Unified Monitoring Protocols for the Multi-Agency Rocky Intertidal Network

(November 2008)

John M. Engle

U.S. Department of the Interior
Minerals Management Service
Pacific OCS Region

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John M. Engle
Marine Science Institute
University of California
Santa Barbara, CA 93106

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Marine Science Institute
University of California
Santa Barbara, CA 93106

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Camarillo, California

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1. INTRODUCTION

1.1 Multi-Agency Rocky Intertidal Network Monitoring Program Background

Periodic monitoring of the condition and dynamics of rocky shore marine life is critical for detecting and understanding community dynamics in order to develop management measures to anticipate and reduce acute or chronic environmental impacts. **Goals of long-term rocky intertidal monitoring include the following:**

- Maintain an historical perspective of important resources.
- Document the effects of long-term climatic changes.
- Enhance understanding of the extent of temporal variation in natural systems.
- Determine compliance with standards or regulations.
- Provide an early warning of abnormal conditions.
- Help assess and reduce environmental impacts.
- Identify trends that may reflect cumulative impacts.
- Guide development and evaluation of impact mitigation measures.
- Provide information to assist in natural resource damage assessments.

The Bureau of Land Management (BLM) (now the Minerals Management Service (MMS)) funded detailed rocky intertidal monitoring at 22 sites in southern California over a 3-4 year period in the mid to late 1970's (Littler 1977, 1978, 1979). However, costs for these intensive surveys precluded their long-term continuation. Channel Islands National Park (CINP) was created in 1980, with a mandate to inventory and monitor biological resources. As a result, they developed a permanent, cost-effective rocky shore monitoring program based on semi-annual surveys of target species assemblages in fixed plots or transects. This innovative program was expanded to the Cabrillo National Monument (Point Loma, San Diego) in 1990. In 1992, as a result of regulatory responsibilities and an increased public concern for oil spills after the EXXON VALDEZ spill in Alaska, MMS funded rocky intertidal monitoring sites in Santa Barbara County, with protocols modeled after the CINP methodology. The use of this core target-species/fixed-plot protocol was expanded to Ventura and Los Angeles Counties as well as Santa Cruz and Santa Catalina Islands (by the California Coastal Commission and Santa Barbara County) in 1994, to San Luis Obispo County (by MMS) and San Diego County (by the U.S. Navy) in 1995, and to Orange County (by MMS) in 1996.

With over 50 sites in central and southern California monitored by various institutions using similar, but slightly varying protocols, it became apparent that a more structured organization was needed for efficient, cooperative operation. The Multi-Agency Rocky Intertidal Network (MARINe) was created as a result of a workshop held at the University of California Santa Barbara (UCSB) in 1997 (Dunaway et al. 1997, Engle et al. 1997).

Objectives of MARINe include the following:

- Increase reliability, efficiency and cost-effectiveness of programs.
- Increase cooperation and communication among agencies and organizations.

- Enhance long-term support to ensure continuity of sampling.
- Provide opportunity for identification and rectification of data gaps.
- Allow more timely access to standardized data by all users.
- Integrate information for efficient analysis, synthesis and reporting.
- Permit evaluation of large-scale spatial and temporal patterns.
- Facilitate periodic review of ability of monitoring to achieve goals.
- Expedite linkages to other relevant programs.
- Enhance public outreach and interpretation programs.
- Assist in designing and critiquing restoration programs for impacted resources.
- Aid in framing research questions regarding cause and effect relationships.
- Increase public awareness of knowledge-based environmental management.
- Provide a cadre of trained biologists capable of rapid response to impacts.

The geographical area for MARINe ranged from San Luis Obispo County to San Diego County, including the Channel Islands. From 1999-2004, additional monitoring sites using the same core protocol were established north of San Luis Obispo County, primarily by the monitoring team from UC Santa Cruz, with funding from the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), the Monterey Bay National Marine Sanctuary, and other organizations. MARINe was expanded to include northern California in 2005, Oregon in 2006 and Washington State in 2008. **Currently MARINe includes 98 core monitoring locations in California and Oregon, with 8 sites soon to be established in Washington State. (Table 1).**

MARINe is composed of partner organizations (Table 2) and monitoring groups (Table 3) that are directed by a Steering Committee, Science Panel, and Data Panel. The **MARINE Steering committee is made up of representatives of agencies and organizations committing resources to quantifying the health of rocky shore marine life and involved in joint assessment of intertidal monitoring data.** Major functions of the Steering Committee include ensuring long-term support of intertidal monitoring and providing oversight of the Science and Data Panels to make sure the goals of the Network are met. **Network goals include the following:**

- To support continuous long-term monitoring of rocky intertidal communities.
- To maximize coordination and communication among sponsoring groups.
- To increase access to the data collected for all users.
- To integrate intertidal surveys with other research efforts.
- To address questions that cannot be answered by individual projects.

1.2 Handbook Purpose

The purpose of this Handbook is to codify a standard set of core monitoring (target species/fixed plot) procedures for use at all MARINe monitoring sites. These standard

procedures should not be modified without network agreement. Agreed-upon changes will be incorporated into periodic updates of the Handbook and communicated to all monitoring groups.

Monitoring groups can opt to add procedures beyond the base monitoring. These optional procedures can be included in the Handbook for communication to other monitoring groups so that if they choose to carry out the optional surveys, they can conform to the same procedures. Data from optional procedures is not necessarily incorporated into the MARINe database, unless the effort to do so is deemed worthwhile and sufficient funding is available. Motile invertebrate counts are an example of an optional protocol.

The Handbook not only describes current protocols, but also documents variants of MARINe survey protocols previously used by particular monitoring groups or at certain sites. This provides historical perspective that is useful for data analysis. Additional information on protocols can be found in monitoring group study plans and handbooks (Ambrose et al. 1992, Engle & Davis 200b, Engle et al. 1994a,b, Richards & Davis 1988, Richards & Lerma 2003), as well as in data reports (Ambrose et al. 1995a,b, Davis & Engle 1991, Engle 2000, 2001, 2002, Engle & Adams 2003, Engle & Davis 2000a,c, Engle & Farrar 1999, Engle et al. 1998a,b, 2001, Miner et al. 2005, Raimondi et al. 1999, Richards 1986, 1988, 1998, Richards & Lerma 2000, 2002).

The Handbook provides a sole source for the standardized protocols that can be incorporated into each monitoring group's site-specific field manual. Field manuals should include such information as directions to the site; a site description that includes the site size, boundaries, and GPS coordinates; site maps showing prominent features and plot locations; print photos of plot locations; site safety considerations, and useful notes to efficiently locate and consistently sample the plots. **A supplement to this Handbook "Site Information for the Multi-Agency Rocky Intertidal Network" (Engle 2008) provides site and plot location information in case an oil spill or other circumstances require surveys by MARINe members who do not typically monitor the sites.** Information from the Supplement also is provided on the MARINe private website. Site-specific coordinates and sensitive species information should not be made available to the public to minimize collecting or other activities that may impact the sites.

The Unified Protocols Handbook also is designed to integrate with other MARINe information sources, including "Methods for Performing Monitoring, Impact, and Ecological Studies on Rocky Shores" (Murray et al. 2002), "MARINe Database User Guide" (Miner et al. 2007), and MARINe public and private websites.

2. TARGET SPECIES ASSEMBLAGE MONITORING SURVEYS

2.1 Monitoring Sites

Long-term MARINe monitoring sites have been established at representative rocky intertidal reefs along the U.S. West Coast and Channel Islands based on monitoring objectives and available funding. Criteria utilized for specific site selection include the following:

- Areas representing the geographic range of the California coastline.
- Areas representing major ecological communities along the California shoreline.

• *Biology*: emphasis on community differences north and south of major biogeographic change areas, such as Pt. Conception.

• *Geology*: with respect to rock type, size, slope, and topography (relief, rugosity, etc.).

• *Oceanography*: with respect to water temperature, wave exposure, currents, and nutrients (upwelling).

• *Meteorology*: with respect to air temperature, sun exposure, wind, and rain.

- Areas previously surveyed or monitored that provide historical data.
- Previously un-surveyed areas representing major data gaps.
- Areas of special human interest

  • Areas of concern with regard to human impacts, especially those vulnerable and/or sensitive to oil spills.

  • Areas with relatively pristine habitats.

  • Areas containing unique habitats or species.

  • Areas designated for protection by governmental agencies.

  • Areas with concentrations of sport or commercial species.

  • Areas visited for recreational, educational, or scientific purposes.

- Areas with optimum conditions for long-term monitoring.

  • With sufficient abundances of the key species chosen for monitoring.

  • With reasonable and safe access by road or by hiking.

  • With moderate protection from waves so the intertidal zone can be worked safely at low tides.

  • With adequate stable rock surfaces for establishing permanent plots.

  • Without major sand or gravel scour, periodic sand burial, or other regular catastrophic disturbances.

Current MARINe sites are listed in Table 1, including County, year established, and protected are designation(s). Information about specific site locations (e.g., directions, GPS coordinates, site maps) can be found in the Supplement to this Handbook (Engle 2008) and on the MARINe Private Website. It is **MARINe policy not to provide site location details to the public to minimize possible interest in collecting species at these areas.**

2.2 Sampling Design: Target Species Assemblage/Fixed Plot Methodology

2.2.1 Target, Core, and Optional Species

Target Species: "Target" species (also called key or indicator species) are **species or species groups specifically chosen for long-term monitoring.** They dominate particular zones or biotic assemblages in rocky intertidal habitats. The **criteria for selecting target species include the following:**

- Species ecologically important in structuring intertidal communities.
  - Species that are competitive dominants or major predators.
  - Species that are abundant, conspicuous or large.
  - Species whose presence provides numerous microhabitats for other organisms.
  - Species that are slow growing and long-lived.
- Species that have interesting distributions along California coasts.
  - Species found throughout California shores.
  - Species characteristic of discrete intertidal heights.
  - Species that are rare, unique, or found only in a particular intertidal habitat.
  - Species approaching their biogeographic limits in California.
- Species that have been well studied, with extensive literature available.
- Species of special human interest.
  - Species vulnerable and/or sensitive to human impacts, especially from oil spills.
  - Species with special legal status.
  - Introduced or invasive species.
  - Species harvested by sport or commercial activities.
- Practical species for long-term monitoring.
  - Readily identifiable species.
  - Sessile or sedentary species of reasonable size.
  - Non-cryptic species.
  - Species located high enough in the intertidal to permit sufficient time to sample.

Currently, there are **18 designated target species**: *Egregia menziezii, Fucus gardneri, Hedophyllum sessile, Hesperophycus californicus, Pelvetiopsis limitata, Silvetia compressa, Endocladia muricata, Neorhodomela larix, Phyllospadix scouleri/torreyi, Anthopleura elegantissima/sola, Mytilus californianus, Lottia gigantea, Haliotis cracherodii, Chthamalus dalli/fissus/Balanus glandula, Semibalanus cariosus, Tetraclita rubescens, Pollicipes polymerus,* and *Pisaster ochraceus* (Table 4). Other species or species groups "targeted" by some monitoring groups include: *Mastocarpus papillatus, Mazzaella* spp (=*Iridaea* spp), *Postelsia palmaeformis*, Red Algae (includes plots targeting *Gelidium spp* and "red algae", and transects targeting "turf"), *Balanus glandula* (separated from *Chthamalus fissus/dalli*), Tar, and Recovery. **Designated target species have the highest priority for monitoring. They are monitored at as many sites as possible**. If the species is present in sufficient numbers and it is logistically possible, plots or transects are established to monitor it every fall and spring in MARINe South or annually (in summer) above San Francisco in MARINe North. Anywhere from 1 to many target assemblages are monitored at a given site. More information on target species (e.g., photos and how to identify) can be found on the MARINe public website.

Core Species: "Core" species are those **species, species groups, or substrates that are scored using one or more survey methods by everyone in MARINe**. Core species must be reasonably and consistently identifiable using the designated scoring protocol (e.g., from lab-scored photos of fixed plots possibly supplemented by plot sketches/notes). They also must be important enough to warrant scoring for abundance trends. Some of these species only occur at northern sites, or conversely, southern sites, yet to ensure that we notice if they expand their range, we must score everywhere. Table 5 provides the official list of core species. All target species (shown in bold on the table) are core species. It is important that **scorers in all monitoring groups be able to identify and record all core species. Data sheets must include all core species**, though core species that are absent or rarely occur at a site can be de-emphasized. Entries for all core species will be required for data submission to the MARINe database. Definitions for core higher taxa and substrates are provided in Table 6.

Optional Species: "Optional" species are **non-core species or species groups that one or more monitoring groups choose to score at their sites; however, for various reasons, are not appropriate or feasible for all groups to score**. Since optional species will not be scored by everyone, regional comparisons of trends for these species will be limited or not possible. **Each monitoring group desiring to score optional species shall provide a list of these species to the MARINe data manager, along with mechanisms to translate optional species data to core species categories.** For example, if choosing to monitor *Codium fragile*, you would submit the optional species data which would be stored in the database as *Codium fragile*, but for standard regional comparisons of core species, would be lumped by the database to the next higher core species group "other green algae". **Choosing optional species requires a commitment to monitor the species consistently for a long period of time.** There is little value in scoring a species on an occasional basis (e.g., only when a particular person is available in the field to identify that species).

2.2.2 Fixed Plot Sampling Design

Background for Fixed Plot Sampling: Fixed plots are permanent areas of rocky intertidal habitat defined by epoxy or bolt markers. Fixed plots may be variable in size and shape, including square, rectangular (including band transects), circular, or even a one-dimensional transect line. The objective of MARINe core protocols is to monitor changes in abundances of target and core "species" within fixed plots over time (seasonal and annual). Fixed plots were chosen instead of randomly-located plots (in different locations for each sample) because intertidal assemblages are so heterogeneous that an impractically high number of replicate plots would be necessary to adequately detect temporal changes in species abundances in the midst of variability due to different plot placements for each sample season. Fixed plots reduce the high variability inherent in random plots and can be monitored easily and inexpensively; however, their dynamics cannot be extrapolated to larger areas without gathering additional larger-scale information. For in-depth discussion of the rationale and pros/cons of MARINe fixed plot sampling, see Ambrose et al. (1992, 1995b) and Murray et al. (2002).

MARINe Fixed Plot Types and Replicates: MARINe core fixed plot types include photoplots, point-intercept transects, circular plots, band transects, and irregular plots. The size and number of plots sampled with limited available effort is a compromise between gathering more detailed information about a limited segment of the resource versus sampling a wider range of resources (see Ambrose et al. (1992, 1995b), Drummond & Connell 2005, and Murray et al.

(2002). Tables 7-8 show the target species monitored (and # of replicate plots) at MARINe sites for each fixed plot methodology. Target species in these tables are listed as their 6-letter codes (see Table 4).

Photoplots: **Rectangular (50 x 75 cm; 0.375 m²)** photoplots are used to monitor the surface cover (top layer only) of relatively small, densely-spaced, sessile target and core species (Table 7). To minimize limited low-tide time in the field and provide a permanent visual record, these plots were designed to be photographed in the field, with photos scored in the lab. The plot size was designed to be the largest area that best utilized the rectangular 35 mm film frame, allowed a comfortable camera working height, and provided sufficient detail to identify target and core species. The MARINe standard is to monitor **5 replicate plots** per target species, placed in a stratified random manner throughout the target species zone of maximum abundance, within the limits set by stable substrate suitable for sampling permanent photoplots and sufficient (relatively high) cover of the target species. Variations from photoplot size and number standards are noted in Table 7.

Point-Intercept Transects: Ten meter long point transects are used to monitor the cover of **surfgrass** (also red algal turf and boa kelp at a few locations) and associated core species (Table 8). These transects were designed to sample a larger area, by field-scoring what occurs under **100 points spaced at 10 cm intervals along a 10 m tape** stretched out between marker bolts. The MARINe standard is to monitor **3 replicate plots** per target species, placed in a stratified random manner throughout the target species zone of maximum abundance, within the limits set by stable substrate suitable for sampling permanent transects and sufficient (relatively high) cover of the target species. Variations from point transect size and number standards are noted in Table 8.

Circular Plots: The number and size of **owl limpets** are monitored within permanent circular plots (**1 m radius, 3.14 m² area**), marked with a central bolt around which a 1 m long tape is circumscribed (Table 8). The size of the plot was designed to enclose enough owl limpets for size-frequency comparisons. The MARINe standard is to monitor **5 replicate plots** per site, placed in a stratified random manner throughout the owl limpet zone of maximum abundance, within the limits set by stable substrate suitable for sampling permanent circular plots and sufficient (relatively high) density of the target species. Variations from circular plot size and number standards are noted in Table 8.

Band Transects and Irregular Plots: The number and size of **ochre seastars and black abalone** are monitored within either band transects or irregular plots, the type and size of which is determined by what best encloses an area containing sufficient numbers of the target species for monitoring consistently (Table 8). The MARINe standard is to monitor **3 replicate plots** per site, placed in a stratified random manner throughout the target species zone of maximum abundance, within the limits set by stable substrate suitable for sampling permanent band transects or irregular plots and sufficient (relatively high) density of the target species. Black abalone and ochre seastars are monitored in the same set of transects/plots at some sites. Variations from transect/plot size and number standards are shown in Table 8.

Plot/Transect Establishment Procedures: Permanent plots or transects are established during the initial set-up of a new monitoring site (or may be added to expand the surveys at an existing site). For maximum comparability among sites, **all of the MARINe target species that occur in sufficient abundances for adequate sampling should be monitored at each site**

(except for those sites established for a particular species, such as black abalone). New sites should be chosen according to the desired criteria (see above), including filling in geographic coverage gaps and evaluating what target species are suitable for monitoring at the location. Site reconnaissance is necessary to evaluate suitability for monitoring, to decide which target species should be surveyed, and to determine possible locations for plots and transects. Gear recommended for setting up a site include quadrat frames, meter tapes, compasses, scrapers, wire brushes, portable hammer drill and drill bits, stainless steel bolts, marine epoxy (e.g., Z•SPAR A-788 Splash Zone Compound), and cameras.

Specific **plot/transect establishment procedures** may vary depending on the nature of the site and preferences of the monitoring group. The following are **recommended guidelines for standard practices** that can increase efficiency, enhance compatibility among MARINe sites, and ease data entry into the MARINe Database:

- **For each target species assemblage, identify all good plot/transect locations within its optimal zone** (area of high abundance), stratify the area of possible plots by differing physical conditions/locations, then randomly choose the desired number of plots/transects from each of the strata. For example, if 2 surfgrass areas (one twice as large as the other) occur at the site, identify all good transect locations within the 2 areas, then choose 2 transects randomly from the large area and 1 transect from the small area to establish the MARINe standard of 3 replicate transects per site. Using numerous quadrat frames or meter tapes as a guide helps in looking at the overall layout.

- When identifying good plot/transect locations, be aware that if setting up on an exceptionally low tide (or during unusually calm conditions) that **plots/transects established in the low intertidal may not be as accessible during future surveys**. Photoplots need to be relatively flat (though not necessarily horizontal) so that the entire plot falls within a similar focal plane, with minimal shadowing from crevices or projections. Also, remember that the plots/transects you set up are permanent, so consider ease of relocation and re-sampling during the setup. Plot markers, especially the primary plot marker, should be placed in prominent locations whenever possible. This is especially important in mussel beds to minimize disruption during plot establishment and to maximize ease of relocating plots.

- **The best plot markers are stainless steel hex bolts** epoxied into holes drilled into the rock. Bolt length and diameter depend on ease of rock drilling as well as bolt conspicuousness versus public safety (tripping hazard) and aesthetic considerations. If bolts eventually become overgrown, large bolts (e.g., 4-6 inch long, 3/8 inch dia) will be more easily found using a metal detector. If the rock is soft, use large, long bolts for best anchorage so they are not easily lost if the rock erodes or flakes away. In remote areas (few visitors) or in mussel beds (where mussels can overgrow bolts) have bolts project out from the rock surface to aid relocation. However, on public access reefs, bolts may need to be small or inconspicuous (even flush with the substrate), or use epoxy blobs instead of bolts (but relocation and maintenance efforts will be greater).

- To **install a plot marker**, clear an area of about 5 cm by 5 cm to bare rock using scrapers and wire brushes. For bolts, drill a central hole and epoxy the bolt firmly in the hole. For plain epoxy markers, press a blob of well-mixed epoxy onto the rock and form it into a smooth mound approximately 4-cm in diameter. Clean rock is important for good adhesion, but it does not have to be dry.

- **Plots should be marked in numerical order starting with #1 for each target species (ideally from upcoast to downcoast).** Notches cut into the top of each primary plot bolt to indicate plot number work well (e.g., 1 to 5 notches for the 5 replicate photoplots). However, careful mapping may be necessary to distinguish similar-numbered plots for each target species (e.g., to distinguish Plot #1 of mussels from Plot #1 of goose barnacles). For photoplots, a good standard is to put a bolt in all 4 corners, with the notched bolt in the upper left corner as you typically stand to take the photo (often with your back to the ocean). If the rock is hard to drill, you can omit the lower right bolt or if necessary, use epoxy instead of bolts for all but the upper left primary bolt corner. Wherever epoxy blobs are used, it is helpful to inscribe code letters (or the plot # if the primary plot marker) in the partially-cured blob to indicate marker location (e.g., "LR" for "Lower Right" photoplot corner. For transects, install the primary bolt at the upcoast end and mark the mid bolt and end bolt with standard marks to distinguish them ("/" or "no mark" for mid and "X" for end (cut across the bolt top) work well).

