria*
*Arundo donax*
*Atriplex semibaccata*
*Cakile edentula*
*Cakile maritima*
*Carpobrotus chilense*
*Carpobrotus edulis*
*Chenopodium macrospermum*
*Conium maculatum*
*Cotula coronopifolia*
*Mesembryanthemum nodiflorum*
*Spergularia bocconii*
*Tetragonia tetragoniodes*

Data Sources: the 58 non-native invertebrate species are documented in a recent paper by K. Wasson, K. Fenn, and J. Pearse (Biological Invasions). Those marked with an asterisk (*) are also found in rocky intertidal habitats in central California; no additional non-native invertebrates were found in extensive surveys. The three non-native fish species were reported by G. Cailliet (Moss Landing Marine Laboratories); the two algae have been noted by K. Wasson (ESNERR) and K. Heiman (Stanford University). The plant list was supplied by A. Woolfolk (ESNERR).

| Appendix E. Wetland and marine NIS found in Elkhorn Slough and TRNERR and its surrounding bays | | | | |
|---|---|---|---|---|
| Species | | | Primary Habitat Association | |
| | | | Marine / Estuarine | Terrestrial / Riparian |
| PLANTS | | | | |
| | *Arundo donax* | Giant reed | | x |
| | *Brassica nigra* | Black mustard | x | x |
| | *Brassica tournetfortii* | Sahara mustard | | x |
| | *Bromus madritensis* ssp. *rubens* | Foxtail | | x |
| | *Carpobrotus edulis* | Hottentot fig | | x |
| | *Chrysanthemum coronarium* | Crown daisy | | x |
| | *Lepidium latifolium* | Perennial pepperweed | | x |
| | *Malephora crocea* | Iceplant | | x |
| | *Mesembryanthemum crystallinum* | Crystalline iceplant | | x |
| | *Mesembryanthemum nodiflorum* | Slender-leaf iceplant | | x |
| | *Myoporum laetum* | Myoporum | | x |
| | *Polypogon monspeliensis* | Rabbitfoot | | x |
| | *Ricinus communis* | Castor bean | | x |
| | *Rumex crispus* | Curly dock | | x |
| | *Schinus terebinthifolius* | Brazilian pepper | | x |
| | *Tamarix* spp. | Salt cedar | | x |
| BRYOZOAN | | | | |
| | *Victorella pavida* | Added by this study | x | |
| OLIGOCHAETES | | | | |
| | *Tubificoides brownea* | | x | |
| POLYCHAETES | | | | |
| | *Pseudopolydora paucibranchiata* | | x | |
| | *Streblospio benedicti* | | x | |
| AMPHIPODS | | | | |
| | *Grandidierella japonica* | | x | |
| | *Jassa mamorata (=falcata)* | | x | |
| ISOPODS | | | | |
| | *Armadillidium vulgare* | Pillbug | | x |
| | *Oniscus asellus* | Woodlouse | | x |
| BARNACLES | | | | |
| | *Balanus amphitrite* | Striped barnacle | x | |
| | *Balanus improvisus* | Added by this study | x | |
| SHRIMP | | | | |
| | *Palaemon macrodactylus* | Oriental grass shrimp | x | |
| INSECTS | | | | |
| | *Forficula auricularia* | Earwig | | x |
| | *Linepithema humile* | Argentine ant | | x |
| GASTROPODS | | | | |
| | *Helix aperta* | Green snail | | x |
| | *Theba pisana* | White garden snail | | x |
| BIVALVES | | | | |
| | *Crassostrea gigas* | Pacific oyster | x | |
| | *Musculista senhousia* | Japanese mussel | x | |
| | *Mytilus galloprovincialis* | Blue mussel | x | |
| FISH | | | | |
| | *Acanthogobius flavimanus* | Yellowfin goby | x | |
| | *Gambusia affinis* | Mosquitofish | | x |
| AMPHIBIAN | | | | |
| | *Xenopus laevis* | African clawed frog | | x |
| | | | | |

