



8 December 2010

First annual review

Summary of findings for the Port of Friday Harbor

The Friday Harbor Marine Health Observatory, a collaborative effort of the Lopez based nonprofit conservation laboratory Kwiáht and WSU Beach Watchers, has deployed volunteer teams on Port docks since the beginning of the year, conducting an inventory of invertebrates living on docks, floats and pilings. Our primary objectives for our first year of work have been: (1) a baseline inventory of invertebrate species utilizing the marina as habitat; (2) selection of a short-list of species to serve as bioindicators for monitoring the health of the port and the bay; (3) collection of seasonal abundance and distribution data for bioindicator species, as a starting point for identifying trends—*e.g.*, changes in timing due to climate change—and for evaluating the effects of human activities on bay wildlife. A major concern has been the potential adverse impact of Spring Street runoff on the bay, and the possible remedial effect of biofiltration measures the county plans to install along Spring Street in 2011.

This document is a summary of the data collected in 2010, highlighting results of our baseline surveys that help us better understand ecological processes in the bay and the sensitivity of bay ecosystems to anthropogenic and climate forcing.

Methods

Data on species' abundance has been adjusted to "observer days"—that is to say, the number of days each month that volunteers were on conducting surveys on the docks. Volunteers are organized in teams, and each team is permanently assigned to a small part of one dock or pier in the port complex, with responsibility to visit its assigned location at least once monthly. Each team's study site includes a small dock or float segment for the most meticulous examination from month to month, within arm's reach; and a larger area that is surveyed at a walk, for larger, and more conspicuous animals. Each team's area of study is constant, and comparable with other teams' sites, making quantitative inferences possible: differences in species' abundance in different parts of the port complex, as well as seasonal differences in total abundance.

It should nevertheless be borne in mind, in reviewing this first report, that the first few months of 2010 fieldwork necessarily involved challenges and learning for the entire team. Adequate reference materials for identifying animals were compiled as we learned what species were actually present, and this changed substantially between winter and the warmer months of late spring and summer. Considerable time was invested in learning to identify animals reliably, and only gradually were we able to focus our attention on those species that we concluded were not only useful indicators, but also relatively easy to find and count consistently. Nudibranchs ("sea slugs") are conspicuous and, as very seasonal visitors to the bay, and also highly specialized in their choice of prey, useful as indicators of climate change and indicators of variations and trends in habitat quality. Barnacles, by comparison, can be *too* numerous to count meaningfully, while sea cucumbers, especially

the small white species *Eupentacta quinquesemita*, are so scarce and difficult to find that they cannot be counted reliably.

Dock letters are used to locate the distribution of animals within the port complex. FD is the fuel dock. FHL refers to the Friday Harbor Labs dock, which we include in the baseline study and monitoring as a “negative control” site—one that is sufficiently distant from the downtown, storm sewer and sewage treatment outfalls, and docks to represent a relatively “undisturbed” condition for comparison with the developed waterfront. We are mindful that there is some boat traffic at FHL, however, and evidence of organisms from other parts of San Juan County being released from the FHL dock rather than returned to the waters from which they were collected.

Data are included in this summary from a complementary study carried out by the environmental science class at Friday Harbor High School, focusing on sediment toxicity. The full report of that study is available separately. FHHS will continue to participate in the Friday Harbor Marine Health Observatory by conducting annual ecotoxicity studies.