- After all plots and transects are set up, locate several representative locations (on prominent spots) to install large hex bolts (e.g., 6 inch long by ½ inch dia) that will serve as **reference markers for relocating plots in the future** (if necessary) **and for fixed photopoint monitoring** (see below). These reference bolts should be placed centrally to groups of plots/transects to facilitate measurements and to allow overview photo pans to include nearby plots/transects. The number of reference/photopoint bolts will depend on site size and plot/transect distributions. An abalone-only site may need only 1 reference, while a large site with multiple target species assemblages may need 5 references.

- Ideally 1-3 **permanent benchmarks** can be established along the upper shore at each site, such as the Bureau of Land Management (BLM) accomplished in 2002-2004 at 19 of the MMS-sponsored mainland sites (from San Luis Obispo County to Orange County) (see Section 3 of Site Information Handbook (Engle 2008)). The monuments are bronze tablets, with 2 inch diameter caps and 2 inch stems, epoxied into a ¾ inch drill hole, with a magnet set in the hole bottom. The caps are marked "BLM", with the monument name (e.g., CAY1) and the surveyed point in the center of a small circle at the center of the cap. The precise coordinates (Datum NAD83 (1998)) include height measurements accurate to 0.2 ft vertical.

Site Mapping: It is important to **document the site location as well as the specific location of all plots and transects**. This can be done through a combination of directions to site, GPS coordinates, inter-plot measurements, sketch maps, plot overview photos, and aerial photos.

Site Directions: Briefly record **how to get to the site** (by car, boat, or on foot) from the monitoring team institution or city/base station closest to the site. Include waypoint mileages and estimated time to reach site.

GPS Coordinates: Record at minimum, **3 principal GPS coordinates** for each site: First, **a single latitude/longitude coordinate pair that defines the location** - preferably close to the physical center of the site. Permanent marker locations, such as the BLM markers or our Reference markers are preferred, or use the location of a specific target species plot. Then, the **two coastal boundaries of the site (north/south or east/west) should be documented**, ideally centered between high and low tide zones, but they could be the positions of the northern- or western-most plot and the southern- or eastern-most plot. Use the most accurate GPS unit available. Be sure to document who took the reading and when, the specific location (e.g., BLM Ref 1, MARINe Ref 2, MYT Plot 5, PHY Transect 3 Center Bolt), the type of unit used and its

accuracy, and the datum used (preferably NAD83 or WGS84). If possible, **record latitudes/longitudes as degrees with decimal minutes and seconds** (otherwise the coordinates must be converted to this decimal format for database entry).

Inter-plot Measurements: These measurements are valuable for site mapping and to aid relocation of plots on future samplings. **Record at least 3 pairs of distance** (to nearest 0.01 m) **and bearing** (to nearest 5°) **measurements from primary plot/transect bolt (# bolt) to closest 3 other plot/transect primary bolts**, preferably running in different directions. Also measure distance and bearing to nearest reference bolt. Be sure to properly record "from" and "to" bolt #'s. Additional measurements should be taken for other bolts of transects, between the bolts of irregular plots, between reference bolts, and between upcoast and downcoast boundaries of the site (defined as upcoast-most plot to downcoast-most plot).

Sketch Maps: From as much of an overhead perspective as possible, sketch the prominent features of the site (e.g., pinnacles, ridges, pools, boulders), with approximate **plot/transect locations shown relative to each other and to the physical features**. Scale relationships on sketch maps can be improved by incorporating the inter-plot measurements in a second draft of the maps. Indicate with a dot the primary marker location for quadrats and transects. For large sites, separate maps can be prepared for different sub-areas. Maps can be scanned into digital format for labeling and other enhancements.

Plot/Transect Overview Photos: Take lots of site overview photos (with digital camera) with plot quadrat frames and transect meter tapes in position. Put orange cones on reference markers. Photos can range from **broad views of large portions of the site to individual overviews of each plot and transect**. For the latter, include the area around each plot/transect to document location relative to nearby features. Plan to make prints of the best photos, label the plot/transect numbers on the prints, and organize in photo sheets in a binder to take on future surveys to aid relocation efforts.

Aerial Site Photos: If possible, take aerial photos of the site during low tide, with plot quadrat frames and transect meter tapes in position. Put orange cones on reference markers. This may be accomplished easily if the site abuts a high cliff. Another possibility being tested is use of a relatively small camera-mounted blimp tethered to a person who pulls it over the site and triggers snapshots. **A good aerial photo could greatly improve the site map** (see above).

Criteria for Adding or Dropping Plots/Transects: Target species abundances might decline dramatically in one or more plots or transects, due to changes in the biological community (e.g., ecological changes or zone shifts) or due to substrate disturbance from storm swells (including rock breakouts and boulder movements). Depending on the severity and persistence of the loss, we may no longer be monitoring the target species (except for its paucity in the plots), even though it could still be present elsewhere at the site. The following are recommendations for how to deal with these types of situations:

- **Greatly reduced or total loss of target species cover within one or more plots or transects should not trigger a decision to stop monitoring these plots** (and the plot should continue to be named after the originally-targeted species even if a different species now dominates). Continued monitoring is important to confirm this major loss over time or perhaps document later recovery. **If the target species remains low/absent in its targeted plot(s) for an extended period of time (perhaps 3 years), but shows reasonable cover elsewhere at the site, plan to add new plot(s) in areas with good cover.** For example, if Rockweed Plots #1, #2, and

#5 lose all rockweed for 3 years (apparently due to a zone shift) and Plots #3 and #4 still have good rockweed cover, in the 4th year establish 3 additional plots (#6, #7, and #8) in areas with similar cover to Plots #3 and #4. From this point on, all 8 plots will be monitored. It is **important to keep the plot numbers consistent** so that one can choose to follow the original plots (#1-#5) through all time or switch after 3 years to follow the good cover plots (#3-4 and #6-8).

If large countable target species such as abalone or seastars become low in the targeted plots and throughout the site, continue monitoring the plots, but also **institute site-wide timed search** (see below) during each survey (like having the entire site as one plot). This situation occurred for black abalone monitoring at Channel Islands sites when withering syndrome caused mass mortalities (Richards & Davis 1993), with practically no recovery to date.

- The above plan also is recommended for **situations where one or more plots have been subject to physical disturbance** such as breakout of the rock surface or movement of a previously stable rock. Typically this results in major reductions in key species cover that may or may not recover over time. Disturbed plots should continue to be monitored to document recovery or lack of recovery over time (replace any missing markers). If the disturbance has substantially changed the microhabitat or tidal height zone such that it is unlikely that recovery of the key species will occur, then add a replacement plot (or plots) with similar cover of the target species to what the original plot would have had if the disturbance had not occurred (based on the remaining undisturbed plots).

Plot Marker Maintenance: **Bolt and epoxy markers need to be cleaned of fowling growth during each survey to aid relocation during the subsequent sampling**. This is especially important for sites sampled only once per year. Stiff plastic or wire brushes and old table knives work well for cleaning markers, taking care not to disturb the rest of the plot. Loose markers should be repaired with fresh epoxy and missing markers replaced. An easy way to note photoplot marker condition is to record it directly on the plot corners of the Photoplot Sketch Data Sheet (Form 3).

3. SURVEY PROTOCOLS

3.1 Field Log and Site Reconnaissance Protocol

During each site monitoring survey, it is important to complete a field log (i.e., who, what, when, where) as well as to observe and record general physical and biological conditions at the site. Additional site-wide categorization of target and other core species abundance, appearance, and recruitment is useful whenever time permits. These observations, along with the habitat overview photographs, **provide valuable perspective on site dynamics that aid interpretation of data from the fixed, plots and transects**.

3.1.1 Completing the Field Log and Conducting Site-Wide Reconnaissance

Core Procedure: Field log information and site reconnaissance characterization are recorded on the two-page field log data form (Form 1a,b,c: Prototype MARINe Rocky Intertidal Field Log). Field log **data that must be recorded (required by database) include site, date, survey time, low tide time and height, and names of survey participants.** Core physical data that should be recorded include weather and sea conditions (swell/surge, wind, rain, recent rain, and water temperature), substratum changes (sediment level, scour, rock movement), and debris/

pollutants presence (plant wrack, driftwood, shells, dead animals, trash, and oil/tar). Relevant biological features that should be recorded include site-wide presence of birds, marine mammals, or humans; and abundance, appearance, and recruitment of target species (primary emphasis) and other core species (secondary consideration). To facilitate standardization and data management, many data entries are restricted to specific category codes (e.g., low, med, high). These codes and other terms are defined in Form 1c. Any additional information can be written as notes. All **data entry blanks on the field log should be filled in with a code, actual value, notes, or a dashed line indicating "no data".**

Physical Conditions: Emphasis is placed on **conditions that could affect quality of sampling**. Some physical conditions recorded in previous years (e.g., cloud cover) were deemed not relevant because the site is visited only 2 days a year. Water temperature can be useful to compare with satellite sea surface temperature records or buoy/thermister data.

Birds and Mammals: Core categories are listed and should be scored. Record maximum number seen at any one time during the sampling, preferably upon arrival at site prior to sampler disturbance. Other more specific categories or species may be added; however, this requires specifying a core taxon for "lumping" the more specific entry during database entry unless the species/higher taxon has officially been designated as an "optional species" (see above for optional species discussion). For example, a bird recorded as "crow" would be lumped with "other birds" during database entry unless the monitoring group designated "crow' as an optional species. Only score species within the defined site, either onshore or within 50 m of shore. Note relevant behaviors.

Humans: Record **maximum number of people seen at any one time during the sampling**. Especially check at low tide. Separate counts for people on the site reef and on nearby sand beach. Note relevant behaviors.

Species Conditions: Give **highest priority to scoring target species**, particularly those monitored at the site. Core species should be scored if possible or indicate "no data". Other species can be added for scoring if desired; however, they will not be entered in the MARINe database unless they have been designated as "optional species" (see above). To score, **consider the site-wide condition of the species within its optimum zone(s).** It is not practical to score for turf or other non-discrete algae and most small invertebrates where determination would be too time-consuming.

Guidelines:

- On a descending tide, it may be practical to start the field log and site reconnaissance upon first arrival at the site because many observations can be recorded before the tide is low enough for performing other tasks. Additional notes can be added later during the monitoring, or even afterwards, when more time is available to organize thoughts or confer with others. The **reconnaissance may take 30-60 min by 1 person** (less time if 2 or more persons participate), depending on site layout and complexity. If time is short, jot notes on blank paper, then transcribe to the data sheet shortly after the survey.

- Useful things to note include: general appearance of algae and encrusting animals, damaged patches of reef, signs of disease, **changes observed since last visit**, absence of animals or algae that might occur at the site, whether anything was done different from the standard methods, and problems encountered with equipment or locating plots.

Variations from and Additions to Core Procedures:

- Plot Marker Loss/Repair and Other Notes: These are **optional categories** that provide for additional information as desired. For example, under plot markers, note any problems with lost markers or difficult to find plots, record any repairs completed or newly installed bolts or plots. Identify problems that need to be fixed on the next visit. This section does not need to be entered in database, but can be checked when planning the next sampling trip. Notes on physical and biological conditions will contain useful information that should be entered in the database (as text entries) if possible.

- Survey Checklist: The **optional** survey checklist is used by some monitoring groups (e.g., UCSB) to mark off procedures done at a site to ensure that all tasks were completed.

- Visitor and Bird Census: **CABR separately monitors visitors and birds** as follows: Whenever possible, the number of people and birds (by species or by 3 ecological categories: wading birds, shore birds, and sea birds) are counted in the 3 CABR sites within 30 min of the low tide on those days throughout the year when the low tide falls between 1000-1600 hrs and is < 0.5 ft above MLLW.

3.1.2 Managing Field Log and Site Reconnaissance Data

Data are recorded on two data sheets (Form 1a,b: Prototype **MARINe Rocky Intertidal Field Log**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the core data and maintain an order consistent with database entry. Prior to Spring 2003, most data were not entered in any computer file. Now, **data are entered into the MARINe Microsoft Access database via a standardized data entry template** (see Bealer & Cooper 2003). This template requires field log information to be entered first, before other survey data can be entered. Field log and site reconnaissance data should be entered into the database entry template as soon as possible after the survey, while memories are fresh and questions can be resolved. All data sheets are organized into notebooks and archived.

3.2 Habitat Overview Photograph Protocol

As an adjunct to the fixed plot/transect sampling, **whenever possible, a habitat-level photographic record of the monitoring site should be made** during the seasonal survey to document larger-scale site conditions including habitat views of survey plots and transects, sand influence (beach level, scour or smothering effects), health of organisms (bleached plants, dead barnacles, etc.), interesting concentrations of species, recruitment events, extent of ephemeral algae, oil/tar presence and extent, evidence of people use and/or pollution, and any unusual phenomena. Periodic overview photos taken from the same viewpoint are particularly useful for putting individual permanent plots or transects into perspective with surrounding assemblages.

3.2.1 Photographing Habitats and Other Site Features

Core Procedure:

Fixed Photopoint Monitoring: Whenever possible, **sequential, overlapping habitat photos (approximately 5-10 m away) are taken (using either film or digital camera) while rotating the view area in a circular fashion from a fixed point marked with a bolt or epoxy**. Often the point is a reference bolt centered among a cluster of plots/transects (reference

bolt also facilitates relocation of plot/transect markers via distance/bearing measurements (see above)). **Delineate all possible plots/transects that will appear in the view with quadrat frames or meter tapes (if conditions permit).** To ensure repeatability of view areas, specific procedures must be written for each photopoint, including horizontal start view, vertical view, and extent of angular pan. Pans typically begin facing north or some major feature, then proceed clockwise or counter clockwise to **encompass a half circle (180°)or full circle (360°)**, depending on the extent of intertidal habitat surrounding the photopoint. Full circle pans can be printed as 2 separate 180° pans.

Other Photographic Documentation: **Whenever possible, photograph plots and transects that are not in view from the fixed photopoints**. It is especially useful to include photos of owl limpet and abalone/seastar plots, and point-intercept transects since these are not photographed for sampling. Each plot/transect should be photographed from a standard (generally unmarked) view point whenever possible (e.g., transect overview photographed from 3 m upcoast of transect start end; owl limpet plot photographed from 5 m away perpendicular to the plot). In addition, repeatable or one-time **photos can be taken to document particular site conditions** such as reef damage, sand levels or scouring, plant/invertebrate appearance (e.g., bleaching or epiphytes), recruitment events, ephemeral conditions, oil/tar presence, pollution, people activities, and any unusual phenomena.

Guidelines:

- Photopoints should be indicated on site maps.
- Salt water and sea spray can ruin cameras. Protective cases should be used or the monitoring group must plan to replace the camera if/when the camera gets wet.
- The same digital camera used for photoplots also can be used for overview photos. Digital cameras provide immediate feedback on image quality and simplify the organization, storage, and analysis of photos. Panoramic photos can be stitched together using available software programs.
- **Repeatability of image view areas is greatly enhanced if you carry print sheets in the field (that show the sequence of standard photo images) to guide aiming the camera**.
- Try to **take photographs during times of lowest tide and best light conditions** (e.g., closest to midday or when overcast). Avoid shooting into the sun, especially when low tides occur in the late afternoon. Avoid including sky, ocean, and tidepools in the view if possible because bright sky and highly reflective water can wash out portions of the image while under-exposing shaded reef areas (creating silhouette effects).
- If necessary, a monopod can be used to stabilize the camera for panoramic sequences.
- Quadrat frames can be split into 2-sided frames if many plots need to be delineated.

Variations from and Additions to Core Procedures:

- Overview Video: Prior to 2002, overview videotape records (including observational narration) often were made at monitoring sites during the seasonal surveys using an 8 mm camcorder. These video recordings provided much of the same visual documentation as the current photo overviews. They consisted of an overview of the entire site if possible from one or

more high cliff vantage points, beach level overviews of plots and surrounding habitats from fixed vantage points, and closer views of interesting phenomena. Complete procedures are described in Engle et al. (1994) and Engle and Davis (2000). The usefulness of video records for detecting population changes at the monitoring sites was evaluated by Rivas et al. (1997) and others within MARINe. Video advantages over film photos included in situ feedback on image quality, ease of recording extensive habitat areas, zooming features, and ability to add narration. However, disadvantages of video included coarse-grained images, susceptibility to flaring, and inconvenience of reviewing and analyzing videotapes. After extensive evaluation of video vs. film photo for habitat overview documentation, a switch was made to film photos in 2001/2002, primarily based on image quality and the ability to zoom in on high quality digital copies scanned from the film photo and stitch the scanned digital images together for panoramic views.

- Digital Photos: As the quality and affordability of digital cameras improved, they became an attractive alternative to film cameras. Digital cameras were tested in 2002 and approved for use by 2003. **By 2004, all monitoring groups were using digital cameras for field photography**.

3.2.2 Managing Habitat Overview Photographs

The same photo log is used as for photoplots (Form 2a,b: Prototype MARINe Rocky Intertidal Photo Log). This information is used for labeling the photos, but not entered into the computer database.

Film Photographs: After the film is developed and mounted into slides, the slides are labeled individually with site name, date, and image information. They are then arranged by site and photopoint or target species habitat into high quality polyethylene slide pages organized into notebooks and archived. **If duplicate slides exist, they should be stored in a separate location to minimize data loss in the event of some catastrophe such as fire or theft**. Eventually, all photo slides should be scanned at a relatively high resolution and copied to CD or DVD for archiving. A backup copy (on a hard drive or another CD/DVD) is recommended. One of the CD's or DVD's can be placed in a folder with the original datasheets and the other in a separate storage location.

Digital Images: The **protocol for managing digital images is still being developed**. Typically images are downloaded from the camera memory chip to a computer for organization and labeling. The images are backed up to CD or DVD for archiving. Photo database software programs are currently being evaluated.

3.3 Photoplot Protocol

Permanent photoplots are employed to monitor the cover of target species assemblages representing different intertidal zones (Tables 10-12). Plots are established at sites with sufficient cover of the target species for monitoring. Plots are sampled each spring and fall at sites south of San Francisco Bay and annually (in summer) at sites north of San Francisco Bay.

3.3.1 Photographing Photoplots

Core Procedure: The cover of target species as well as core and optional species (including higher taxa and substrates) is sampled by photographing **5 permanent 50 x 75 cm (0.375 m²) plots per target species** (see Table 7 for exceptions to plot size and number of

replicates), then **scoring point contact occurrences by superimposing a uniform grid of 100 dots on the photo image**.

Camera set-ups include 35 mm Nikonos waterproof camera, land cameras, or digital cameras with or without waterproof housings – all with added single or double strobe lighting. A **quadrapod apparatus is used to support the camera at a constant height (1 m with a 35 mm lens) and orientation to ensure consistent framing of each plot**. The quadrapod, constructed of PVC pipe, consists of a bottom photoplot-sized frame (50 x 75 cm internal dimensions) connected to a smaller camera frame by 4 poles. The lens of the camera is aligned to provide coverage of the entire plot. The quadrapod is placed over each plot in a consistent orientation, typically with the permanent plot number marker in the upper left corner. The plot number (also site, date, and target species) is written or otherwise set up on the quadrapod such that it will be recorded by the plot photo.

Specific photographic procedures vary depending on camera/strobe set-ups and **should be established by each monitoring team**. Resulting images must be of sufficient quality to consistently recognize target and core species when scoring. Unattached drift plants (e.g., giant kelp blades), large motile invertebrates that are not scored in photoplots (e.g., *Aplysia*; record count if doing motile invertebrate protocol), invertebrate debris (e.g., lobster exoskeleton or loose mollusk shell), or flotsam (e.g., driftwood) are removed prior to photographing plots (see Guidelines below). Otherwise, plot photos are taken "as is" without moving live organisms. For each consecutive photograph, record target species, plot number, and plot-specific notes (Form 2a,b: Prototype MARINe Rocky Intertidal Photo Log).

Guidelines:

- It is **important to properly locate and orient each photo so the same plot is sampled through time**. Over-view plot print photos (with plot frame in place) aid plot location and orientation of quadrapod if plot corner markers are obscured or missing.

- Cleaning plot corner markers aids in keeping overgrowth down so plots can more easily be located during the next survey.

- If algae such as rockweed must be moved to locate plot markers, be sure to return them to their original position for the photo.

- Waterproof camera/strobe set-ups protect sensitive equipment from salt spray and seawater, but can be bulky. Waterproof housings are subject to fogging if moist air is present between camera lens and housing. Place desiccant packs inside housing to minimize this problem.

- **Bracketing exposures helps ensure a good exposure for scoring and provides back-up photographs of each plot**.

- Strobes, preferably mounted laterally away from the camera, provide fill-in lighting to reduce shadows. A photographic umbrella will further reduce shadowing.

- Painting the white PVC gray or using gray Schedule 80 PVC for the bottom quadrapod frame reduces flaring (particularly evident with digital media) that may over-expose plot margins.

- The best quality photos are obtained by optimizing ASA (low requires more light while high becomes increasingly grainy), Aperture (small needs more light while large has poor depth of field), and Shutter Speed (slow increases likelihood of blurring while fast needs more light).

- **Remove large or abundant top-layer active motile invertebrates** (including *Aplysia*, *Lithopoma*, *Tegula*, predatory snails, hermit crabs) from photoplots prior to photo/scoring **if their presence significantly blocks scoring of topmost sessile cover** layer. Record appropriate data for removed individuals if plot is going to be sampled for motile invertebrates.