| Species | | Notes | | | |
|---|---|---|---|---|---|
| PLANTS | | | | | |
| | *Avicennia marina* | | | | |
| | *Tamarix spp.* | | | | |
| ALGAE | | | | | |
| | *Caulerpa taxifolia* | | | | |
| | *Lomentaria hakodatensis* | | | | |
| | *Sargassum muticum* | | | | |
| CILIATES | | | | | |
| | *Lobochona prorates* | | | | |
| ANENOMES | | | | | |
| | *Bunodeopsis sp.* | | | | |
| | *Diadumene franciscana* | | | | |
| | *Diadumene lineata* | | | | |
| HYDROZOAN | | | | | |
| | *Tubularia (AKA Ectopleura) crocea* | | | | |
| BRYOZOAN | | | | | |
| | *Bowerbankia gracilis ?* | | | | |
| | *Bugula "neritina"* | | | | |
| | *Cryptosula pallasiana* | | | | |
| | *Victorella pavida* | Added by this study | | | |
| | *Watersipora "subtorquata"* | | | | |
| | *Watersipora arcuata* | | | | |
| | *Zoobotryon verticillatum* | | | | |
| OLIGOCHAETES | | | | | |
| | *Tubificoides brownea* | | | | |
| POLYCHAETES | | | | | |
| | *Amblyosyllis speciosa* | | | | |
| | *Demonax sp.* | | | | |
| | *Hydroides dirampa* | | | | |
| | *Hydroides elegans* | | | | |
| | *Lycatopsis pontica* | | | | |
| | *Myrianida pachycera* | | | | |
| | *Neanthes acuminata (= caudata)* | | | | |
| | *Nicolea sp. A* | | | | |
| | *Pseudopolydora paucibranchiata* | | | | |
| | *Streblospio benedicti* | | | | |
| COPEPODS | | | | | |
| | *Pseudodiaptomus marinus* | | | | |
| AMPHIPODS | | | | | |
| | *Aoroides secunda* | | | | |
| | *Corophium acherusicum* | | | | |
| | *Corophium heteroceratum* | | | | |
| | *Corophium insidiosum* | | | | |
| | *Corophium uenoi* | | | | |
| | *Elasmopus rapax* | | | | |
| | *Ericthonius brasiliensis* | | | | |
| | *Grandidierella japonica* | | | | |
| | *Jassa marmorata (= falcata)* | | | | |
| | *Leucothoe alata* | | | | |
| | *Liljeborgia sp.* | | | | |
| | *Stenothoe valida* | | | | |
| TANAIDS | | | | | |
| | *Sinelobus? stanfordi* | | | | |
| OSTRACOD | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | *Aspidoconcha limnoriae* | | | | |
| | *Redekea californica* | | | | |
| ISOPODS | | | | | |
| | *Iais californica* | | | | |
| | *Limnoria tripunctata* | | | | |
| | *Limnoria quadripunctata* | | | | |
| | *Paranthura japonica* | | | | |
| | *Spaeroma quoyanum* | | | | |
| | *Sphaeroma walkeri* | | | | |
| BARNACLES | | | | | |
| | *Balanus amphitrite* | | | | |
| | *Balanus improvisus* | Added by this study | | | |
| | *Balanus reticulatus* | Added by this study | | | |
| SHRIMP | | | | | |
| | *Palaemon macrodactylus* | | | | |
| GASTROPODS | | | | | |
| | *Aoelidella takanosimensis* | may not be established | | | |
| | *Babakina festiva* | | | | |
| | *Catriona rickettsi* | | | | |
| | *Philine auriformis* | | | | |
| BIVALVES | | | | | |
| | *Crassostrea gigas* | | | | |
| | *Lyrodus pedicellatus* | | | | |
| | *Mercenaria mercenaria* | may not be established | | | |
| | *Musculista senhousia* | | | | |
| | *Mytilus galloprovincialis* | | | | |
| | *Teredo navalis* | | | | |
| | *Theora fragilis (= lubrica)* | | | | |
| TUNICATES | | | | | |
| | *Ascidia sp.* | | | | |
| | *Ascidia zara* | | | | |
| | *Bostrichobranchus pilularis* | | | | |
| | *Botrylloides perspicuum* | Added by this study; ID needs verification | | | |
| | *Botrylloides violaceus* | | | | |
| | *Botryllus firmus* | | | | |
| | *Botryllus schlosseri* | | | | |
| | *Botryllus sp. A* | | | | |
| | *Ciona intestinalis* | | | | |
| | *Ciona savigny* | | | | |
| | *Diplosoma listerianum* | Added by this study; ID needs verification | | | |
| | *Microcosmus squamiger* | | | | |
| | *Mogula sp. A* | Added by this study; ID needs verification | | | |
| | *Polyandrocarpa zorritensis* | | | | |
| | *Styela canopus* | | | | |
| | *Styela clava* | | | | |
| | *Styela plicata* | | | | |
| | *Symplegma brakenhelmi* | | | | |
| | *Symplegma reptans* | | | | |
| FISH | | | | | |
| | *Acanthogobius flavimanus (yellowfin goby)* | | | | |
| | *Poecilia latipinna (sailfin molly)* | | | | |
| | *Tridentiger trigonocephalus (chameleon goby)* | | | | |

**Appendix F. NIS work at US West Coast National Estuarine Research Reserves and National Marine Sanctuaries**

| Timeline | Lead local researcher(s) | Project type | Project title/description | NIS studied | Links |
|---|---|---|---|---|---|
| **Elkhorn** | **Slough NERR** | | | | |
| Ongoing | Kerstin Wasson, ESNERR RC | Regional Monitoring & Management | Early detection program (discover new invasions of least wanted species and intervene) | Aquatic nuisance species | |
| Ongoing | Kerstin Wasson, ESNERR RC | Broadscale Montioring | Crab monitoring (detects non-native green crab, new invasions) | *Carcinus maenas* | |
| Ongoing | Kerstin Wasson, ESNERR RC | Broadscale Montioring | Recruitment monitoring (new pilot examining settlement of natives/non-natives). | marine invertebrates | |
| Present | Kerstin Wasson, ESNERR RC | Research & Monitoring | Ecotone monitoring, transplant, and restoration experiments (effect of native vs. invasive upland plants on adjacent marsh community) | | |
| Present | Kerstin Wasson, ESNERR RC | Research | Characterization of invertebrate invaders of ESNERR (##, transport mechanisms, notorious characters) | | |
| Present | Kerstin Wasson, ESNERR RC | Research | Examination of habitat bias in invertebrate invasions (hard substrates more invaded than soft; estuaries more invaded than open coast) | Marine invertebrates of the fouling community | |
| Present | Rikke Kvist Preisler, UC Santa Cruz | Research | Green crab behavior and impacts | *Carcinus maenas* | |
| Present | Kimberly Heiman, RGF (Stanford) | Research | Community effects of invasive reef-building worm | *Ficopomatus enigmatus* | www.elkhornslough.org/research/grf_kimberly.htm |
| Past | Jeb Byers, former RGF | Research | A mechanistic understanding of species invasion: Toward a predictive science of introduced species' effects on estuarine ecosystems (Invasive snail outcompetes native) | *Batillaria attramentaria* | www.elkhornslough.org/research/grf_jeb.html |
| Past | Kerstin Wasson, ESNERR RC | Workshop | National invasion monitoring workshop and summary | | |

**Kachemak Bay NERR**

| | | | | | |
|---|---|---|---|---|---|
| Ongoing | W. Scott Pegau KBNERR RC | Monitoring (regional) | Community detection of non-indigenous crabs. School groups are to be trained in how to trap and identify crabs to monitor for non-indigenous species. | *Carcinus maenas*, others | |
| Past (2000) | Tuck Hines, Greg Ruiz, SERC | Research | Marine invasive species and biodiversity of South Central Alaska | Fouling community | http://www.pwsrcac.org/NIS/pws.html#marine |

**Monterey Bay NMS**

| | | | | | |
|---|---|---|---|---|---|
| Present | Steve Lonhart, Sanctuary Integrated Monitoring Network Coordinator | Local Monitoring & Management | Monitoring and management of *Undaria* to determine whether manual removal effectively reduces the harbor population; mapping to measure rate of spread and identify areas susceptible to future invasion. | *Undaria pinnatifida* (alga) | http://www.mbnms-simon.org/sections/rockyShores/project_info.php?pid=100184&sec=rs |
| Present | Lonhart, collaborating with Moss Landing Marine Lab | Regional Monitoring | Survey for NIS along the open coast | | |
| Past | | Compiliation | NIS list for Monterey Bay NMS | | *http://www.mbnms.nos.noaa.gov/sitechar/spex.html* |

**Olympic Coast NMS**

| | | | | | |
|---|---|---|---|---|---|
| Ongoing | Mary Sue Brancato, Resource Protection Specialist | Broadscale Monitoring | Crab monitoring (monthly monitoring in the lower intertidal zone to detect new invasions of non-native crabs) | To detect *Carcinus maenas,* others | |
| Present | Mary Sue Brancato, Resource Protection Specialist | Local Monitoring/ Baseline Survey | Rapid assessment of intertidal organisms at coastal sites throughout sanctuary | | |