- **Do not remove sedentary motile invertebrates** (including chitons, limpets, black abalone, ochre seastars, purple urchins), particularly since they may be harmed by removal and displacement.

Variations from and Additions to Core Procedures:

- See footnotes in Table 7 for variations to core procedures (e.g., plot size and # replicates).

- CSUF does not use a quadrapod; they hand hold the camera while straddling the plot.

- CSUF uses a photographic umbrella to minimize shadows in the plot.

3.3.2 Sketching Plots and Taking Notes

Core Procedure: If time and resources permit, **rough field sketches and notes** are made of the distribution of organisms and substrates in each plot to **clarify species identifications when the photos are scored in the lab** (Form 3a,b: Prototype MARINe Rocky Intertidal Photoplot Sketch Data Sheet). For example, species that seem reddish in the field may look black in slides, and lighter-colored species like crustose corallines may not be obvious in photos. Code letters are used to indicate species in the plot sketch. Sketches and notes should take only a brief time for each quadrat (perhaps 1-2 min; thus a site with 25 plots might take 1 person up to 1 hr to complete (including time to move between plots)).

Guidelines:

- There is a temptation to get too detailed and spend too much time on sketching and noting. Keep in mind that this is just an aid to scoring. If too much effort is devoted to this task, then one might as well have scored the plot in the field, with more accurate results.

- It is not necessary to sketch obvious target or other distinct species.

- **It is preferable that the person who will score the data makes the sketches and notes**.

- Things to sketch/note include rock surfaces that may be confused with tar or crusts, tar spots, coralline and non-coralline crusts, sand depth (is it 5 cm or greater?), obviously dead invertebrate parts (e.g., shells, barnacle tests, *Phragmatopoma* tube fragments), un-removed drift algae fragments, bleached coralline algae, species recruits, closed anemones, motile invertebrates, uncommon species, unusual conditions, and obvious epibionts and layering – particularly as they affect the target and core species (e.g., algae atop mussels).

- Species scattered throughout the plot can be noted but not sketched.
- If possible, estimate extent of cover for sketched species or substrates.
- For barnacle plots where *Chthamalus* and *Balanus* are not distinguished in photo scoring, record quick visual estimate of % cover of each of these barnacle species (nearest 5%) whenever possible.
- The sketches are a good place to record plot corner marker conditions.

3.3.3 Scoring Cover in Photoplots – General Procedures

Core Procedure: Photoplots are scored from photographs or digital images in the laboratory, supplemented when possible by field plot sketches and notes. **Digital image scoring has become the standard since 2002/2003** because computer software provides a more convenient method of scoring images (e.g., ability to zoom and to enhance image quality). For film photographs, each slide is projected onto a white board that is marked with a grid of one hundred evenly-spaced points (10 x 10). Species, higher taxa, or substrates beneath the points are identified and recorded. When scoring digital images, a **grid of one hundred evenly-spaced points (10 x 10) is created on the computer monitor** (using Adobe Photoshop), and placed on a separate layer. This allows the scorer to easily remove the dot to see what lies beneath. The image can then be saved with the "grid layer", clearly documenting the exact points scored. With either film or digital image scoring, grid size is manipulated to provide complete coverage of the plot within the quadrapod frame. Layering is not scored separately, so the total cover is 100%.

Film photographs of each photoplot have been scored in the lab by all groups from their initial survey dates until 2002/2003, except CINP has scored their photoplots in the field whenever practical since 1991, and UCSC began scoring acorn barnacle plots in the field in 2001 (see below). **If field scoring is done, the field protocol must be carefully specified to assure comparable results to photo scoring**. For example, discrepancies could arise because it is easier to identify species and to determine layering and epibiont conditions in the field versus lab. For consistency, it is preferable to use the same plan (either field or lab scoring) at given sites over time. If field scoring, plot photos should still be taken and "field scored" should be noted on the photoplot score sheet.

Variations from and Additions to Core Procedures:

- Switch to Digital Image Scoring: CSUF, UCSC, and UCLA began scoring digital photoplot images for all sites on a computer monitor in Fall 2002, except Bird Rock and Little Harbor photoplots were scored digitally beginning Spring 2003. UCSB began digital scoring in Spring 2003.
- Field Scoring: **CINP switched to field scoring whenever practical since 1991** for the following reasons: 1) Samplers sometimes had sufficient expertise and time in the field when sea conditions were mild enough to score in situ, 2) Field scoring is more accurate than scoring from photos, 3) Data are preserved if something happens to photos prior to lab scoring, and 4) Office demands made it difficult to find time for lab scoring. Plots are field scored using a collapsible 50 cm x 75 cm frame divided by 10 evenly-spaced string lines. With the frame over the plot, a narrow steel rod is placed across each string in sequence (using predetermined slots) to create 10 intersection points per string, making 100 points total under which organisms are

identified and recorded. Use of a multi-tally meter (tally-clicker) helps facilitate counting of multiple species.

- Acorn Barnacle Plot Field Scoring: **UCSC switched to field scoring of acorn barnacle plots in Spring 2001** in order to separately monitor live and dead (empty tests) *Chthamalus dalli/fissus*, *Balanus glandula*, and *Semibalanus cariosis*. They added the following categories to their optional species list for barnacle plots only: *S. cariosis* and dead *S. cariosis* (starting Fall 2000), live *C. dalli/fissus* and live *B. glandula* (starting Spring 2001), and dead *C. dalli/fissus* and dead *B. glandula* (starting Fall 2001). Acorn barnacle plots are scored in the field using a 50 cm X 75 cm frame with a 10 X 10 grid of evenly-spaced string lines. With the frame over the plot, a species, higher taxon, or substrate is identified below each of the 100 string intersection points.

3.3.4 Scoring Cover in Photoplots – Specific Procedures

Core Procedure: **Each of the 100 points within the photoplot is identified and scored as one of 46 categories of core species, higher taxa, or substrates** (Table 5 & Form 4: Prototype MARINe Rocky Intertidal Photoplot Slide-Scoring Data Sheet). Definitions for the lumped taxa and substrate categories are provided in Table 6. Monitoring groups can opt to score photos in greater taxonomic detail (e.g., some groups identify all organisms to the lowest level possible); however, finer-scaled data must be lumped to fit the core categories for database entry unless optional species have been formally registered with the database (requiring a commitment to consistently score the species in all surveys) (see above for optional species discussion). Prior to establishing core species, monitoring groups scored target species similarly, but secondary species categories varied somewhat among monitoring groups and through time (relational tables have been established in the MARINe database to document and standardize these lists, but the effort is not complete). An advantage of photos is that they can be rescored for standardization purposes or if a more thorough inventory becomes necessary (e.g., in the event of an oil spill). Layering is not scored separately, so the total percent cover is constrained to 100% (see below). **The following are core rules for photo scoring:**

- **Always score the top-most (visible) layer that is attached to the substrate (i.e., not an obvious epibiont) unless the top-most layer is a "weedy" species obviously overlaying a non-weedy species.** This rule applies regardless of the target or core species involved. The rule was formulated to work consistently for scoring from photos, supplemented when possible with rough plot sketches and brief notes. "Obvious" means that the layering can be discerned from the photograph or is clear from the brief field sketch/notes (e.g., a plot noted in the field to have 100% cover of mussels topped with weedy algae). Examples of epibionts include algae (e.g., crusts, articulated corallines, *Endocladia*) or invertebrates (e.g., barnacles or limpets) on live mussel shells or *Tetraclita* tests. Examples of "weedy" species include *Ulva*, *Enteromorpha*, *Endarachne*, *Porphyra*, and *Scytosiphon*. The top-most rule eliminates much of the uncertainty of trying to determine what lies below the upper layer, does not bias for or against target species, and generally keeps the photograph as the primary source of archival data (rather than some difficult to reconstruct combination of photo, plot sketch, and/or field scoring). This method will underestimate target species cover whenever the target species is covered by another species (e.g., by rockweeds or any plant whose attachment lies outside the plot). Such situations should be noted and considered when evaluating data trends. Though desirable, scoring cover of understory target species is too complex and time consuming to fall within the scope of this core

laboratory-scored monitoring protocol. **Monitoring groups have the option to separately score epibionts or other layering; however, the current MARINe database is not capable of accepting the layered data**. Fortunately layering is not a major issue for most target species, except in plots where rockweeds occur.

- **Score sedentary motile invertebrates occurring under a photopoint as one of the following core categories: *Lottia gigantea*, limpet, chiton, *Pisaster ochraceus*, or other invertebrate.** Since black abalone and purple urchins are rarely encountered (if at all) in photoplots, they have not been designated as core species for this protocol. If encountered, they would be scored as "other invertebrate". **If an un-removed active motile invertebrate occurs under a photopoint, score what is likely underneath it if possible; otherwise, score the point as "unidentified"** (do not score the active motile invertebrate as "other invertebrate"). For example, the predatory snail *Mexacanthina* in CABR photoplots should be counted as an active motile invertebrate, not scored as sedentary invertebrate cover.

- **Score bleached crustose corallines (appearing white) as "crustose corallines", not "rock".** Bleached crustose corallines may still be alive, so assume they are live and score as such.

- **Score obviously dead barnacle tests, dead mollusk shells, and other non-living substrates that are not "rock", "sand" or "tar" as "other substrates".** This "other substrates" category was established in 2004. In prior years, dead shells and tests were scored primarily as "rock". UCSC scores each dead barnacle species separately in the field as an optional category. It is a more accurate determination that can be done with experienced samplers scoring in the field; however, these data must be lumped to the core category "other substrates" when comparing data with other MARINe sites scored from photos. When scoring from photos, if it is not obvious whether white acorn barnacles are live or dead, they must be assumed to be live and scored as "*Chthamalus dalli/fissus/Balanus glandula*". Larger, dead *Tetraclita* tests might be obvious in a photo, and if so, should be scored as "other substrates".

- **Epoxy corner markers and bolts should be scored as "rock".**

- **When sand is present under a point in the photo, if you can positively identify what is under the sand, then score the underlying core species or "rock"; otherwise score "sand".** This means that "sand" will be scored whenever sand thickness is greater than just a thin layer with patches of rock or some core species showing through.

Guidelines:

- If *Chthamalus* occurs as an epibiont on *Tetraclita*, score the point as "*Tetraclita*".

- If one species of rockweed overlays another species of rockweed, simply score the top layer as is, without moving either species. If a rockweed is obviously overlaying a mussel, score the rockweed because it is the top layer, is not an epibiont, and is not a "weedy" species.

- **If plant species are attached outside the plot but draping over target or core species in the plot, score the overlying species (if it is not a "weedy" species) without regard to place of attachment.** For example, in the rare case where *Egregia* drapes across a mussel plot, leave it in place and score it as the top-layer species (but note on the Sketch Data Sheet what it is covering). Ideally one would like to follow the target or core species despite over-

draping, but in practice it would be too complex for field samplers to record and would likely lead to inconsistencies.

Variations from and Optional Additions to Core Procedures:

- Prior to establishing core species, non-target species categories varied among monitoring groups and through time. Relational tables have been established in the MARINe database to document and relate these species variations to core categories, but the effort is not complete (see Database User Guide: Bealer & Cooper 2003).

- CSUF scores all species layers evident in plot photos, but only transfers to the MARINe database those data that fit core rules.

3.3.5 Managing Photoplot Data and Photographs

Photoplot Data: The Photo Log and Photoplot Sketch Data Sheets are completed in the field (Forms 2 & 3), but not entered into the computer database. With either lab or field point scoring, data are recorded on data sheets (Form 4: Prototype **MARINe Rocky Intertidal Photoplot Slide Scoring Data Sheet**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the core data and maintain an order consistent with database entry. Prior to Spring 2003, data were entered into various computer spreadsheets or databases by the different monitoring groups. Now, data are entered into the MARINe Microsoft Access database via standardized data entry templates (see Database User Guide: Bealer & Cooper 2003). Photoplot data should be entered into the database entry template as soon as possible after scoring, while memories are fresh and questions can be resolved. All data sheets are organized into notebooks and archived.

Photographs: After the film is developed and mounted into slides, the slides are labeled individually with site name, date, target species and plot number. They are then arranged by site and target species into high quality polyethylene slide pages organized into notebooks and archived. **If duplicate slides exist, they should be stored in a separate location to minimize data loss in the event of some catastrophe such as fire or theft.** Eventually, all photo slides should be scanned at a high resolution and copied to CD or DVD for archiving. A backup copy (on a hard drive or another CD/DVD) is recommended. One of the CD's or DVD's can be placed in a folder with the original datasheets and the other in a separate storage location.

Digital Images: The protocol for managing digital images is still being developed. Typically images are downloaded from the camera memory chip to a computer for organization and labeling. The images are superimposed with the dot grid in Adobe Photoshop for scoring. Original images and dot grid sets of images are backed up to CD or DVD for archiving. Photo database software programs are currently being evaluated.

Digital Photoplot Image File Naming Standard: The rationale for the photoplot file name standard includes the following:

- Photo file name must be easy to understand and implement and compatible with typical database style.

- Photo file names should not use spaces or special characters. Underscore is OK as a separator.

- For simplicity and reducing possibility of errors, photo file names should include only lower case letters.
- Even though a photo database can organize files based on key words, etc, it is best if file names are descriptive and display in a logical order. However, not all information needs to be included in the file name (directories can be used to separate some broad categories), and the file name should not be lengthy (<20 characters preferred).
- There are 6 main types of info that have been incorporated into MARINe photoplot file names. This hierarchy (in order from general to specific) is as follows:

1) **Site**: use our standardized 3-5 letter codes (lowercase) to conform with the database.

2) **Target Species**: Use the first 3 letters (lowercase) of the target species plot names in the database (see Table 7). Using fewer than 3 letters could lead to ambiguities, while more letters unnecessarily lengthens the file name.

3) **Plot Number**: Plot identifiers should conform to consecutive #'s starting with "1" if possible (e.g., 1, 2, 3, 4, 5 ...). Other unique and consistently applied plot #'s can be used (e.g., 212, 213,…); however, for simplicity in labeling, mapping, and database operations, we should strive to convert to the "1, 2, 3, 4, 5" format when feasible.

4) **Date (Season/Year)**: Most of core MARINe sampling takes place semi-annually, in fall and spring, though some northern sites are sampled annually, in summer. Due to the nature of our sampling schedules (including limited # of adequate low tide periods, site access limitations and weather delays), we have defined 3 sampling seasons (no winter), each 4 months long as follows: "Fall = October-January, Spring = February-May, and Summer = June-September (This does not quite match the calendar year; thus a sample in January 2005 would be listed as a Fall 2004 sample).

Seasons will be abbreviated as lowercase 2-letter codes (Fall = fa, Spring = sp, Summer = su) and years will be abbreviated as the final 2 digits (e.g., 1997 = 97, 2004 = 04). Using these codes means the file names as listed in alphanumeric order will group all Fall photos, followed by all Spring photos, and then all Summer photos. Also years in the new century (2000's) will sort out before the 1900's. This partial breakdown of chronological order was not considered significant enough to change to lengthier and less intuitive file names since the eventual implementation of a photo database will allow all kinds of sorts, including chronological.

5) **Photo Replicate:** For each photoplot sampling, there will be at least 2 photos to store: 1) the photo used for scoring and 2) that same photo overlain with the grid of 100 dots). In addition there may be 1-2 or more other photos, often representing different exposures (e.g., 1 more overexposed and 1 more underexposed) (Note: we should not label and organize photos that we are unlikely to use, such as duplicate exposure or poor quality extra photos). To differentiate the various photos for a given plot, we will add a single lowercase letter after the year in the file name as follows:

"a" = scored photo (no dot grid)

"b", "c", "d", "e", or "f" = additional photos taken (e.g., different exposures)

"g" = scored photo overlain with dot grid

6) **Photo Variants**: For some plots, there may be photos taken from different perspectives or of different subsections of the plot. For example, if plot lies over a ledge, 1 photo may be taken with the frame mostly horizontal and another photo taken more vertically. Another example: CSUF takes separate photo of each ¼ of the barnacle plots to get better resolution for scoring. To differentiate these types of photos in the relatively few circumstances when they occur, we will add an appropriate code at the end of the file name, such as (these example codes could be changed if other designations are found to be more appropriate):

"horiz" = horizontal or "vert" = vertical

"ul" = upper left, "ur" = upper right, "ll" = lower left, or "ul" = lower right quadrants

Based on the above criteria, the MARINe photoplot digital photo name standard is:

"site" "_" "target species" "plot #" "_" "season" "year" "replicate" "_" "variant"

Photoplot File Name Examples:

psn_maz2_fa04a.jpg = Pt Sierra Nevada, Mazzaella Plot #2, Fall 2004, Replicate "a" (scored photo)

psn_maz2_fa04b.jpg = Pt Sierra Nevada, Mazzaella Plot #2, Fall 2004, Replicate "b" (different exposure)

psn_maz2_fa04g.jpg = Pt Sierra Nevada, Mazzaella Plot #2, Fall 2004, Replicate "g" (dot grid photo)

shco_sil5_sp05a.jpg = Shaws Cove, Silvetia Plot #5, Spring 2005, Replicate "a" (scored photo)

shco_cht3_sp05a_ul.jpg = Shaws Cove, Chthamalus/Balanus Plot #3, Spring 2005, Replicate "a" (scored photo), upper left quadrant

care_pol4_fa03b_vert.jpg = Cardiff Reef, Pollicipes Plot #4, Fall 2003, Replicate "b", vertical emphasis

bml_myt1_su04g.jpg = Bodega, Mytilus Plot #1, Summer 2004, Replicate "g" (dot grid photo)

3.4 Point-Intercept Transect Protocol

Permanent point-intercept transects are employed to **monitor the cover of 3 target species: *Phyllospadix scouleri/torreyi* (33 sites), *Egregia menziezii* (3 sites), and Red Algae (turf algae, including articulated corallines and other red algae) (7 sites)** (Table 8). Transects are established at sites with sufficient cover of the target species for monitoring.

3.4.1 Scoring Cover on Point-Intercept Transects

Core Procedure: The cover of target species, as well as secondary core and optional species/taxa/substrates, is sampled each spring and fall by scoring point-intercepts along 3 permanent 10 m transects (see Table 8 and below for exceptions). Transects, which are marked at both ends (and often the center) with stainless steel bolts, usually are separate, but may run end to end depending on the shape and expanse of the target species habitat. Each transect is sampled by scoring occurrences under 100 points uniformly distributed at 10 cm intervals (10 cm, 20 cm, 30 cm …1000 cm) along a meter tape laid out along the transect. **Rules for scoring are as follows:**

Each of the 100 points along the transect meter tape is located and scored as one of 24 categories of core species, higher taxa, or substrates (Table 5 & Form 5). Only the topmost (visible) layer that is attached to the substrate (i.e., not an obvious epibiont) is scored, except that surfgrass is also scored separately when it is covered by another non-

epibiont species (see below). For example, if *Egregia* drapes across articulated corallines, leave it in place and score it as the top-layer species. Definitions for the lumped taxa and substrate categories are provided in Table 69. Monitoring groups can opt to score transects in greater taxonomic detail; however, finer-scaled data must be lumped to fit the core categories for database entry unless optional species have been formally registered with the database (requiring a commitment to consistently score the species (if present) in all surveys) (see above). Some monitoring groups previously recorded each point in order along the transect from start to end (generally north to south). This was deemed not necessary, so for efficiency the core method is to simply record the number of "hits" in each category without regard to position along the transect.

***Phyllospadix* is scored in either of 2 categories: "*Phyllospadix* Overstory" and "*Phyllospadix* Understory".** This procedure, initiated in Fall 2002, documents surfgrass even when it is covered by another species. Total transect cover will be greater than 100% whenever understory surfgrass is scored. Since any amount >100% cover represents understory surfgrass only, compatibility with previous "top-layer only" scoring is maintained. Scoring other understory species, though possible in the field, would be tedious and impractical (especially when transects are periodically awash) given personnel and time constraints. Except in San Diego County, all transects target surfgrass, so it is logical to deal with layering only when surfgrass is covered by another plant (e.g., *Egregia*). The categories "*Egregia* on *Phyllospadix*" or "*Phyllospadix* on *Egregia*" were scored by UCSC during 2002; thereafter, this practice was discontinued.

Score obviously dead barnacle tests, dead mollusk shells, and other non-living substrates that are not "rock", "sand" or "tar" as "other substrates". This "other substrates" category was established in 2004. In prior years, dead shells and tests were scored primarily as "rock".

Epoxy corner markers and bolts should be scored as "rock".

When sand is present under a point along the transect, score "sand" whenever the sand cover is 2 cm or greater; otherwise score "rock" or the underlying core species. This is determined by probing with the index finger, with 2 cm roughly being the distance from fingertip to the first joint. Note that the field-scored transect definition of "sand" is different than that for lab-scored photoplots (see above).

In addition to scoring point intercepts, abundance (none, low, med, high) of the following surfgrass epiphyte and appearance conditions are categorized for the transect areas: *Smithora* and *Melobesia* epiphyte cover, bleached and abraded appearance, and presence of flowers. Other notes may be recorded.

Guidelines:

- Minimize disturbance of surfgrass or algae along transects when laying out meter tapes. If vegetation must be moved to locate marker bolts, be sure to return it to its original position.

- Wave surge can rearrange surfgrass and other algae along the transect depending on the extent of low tide and sea conditions. Try to survey the entire transect during a period when the tape and grass are undisturbed. If this is not possible, get help to hold the tape in place and score during the calm periods.

- "Surfgrass" is scored under a point no matter what its appearance (bleached, abraded, etc.). Leaves, flowers, and rhizomes all are scored as "surfgrass".

- If possible, photograph each transect (lengthwise) during the seasonal monitoring to document the species assemblage and appearance.

Variations from and Additions to Core Procedures

- The footnotes in Table 8 describe variations to the core protocol with respect to transect length and number of replicates.

- Line-Intercept: The original method for scoring transects (developed at the CABR sites) used line-intercepts, where the sampler scored the core taxa and substrates lying under the entire edge of the 10 m transect tape. Line cover extents were rounded off to the nearest centimeter, thus 1000 separate segments were scored, then divided by 10 to get % cover. **UCSB and CABR scored line intercepts for all transects at their San Diego County sites until Fall 2000, when both groups switched to the point intercept method to standardize with other monitoring groups** (Pete Raimondi had compared the 2 methods and found that the point-intercept sub-sampling (100 versus 1000 data points) yielded similar cover results for surfgrass). Line-intercept data have been entered in the MARINe database, as percentage values just like the point-intercept values.

- Surfgrass Thickness: **As an optional procedure, UCSC collects information on thickness of the surfgrass layer.** Each transect is divided into ten 1 m long segments. If the entire segment is covered by surfgrass, surfgrass layer thickness is measured in the segment middle. If surfgrass covers only a portion of the segment, thickness is measured in the middle of the covered portion. To measure surfgrass thickness, lowermost through uppermost layers are compressed together (not bunched), then measured with calipers. These data have not been entered in the MARINe database.

- Surfgrass Species Separation: **As an optional procedure, UCSC records the percent cover of *Phyllospadix torreyi* vs. *Phyllospadix scouleri* along each transect** by estimating the proportion of each species for surfgrass covered areas. Overlapping morphological characters (e.g., leaf width 1-2 mm for *P. torreyi* vs. 2-4 mm for *P. scouleri*) and paucity of flower stalks (which can distinguish the 2 species) make species separation difficult. If transect sections contain surfgrass that is difficult to identify, the percentage of each species is based on the proportion of the transect that can be confidently identified. These data have not been entered in the MARINe database.

- **CSUF scores all species layers in point transects**, but only transfers to the MARINe database those data that fit core rules.

3.4.2 Managing Point-Intercept Transect Data

Data are recorded on data sheets (Form 5: Prototype **MARINe Rocky Intertidal Point-Intercept Transect Data Sheet**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the core data and maintain an order consistent with database entry. Prior to Spring 2003, data were entered into various computer spreadsheets or databases by the different monitoring groups. Now, data are entered into the MARINe Microsoft Access database via standardized data entry templates (see

Database User Guide: Bealer & Cooper 2003). Point-transect data should be entered into the database entry template as soon as possible after scoring, while memories are fresh and questions can be resolved. All data sheets are organized into notebooks and archived. Any photographs are archived in notebooks, with digital images stored on CD's or DVD's.

3.5 Owl Limpet Plot Protocol

Permanent plots are employed at **43 MARINe sites** to monitor the density and size distribution of owl limpets (*Lottia gigantea*) (Table 8). Plots are established at sites with sufficient densities for monitoring.

3.5.1 Counting and Measuring Owl Limpets in Plots

Core Procedure: The density and size distribution of owl limpets are monitored each spring and fall to follow population dynamics within **5 permanent 1 m radius circular plots** per site (see Table 8 and below for exceptions). Plots were established in areas of high density to obtain as many counts and measurements for size-frequency as possible (preferably >20 individuals/plot for a total of >100 per site). Therefore, plot densities reflect maximum densities rather than average densities at each site. Plots are marked with one center bolt, notched to indicate the plot number. Limpets are measured within a circle (1 m radius, 3.14 m^2 area) projected around each bolt.

To survey a plot, a 1 m length of line or tape is attached to the center bolt and arced around to form a circle. The **maximum length of all owl limpets ≥15 mm** found within that circle (including those touched by the 1 m mark) are measured with calipers to the nearest millimeter, then temporarily marked with a yellow forestry crayon to avoid scoring duplication. If a limpet cannot be measured directly by the calipers (due to tight crevices or other irregularities), its size is estimated. **Limpets are never removed from the rock**. The measurement tape is either pulled taught along the topography of the substrate (i.e., if a limpet can be touched by the end of the line, it is included) or laid more loosely along the topographic contours (CINP & UCSC) to determine which limpets lie within the circle, with the method of choice employed consistently at each site. Some monitoring groups (e.g., UCSB) include limpets in narrow crevices within the circle even if the limpet cannot be touched by the line.

Guidelines:

- **It is important that each monitoring group documents its rules for delineating owl limpet plot boundaries so that plots are surveyed consistently.**

- To ease decisions about plot boundaries for plots on irregular rock surfaces, take a print photo (if possible) of each plot with a line or series of markers indicating the plot boundary, then use the prints in the field to confirm plot edges. Add notes about plot irregularities if necessary.

- Observers must refine their search image to locate owl limpets in narrow crevices and those covered with barnacles or algae. It helps to look through the plot from different angles of view. It is good practice to have a second scorer search the plot for limpets possibly missed by the first scorer. Also, *Lottia gigantea* may be confused with other large limpets (especially large *L. pelta* or *L. limatula*).

- Plot observations should be recorded on the data sheet, including obvious scars from missing limpets and any evidence of predation.

- If possible, photograph each owl limpet plot at least once a year to document the species assemblage and appearance.

Variations from and Additions to Core Procedures

- See footnotes in Table 8 for variations to core procedures (e.g., plot size, shape, and # replicates).

- Small owl limpets: The 15 mm minimum size for counting and measuring owl limpets was implemented during the initial design of this monitoring (at CABR) to reduce variability associated with increasing difficulty in locating and identifying smaller sizes of *Lottia gigantea*. Small owl limpets can be hidden in tiny crevices and may look similar to other limpet species, except to experienced samplers. **As an optional protocol, UCLA has recorded all owl limpets ≥ 10 mm since 1999, and UCSC records all limpets identified with no minimum size.** Data for owl limpets <15 mm shell length have been entered in the MARINe database; however, such data can result in incompatible comparisons of mean sizes and size-frequency histograms.

- **CINP samples annually in fall, unless the site is visited only in spring**.

3.5.2 Managing Owl Limpet Plot Data

Data are recorded on data sheets (Form 6: Prototype **MARINe Rocky Intertidal Owl Limpet Data Sheet**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the core data and maintain an order consistent with database entry. Prior to Spring 2003, data were entered into various computer spreadsheets or databases by the different monitoring groups. Now, data are entered into the MARINe Microsoft Access database via standardized data entry templates (see Database User Guide: Bealer & Cooper 2003). Owl limpet data should be entered into the database entry template as soon as possible after scoring, while memories are fresh and questions can be resolved. All data sheets are organized into notebooks and archived. Any photographs are archived in notebooks, with digital images stored on CD's or DVD's.

3.6 Black Abalone and Ochre Seastar Monitoring Protocol

Permanent plots or transects are employed to monitor the density and size distribution of black abalone (*Haliotis cracherodii*) and ochre seastars (*Pisaster ochraceus*) (Table 8). Plots/transects were established at sites with sufficient densities for monitoring. At most other sites, timed searches are used to document the absence or rarity of these species.

3.6.1 Counting and Measuring Black Abalone and Ochre Seastars

Core Procedure: The number and size of black abalone and ochre seastars are monitored each spring and fall within irregularly-shaped plots or along band transects, depending on site topography. **3-5 plots/transects generally were established in areas of high density to obtain as many counts and measurements for size-frequency as possible** (preferably >20 individuals/plot for a total of > 60-100 animals per site; primarily for black abalone). Irregular plots are marked by four or more "corner" bolts, one of which is notched as the plot number bolt.

These markers were placed on conspicuous (i.e., higher) rock features to ease relocation efforts, thus plot boundaries may include habitat unsuitable for abalone or seastars. For this reason, **irregular plots were not intended to provide densities for comparison between sites**. They were designed to provide temporal comparisons within a site. Seastar transects are 2 x 5 m; abalone transects are 1 x 10 m (see Table 8 and below for exceptions). Transects are marked at both ends (and often in the center) by bolts. At some sites, the same plots or transects are used to monitor both species.

To survey a plot or transect, once the tide is low enough, a meter tape (or line) is laid out along the transect length or around the irregular plot perimeter. Transects are surveyed by moving a 1 m wand down each side of the 2 x 5 m transects or down the center of the 1 x 10 m transects. All seastars or abalone present (wholly or in part) under the path of the wand are recorded and measured. For irregular plots, the entire area encompassed by the boundary tape (or line) is searched carefully. Seastars and abalone are included if any part of the animal is inside the plot.

Abalone shell lengths are measured with calipers or a ruler to the nearest 5 mm for animals <40 mm and the nearest 10 mm for larger abalone (CINP measures to the nearest mm). Each abalone is temporarily marked with a yellow forestry crayon to avoid duplication. Sometimes it is necessary to estimate lengths for abalone lodged deeply in cracks or otherwise inaccessible. Abalone are never removed from the rock. **Seastars are measured from the center of the disc to the tip of the longest ray with calipers to the nearest 5 mm for animals <10mm and the nearest 10 mm for larger seastars.** Often sizes must be estimated because seastars typically are wedged in tight spots with rays curved. Seastars should never be "straightened" or removed from the rock. CINP began measuring *P. ochraceus* in 2002 using estimated size classes (<50, 50-100, >100 mm). Starting Spring 2003, CINP switched to different size classes (<75, 75-150, >150 mm). UCLA and UCSC began recording seastar sizes in Fall 2000.

Guidelines:

- **Each monitoring group should document its rules for delineating abalone/seastar plots or transects so that areas are surveyed consistently**.

- Observers must refine their search image to locate abalone and seastars in deep or narrow crevices. Use a waterproof flashlight if necessary to see into dark areas. It helps to look through the plot from different angles of view. It is good practice to have a second scorer search the plot for abalone/seastars possibly missed by the first scorer.

- At some sites, seastar counts may be variable because these motile invertebrates move outside the plots/transects. If plot/transect boundaries are extended to reduce this variability, separate counts for old and new plots/transects are necessary to maintain compatibility with prior data.

- If possible, photograph each abalone/seastar plot or transect at least once a year to document the species assemblage and appearance.

Variations from and Additions to Core Procedures:

- The footnotes in Table 8 describe variations to the core protocol with respect to plot and transect sizes and shapes and number of replicates.

- In 2003 UCLA added large irregular plots for seastars at Arroyo Hondo, Carpinteria, and Old Stairs (3 replicates each). These plots are monitored in addition to the existing band transects (but scored separately) to provide larger search areas for seastars.

- Other abalone and seastar species: As an optional procedure, some monitoring groups also record number and sometimes size data for green abalone (*H. fulgens*), bat stars (*Patiria miniata*), sun stars (*Pycnopodia helianthoides)*, giant-spined stars (*Pisaster giganteus*), and fragile stars (*Astrometis sertulifera*).

- Ochre Seastar Color: As an optional procedure, UCSC has recorded color categories (orange or not orange (purple/brown)) of *Pisaster ochraceus* since Spring 1996. UCLA began recording these colors in Fall 1999.

3.6.2 Timed Search Protocol

Core Procedure: Site-wide timed searches have been **employed at locations where abalone and seastars have been absent or exist in too few numbers to monitor within replicated plots or transects**. The purpose of timed searches is to document absence/rarity or to recognize a population increase such that monitoring in replicated plots could be instituted. This method is primarily qualitative (indicating levels of abundance) because time limitations prevent a thorough search of the entire site and low tide/swell conditions affect the lower boundary accessible for searching. To survey (around the time of low tide), one person spends 30 min (or 2 persons 15 min each) searching appropriate abalone/seastar habitats (e.g., crevices and pools) along the low intertidal zone throughout the defined site (between upcoast and downcoast boundaries) for possible occurrences of ochre seastars or black abalone. Numbers encountered and sometimes size measurements are recorded.

Guidelines:

- **It is important that each monitoring group documents its rules for delineating timed search boundaries so that areas are surveyed consistently**.

- Observers must refine their search image to locate abalone and seastars in deep or narrow crevices. Use a waterproof flashlight if necessary to see into dark areas.

- If abalone or seastars show up in moderate numbers during timed searches over several sampling seasons, consider setting up fixed irregular plots (3 replicate plots) of sufficient size for adequate long-term quantitative monitoring.

Variations from and Additions to Core Procedures:

- Other abalone and seastar species: As an optional procedure for timed search sites, some monitoring groups also record number and sometimes size data for green abalone (*H. fulgens*), bat stars (*Patiria miniata*), sun stars (*Pycnopodia helianthoides)*, giant-spined stars (*Pisaster giganteus*), and fragile stars (*Astrometis sertulifera*).

- Ochre Seastar Color: As an optional procedure, some monitoring groups record color categories (orange or not orange (purple/brown)) of *Pisaster ochraceus*.

3.6.3 Managing Black Abalone and Ochre Seastar Plot Data

Data are recorded on data sheets (Form 7: Prototype **MARINe Rocky Intertidal Abalone and Seastar Data Sheet**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the core data and maintain an order consistent with database entry. Prior to Spring 2003, data were entered into various computer spreadsheets or databases by the different monitoring groups. Now, data are entered into the MARINe Microsoft Access database via standardized data entry templates (see Database User Guide: Bealer & Cooper 2003). Abalone/seastar data should be entered into the database entry template as soon as possible after scoring, while memories are fresh and questions can be resolved. All data sheets are organized into notebooks and archived. Any photographs are archived in notebooks, with digital images stored on CD's or DVD's.

3.7 Northern Sea Palm Monitoring Protocol

Northern Sea Palms (*Postelsia palmaeformis*) are counted within grid transects at some sites in central and northern California where there are sufficient abundances for monitoring (Table 8). At other sites, presence or relative abundance of northern sea palms is noted during site-wide species reconnaissance and recorded on the Field Log (Form 1b).

3.7.1 Counting Northern Sea Palms in Grid Transects

Core Procedure: The density of Northern Sea Palms are monitored each spring and fall (or annually) to follow population dynamics in permanent grid transects whose size and number vary by site. Meter tapes are laid out between permanent bolts to define the survey area. Each area is subdivided into a grid of 1m x 1m quadrats (except 1m x 1.5m at Mal Paso & 1m x "swath to water line" at Scott Creek & Sand Hill Bluff). Within each quadrat, all intact *Postelsia* stipes are counted and recorded. The relative abundances of recruits and adults are noted.

Site-specific grid arrangements are as follows:

Fogarty Creek: 1 area: a 9m transect line with 1m x 1m quadrats in each direction (18 quadrats total).

Shelter Cove: 3 areas: each made up of a 5m long transect line with 1m x 1m quadrats in each direction (30 quadrats total).

Sea Ranch: 2 areas: A 5m transect line and a 7m transect line, both with 1m x 1m quadrats in each direction (24 quadrats total).

Scott Creek: 2 areas: A 20m transect line with a swath quadrat to water line every 1m, and a 6x4 m grid with 1m x 1m squares, with the last row being swath quadrats to the water line (44 quadrats total).

Sand Hill: 1 area: a 7m x 20m grid with 1m x 1m squares, and the offshore row of quadrats being swaths to the water line (140 quadrats total).

Mal Paso: 1 area: a 12m transect line with 1m x 1.5m quadrats in each direction (24 quadrats total).

Bodega Bay: 2 areas: a 10m transect line and a 9m transect line, both with 1m x 1m quadrats in each direction 38 quadrats total).

Point Sierra Nevada: 1 area: a 6m transect line with 1m x 1m quadrats in each direction (12 quadrats total).

3.7.2 Managing Northern Sea Palm Data

Data are recorded on data sheets (Form 8: Prototype **MARINe Rocky Intertidal Northern Sea Palm Data Sheet**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the standard data and maintain an order consistent with database entry. Northern Sea Palm data have not yet been incorporated into the MARINe Microsoft Access database; however, the database has been designed to facilitate the addition of these data. All data sheets are organized into notebooks and archived.

3.8 Motile Invertebrate Monitoring Protocol

The number and in some cases sizes of select motile invertebrates are monitored within the photoplots at sites where the monitoring group has sufficient experienced samplers and time to conduct this survey (Table 9). Though not a core procedure, the protocol has been tested and standardized for those monitoring groups choosing to use it. The **standard protocol was implemented in 2002/2003** (variations were tested in earlier years) by UCSC, CINP, UCLA, and CSUF. UCSB and CNM chose not to use this protocol due to sampling effort/expertise limitations. CINP conducts motile invertebrate surveys only once per year (in spring), alternating this protocol with owl limpet size/counts (in fall). The other **groups switched from semi-annual sampling to annual (in spring) in 2004** to reduce sampling effort and because analysis indicated motile invertebrates exhibited little seasonal variation in abundance.

3.8.1 Counting and Measuring Motile Invertebrates in Photoplots

Standard Procedure: The density of **16 motile invertebrates species or higher taxa** are monitored each spring and fall (or annually) to follow population dynamics in many of the permanent 50 x 75 cm photoplots at each site (Table 9). The **systematic plot searches are facilitated by subdividing the quadrat frames into 4 equal subsections with string**. Abundant species are sub-sampled.

Core motile invertebrate species/higher taxa by category include: gastropods (*Acanthina* sp., *Fissurella volcano,* limpets (excluding *Lottia gigantea*), *Littorina* spp., *Lottia gigantea*, *Nucella emarginata, N. canaliculata, Ocenebra circumtexta, Tegula brunnea, T. funebralis, T. gallina*), chitons (*Lepidochitona hartwegii*, *Mopalia* spp., *Nuttalina* spp.), and crabs (*Pachygrapsus crassipes*, *Pagurus* spp.) (see Table 5).

Limpets < 5 mm and limpets 5-15 mm are sub-sampled in three 20 x 20 cm quadrats, which are placed in upper left, middle, and lower right corner of each photoplot. Sub-sample counts are facilitated by subdividing the 20 x 20 cm quadrat frames into 4 equal subsections with string. If limpets are super-abundant, (as commonly occurs with the < 5 mm category), they can be sub-sampled in a 10 x 10 cm section of the 20 x 20 cm quadrat. If no limpets are counted in the 20 x 20 cm areas and limpets are present in the plot, then the entire photoplot is counted. Counts of limpets that are done in either the smaller 20 x 20 cm or 10 x 10 cm areas must be noted on the data sheet. Sub-sampled limpet counts will be extrapolated to the full 50 x 75 cm photoplot area (counts in 20 x 20 cm areas are summed and multiplied by 3.125, counts in 10 x 10 cm areas are summed and multiplied by 12.5).

Littorines are sub-sampled in a 10 x 10 cm section of the 20 x 20 cm sub-sampling quadrats. If no littorines are found in the 10 x 10 cm area, and littorines are present in the plot, then counts should be done in the entire 20 x 20 cm quadrats. As with limpets, counts from sub-sampled areas will be extrapolated to the full 50 x 75 cm photoplot area.

Sizes of the first 10 individuals encountered in each plot are measured to the nearest mm for the following 7 gastropod species: *Acanthina* spp., *Lottia gigantea*, *Nucella emarginata*, *N. canaliculata*, *Tegula brunnea*, *T. funebralis*, and *T. gallina*. Measured species will vary slightly among regions since only those that are abundant enough to get useful size data should be measured.

Guidelines:

- Sampling in plots with foliose algae that need to be rearranged to find motile invertebrates should be done after plot photos and photo notes have been taken.
- Motile invertebrates can be removed from plots and placed in a container for counting, but should be returned to the plot when sampling is completed. Forceps are useful for extracting whelks from crevices and from amongst mussels.
- It is not possible to locate all cryptic or tiny individuals in complex plots. Practical time limits should be placed on search efforts.
- A tally counter can be used to keep track of counts.
- Sampling often works best by conducting multiple searches through the plot, concentrating your search image on one or two species during each search.

Variations from and Additions to Core Procedures:

- Optional Species: The following optional species can also be counted in photoplots: gastropods (*Amphissa versicolor, Epitonium tinctum, Ceratostoma nuttalii, Haliotis cracherodii, H. fulgens,* Mexa*canthina lugubris),* chitons (*Lepidochitona* spp., *Lepidozona* spp., *Stenoplax* spp., *Tonicella lineata*), seastars (*Patiria miniata*, *Leptasterias hexactis*, *Pisaster ochraceus*, and *P. giganteus*), and sea urchins (*Strongylocentrotus purpuratus* and *S. franciscanus*.
- The 1st 10 Pagurus spp. are identified to species by UCSC. This ratio is multiplied out for the total # counted.
- UCSC keeps separate counts of limpets occurring on rock vs. those occurring on *Mytilus* and *Pollicipes*.
- CINP samples annually in spring, except in fall only at Santa Barbara Island (to avoid disturbing nesting pelicans in spring) and semi-annually at Anacapa Island to evaluate rat removal effects (rats may have been foraging on small motile invertebrates. ANME is sampled only when there is enough time, since it is not expected to be much different from adjacent ANMW. When time is short at SCOC, may score 3 plot types in 1 season and 2 plot types in the other season.

3.8.2 Managing Motile Invertebrate Data

Data are recorded on data sheets (Form 9: Prototype **MARINe Rocky Intertidal Motile Invertebrate Data Sheet**). Prototype data sheets can be used "as is" or may be slightly modified to meet specific needs of monitoring groups so long as they capture the standard data and maintain an order consistent with database entry. Motile invertebrate data have not yet been incorporated into the MARINe Microsoft Access database; however, the database has been

designed to facilitate the addition of these data. All data sheets are organized into notebooks and archived.