**Padilla Bay NERR**

| | | | | | |
|---|---|---|---|---|---|
| Ongoing | Sharon Riggs, | Broadscale Montioring | Monitoring for invasive crabs in seagrass and rip-rap habitats (detects new invasions of nearshore non-native crabs, provides information on native crab community) | To detect *Carcinus maenas,* others | |
| Ongoing | | Management & Monitoring | Spartina eradication | *Spartina alterniflora* | |
| Current | Jamey Selleck, Western Washington U | Research | Spawning and recruitment events of the invasive, purple varnish clam | Nuttallia obscurata | |
| Past | C. Eric Hellquist, former GRF, U Washington | Research | Predicting the invasion potential and consequences of the non-indigenous cordgrass, *Spartina anglica*, within Padilla Bay, Washington | *Spartina anglica* | |
| Past | Dan Hahn, former GRF, U Washington | Research | Competition between, and biodiversity associated with, an introduced seagrass, *Zostera japonica*, and its native congener, | *Zostera japonica* | |

| | | | | | |
|---|---|---|---|---|---|
| | | | *Zostera marina* | | |
| Past | Marjorie Wonham, former GRF, U Washington | Research | Why are estuarine communities more invaded? An experimental test with the invasive mussel, *Mytilus galloprovincialis* | *Mytilus galloprovincialis* | |
| Past | Chris Harley, U Washington | Research | Positive effects of a dominant invader on introduced and native mudflat species | *Batillaria attramentaria* | |

**South Slough NERR**

| | | | | | |
|---|---|---|---|---|---|
| Present | Lisa Turnbull, GRF, U Oregon | Research | The effects of the invasive grasses *Phalaris arundinacea* and *Zostera japonica* on ecosystem processes in the South Slough Reserve | *Phalaris arundinacea, Zostera japonica* | |
| Present | Kerri Kidder GRF, U Oregon | Research | A biological vector for invasive species: Drifting path, species associations, and recruitment of *Nereocystis luetkeana* | | |

**Tijuana River NERR**

| | | | | | |
|---|---|---|---|---|---|
| Ongoing | Drew Talley, SFB NERR | Management, Research | Invasive plant program: Tamarisk research and removal | *Tamarix spp* | |
| Ongoing | Christine Whitcraft, Scripps Institution of Oceanography | Research | Effects of tamarisk on salt marsh soils and infauna | *Tamarisk* spp. | |
| Ongoing | Jeff Crooks, TR NERR | Management, Research | Studies examining how research can facilitate management decisions | Plant invaders | |
| Ongoing | Jeff Crooks, TR NERR | Research | Invasion of terrestrial snails into salt marshes | *Theba pisana, Helix aperta* | |
| Ongoing | Jeff Crooks, TR NERR | Research | Distribution of *Crassostrea gigas* in San Diego County | *Crassostrea gigas* | |
| Present | Sean Menke, GRF, UC San Diego | Research | Role of abiotic factors in determining invasion success of Argentine ants, *Linepithema humile* | *Linepithema humile* | |
| Past | Edward Woch, GRF,S an Diego State University | Research | Dispersion patterns and associations of invasive exotic plants within the Tijuana River Watershed | *Tamarix* spp. | |
| Past | John Callaway, University of San Francisco | Research | Effects of freshwater inflows on invasive grasses in the high marsh | *Polypogon monspeliensis* | |
| Past | Meghan Fellows, San Diego State University | Research | Interactions between exotic sicklegrass and endangered native plants | *Parapholis incurva* | |