3.9 Invertebrate Recruitment Protocol

Though not a core procedure, white barnacle (*Chthamalus dalli/fissus/Balanus glandula*) and California mussel (*Mytilus californianus*) recruitment have been monitored at many MARINe sites (Table 10). Barnacle recruitment is monitored by scoring settlement on 5 10 x 10 cm PVC plates (covered in safety-walk) screwed into the substrate next to the white barnacle photoplots. The PVC plates are retrieved during each field survey (replaced with clean plates) and scored in the lab. White barnacle recruitment also is monitored in 10 x 10 cm clearings (wire-brushed to bare rock). Settlers are counted in the field during each survey, then the small plot is re-cleared. Mussel recruitment is monitored by scoring settlement into "Tuffy" mesh balls screwed into the substrate next to the mussel photoplots. The Tuffys are retrieved during each field survey (replaced with clean ones) and scored in the lab.

3.9.1 Field scoring barnacle clearings and collecting barnacle plates and mussel Tuffys

Clearings:

- Choose 5 random fields of view per clearing. Fields should represent entire clearing so try to pick one field per corner and one in center.
- In each field of view use scope or hand lens (magnifying glass) to count by species all barnacles and cyprids found.
- If the density of barnacles in the clearing is low and the field of view method does not accurately reflect actual density, count entire plot. A hand lens or magnifying glass is useful for this.
- Randomly measure 10 *Chthamalus* and 10 *Balanus* per clearing. Preferably, measure 2 from each field of view.
- Measure 1 cyprid of each species per clearing (if present).
- Use the metal brush and probe to clear the plot of all barnacles when done counting.

Plates:

- Remove each plate with nutdriver and store in "plate rack" (4" long bolt with 4 "spacer" nuts of larger diameter than bolt threading and 1 nut to secure plates on "rack").
- Replace each plate with clean plate using nutdriver.

Tuffys:

- Remove each Tuffy with nutdriver and store in labeled bag.
- Replace each Tuffy with clean Tuffy using nutdriver.

3.9.2 Lab scoring barnacle plates and mussel Tuffys

3.10 Intertidal Temperature Loggers

Though not a core procedure, intertidal temperature loggers have been deployed at many MARINe sites (Table 11). These small units ("Stowaways", "Tidbits", or "Pendants" from Onset Corporation) **record automated ambient temperatures (sea or air depending on**

tide height) at pre-set time intervals (usually every 15 min). Typically they are housed in capped PVC tubes bracketed to the rock, **in the mid-mussel zone or just below the mussel zone.** The units are changed out (or downloaded to an "Optic Shuttle") during the monitoring survey. After data are downloaded, the unit can be reset to use again. They may be triggered by a magnet to start sampling when deployed at a site. Battery life for the ~$100 Tidbits is about 5 years; once batteries fail, units are discarded. Battery life for the ~$50 Pendants is about 1 year; battery can be replaced by user. Start use dates should be noted and units (Tidbit) or batteries (Pendant) replaced after end of specified battery life span to prevent loss of data. Data managers can process the temperature records to separate submerged periods from times when the units are exposed to air.

4. MARINE DATA MANAGEMENT

Data sheets, maps, photographs, videotapes, and computer files are managed as described for each survey method (see above). Data entry, error checking and correction, and other data management procedures for the Microsoft Access database are described in the **MARINe Database User Guide** (Miner et al. 2007).

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Table 1: MARINe Core Monitoring and PISCO Biodiversity Survey Sites

SITE	County	PISCO Biodiversity			MARINe Core Survey				In or Near (<2mi) ASBS	In or Near (<2mi) CFG MPA	In or Near (<2mi) NOAA Mussel Watch Station	Other Designation #1	Other Designation #2
		Site Code	Initial Date	Re-Sample Date	Site Code	Region		Initial Date					
						North	South						
ALASKA													
Graves Harbor	Skagway	3001	8/03	7/07									
Yakobi	"	3002	8/03	7/07									
Port Mary	Sitka	3003	8/03										
Puffin Bay		3009	7/07										
Coronation Island		3010	7/07										
BRITISH COLUMBIA													
Tow Hill		3008	6/05										
Hippa Island		3007	6/05										
Duck Island		3006	6/05										
Palmerston		3004	8/03	6/07									
Little Ohiat		3005	8/03	6/07									
WASHINGTON													
Cannonball Island	Clallam	1	7/02	6/06									
Chilean Memorial	Clallam	2	7/02	6/07									
Taylor Pt	Jefferson	3	7/02	7/03, 6/04									
Starfish Pt	Jefferson	4	7/02	6/06									
OREGON													
Ecola	Clatsop	5	6/01	6/05	**ESP**	**X**		6/01				Ecola State Park	
Fogarty Creek	Lincoln	6	6/01	7/03, 6/04	**FOG**	**X**		8/00					
Bob Creek	Lane	7	6/01	5/07	**BOB**	**X**		7/00					
Cape Arago	Coos	8	6/01	6/05	**ARG**	**X**		8/00				Cape Arago State Park	
Burnt Hill	Curry	9	5/02	5/06	**BRN**	**X**		6/02					
N. CALIFORNIA													
Enderts	Del Norte		None		**END**	**X**		6/04	Redwoods National Park			Redwoods National Park	Redwoods State Park
Damnation Creek	"	52	6/04		**DMN**	**X**		6/04	Redwoods National Park			Redwoods National Park	Redwoods State Park
False Klamath Cove	"		None		**FKC**	**X**		6/04	Redwoods National Park			Redwoods National Park	Redwoods State Park
Cape Mendocino	Humboldt	10	5/02	4/06	**MEN**	**X**		6/04					
Shelter Cove	"	11	7/01	4/06	**SHT**	**X**		6/04	King Range Nat Conser Area		Point Delgado Shelter Cove	King Range Nat Conser Area	
Kibisillah Hill	Mendocino	12	7/01	6/03, 5/07	**KIB**	**X**		6/04				Mendocino Headlands State Park	
Stornetta Ranch	"	53	5/04	5/07	**STO**	**Xa**		7/05			1.3mi SE Pt Arena Lighthouse		

Sea Ranch	"	13	8/01	6/05	**SEA**	**X**		su 04	1.1mi SE Del Mar Ldg ER		0.2mi NW Sea Ranch Fort Ross Cove*	Sea Ranch Preserve	
Bodega	Sonoma	14	7/01	7/03, 5/04	**BML**	**X**		4/01	Bodega Marine Life Refuge	Bodega State Marine Res	1.0mi N Bodega Bay Entrance		
Santa Maria Creek	Marin	15	5/02	5/05	**SMC**	**X**		5/06				Point Reyes National Seashore	
Bolinas Pt	"	16	5/02	5/05, 2/08	**BOL**	**X**		11/05	Duxbury Reef Res		1.4mi NW Duxbury Reef Point*	Point Reyes National Seashore	
Bolinas Pt Wreck	"	59	5/05	10/05					Duxbury Reef Res		1.2mi NW Duxbury Reef Point*	Point Reyes National Seashore	
Alder Creek	"	71	2/08						Duxbury Reef Res		0.5mi NW Duxbury Reef Point*	Point Reyes National Seashore	
Slide Ranch	"		None		**SLR**	**X**		6/06				Golden Gate Nat Recreation Area	
Pt Bonita	"		None		**PTB**	**X**		su 06				Golden Gate Nat Recreation Area	
Alcatraz Island	San Francisco	58	2/05										
Mussel Flat SE Farallon	"	57	2/05						Farallon Island	Farallon Is State Marine Cons Area	0.2mi W Farallon Is East Landing		
C. CALIFORNIA													
Fitzgerald	San Mateo	17	11/02	11/06					James Fitzgerald Marine Reserve				
Pebble Beach	"		None		**PEB**	**Xa**		su 04				Gulf of Farallones Nat Marine Sanctuary	Pescadero/Bean Hollow State Beach
Pigeon Pt	"	18	11/02	10/06	**PPT**	**Xa**		2002				Gulf of Farallones Nat Marine Sanctuary	Pigeon Pt Light State Historic Park
Franklin Pt	"		None		**FRA**	**Xa**		2004	1.6mi NW Ano Nuevo Pt/Is	Ano Nuevo State Mar Cons Area		Monterey Bay Nat Marine Sanctuary	
Año Nuevo	"	19	6/02	4/08					Ano Nuevo Point & Island	Ano Nuevo State Mar Cons Area	0.5mi NE Ano Nuevo Island	Monterey Bay Nat Marine Sanctuary	Ano Nuevo State Park
Scott Creek	Santa Cruz	20	1/00	1/03, 12/06	**SCT**	**X**		5/99		Greyhound Rk State Mar Cons. Area		Monterey Bay Nat Marine Sanctuary	
Davenport Landing	"	62	10/07		**DAV**	**X**		10/07		1.8miSE Greyhound Rock SMCA		Monterey Bay Nat Marine Sanctuary	
Sandhill Bluff	"	21	1/00	5/04	**SAD**	**X**		11/99		1.9mi NW NBSMR		Monterey Bay Nat Marine Sanctuary	
Wilder Ranch	"	63	10/07		**WIL**	**X**		10/07		Natural Bridges State Mar Res		Monterey Bay Nat Marine Sanctuary	Wilder Ranch State Park
Terrace Pt	"	22	1/00	1/03, 1/06	**TPT**	**X**		5/99		Natural Bridges State Mar Res		Monterey Bay Nat Marine Sanctuary	Natural Bridges State Park
Natural Bridges	"	64	10/07		**NAT**	**X**		10/07		Natural Bridges State Mar Res		Monterey Bay Nat Marine Sanctuary	Natural Bridges State Park
Hopkins	Monterey	23	2/00	1/03, 12/06	**HOP**	**X**		12/99	Pacific Grove Marine Gardens	Lovers Point State Mar Res	0.6mi SE Pacific Grove Lovers Point	Monterey Bay Nat Marine Sanctuary	
Pt Pinos	"	66	11/07		**PIN**	**X**		11/07	0.4mi W PacGrove Marine Gardens	Asilomar State Mar Res	1.55mi NW Pacific Grove Lovers Point	Monterey Bay Nat Marine Sanctuary	

China Rocks	"	67	11/07		**CHI**	**X**		11/07		0.3mi S Asilomar State Mar Res		Monterey Bay Nat Marine Sanctuary	
Stillwater Cove	"	24	2/01	4/05	**SWC**	**X**		4/00	Carmel Bay	Carmel Bay State Mar Cons Area	Carmel Bay Arrowhead Point*	Monterey Bay Nat Marine Sanctuary	
Carmel Pt	"		None		**CAR**	**Xa**		2004	Carmel Bay	Carmel Bay State Mar Cons Area	Carmel Bay Arrowhead Point*	Monterey Bay Nat Marine Sanctuary	
Point Lobos	"	25	2/01	3/05	**PTL**	**X**		5/99	Point Lobos Ecol Reserve	Point Lobos State Mar Res	0.3mi NW Pt Lobos Weston Beach*	Monterey Bay Nat Marine Sanctuary	Point Lobos State Park
Mal Paso	"		None		**MAL**	**Xa**		6/00		0.1mi S Pt Lobos State Mar Res		Monterey Bay Nat Marine Sanctuary	
Garrapata	"	65	11/07		**GAR**	**X**		11/07		0.9mi S Pt Lobos State Mar Res		Monterey Bay Nat Marine Sanctuary	Garrapata State Park
Soberanes	"		None		**SOB**	**Xa**		su 04				Monterey Bay Nat Marine Sanctuary	Garrapata State Park
Andrew Molera	"	26	2/01	3/03, 2/04	**MOL**	**X**		11/99		Point Sur State Mar Res		Monterey Bay Nat Marine Sanctuary	Andrew Molera State Park
Partington Pt	"	54	11/03	4/04	**PAR**	**Xa**		su 04	Julia Pfeiffer Burns Underwater Park		Partington Point Julia Burns ASBS*	Monterey Bay Nat Marine Sanctuary	Julia Pfeiffer State Park
Lucia	"	55	4/04									Monterey Bay Nat Marine Sanctuary	
Mill Creek	"	27	2/01	11/03, 4/04	**MCR**	**X**		5/99				Monterey Bay Nat Marine Sanctuary	
Pacific Valley	"		None		**PVA**	**Xa**		su 04				Monterey Bay Nat Marine Sanctuary	
Duck Ponds	"	56	11/03	2/08								Monterey Bay Nat Marine Sanctuary	
Pt Sierra Nevada	San Luis Obispo	28	4/01	4/03, 4/04	**PSN**		**X**	10/95		1.1mi N Piedras Blancas St Mar Res		Monterey Bay Nat Marine Sanctuary	Hearst Ranch State Park
Piedras Blancas	"	68	1/08		**PBL**		**X**	11/97 9/07		Piedras Blancas State Mar Res		Monterey Bay Nat Marine Sanctuary	BLM Field Station
San Simeon Point	"	61	9/07		**SSP**		**X**	9/07			San Simeon Point	Monterey Bay Nat Marine Sanctuary	access via Hearst Property White Rk State Beach
Vista del Mar (previously called "San Simeon" **SIM**)	"	69	12/07 1/08		**VDM**		**X**	su04 9/07		Cambria State Mar Cons Area		Monterey Bay Nat Marine Sanctuary	San Simeon State Park
Cambria (Rancho Marino)	"	29	6/01	7/05	**RMR**		**Xa**	2001		White Rk State Mar Cons Area		Rancho Marino Univ Calif Reserve	
Cayucos	"	30	5/01	2/08	**CAY**		**X**	10/95				Estero Bay State Park	
Hazards	"	31	4/01	3/05	**HAZ**		**X**	10/95				Montano de Oro State Park	
Diablo	"	70	12/07 1/08		**DIA**		**X**	11/07		Point Buchon State Mar Res			
Shell Beach	"	32	3/01	3/06	**SHB**		**X**	10/95					
Occulto	Santa Barbara		None		**OCC**		**X**	3/92				Vandenberg Ecological Reserve	

Purisima	"		None		**PUR**		**Xa**	11/93		1.0mi NW Vandenberg State Mar Res		Vandenberg Ecological Reserve	
Stairs	"	33	3/01	3/03, 2/04	**STA**		**X**	3/92		Vandenberg State Mar Res		Vandenberg Ecological Reserve	
Lompoc	"	60	3/07							Vandenberg State Mar Res		Vandenberg Ecological Reserve	
Boat House	"	36	3/01	3/07	**BOA**		**X**	3/92		0.6mi E Vandenberg State Mar Res		Vandenberg Ecological Reserve	
S. CALIFORNIA													
Government Pt	"	35	5/01	3/06	**GPT**		**X**	3/92			Point Conception		
Alegria	"	38	5/01	5/03, 5/04	**ALEG**		**X**	3/92					
Arroyo Hondo	"	37	5/01	4/05	**ARHO**		**X**	3/92			0.2 mi W Arroyo Hondo Canyon Mouth**		
Coal Oil Point	"	39	3/02	3/06	**COPT**		**X**	3/92				Coal Oil Point Univ Calif Reserve	
Carpinteria	"	40	6/01		**CARP**		**X**	3/92			Carpinteria State Beach**	Carpinteria State Beach	
Mussel Shoals	Ventura	41	5/01		**MUSH**		**X**	11/94					
Old Stairs	"	42	5/01	3/08	**OLDS**		**X**	11/94	Mugu Lagoon to Latigo Point		Old Stairs**		
Paradise Cove	Los Angeles	43	4/01	2/06	**PCOV**		**X**	11/94	Mugu Lagoon to Latigo Point		1.2 mi NE Point Dume Mussel Site		
Whites Pt	"	44	5/01	3/08	**WHPT**		**X**	11/94			0.2 mi SE Royal Palms Mussel Site		
Pt Fermin	"	45	6/01		**PTFM**		**X**	10/99		Point Fermin State Mar Park			
Crystal Cove	Orange	46	4/01	5/03, 5/04	**CRCO**		**X**	11/96	Irvine Coast Mar Life Refuge	Irvine Coast State Mar Cons Area	Crystal Cove State Park**	Crystal Cove State Park	
Shaws Cove	"	47	5/01	4/05	**SHCO**		**X**	10/96	1.5mi SE Irvine Coast MLR; 0.3mi W Heisler Park Ecol Reserve	Heisler Park State Mar Res			
Treasure Island	"		None		**TRIS**		**X**	10/96					
Dana Pt	"	48	5/01	2/06	**DAPT**		**X**	12/96		Dana Point State Mar Cons Area	Dana Point**		
Cardiff	San Diego		None		**CARE**		**X**	10/97		0.2mi S Cardiff-San Elijo State Mar Cons Area	Cardiff Reef**	Cardiff State Beach	
Scripps	"	49	3/02	2/06	**SCRE**		**X**	10/97	San Diego Marine Life Refuge	San Diego-Scripps State Mar Cons Area	Scripps Reef; 1.9mi NE Pt La Jolla Mussel**	Scripps Univ Calif Coastal Reserve	
Navy North	"		None		**NANO**		**X**	2/95				US Navy	
Navy South	"		None		**NASO**		**X**	3/95			0.2mi N Point Loma "Lighthouse" Mussel	US Navy	
Cabrillo Zone I	"	50	3/02	5/04	**CAB1**		**X**	2/90		Mia J Tegner State Mar Cons Area		Cabrillo National Monument	
Cabrillo Zone II	"		None		**CAB2**		**X**	2/90		Mia J Tegner State Mar Cons Area		Cabrillo National Monument	
Cabrillo Zone III	"	51	3/02		**CAB3**		**X**	2/90		Mia J Tegner State Mar Cons Area		Cabrillo National Monument	

SAN MIGUEL ISL													
Otter Harbor	Santa Barbara		None		**SMOH**		**X**	4/85	San Miguel Island		San Miguel Island Otter Harbor**	Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Harris Point	"		None		**SMHP**		**X**	4/85	San Miguel Island	Harris Point State Mar Res		Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Cuyler Harbor	"	101	11/01	12/02	**SMCH**		**X**	4/85	San Miguel Island	Harris Point State Mar Res		Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Crook Pt	"	100	11/01		**SMCP**		**X**	4/85	San Miguel Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
SANTA ROSA ISL													
NW Talcott	Santa Barbara	201	12/01	12/04	**SRNW**		**X**	11/86	Santa Rosa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Fossil Reef	"	200	12/01	12/04	**SRFR**		**X**	3/88	Santa Rosa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
East Pt	"	204	12/01	12/04	**SREP**		**X**	12/86	Santa Rosa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Ford Pt	"	203	12/01		**SRFP**		**X**	12/85	Santa Rosa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Johnsons Lee	"	202	12/01	12/02, 12/04	**SRJL**		**X**	12/85	Santa Rosa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
SANTA CRUZ ISL													
Fraser Pt	Santa Barbara	300	1/02	1/03, 1/04	**SCFC**		**X**	9/94	Santa Cruz Island		Santa Cruz Island Fraser Point	Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Orizaba	"		None		**SCOC**		**X**	9/94	Santa Cruz Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Scorpion	"		None		**SCSR**		**X**	9/94	Santa Cruz Island	Scorpion State Mar Res		Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Forney	"	301	1/02				**X**	9/94	Santa Cruz Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Prisoners	"	305	4/02	4/03, 1/04	**SCPH**		**X**	9/94	Santa Cruz Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Trailer	"	302	1/02	1/06	**SCTR**		**X**	9/94	Santa Cruz Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Valley	"	304	1/02	1/06					Santa Cruz Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Willows	"	303	1/02	1/06	**SCWA**		**X**	9/94	Santa Cruz Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
ANACAPA ISL													
Middle East	Ventura		None		**ANME**		**X**	3/82	Anacapa Island	Anacapa Island State Mar Res	Anacapa Island North Middle Island**	Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Middle West	"	402	10/01	12/05	**ANMW**		**X**	3/82	Anacapa Island	Anacapa Island State Mar Res		Channel Islands Nat Marine Sanctuary	Channel Islands National Park

Frenchys Cove	"	401	10/01	12/05	**ANFC**		**X**	3/82	Anacapa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Cat Rock	"	400	12/05		**ANCR**		**X**	3/82	Anacapa Island			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
SAN NICOLAS ISL													
Thousand Springs		700	2/03	2/07					San Nicolas Island			US Navy	
Marker Poles		701	2/03	2/07					San Nicolas Island			US Navy	
SANTA BARBARA ISL													
Landing Cove	Santa Barbara	500	11/01	11/06	**SBLC**		**X**	3/85	Santa Barbara Is			Channel Islands Nat Marine Sanctuary	Channel Islands National Park
Sea Lion Rookery	"	501	12/01	11/06	**SBSL**		**X**	3/85	Santa Barbara Is	Santa Barbara Island State Mar Res		Channel Islands Nat Marine Sanctuary	Channel Islands National Park
CATALINA ISL													
Bird Rock	Los Angeles	600	4/02	1/04, 4/07	**CTBR**		**X**	2/82	Santa Catalina Is		Bird Rock		
Little Harbor	"	601	4/02	4/07	**CTLH**		**X**	12/94	Santa Catalina Is				
BAJA CALIFORNIA													
La Buffadora		1001	2/03										
La Chorera		1002	2/03										
Punta Baja		1003	2/03										
El Tivo, Natividad I			3/07										
Punta Prieta, Natividad I			3/07										
Babencho Grande, Natividad			3/07										
El Nido, Natividad I			3/07										
La Cueva, Natividad I			3/07										
La Plana, Natividad I			3/07										
Punta Rompiente		1004	2/03										
Punta San Roque		1005	2/03										
Punta Abreojos		1006	2/03										
MAINLAND MEXICO													
Punta Borascosa		2001	3/03										
Pelican Pt		2002	3/03										
Punta Libertad		2003	3/03										
Punta Cerro Prieto II		2004	3/03										

Note: Biodiversity survey dates based on 4/15/08 Coastal Biodiversity website (http://cbsurveys.ucsc.edu/).
ASBS = Area of Special Biological Significance (California State Water Board)
CFG MPA = California Department of Fish and Game Marine Protected Area
xa = Abalone only monitoring site
*New Mussel Watch sites to be established 2008/09
**New Mussel Watch sites established 2007/08

Table 2. MARINe Partners

Primary Sponsors

- U.S. Minerals Management Service
- Channel Islands National Park
- Partnership for Interdisciplinary Studies of Coastal Oceans

Major Sponsors

- Cabrillo National Monument
- California Ocean Protection Council
- Golden Gate National Recreation Area
- Monterey Bay National Marine Sanctuary
- Point Reyes National Seashore
- Redwoods National and State Parks
- Southern California Coastal Water Research Project
- California Coastal Commission (past)
- County of Santa Barbara (past)
- San Diego Association of Governments (past)
- United States Navy (past)

Other Sponsors

- Cabrillo Marine Aquarium
- California Department of Fish and Game
- California State Water Quality Control Board
- National Center for Ecological Analysis and Synthesis
- National Park Service Northeast Temperate Network
- Tatman Foundation
- Tenera Environmental

MARINe Partners (continued)

Contributors

- California State University Fullerton
- Gulf of the Farallones National Marine Sanctuary
- Santa Barbara Channelkeeper
- University of California Berkeley
- University of California Los Angeles
- University of California Santa Barbara
- University of California Santa Cruz
- University of Southern California

Collaborators (past and presesent)

- Bodega Bay Marine Laboratories
- Bureau of Land Management California Coastal Monument
- California Coastal Commission
- California Coastal Conservancy
- California Polytechnic University, San Luis Obispo
- California State Parks and Recreation
- California State University Humboldt
- California State University Los Angeles
- Channel Islands National Marine Sanctuary
- County of San Luis Obispo
- County of Ventura
- Los Angeles County Natural History Museum
- Moss Landing Marine Labs
- NOAA National Status and Trends Program
- Santa Monica Bay Restoration Commission
- Scripps Institution of Oceanography
- Southern California Coastal Ocean Observing System
- Stanford University: Hopkins Marine Station
- University of California Natural Reserve System

Table 3. MARINe Monitoring Groups

Monitoring Group	Monitoring Regions
Olympic Coast National Marine Sanctuary (**OCNMS**)	Wahington State sites in OCNMS outside OLYM
Olympic National Park (**OLYM**)	Washington State sites in OLYM and San Juan Island National Historic Park
University of California Santa Cruz (**UCSC**)	Sites from Pt Conception north to Oregon & all biodiversity sites
Point Reyes National Seashore	Sites within Point Reyes National Seashore
Golden Gate National Recreation Area	Sites within Golden Gate National Recreation Area
University of California Santa Barbara (**UCSB**)	San Diego County & Santa Catalina Island
Channel Islands National Park (**CINP)**	Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, & San Miguel Islands
MMS Intertidal Team (**MINT**)	San Luis Obispo, Santa Barbara, Ventura, & LA Counties
University of California Los Angeles (**UCLA**)	Southern Santa Barbara, Ventura, & LA Counties
California State University Fullerton (**CSUF**)	Orange County
Cabrillo National Monument (**CABR**)	Cabrillo National Monument sites (San Diego)

Table 4. Standardized Names for Target Species Plots

		Official Target Species for MARINe			
Plot Name	**Plot Type**	**Scientific Name**	**Common Name**	**6-Letter Code**	**3-LetterBrief**
Plants					
Egregia	Transect	*Egregia menziesii*	Boa Kelp	EGRMEN	EGR
Fucus	Photoplot	*Fucus gardneri*	Northern Rockweed	FUCGAR	FUC
Hedophyllum	Transect	*Hedophyllum sessile*	Sea Cabbage	HEDSES	HED
Hesperophycus	Photoplot	*Hesperophycus californicus*	Olive Rockweed	HESCAL	HES
Pelvetiopsis	Photoplot	*Pelvetiopsis limitata*	Dwarf Rockweed	PELLIM	PEL
Silvetia	Photoplot	*Silvetia compressa*	Golden Rockweed	SILCOM	SIL
Endocladia	Photoplot	*Endocladia muricata*	Turfweed	ENDMUR	END
Neorhodomela	Photoplot	*Neorhodomela larix*	Black Pine	NEOLAR	NEO
Phyllospadix	Transect	*Phyllospadix scouleri/torreyi*	Surfgrass	PHYOVR	PHY
Invertebrates					
Anthopleura	Photoplot	*Anthopleura elegantissima/sola*	Green Anemone	ANTELE	ANT
Mytilus	Photoplot	*Mytilus californianus*	California Mussel	MYTCAL	MYT
Lottia	Size/Count	*Lottia gigantea*	Owl Limpet	LOTGIG	LOT
Haliotis	Size/Count	*Haliotis cracherodii*	Black Abalone	HALCRA	HAL
Chthamalus/Balanus	Photoplot	*Chthamalus dalli/fissus/Balanus glandula*	White Barnacle	CHTBAL	CHT
Semibalanus	Photoplot	*Semibalanus cariosus*	Thatched Barnacle	SEMCAR	SEM
Tetraclita	Photoplot	*Tetraclita rubescens*	Pink Barnacle	TETRUB	TET
Pollicipes	Photoplot	*Pollicipes polymerus*	Goose Barnacle	POLPOL	POL
Pisaster	Size/Count	*Pisaster ochraceus*	Ochre Seastar	PISOCH	PIS
		Other Species "Targeted" by Some Monitoring Groups			
Plot Name		**Scientific Name**	**Common Name**	**6-Letter Code**	**3-LetterBrief**
Plants					
Mastocarpus	Photoplot	*Mastocarpus papillatus*	Turkish Washcloth	MASPAP	MAS
Mazzaella	Photoplot	*Mazzaella spp (=Iridaea spp)*	Iridescent Weed	MAZSPP	MAZ
Postelsia*	Size/Count	*Postelsia palmaeformis*	Northern Sea Palm	POSPAL	POS
Red Algae	Photoplot Transect	(includes plots targeting *Gelidium* & Red Algal & transects targeting Turf)	Red Algae	REDALG	RED
Invertebrates					
Balanus	Photoplot	*Balanus glandula*	Northern Barnacle	BALGLA	BAL
Other					
Tar	Photoplot		Tar	TAR	TAR
Recovery	Photoplot		Recovery	RECOV	REC
*note these data are not yet in database, and will likely be added to tblSpeciesCountSize (# of plants counted in 2 m swaths or in grids)					

Table 5. MARINe Core Species, Higher Taxa, and Substrates

(Target species are shown in bold.)	Photoplots	Transects	Size & Counts	Field Log Recon	Motile Inverts
GREEN ALGAE					
Cladophora columbiana	X			X	
Ulva/Enteromorpha	X			X	
Other Green Algae (any greens not listed above)*	X	X			
BROWN ALGAE					
Egregia menziezii **(Boa Kelp)**	X	X		X	
Eisenia arborea	X	X		X	
Endarachne/Petalonia	X			X	
Fucus gardneri **(=** ***F. distichus*****)(Northern Rockweed)**	X			X	
Halidrys dioica/Cystoseira spp	X	X		X	
Hedophyllum sessile **(Sea Cabbage)**	X	X		X	
Hesperophycus californicus (= H. harveyanus)**(Olive Rockweed)**	X			X	
Pelvetiopsis limitata **(Dwarf Rockweed)**	X			X	
Postelsia palmaeformis **(Northern Sea Palm)**			X	X	
Sargassum muticum	X	X		X	
Scytosiphon spp	X			X	
Silvetia compressa **(=** ***Pelvetia fastigiata*****)(Golden Rockweed)**	X			X	
Other Brown Algae (any browns not listed above)*	X	X			
RED ALGAE					
Chondracanthus canaliculatus (= Gigartina canaliculata)	X			X	
Endocladia muricata **(Turfweed)**	X			X	
Mastocarpus papillatus **(blade)(Turkish Washcloth)**	X			X	
Mazzaella affinis (= Rhodoglossum affine)	X			X	
Mazzaella **spp.*****(= Iridaea*** **spp.)(Iridescent Weed)**	X			X	
Neorhodomela larix) **(Black Pine)**	X			X	
Porphyra sp	X			X	
Articulated Corallines (Erect Corallines)	X	X			
Crustose Corallines (Encrusting Corallines)	X	X			
Other Red Algae (any reds not listed above)*	X	X			
ALGAE/PLANTS					
Phyllospadix scouleri/torreyi **(Surfgrass)**	X	X		X	
Non-Coralline Crusts (reds and browns)	X	X			
Other Plant/Algae*	X	X			
ANEMONES					
Anthopleura elegantissima/sola **(Green Anemone)**	X	X		X	
POLYCHAETE WORMS					
Phragmatopoma californica	X	X		X	
MOLLUSKS					
Acanthina spp					X
Fissurella volcano					X
Haliotis cracherodii **(Black Abalone)**			X	X	
Katharina tunicata			X		
Lepidochitona hartwegii					X
Littorina spp				X	X
Lottia gigantea **(Owl Limpet)**	X		X	X	X

Table 5. MARINe Core Species (cont.)

(Target species are shown in bold.)

	Photoplots	Transects	Size & Counts	Field Log Recon	Motile Inverts
MOLLUSKS (cont.)					
Mopalia spp					X
***Mytilus californianus* (California Mussel)**	X	X		X	
Nucella emarginata					X
Nucella canaliculata					X
Nuttalina spp					X
Ocenebra circumtexta					X
Tegula brunnea					X
Tegula funebralis					X
Tegula gallina					X
Tegula spp				X	
Limpets	X				
Large Limpets > 15mm (excluding *L. gigantea*)					X
Medium Limpets 5-15mm					X
Small Limpets < 5mm					X
Chitons	X				
BARNACLES					
***Balanus glandula* (Northern Barnacle)**	X**				
***Chthamalus dalli/fissus & Balanus glandula* (White Barnacle)**	X			X	
***Pollicipes polymerus* (Goose Barnacle)**	X			X	
***Semibalanus cariosus* (Thatched Barnacle)**	X			X	
***Tetraclita rubescens* (Pink Barnacle)**	X			X	
Barnacles		X			
Other Barnacles (any barnacles not listed above)*	X				
ECHINODERMS					
***Pisaster ochraceus* (Ochre Star)**	X	X	X	X	
Henricia spp			X		
Strongylocentrotus purpuratus				X	
CRUSTACEANS					
Ligia occidentalis				X	
Pachygrapsis crassipes					X
Pagurus spp					X
INVERTEBRATES					
Other Invertebrates (Other Animals) (any inverts not listed above)*	X	X			
SUBSTRATES					
Rock (Bare Rock)	X	X			
Sand	X	X			
Tar	X	X		X	
UNDETERMINED					
Other Substrate (e.g., dead mussel shells or barnacle tests)	X	X			
Unidentified (cannot tell if plant, invert or substrate)	X	X			

* The specific definitions of these categories are different for photoplots compared to transects.

** Core species for MARINe North only.

Table 6. Definitions for Core Higher Taxa and Substrates.

Articulated (Erect) Corallines: erect, jointed, calcified, red algae of the Family Corallinaceae, with flexible, articulate fronds arising from crustose bases.

Barnacles: adults or juveniles of any barnacle (Phylum Arthropoda, Class Crustacea, Subclass Cirripedia) species.

Chitons: adults or juveniles of any chiton (Phylum Mollusca, Class Polyplacophora) species.

Crustose (Encrusting) Corallines: thin, flattened, calcified, crust-like red algae of the Family Corallinaceae, having no erect, articulated fronds. Bleached crustose corallines (white) are scored as well because they may be alive.

Limpets: adults or juveniles of any limpet (Phylum Mollusca, Class Gastropoda, Family Acmaeidae) species, including *Lottia gigantea*.

Non-Coralline Crusts: any thin, flattened, crust-like red or brown algae that are not calcified species of the Family Corallinaceae.

Other Invertebrates (Other Animals): any invertebrates not listed or not identifiable in other more specific categories on the score sheet.

Other Barnacles: any barnacles not listed or not identifiable in other more specific categories on the score sheet.

Other Brown Algae: any brown algae not listed or not identifiable in other more specific categories on the score sheet (score "non-coralline crusts" separately).

Other Green Algae: any green algae not listed or not identifiable in other more specific categories on the score sheet.

Other Plant (Other Algae): any plants (algae) not listed or not identifiable in other more specific categories on the score sheet.

Other Red Algae: any red algae not listed or not identifiable in other more specific categories on the score sheet (score "non-coralline crusts" separately).

Rock (Bare Rock): bare, unconsolidated substrates larger than sand/gravel (including cobble, rocks, and boulders) and all consolidated substrates (i.e., bedrock) that contain no obvious living organisms or tar (epoxy corner markers and inconspicuous blue-green algal films are scored as "rock").

Sand: granular, particulate (fine sand to gravel) substrate. Photoplots: score "sand" unless you can positively identify what lies under the sand in the photo. Transects: score "sand" whenever sand cover is 2cm or greater.

Tar: fresh or weathered oil or tar coating on the substrate.

Unidentified: cannot tell if plant, invertebrate, or substrate.

Table 7. Target Species Monitored in Photoplots at MARINe Core Sites.

MAINLAND	Start	FUCGAR	HESCAL	PELLIM	SILCOM	ENDMUR	NEOLAR	MAZSPP	MASPAP	REDALG	ANTELE	MYTCAG	BALGLA	CHTBAL	SEMCAR	TETRUB	POLPOL	TAR
Oregon	**Year**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**
Clatsop Co.																		
Ecola	2001			5			5					5	5					
Lincoln Co.																		
Fogarty Creek	2000	5		5			5					5	5					
Lane Co.																		
Bob Creek	2000	5		5		5						5	5					
Coos Co.																		
Cape Arago	2000	5		5		5						5	5					
Curry Co.																		
Burnt Hill	2002			5		5						5	5					
California																		
Del Norte Co.																		
Enderts	2004			5		5						5		5				
Damnation Creek	2004	5				5						10*		5				
*5 plots are surrounded by freshwater (upcoast) and 5 are regular marine (downcoast)																		
False Kalamath Cove	2004	5		5		5						5		5				
Humboldt Co.																		
Cape Mendocino	2004	5		5		5			5			5		5				
Shelter Cove	2004	5		5		5						5		5	5			
Mendocino Co.																		
Kibesillah Hill	2004	5		5		5			5			5		5				
Stornetta																		
Sea Ranch	2004	5		5		5	5					5		5				
Sonoma Co.																		
Bodega	2001			5		5						5		5				
Marin Co.																		
Santa Maria Creek	2006			5								5						
Bolinas Point	2005																	
Slide Ranch	2006																	
Point Bonita	2006																	
San Mateo Co.																		
Pebble Beach	2004																	
Pigeon Point	2002																	
Franklin Point	2004																	
Santa Cruz Co.																		
Scott Creek	1999	5			5	5						5		5				
Davenport Landing	2007																	
Sand Hill Bluff*	1999			5								5	5	5				
*UCSC PISCO monitors 2 “Recovery” plots at Sand Hill Bluff set up SP03																		
Wilder Ranch	2007																	
Terrace Point	1999				5				5			5	5	5				

	Start	FUCGAR	HESCAL	PELLIM	SILCOM	ENDMUR	NEOLAR	MAZSPP	MASPAP	REDALG	ANTELE	MYTCAG	BALGLA	CHTBAL	SEMCAR	TETRUB	POLPOL	TAR
Santa Cruz Co.	**Year**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**
Natural Bridges	2007																	
Monterey Co.																		
Hopkins	1999				5	5			5			5	5	5				
Point Pinos	2007																	
China Rocks	2007																	
Stillwater	2000				5	5			5			5		5				
Carmel Point	2004																	
Point Lobos	1999				5	5			5			5		5				
Mal Paso	2000																	
Garrapata	2007																	
Soberanes	2004																	
Andrew Molera	1999	5			5	5						5		5				
Partington Cove	2004																	
Mill Creek	1999				5	5			5			5		5				
Pacific Valley	2004																	
San Luis Obispo Co																		
Pt Sierra Nevada	1995		5		5			5	5			5		5				
Piedras Blancas	1997																	
San Simeon Point	2007																	
Vista del Mar	2007																	
Rancho Marino	2001																	
Cayucos	1995		5		5	5						5		5				
Hazard's	1995				5	5		5				5		5				
Diablo	2007																	
Shell Beach	1995				5	5			5			5		5				
Santa Barbara Co																		
Occulto	1992					5						5		5				
Purisima	1993																	
Stairs*	1992				5	5						5		5				
*UCSC monitors 6 “Recovery” plots at Stairs																		
Boat House	1992				5	5					5	5		5				
Government Point	1992				5	5						5		5			5	
Alegria	1992										5	5		5			5	
Arroyo Hondo	1992											5		5				
Coal Oil Pt.	1992										5	5*						
*5 MYTCAL plots added SP03																		
Carpinteria	1992										5	5		5			5	
Ventura Co.																		
Mussel Shoals	1994										5	5		5				
Old Stairs	1994					5					5	5		5				
LA Co.																		
Paradise Cove	1994					5						5		5				
White's Point	1994					5						5		10*				
*5 plots emphasize *Chthamalus* spp. and 5 emphasize *Balanus glandula*, but both barnacle species are scored as *Chthamalus/Balanus*																		

	Start	FUCGAR	HESCAL	PELLIM	SILCOM	ENDMUR	NEOLAR	MAZSPP	MASPAP	REDALG	ANTELE	MYTCAG	BALGLA	CHTBAL	SEMCAR	TETRUB	POLPOL	TAR
LA Co.	**Year**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**
Point Fermin	1999				5							5		5				
Orange Co.																		
Crystal Cove	1996				5							5		5				
Shaws Cove	1996				5	5						5		5				
Treasure Island	1996				5							5		5				
Orange Co.																		
Dana Point	1996				5							5		5				
San Diego Co.																		
Cardiff Reef	1997											10*		5			5	
*5 plots located on onshore reef and 5 on offshore reef																		
Scripps Reef	1997				5							5		5			5	
Navy North	1995				5							5		5		5	6^{1}	
Navy South	1995				5							5		5		5	6^{1}	
Cabrillo I	1990				5							5		5		5	6^{1}	
Cabrillo II	1990				5							5		5		5	6^{1}	
Cabrillo III	1990				5							5		5		5	6^{1}	
ISLANDS																		
San Miguel I.																		
Otter Harbor	1985				5^{2}	5^{3}						5		5				
Harris Point	1985		5^{2}			5^{3}						5		2		3		
Cuyler Harbor	1985				5^{2}	5^{3}						5		5				
Crook Point	1985				5^{2}	5^{3}						5		5				
Santa Rosa I.																		
NW Talcott	1986				5^{2}	5^{3}						5		5				
Fossil Reef	1988				5^{2}	5^{3}						5		5				
Johnson's Lee	1985					5^{3}						5		5				
Ford Point	1985					5^{3}						5		5				
East Point	1986				5^{2}	5^{3}						5		5				
Santa Cruz I.																		
Fraser	1994		5		5	5						5		5			5	5
Trailer	1994		5		5							5		5				
Willows	1994		5		5	5						5						
Orizaba	1994		5		5							5		5		5		
Prisoner's	1994		5		5	5						5		5				
Scorpion	1994		5			5						5		5		5		
Anacapa I.																		
Middle West	1982				$5^{2,4}$	$5^{3,4}$						5^{4}		5^{4}				
Middle East	1982				$3^{2,4}$	$3^{3,4}$						3^{4}		3^{4}				
Frenchy's Cove	1982				5^{2}	5^{3}						5		5				
Cat Rock	1982				$9^{2,4}$	$9^{3,4}$						9^{4}		9^{4}				
Santa Barbara I.																		
Landing Cove	1985				5^{2}					5*		5		5				
*In REDTUR plots, points scored as REDTUR are primarily *Gelidium* spp. and *Chondracanthus canaliculatus*.																		
Sea Lion Rookery	1985				5^{2}	5^{3}						5		5				

	Start	FUCGAR	HESCAL	PELLIM	SILCOM	ENDMUR	NEOLAR	MAZSPP	MASPAP	REDALG	ANTELE	MYTCAG	BALGLA	CHTBAL	SEMCAR	TETRUB	POLPOL	TAR
Santa Catalina I.	**Year**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**
Bird Rock	1982				5*					5*		5*		5*		5	5	
*1 year trampling experiment followed by recovery monitoring from 1/82-F94 (21 SILCOM, 12 GELSPP, 12 CHTBAL, and 12 MYTCAL ¼ m2 plots (3 control, 3 light, 3 med, and 3 heavy trample (+ 3 Boots—SILCOM))). In F94, a subset of plots was converted to core MARINe monitoring.																		
Little Harbor	1982				5							5		5		5		

[1] 3 *Pollicipes* 1m X 10m transects at Cabrillo I, II, III converted to 6 photoplots starting S95; 6 plots established at Navy North & South to compare same number of replicates as Cabrillo.
[2] In some SILCOM plots and HESCAL plots, SILCOM and HESCAL were scored together as "rockweed."
[3] ENDMUR plots may include some *Gelidium* spp and *Chondracanthus canaliculatus* scored as ENDMUR.
[4] 8 or 9 plot replicates were initially established as part of a pre-monitoring experiment (3 Control, 3 Trample, 3 Scrape). Middle E & Middle W were originally one site.