**Appendix OC-A. Survey and Taxonomy Participants**

| Participant | Expertise | Dates of Field Participation |
|---|---|---|
| Jessica Anchor | Field Expeditor | 8/6/02-8/8/02 |
| Liam Antrim | Generalist | 8/7/02 |
| Bill Austin | Sponges | Laboratory identifications |
| Helen Berry | Generalist | 8/20/01-8/23/01 |
| Brian Bingham | Generalist | 8/6/02-8/11/02 |
| Barbara Blackie | Field Expeditor | 8/20/01-8/21/01 |
| Ed Bowlby | Generalist | 8/18/01-8/20/01 |
| Mary Sue Brancato | Generalist, Project Manager | 8/18/01-8/23/01, 6/27/02, 8/6/02-8/12/02 |
| Katie Brenkman | Field Expeditor | 8/21/01-8/23/01, 8/6/02-8/12/02 |
| Betty Bookheim | Algae, Generalist | 8/18/01-8/19/01, 8/6/02-8/8/02 |
| John Chapman | Crustaceans | 8/18/01-8/23/01, 7/23/02, 8/7/02-8/10/02; Laboratory identifications |
| Jeff Cordell | Copepods | Laboratory identifications |
| Allen Fukuyama | Molluscs, Generalist | 8/18/01-8/20/01, 8/6/02-8/12/02 |
| Jeff Goddard | Bryozoans, Nudibranchs, Hydroids, Generalist | 8/18/01-8/23/01, 8/6/02-8/12/02 |
| Leslie Harris | Polychaetes | 8/18/01-8/23/01, 8/6/02-8/12/02; Laboratory identifications |
| Kristin Hemmelgarn | Field Expeditor, Generalist | 8/6/02-8/12/02 |
| Gordon Hendler | Echinoderms | Laboratory identifications |
| Yayoi Hirano | Stauromedusae | Laboratory identifications |
| Valerie Hironaka | Generalist | 8/10/02 |
| Greg Jensen | Decapods, Shrimps | Laboratory identifications |
| Howard Jones | Generalist | 8/21/02 |
| David Kirner | Field Expeditor | 8/18/01-8/23/01, 6/27/02 |
| Alan Kohn | Gastropods, Generalist | Laboratory identifications |
| Gretchen Lambert | Ascidians | Laboratory identifications |
| Alberto Lindner | Hydroids | Laboratory identifications |
| John Ljubenkov | Flatworms, Nemerteans, Anemones, Bivalves, Misc. | Laboratory identifications |
| Mary McGann | Foraminiforas | Laboratory identifications |
| Kathy Ann Miller | Algae | 8/18/01-8/23/01; Laboratory identifications |
| Claudia Mills | Hydromedusae, Ctenophores | 8/18/01-8/20/01, 6/27/02 |
| Ben Miner | Generalist | 8/6/02-8/10/02 |
| Jon Norenburg | Nemerteans | Laboratory identifications |
| Bruno Pernet | Polychaetes, Generalist | 8/6/02-8/10/02 |
| Paul Scott | Molluscs, Gastropods | 8/18/01-8/23/01 |
| David Secord | Anemones, Generalist | 8/18/01-8/23/01 |
| Amy Sewell | Field Expeditor | 8/18/01-8/19/01 |
| Craig Staube | Pericarid Amphipods | Laboratory identifications |
| Jason Whitaker | Field Expeditor | 8/18/01-8/23/01 |
| Melissa Wilson | Algae | 8/6/02-8/12/02 |
| Judith Winston | Bryozoans | Laboratory identifications |
| Marjorie Wonham | Generalist | 8/18/01-8/20/01 |
| Sandy Wylee-Eschuveria | Seagrasses | Laboratory identifications |

**Appendix B. Nearshore Survey Sites Sampled 27 June 2002 (North to South)**

| Site Code | Site Name | Latitude | Longitude |
|---|---|---|---|
| NBMN | Neah Bay - Marina Entrance Nearshore | 48.36961667 | -124.61495 |
| NBWN | Neah Bay West Nearshore | 48.3749 | -124.6193333 |
| WBN | Warmhouse Beach Nearshore | 48.39136667 | -124.665 |
| TIN | Tatoosh Island Nearshore | 48.39396667 | -124.7327 |
| WPN | Waatch Point Nearshore | 48.3353 | -124.6865167 |
| MBHN | Makah Bay - Hobuck South Nearshore | 48.32873333 | -124.6698167 |
| MBSNN | Makah Bay - Sooes North Nearshore | 48.30728333 | -124.6728833 |
| MBSSN | Makah Bay - Sooes South Nearshore | 48.30031667 | -124.6744 |
| PHSN | Portage Head South Nearshore | 48.2805 | -124.6904333 |
| CAN | Cape Alava Nearshore | 48.17713333 | -124.7446833 |
| SPSN | Sand Point South Nearshore | 48.11041667 | -124.7090833 |
| JRN | Jagged Rock Nearshore | 47.99235 | -124.6917333 |
| PAN | Point of Arches Nearshore | 48.25261667 | -124.70505 |
| HRNN | Hand Rock North Nearshore | 48.05541667 | -124.7 |
| CJN | Cape Johnson Nearshore | 47.97028333 | -124.6833333 |
| LPN | La Push Nearshore | 47.8956 | -124.6454 |