Table 8. Target Species Monitored in Transects and Plots (not photoplots)

	Point-Intercept Transects			Circular Plots		Band Transects/Irregular Plots		
MAINLAND	**EGRMEN**	**REDALG**	**PHYOVE**	**Owl Limpets**		**Black Abalone**	**Ochre Seastars**	**Northern Sea Palm**
Oregon	**#Transects &Start Year**	**#Transects &Start Year**	**#Transects &Start Year**	**# Plots & Type**	**Start Year**	**# Plots, Type, & Start Year**	**# Plots, Type, & Start Year**	**# Plots, Type, & Start Year**
Clatsop Co.								
Ecola			1 2001			**Abalone**	3 IP 2001	**Sea Palm**
Lincoln Co.						**Monitoring**		**Monitoring**
Fogarty Creek			3 2000			**Sites**	3 IP 2000	**Sites**
Lane Co.						**Not**		**Not**
Bob Creek			3 2000			**Indicated**	3 IP 2000	**Indicated**
Coos Co.								
Cape Arago			3 2000					
Curry Co.								
Burnt Hill			3 2002				3 IP 2002	
California								
Del Norte Co.								
Enderts							2 IP 2004	
Damnation Creek			2 2004				3 IP 2004	
False Kalamath Cove							2 IP 2004	
Humboldt Co.								
Cape Mendocino							3 IP 2004	
Shelter Cove							3 IP 2004	
Mendocino Co.								
Kibesillah Hill			3 2004				3 IP 2004	
Stornetta								
Sea Ranch							3 IP 2004	
Sonoma Co.								
Bodega							3 IP 2001	
Marin Co.								
Santa Maria Creek							3 IP 2006	
Bolinas Point			3 2006				3 IP 2006	
Slide Ranch								
Point Bonita								
San Mateo Co.								
Pebble Beach								
Pigeon Point								
Franklin Point								
Santa Cruz Co.								
Scott Creek			3 1999				3 IP 1999	
Davenport Landing								
Sand Hill Bluff			2 1999	3 CP	1999			
Wilder Ranch								
Terrace Point				5 RP	1999		3 IP 1999	
Natural Bridges								
Monterey Co.								
Hopkins			3 1999	5 CP	1999		3 IP 1999	
Point Pinos								
China Rocks								
Stillwater			3 2000	5 CP	2000		3 IP 2000	
*Abalone sampled in 2 irregular plots established SP02 and in existing seastar plots.								
Carmel Point								
Point Lobos				5 CP	1999		3 IP 2003	
Mal Paso								
Garrapata								
Soberanes								
Andrew Molera			3 1999				3 IP 1999	
Partington Cove								
Mill Creek			3 1999	5 RP	1999		3 IP 1999	
Pacific Valley								
San Luis Obispo Co.								
Pt. Sierra Nevada			3 1995				3 IP 1995	
*Abalone sampled in 2 seastar plots in addition to 3 abalone plots.								
Piedras Blancas								
San Simeon Point								

	Point-Intercept Transects			Circular Plots		Band Transects/Irregular Plots		
	EGRMEN	REDALG	PHYOVE	Owl Limpets		Black Abalone	Ochre Seastars	Northern Sea Palm
San Luis Obispo Co.	#Transects &Start Year	#Transects &Start Year	#Transects &Start Year	# Plots & Type	Start Year	# Plots, Type, & Start Year	# Plots, Type, & Start Year	# Plots, Type, & Start Year
Vista del Mar				5 CP	2004			
Rancho Marino				5 CP	2002	**Abalone**		**Sea Palm**
Cayucos			3 1995	5 CP	1995	**Monitoring**	3 IP[1] 1995	**Monitoring**
Hazard's			3 2001	5 RP	1995	**Sites**	3 IP[1] 1995	**Sites**
Diablo						**Not**		**Not**
Shell Beach			3 1999			**Indicated**	3 IP[1] 1995	**Indicated**
Santa Barbara Co.								
Occulto							1 IP 2000	
Purisima								
Stairs			3 1992	5 CP	1992		3 IP 1992	
Boat House				5 CP	1992		3 IP[1] 1992	
Government Pt.			3 1992	5 CP	1992		3 IP[1] 1992	
Alegria			3 2002	5 CP	1992		3 IP 2002	
Arroyo Hondo			3* 1992				3 BT[2] 1992	
*3rd PHYOVE transect added SP01.								
Coal Oil Pt.			3 1992					
Carpinteria			3 1992	5 CP	2001		3 BT[2] 1992	
Ventura Co.								
Mussel Shoals			3 1994	5 CP	2002		3 IP 1994	
Old Stairs				5 CP	1994		3 IP[2] 1994	
Los Angeles Co.								
Paradise Cove			3 1994	5 CP	1994		3 IP 2002	
White's Point				5 CP	2003			
Point Fermin			3 1999	5 CP	2003		3 IP 2003	
Orange Co.								
Crystal Cove			6* 1996	5 CP	1996		TS 1996	
*PHYOVE transects initially established as 3 20m transects; Transects divided into 6 10m transects in SP97.								
Shaws Cove				5 CP	1996		TS 1996	
Treasure Island							TS 1996	
Dana Point				5 CP	1996		TS 1996	
San Diego Co.								
Cardiff Reef		3[3] 1997	3[3] 1997	5 CP*	1997		TS 1997	
*Owl limpet plots are 3m diameter.								
Scripps Reef		3[3] 1997	3[3] 1997	5 CP	1997		TS 1997	
Navy North		3[3]* 1995	4[3]** 1995	6 CP[4]	1995		TS 1995	
Navy South		3[3]* 1995	4[3]** 1995	6 CP[4]	1995		TS 1995	
*3rd PHYOVE transect added SP02; **2 transects located on inshore reef and 2 transects located on offshore reef.								
Cabrillo I	2[3] 1990	2[3] 1990	2[3] 1990	6 CP[4]	1990		TS 1990	
Cabrillo II	2[3] 1990	2[3] 1990	2[3] 1990	6 CP[4]	1990		TS 1990	
Cabrillo III	2[3] 1990	2[3] 1990	2[3] 1990	6 CP[4]	1990		TS 1990	
ISLANDS								
San Miguel Island								
Otter Harbor				5 CP[5]	2001		5 IP[1] 1985	
Harris Point				5 CP	2001		5IP+1BT[1]	
Cuyler Harbor							TS 1994	
Crook Point				3 IP[5]	1987		5 IP[1] 1985	
Santa Rosa Island								
NW Talcott			3 2001	5 CP	1993		5 IP 1986	
Fossil Reef				5 CP	1999		1 BT 1988	
Johnson's Lee				5 CP*	1988		5IP+1BT[1]	
Ford Point				5 CP*	1988		5 IP[1] 1985	
East Point			3 2002				TS 1994	
Santa Cruz Island								
Fraser			3 1994	5 CP*	1994		TS 1994	
Trailer			3 1994	5 CP	1994		TS 1994	
Willows				5 CP	1994		TS 1994	
Orizaba							TS 1994	
Prisoner's							TS 1994	
Scorpion							TS 1994	
Anacapa Island								
Middle West							TS 1994	

	Point-Intercept Transects			Circular Plots		Band Transects/Irregular Plots		
	EGRMEN	REDALG	PHYOVE	Owl Limpets		Black Abalone	Ochre Seastars	Northern Sea Palm
Anacapa Island	#Transects &Start Year	#Transects &Start Year	#Transects &Start Year	# Plots & Type	Start Year	# Plots, Type, & Start Year	# Plots, Type, & Start Year	# Plots, Type, & Start Year
Middle East								
Frenchy's Cove				3 CP	1999	**Abalone**	TS 1994	**Sea Palm**
Cat Rock				3 CP	1999	**Monitoring**	5 IP[1] 1982	**Monitoring**
Santa Barbara						**Sites**		**Sites**
Landing Cove						**Not**	1 BT 1985	**Not**
Sea Lion Rookery						**Indicated**	5 IP[1] 1985	**Indicated**
Santa Catalina								
Bird Rock				1 IP*	1998		TS 1994	
*Single owl limpet irregular plot = bedrock dike. No other suitable plot locations.								
Little Harbor							TS 1994	

CP = Circular Plot (2m diameter), **RP** = Rectangular Plot (1.5m X 1m plots), **IP** = Irregular Plot, **BT** = Band Transect (2m X ~8m band).
TS = Timed Search, **GT** = Grid Transect (w/ multiple $1m^2$ or other size quadrats)

[2] 3rd IP added 2004.

[3] Transects scored using Line-Intercept method (1cm increments for 10m line thus 1,000 segments) from site establishment through SP00.

[4] 3 plots on inshore cliff & 3 on offshore rocks @ Cabrillo sites; 6 plots on cliff faces @ Navy sites for similar # replicates.

Table 9. Motile Invertebrate Monitoring at MARINe Sites.

See Table 4 for full target species plot name; sampling frequency semi-annual, except annual (spring) for island sites (starting 2002), Ventura/LA County (starting 2004), and annual (summer) for sites from Sonoma County north to Oregon; start Year represents 1st year using standard protocol. Sites may have protocol testing data for prior year(s).

MAINLAND	**Start**	**FUC**	**HES**	**PEL**	**SIL**	**END**	**NEO**	**MAZ**	**RED**	**ANT**	**MYT**	**MYTdn**	**BAL**	**CHT**	**SEM**	**TET**	**POL**	**TAR**
Oregon	**Year**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**
Clatsop Co.																		
Ecola																		
Lincoln Co.																		
Fogarty Creek																		
Lane Co.																		
Bob Creek																		
Coos Co.																		
Cape Arago																		
Curry Co.																		
Burnt Hill																		
California																		
Del Norte Co.																		
Enderts	2004			5		5					5			5				
Damnation Creek	2004	5				5					5	5		5				
False Kalamath Cove	2004	5		5		5					5			5				
Humboldt Co.																		
Cape Mendocino	2004	5		5		5		5			5			5				
Shelter Cove	2004	5		5		5					5			5	5			
Mendocino Co.																		
Kibesillah Hill	2004	5		5		5		5			5			5				
Stornetta																		
Sea Ranch	2004	5		5		5					5			5				
Sonoma Co.																		
Bodega	2002			5		5					5			5				
Marin Co.																		
Santa Maria Creek																		
Bolinas Point																		
Slide Ranch																		
Point Bonita																		
San Mateo Co.																		
Pebble Beach																		
Pigeon Point																		
Franklin Point																		
Santa Cruz Co.																		
Scott Creek	2002	5			5	5					5			5				
Davenport Landing																		
Sand Hill Bluff	2002			5							5		5	5				
Wilder Ranch																		
Terrace Point	2002				5			5			5		5	5				
Natural Bridges																		

	Start	FUC	HES	PEL	SIL	END	NEO	MAZ	RED	ANT	MYT	MYTdn	BAL	CHT	SEM	TET	POL	TAR
	Year	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots	# Plots
Monterey Co.					5	5		5			5		5	5				
Hopkins	2002																	
Point Pinos																		
China Rocks																		
Stillwater	2002				5	5		5			5			5				
Carmel Point																		
Point Lobos	2002				5	5		5			5			5				
Mal Paso																		
Garrapata																		
Soberanes																		
Andrew Molera	2002	5			5	5					5			5				
Partington Cove																		
Mill Creek	2002				5	5		5			5			5				
Pacific Valley																		
San Luis Obispo Co																		
Pt Sierra Nevada	2001		5		5						5			5				
Piedras Blancas																		
San Simeon Point																		
Vista del Mar																		
Rancho Marino																		
Cayucos	2001		5		5	5					5			5				
Hazard's	2001				5	5					5			5				
Diablo																		
Shell Beach	2001				5	5		5			5			5				
Santa Barbara Co																		
Occulto	2001					5					5			5				
Purisima																		
Stairs	2001				5	5			5		5			5				
Boat House	2001				5	5					5			5				
Government Point	2001				5	5					5			5				
Alegria	2001									5	5			5			5	
Arroyo Hondo	2001										5			5				
Coal Oil Pt.	2001									5	5							
Carpinteria	2001									5	5			5			5	
Ventura Co.																		
Mussel Shoals	2002									5	5			5				
Old Stairs	2002					5				5	5			5				
LA Co.																		
Paradise Cove	2002					5					5			5				
White's Point	2002					5					5		5	5				
Point Fermin	2002				5						5			5				
Orange Co.																		
Crystal Cove	2003				5						5			5				
Shaws Cove	2003				5	5					5			5				
Treasure Island	2003				5						5			5				

	Start	FUC	HES	PEL	SIL	END	NEO	MAZ	RED	ANT	MYT	MYTdn	BAL	CHT	SEM	TET	POL	TAR
Orange Co.	**Year**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**	**# Plots**
Dana Point	2003				5						5			5				
San Diego Co.																		
Cardiff Reef																		
Scripps Reef																		
Navy North																		
Navy South																		
Cabrillo I																		
Cabrillo II																		
Cabrillo III																		
ISLANDS																		
San Miguel I.																		
Otter Harbor	2002				5	5					5			5				
Harris Point	2002		5			5					5			5		5		
Cuyler Harbor	2002				5	5					5			5				
Crook Point	2002				5	5					5			5				
Santa Rosa I.																		
NW Talcott	2002				5	5					5			5				
Fossil Reef	2002				5	5					5			5				
Johnson's Lee	2002					5					5			5				
Ford Point	2002					5					5			5				
East Point	2002				5	5					5			5				
Santa Cruz I.																		
Fraser	2002		5		5	5					5			5			5	5
Trailer	2002		5		5						5			5				
Willows	2002		5		5	5					5							
Orizaba	2002		5		5						5			5		5		
Prisoner's	2002		5		5	5					5			5				
Scorpion	2002		5			5					5			5		5		
Anacapa I.																		
Middle West	2002				5	5					5			5				
Middle East	2002				5	5					5			5				
Frenchy's Cove	2002				5	5					5			5				
Cat Rock	2002				5	5					5			5				
Santa Barbara I.																		
Landing Cove	2002				5						5			5				
Sea Lion Rookery	2002				5	5					5			5				
Santa Catalina I.																		
Bird Rock																		
Little Harbor																		

Table 10. Barnacle and Mussel Recruitment Monitoring at MARINe Sites.

MAINLAND	*Chthamalus dalli/fissus/Balanus glandula*		*Mytilus californianus*	
Oregon	**# Plates/Clearings**	**Start Year**	**# Tuffys**	**Start Year**
Clatsop Co.				
Ecola				
Lincoln Co.				
Fogarty Creek				
Lane Co.				
Bob Creek				
Coos Co.				
Cape Arago				
Curry Co.				
Burnt Hill				
California				
Del Norte Co.				
Enderts				
Damnation Creek				
False Kalamath Cove				
Humboldt Co.				
Cape Mendocino	5[1]	2004		
Shelter Cove	5[1]	2004		
Mendocino Co.				
Kibesillah Hill	5[1]	2004		
Stornetta				
Sea Ranch	5[1]	2004		
Sonoma Co.				
Bodega	5	2004		
Marin Co.				
Santa Maria Creek				
Bolinas Point				
Slide Ranch				
Point Bonita				
San Mateo Co.				
Pebble Beach				
Pigeon Point				
Franklin Point				
Santa Cruz Co.				
Scott Creek	5	1999		
Davenport Landing				
Sand Hill Bluff	5	1999		
Wilder Ranch				
Terrace Point	5	1999		
Natural Bridges				
Monterey Co.				
Hopkins	5	1999		
Point Pinos				
China Rocks				
Stillwater	5	2000		
Carmel Point				
Point Lobos	5	1999		
Mal Paso				
Garrapata				
Soberanes				
Andrew Molera	5	1999		
Partington Cove				
Mill Creek	5	1999		
Pacific Valley				
San Luis Obispo Co.				
Pt. Sierra Nevada	5			
Piedra Blancas				
San Simeon Point				
Vista del Mar				
Rancho Marino				
Cayucos	5			
Hazard's	5			
Diablo				

	Chthamalus dalli/fissus/Balanus glandula		*Mytilus californianus*	
San Luis Obispo Co.	**# Plates/Clearings**	**Start Year**	**# Tuffys**	**Start Year**
Shell Beach	5			
Santa Barbara Co.				
Occulto	5			
Purisima				
Stairs	5			
Boat House	5			
Government Pt.	5			
Alegria	5		5	
Arroyo Hondo	5			
Coal Oil Pt.	5		5	
Carpinteria	5			
Ventura Co.				
Mussel Shoals	5			
Old Stairs	5			
Los Angeles Co.				
Paradise Cove	5			
White's Point	5			
Point Fermin				
Orange Co.				
Crystal Cove				
Shaws Cove				
Treasure Island				
Dana Point				
San Diego Co.				
Cardiff Reef				
Scripps Reef				
Navy North				
Navy South				
Cabrillo I				
Cabrillo II				
Cabrillo III				
ISLANDS				
San Miguel Island				
Otter Harbor				
Harris Point				
Cuyler Harbor				
Crook Point				
Santa Rosa Island				
NW Talcott				
Fossil Reef				
Johnson's Lee				
Ford Point				
East Point				
Santa Cruz Island				
Fraser	5	1994	5	1994
Trailer	5	1994	5	1994
Willows	5	1994	5	1994
Orizaba				
Prisoner's	5	1994	5	1994
Scorpion				
Anacapa Island				
Middle West				
Middle East				
Frenchy's Cove				
Cat Rock				
Santa Barbara Island				
Landing Cove				
Sea Lion Rookery				
Santa Catalina Island				
Bird Rock				
Little Harbor				

[1] Clearings only – no plates.

Table 11. Temperature Logger Deployment at MARINe Core Sites.

MAINLAND *Oregon*	Shore Zone Location	Sampling Interval (min)	Deployment Mo/Year	Logger Type (e.g. Tidbit)	Logger Housing (e.g. PVC tube, epoxy mussel)
Clatsop Co.					
Ecola					
Lincoln Co.					
Fogarty Creek					
Lane Co.					
Bob Creek					
Coos Co.					
Cape Arago					
Curry Co.					
Burnt Hill					
California					
Del Norte Co.					
Enderts	Below Mussel	15[1]	4/2004		
Damnation Creek	Below Mussel	15[1]	4/2004		
False Kalamath Cove	Below Mussel	15[1]	4/2004		
Humboldt Co.					
Cape Mendocino	Below Mussel	15	6/2005		
Shelter Cove	Below Mussel	15	6/2005		
Mendocino Co.					
Kibesillah Hill	Below Mussel	15	6/2005		
Stornetta					
Sea Ranch	Below Mussel	15	6/2005		
Sonoma Co.					
Bodega	Below Mussel	15	6/2005		
Marin Co.					
Santa Maria Creek					
Bolinas Point					
Slide Ranch					
Point Bonita					
San Mateo Co.					
Pebble Beach					
Pigeon Point (North)	Below Mussel	15	6/2000		
Pigeon Point (South)	Below Mussel	15	12/2003		
Franklin Point					
Santa Cruz Co.					
Scott Creek	Below Mussel	15	6/2001		
Davenport Landing					
Sand Hill Bluff	Below Mussel	15	12/1999		
Wilder Ranch					
Terrace Point	Below Mussel	15	12/1999		
Natural Bridges					
Monterey Co.					
Hopkins	Below Mussel	15	12/1999		
Point Pinos					
China Rocks					
Stillwater	Below Mussel	15	3/2000		
Carmel Point					
Point Lobos	Below Mussel	15	3/2004		
Mal Paso					
Garrapata					
Soberanes	Below Mussel	15	7/2003		
Andrew Molera	Below Mussel	15	12/1999		
Partington Cove					
Mill Creek	Below Mussel	15	4/2004		
Pacific Valley					
San Luis Obispo Co.					
Pt. Sierra Nevada	Below Mussel	15	2005		
Piedra Blancas	Below Mussel	15	2005		
San Simeon Point					
Vista del Mar					
Rancho Marino	Below Mussel	15	2005		
Cayucos	Below Mussel	15	2005		

Hazard's	Below Mussel	15	2005		
Diablo					
Shell Beach	Below Mussel	15	2005		
Santa Barbara Co.					
Occulto	Below Mussel	15	2005		
Purisima	Below Mussel	15	2005		
Stairs	Below Mussel	15	2005		
Boat House	Below Mussel	15	2005		
Government Pt.	Below Mussel	15	2005		
Alegria					
Arroyo Hondo					
Coal Oil Pt.					
Carpinteria					
Ventura Co.					
Mussel Shoals					
Old Stairs					
Los Angeles Co.					
Paradise Cove					
White's Point					
Point Fermin					
Orange Co.					
Crystal Cove	Above Mussel	5	10/2005		
Shaws Cove	Above Mussel	30	11/2005		
Treasure Island	Above Mussel	30	11/2005		
Dana Point	Above Mussel	5	9/2005		
San Diego Co.					
Cardiff Reef					
Scripps Reef					
Navy North					
Navy South					
Cabrillo I	Below Mussel	4	2000		
Cabrillo II	Below Mussel	4	2000		
Cabrillo III	Below Mussel	4	2000		
ISLANDS					
San Miguel Island					
Otter Harbor					
Harris Point	Mid Mussel	16*	1992		
*Housing lost winter 2000—no deployment since.					
Cuyler Harbor					
Crook Point	Mid Mussel	16[2]	1992		
Santa Rosa Island					
NW Talcott	Mid Mussel	16[2]	1992		
Fossil Reef					
Johnson's Lee	Mid Mussel	16[2]	1992		
Ford Point					
East Point	Mid Mussel	16*	1992		
*Housing lost winter 2004—no deployment since.					
Santa Cruz Island					
Fraser	Mid Mussel	16			
Trailer	Mid Mussel	16			
Willows	Mid Mussel	16			
Orizaba					
Prisoner's	Mid Mussel	16			
Scorpion					
Anacapa Island					
Middle West	Mid Mussel	16	1992		
Middle East					
Frenchy's Cove	Mid Mussel	16[2]	1992		
Cat Rock					
Santa Barbara Island					
Landing Cove	Mid Mussel	16	1992		
Sea Lion Rookery					
Santa Catalina Island					
Bird Rock					
Little Harbor					

[1] Switched to 20 min interval starting 8/05.
[2] Data gaps occurred since deployment date.

Form 1a: Prototype MARINe Rocky Intertidal Field Log

(Fill in all blanks.: **----**=No Data; **0**=None: **L**=Low; **M**=Med; **H**=High; or Actual Value)

Site:_____ Date:___/___/___ Time:_____ to _____ Low Tide:_____(ft) at _____(hr)
Participants (Recorder 1st):_____
_____

Weather and Sea Conditions (affecting quality of sampling)(use codes listed above)
Swell/Surge:_____ Wind:_____ Rain:_____ Recent Rain:_____ Water Temp (°C):_____
Substratum Changes (sediment=sand, gravel, cobble) (magnitude at site)
Sediment Level:_____ Scour:_____ Rock Movement:_____
Debris and Pollutants (magnitude at site):
Plant Wrack:_____ Driftwood:_____ Shells:_____ Dead Animals:_____ Trash:_____ Oil/Tar:_____
Notes on Physical Conditions:_____
_____
_____
_____
_____
_____

Birds and Mammals (maximum # seen at any one time during the sampling)(see bird/mammal list for other species)

Pelican	Great Egret			CA Sea Lion
Cormorant	Snowy Egret			Harbor Seal
Gull	Lg Shorebird			Elephant Seal
Tern	Sm Shorebird			Sea Otter
Oystercatcher	Other Birds			Dog
Blue Heron				

Bird/Mammal Notes:_____
_____

Humans (maximum # seen at any one time during the sampling; note behavior) Reef:_____ Sand:_____
_____

Plot Marker Loss/Repair Notes:_____
_____
_____

Other Notes:_____
_____
_____
_____
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_____

Site:_____ Date:___/___/___ Recorder_____

Form 1b: Prototype MARINe Rocky Intertidal Site-Wide Species Conditions

Species	Abundance	Appearance	Recruitment	Notes
Target Species shown in bold. **Optimum Intertidal Zone** (may occur in 1, 2 or 3 zones) **H**=High **M**=Mid **L**=Low	-----=No Data **0**=Absent **R**=Rare **U**=Uncommon **P**=Present **C**=Common **A**=Abundant	-----=No Data √=Typical (healthy) **F**=Fertile/Flowers **B**=Bleached **D**=Damaged_____ **L**=Low level **M**=Med level **H**=High level	-----=No Data **0**=Absent **L**=Low level **M**=Med level **H**=High level	
Cladophora columbiana				
Ulva/Enteromorpha				
Egregia menziezii				
Eisenia arborea				
Endarachne/Petalonia				
Fucus gardneri				
Halidrys dioica/Cystoseira spp.				
Hesperophycus californicus				
Pelvetiopsis limitata				
Sargassum muticum				
Scytosiphon spp.				
Silvetia compressa				
Endocladia muricata				
Chondracanthus canaliculatus				
Mastocarpus papillatus				
Mazzaella affinis				
Mazzaella spp.(= Iridaea spp.)				
Porphyra sp.				
Phyllospadix scouleri/torreyi				
Anthopleura elegantissima/sola				
Phragmatopoma californica				
Mytilus californianus				
Littorina spp				
Lottia gigantea				
Haliotis cracherodii				
Tegula spp				
Chthamalus spp/B. glandula				
Tetraclita rubescens				
Pollicipes polymerus				
Ligia occidentalis				
Pisaster ochraceus				
Strongylocentrotus purpuratus				
Tar				

Form 1c: MARINe Rocky Intertidal Field Log Definitions

Codes

No Data (----): Draw a horizontal line through any blank area to indicate that this category was not evaluated or does not apply.

None (0): None were found within the defined site boundaries.

Low (L): Relatively few or low levels were found within the defined site boundaries.

Med (M): Medium numbers or moderate levels were found within the defined site boundaries.

High (H): High numbers or high levels were found within the defined site boundaries.

Weather and Sea Conditions

Swell/Surge: L/M/H relative levels of water movement over seaward portion of site.

Wind: L = ≤10 knots M = 11-20 knots H => 20 knots

Rain: L/M/H relative amounts of precipitation at the site during the survey.

Recent Rain: Evidence or knowledge of L/M/H amounts rain at the site within the past few days.

Water Temp: Actual seawater temperature (°C) or L: ≤14°C (57°F) M: 15-18°C H: >18°C (64°F).

Substratum Changes

Sediment Level: L/M/H relative levels of unconsolidated sand/gravel/cobble along reef/sediment interfaces.

Scour: L/M/H relative extent of scoured reef surfaces within the defined site boundaries.

Rock Movement: L/M/H relative extent of overturned boulders or bedrock breakouts.

Debris and Pollutants

Plant Wrack: L/M/H levels of unattached algae or other drift plants within the site.

Driftwood: L/M/H levels of sticks, branches, and logs within the site.

Shells: L/M/H levels of dead shells, especially mussel shells.

Dead Animals: L/M/H levels of dead invertebrates, fish, birds, or mammals.

Trash: L/M/H levels of human debris including cans, bottles, plastics, and metal items.

Oil/Tar: L/M/H relative extent of fresh or weathered oil/tar within the site.

Site-Wide Species Conditions

Abundance: Relative numbers of individuals or cover of species, in 5 levels, with “Present” representing the middle level.

Appearance: Checkmark indicates typical “healthy” non-reproductive appearance. If appearance is not typical, pair noted appearance codes with level codes (FL, FM, FH, BL, BM, BH, DL, DM, DH). Score L/M/H relative levels of reproductive appearance (F) (plants showing evidence of fertility), bleaching (B) (plants only: e.g., appearing pale or translucent or red algae appearing greenish), or damage (D) (plants & animals: e.g., abraded, torn, broken, withered, diseased, injured, or dead individuals). It is possible to record multiple entries (e.g., *Silvetia* = FL, BL, & DM).

Recruitment: For appropriate species when evident, score L/M/H relative levels of recruit abundances (settlers that have become obvious since the previous sampling).

Form 2a: Prototype MARINe Rocky Intertidal Photo Log

Site:_____ Camera:_____ Roll No.:_____ Date:_____
Photographer:_____ Recorder:_____

Photo #	Plot/Area Photographed (if area, indicate viewpoint)	Notes
1		
2		
3		
4		
5		
6		
7		
8		
9		
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11		
12		
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50		

Form 2b: Prototype MARINe Rocky Intertidal Photo Log

Site:_____ Camera:_____ Roll No.:_____ Date:_____

Photographer:_____ Recorder:_____

Photo #	Plot/Area Photographed (if area, indicate viewpoint)	Notes
51		
52		
53		
54		
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96		
97		
98		
99		
100		

Form 3a: Prototype MARINe Rocky Intertidal Photoplot Sketch Data Sheet

Site:_____ Date:_____ Photographer:_____ Roll #:_____
Target Species:_____ Observer:_____ Photo #s:____ - ____

Plot 1 ( ) Notes:_____

Plot 2 ( ) Notes:_____

Plot 3 ( ) Notes:_____

Green Algae: **CL**=Cladophora columbiana; **UE** = Ulva/Enteromorpha; **OG**=Other Green
Brown Algae: **EM**=Egregia; **EA**=Eisenia; **EP**=Endarachne/Petalonia; **FG**=Fucus; **HC**=Halidrys/Cystoseira; **HE**=Hesperophycus; **PL**=Pelvetiopsis; **SM**=Sargassum muticum; **SC**=Scytosiphon; **SI**=Silvetia: **OB**=Other Brown
Red Algae: **AC**=Articulated Corallines; **CC**=Crustose Corallines; **CO**=Chondracanthus can.; **EN**=Endocladia; **MP**=Mastocarpus pap.; **MZ**=Mazaella affinis; **MS**=Mazaella (Ididaea); **PS**=Porphyra spp;; **OR**=Other Reds
Algae/Plants: **PY**=Phyllospadix; **NC**=Non-Coralline Crusts; **OP**=Other Plants
Barnacles: **CB**=Chthamalus/Balanus; **TE**=Tetraclita; **PO**=Pollicipes; **BA**=Other Barnacles
Mollusks: **MY**=Mytilus; **LG**=Lottia gigantea; **LI**=Limpets; **CI**=Chitons
Invertebrates: **AE**=Anthopleura; **PH**=Phragmatopoma; **PI**=Pisaster ochraceus; **OI**=Other Invertebrates
Substrates: **R**=Rock, **S**=Sand, **T**=Tar

Form 3b: Prototype MARINe Rocky Intertidal Photoplot Sketch Data Sheet

Site:_____ **Date:**_____ **Photographer:**_____ **Roll #:**_____

Target Species:_____ Observer:_____ Photo #s:____ - ____

Plot 4 ( ) Notes:_____

Plot 5 ( ) Notes:_____

Plot ( ) Notes:_____

Green Algae: **CL**=Cladophora columbiana; **UE** = Ulva/Enteromorpha; **OG**=Other Green
Brown Algae: **EM**=Egregia; **EA**=Eisenia; **EP**=Endarachne/Petalonia; **FG**=Fucus; **HC**=Halidrys/Cystoseira; **HE**=Hesperophycus; **PL**=Pelvetiopsis; **SM**=Sargassum muticum; **SC**=Scytosiphon; **SI**=Silvetia: **OB**=Other Brown
Red Algae: **AC**=Articulated Corallines; **CC**=Crustose Corallines; **CO**=Chondracanthus can.; **EN**=Endocladia; **MP**=Mastocarpus pap.; **MZ**=Mazaella affinis; **MS**=Mazaella (Ididaea); **PS**=Porphyra spp;; **OR**=Other Reds
Algae/Plants: **PY**=Phyllospadix; **NC**=Non-Coralline Crusts; **OP**=Other Plants
Barnacles: **CB**=Chthamalus/Balanus; **TE**=Tetraclita; **PO**=Pollicipes; **BA**=Other Barnacles
Mollusks: **MY**=Mytilus; **LG**=Lottia gigantea; **LI**=Limpets; **CI**=Chitons
Invertebrates: **AE**=Anthopleura; **PH**=Phragmatopoma; **PI**=Pisaster ochraceus; **OI**=Other Invertebrates
Substrates: **R**=Rock, **S**=Sand, **T**=Tar

Form 4: Prototype MARINE Rocky Intertidal Photoplot Slide-Scoring Data Sheet

Site:_____ Sampling Season:_____ Date Sampled:_____

Assemblage:_____ Recorder:_____ Date Scored:_____

Core Taxa		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6
Cladophora columbiana	CLACOL						
Ulva/Enteromorpha	ULVENT						
Other Green Algae	OTHGRE						
•Egregia menziesii	**EGRMEN**						
Eisenia arborea	EISARB						
Endarachne/Petalonia	ENDPET						
Fucus gardneri	FUCGAR						
Halidrys/Cystoseira spp	HALCYS.						
Hedophyllum sessile	**HEDSES**						
•Hesperophycus californicus	**HESCAL**						
Pelvetiopsis limitata	PELLIM						
Sargassum muticum	SARMUT						
Scytosiphon spp	SCYSPP						
•Silvetia compressa	**SILCOM**						
Other Brown Algae	OTHBRO						
Chondracanthus canaliculatus	CHOCAN						
•Endocladia muricata	**ENDMUR**						
Mastocarpus papillatus	MASPAP						
Mazzaella affinis	MAZAFF						
Mazzaella spp.(= Iridaea spp.)	MAZSPP						
Neorhodomela larix	**NEOLAR**						
Porphyra spp	PORSPP						
Articulated Corallines	ARTCOR						
Crustose Corallines	CRUCOR						
Other Red Algae	OTHRED						
•Phyllospadix scouleri/torreyi	**PHYOVE**						
Non-Coralline Crusts	NONCRU						
Other Plant	OTHPLA						
•Anthopleura elegantissima/solis	**ANTELE**						
Phragmatopoma californica	PHRCAL						
•Lottia gigantea	**LOTGIG**						
•Mytilus californianus	**MYTCAL**						
Limpets	LIMPET						
Chitons	CHITON						
•Chthamalus spp/Bal glandula	**CHTBAL**						
•Pollicipes polymerus	**POLPOL**						
Semibalanus cariosus	**SEMCAR**						
•Tetraclita rubescens	**TETRUB**						
Other Barnacles	OTHBAR						
•Pisaster ochraceus	**PISOCH**						
Other Invertebrates	OTHINV						
Rock	ROCK						
Sand	SAND						
Tar	**TAR**						
Other Substrate	OTHSUB						
Unidentified	UNIDEN						

Form 5: Prototype MARINe Rocky Intertidal Point Intercept Transect Data Sheet

Site:_____Date:_____Time:_____Sampler:_____Recorder:_____

Directions: Record 100 point-intercepts (every 10 cm) along 10m transect lines. Target Species (circle): Boa Kelp Surfgrass Turf.

Species/Taxa/Substrate		Transect 1 ( )	Transect 2 ( )	Transect 3 ( )
Phyllospadix ***Overstory***				
Phyllospadix Understory				
Egregia menziesii				
Eisenia arborea				
Halidrys dioica/Cystoseira				
Hedophyllum sessile				
Sargassum muticum				
Crustose Algae	Coralline			
	Non-Coralline			
Articulated Corallines				
Other Algae	Red			
	Brown			
	Green			
Other Plant				
Anthopleura elegan/sola				
Phragmatopoma calif.				
Mytilus californianus				
Barnacles				
Pisaster ochraceus				
Other Invertebrates				
Rock				
Sand				
Tar				
Other Substrate				
Unidentified				
Total:				

For each entry box, add the tick marks or counts, record the sum, and circle it.

Use the following classifications for epiphyte cover/appearance estimates: (0, L, M, H)=(none, low, med, high)

Cover of *Smithora:*_____ *Melobsia:*_____ bleached/brown grass:_____ Abraded:_____ Flowers:_____

Notes:_____

_____

_____

_____

Form 6a: Prototype MARINe Rocky Intertidal Owl Limpet Data Sheet

Site:_____ Date:_____ Time:_____ Plot Size:_____

Measurers:_____ Recorders:_____

Plot 1 ( )				Plot 2 ( )				Plot 3 ( )			
Size mm	#	Size mm	#	Size mm	#	Size mm	#	Size mm	#	Size mm	#
<15				<15				<15			
15		60		15		60		15		60	
16		61		16		61		16		61	
17		62		17		62		17		62	
18		63		18		63		18		63	
19		64		19		64		19		64	
20		65		20		65		20		65	
21		66		21		66		21		66	
22		67		22		67		22		67	
23		68		23		68		23		68	
24		69		24		69		24		69	
25		70		25		70		25		70	
26		71		26		71		26		71	
27		72		27		72		27		72	
28		73		28		73		28		73	
29		74		29		74		29		74	
30		75		30		75		30		75	
31		76		31		76		31		76	
32		77		32		77		32		77	
33		78		33		78		33		78	
34		79		34		79		34		79	
35		80		35		80		35		80	
36		81		36		81		36		81	
37		82		37		82		37		82	
38		83		38		83		38		83	
39		84		39		84		39		84	
40		85		40		85		40		85	
41		86		41		86		41		86	
42		87		42		87		42		87	
43		88		43		88		43		88	
44		89		44		89		44		89	
45		90		45		90		45		90	
46		91		46		91		46		91	
47		92		47		92		47		92	
48		93		48		93		48		93	
49		94		49		94		49		94	
50		95		50		95		50		95	
51		96		51		96		51		96	
52		97		52		97		52		97	
53		98		53		98		53		98	
54		99		54		99		54		99	
55		100		55		100		55		100	
56				56				56			
57				57				57			
58				58				58			
59				59				59			

Notes:_____

_____

Form 6b: Prototype MARINe Rocky Intertidal Owl Limpet Data Sheet

Site:_____ Measurers:_____

Date:_____ Time:_____ Recorders:_____

Plot 4 ( )				Plot 5 ( )				Plot 6 ( )			
Size mm	**#**	**Size mm**	**#**	**Size mm**	**#**	**Size mm**	**#**	**Size mm**	**#**	**Size mm**	**#**
<15				<15				<15			
15		60		15		60		15		60	
16		61		16		61		16		61	
17		62		17		62		17		62	
18		63		18		63		18		63	
19		64		19		64		19		64	
20		65		20		65		20		65	
21		66		21		66		21		66	
22		67		22		67		22		67	
23		68		23		68		23		68	
24		69		24		69		24		69	
25		70		25		70		25		70	
26		71		26		71		26		71	
27		72		27		72		27		72	
28		73		28		73		28		73	
29		74		29		74		29		74	
30		75		30		75		30		75	
31		76		31		76		31		76	
32		77		32		77		32		77	
33		78		33		78		33		78	
34		79		34		79		34		79	
35		80		35		80		35		80	
36		81		36		81		36		81	
37		82		37		82		37		82	
38		83		38		83		38		83	
39		84		39		84		39		84	
40		85		40		85		40		85	
41		86		41		86		41		86	
42		87		42		87		42		87	
43		88		43		88		43		88	
44		89		44		89		44		89	
45		90		45		90		45		90	
46		91		46		91		46		91	
47		92		47		92		47		92	
48		93		48		93		48		93	
49		94		49		94		49		94	
50		95		50		95		50		95	
51		96		51		96		51		96	
52		97		52		97		52		97	
53		98		53		98		53		98	
54		99		54		99		54		99	
55		100		55		100		55		100	
56				56				56			
57				57				57			
58				58				58			
59				59				59			

Notes:_____

_____

_____

_____

Form 7: Prototype MARINe Rocky Intertidal Abalone and Seastar Data Sheet

Site:_____ Sampling Date:_____ Sampling Season_____
Recorder:_____ Sampler:_____
Is This a Time Search? (check if yes):____ Time Period for Search: From_____to_____

Black Abalone

Length (mm)	Plot/Transect 1 ( )	Plot/Transect 2 ( )	Plot/Transect 3 ( )
5			
10			
15			
20			
25			
30			
35			
40			
50			
60			
70			
80			
90			
100			
110			
120			
130			
140			
150			
160			
170			
All			

Ochre Seastars

Radius (mm)	Plot/Transect 1 ( )	Plot/Transect 2 ( )	Plot/Transect 3 ( )
5			
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			
110			
120			
130			
140			
150			
160			
170			
180			
190			
200			
All			

Other Abalone (total # only – no sizes)

Species	Plot/Transect 1	Plot/Transect 2	Plot/Transect 3	Site

Other Seastars (total # only – no sizes)

Species	Plot/Transect 1	Plot/Transect 2	Plot/Transect 3	Site

Form 8: Prototype MARINe Rocky Intertidal Northern Sea Palm Data Sheet

Shelter Cove - *Postelsia* Date_____

Plot 1 (blank bolt)- Upcoast to Downcoast 5m long Name_____

Pp1

1 m onshore	0 m	offshore 1m
	0-1	
	1-2	
	2-3	
	3-4	
	4-5	

C

Plot 2 (2 notches)- Upcoast to Downcoast 5m long

Pp2

1 m onshore	0 m	offshore 1m
	0-1	
	1-2	
	2-3	
	3-4	
	4-5	

D

Plot 3 (3 notches)- Upcoast to Downcoast 5m long

Pp3

1 m onshore	0 m	offshore 1m
	0-1	
	1-2	
	2-3	
	3-4	
	4-5	

E

Form 9: Prototype MARINe Rocky Intertidal Motile Invertebrates Data Sheet

Plot Type:_____ Site:_____

Counter:_____ Date:_____

	Plot 1		Plot 2		Plot 3		Plot 4	
Species counted in whole plot (can be sub-sampled if abundant)* For hermits, I.D. 1st 10 & multiply % by total.								
Lepidochitona hartwegii								
Nuttalina spp.								
Mopalia spp.								
Fissurella volcano								
Pachygrapsis crassipes								
Pagurus samuelis								
Pagurus hirsutiusculus								
Pagurus granosimanus								
Ocenebra circumtexta								
Large limpets (>15mm) (excluding L. gigantea)								
Species counted and measured (1st 10 encountered only) in whole plot (can be sub-sampled if abundant)*								
	#	sizes	#	sizes	#	sizes	#	sizes
Nucella emarginata								
Nucella canaliculata								
Acanthina spp.								
Tegula funebralis								
Lottia gigantea								
Species sub-sampled in 3 20x20cm quadrats placed in UL, middle & LR of plot** Count limpets on rock (R) and mus								
	R	M	R	M	R	M	R	M
limpet < 5mm								
limpet 5-15 mm								
Sample in 10x10 cm section of 20x20 cm quadrat**								
Littorina spp.								