Results

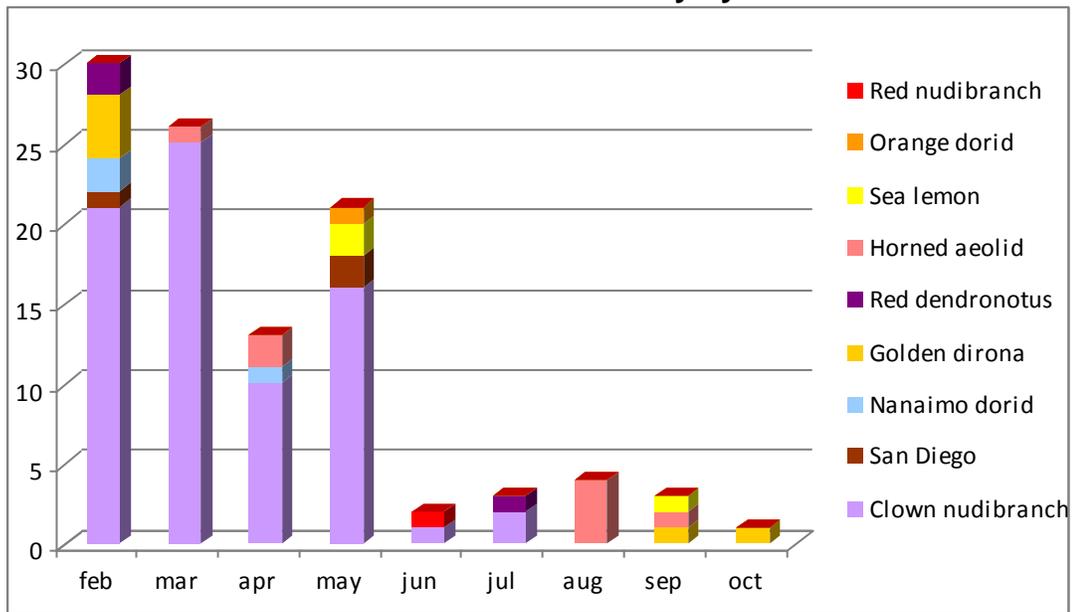
As expected, invertebrate abundance and diversity was generally highest at Friday Harbor Labs, our control site. Some of the port docks were also relatively rich in marine life, however: the fuel dock for nudibranchs, and outer dock H for nudibranchs and crabs, for example. Greater richness outer H dock may reflect greater depth, higher circulation, and greater distance from downtown streets and storm sewers. Ironically it may also be a function of the location of the town’s sewage treatment outfall, near the marina entrance, a source of additional nutrients.

Seasonal migration patterns were evident for many species: the nudibranchs were most abundant from winter to spring (February-May), starfish in spring (March-May) and crabs from spring to mid-summer (April-July). On the whole, invertebrate activity in the port complex was greatest in spring, decreasing from June to August and remaining quite low in the fall. This pattern dovetails with the life cycles of phytoplankton, the miniscule photosynthetic micro-algae, diatoms and dinoflagellates that are the foundation of marine food webs. Algal “green-up” can occur as early as late February in our area and is rarely later than April. Many animals congregate and reproduce just before green-up, or during the early weeks of green-up, to take advantage of this rich seasonal source of food.

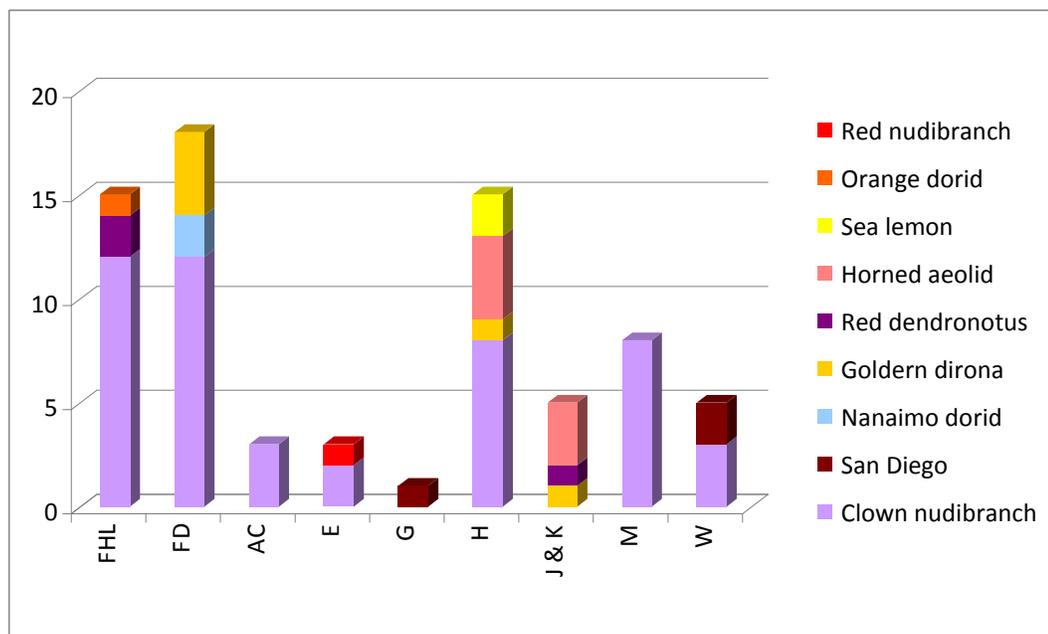
We will see in future years whether the exact timing changes to earlier or later as the seas around San Juan Island grow slightly warmer.

1. **Nudibranchs** (“sea slugs”) were most numerous *and* most diverse in winter. The conspicuous white and orange Clown nudibranch, *Triophae catalinae*, was by far the most abundant nudibranch species, and congregates in the marina presumably to reproduce, although we did not observe any identifiable egg masses. Sea slugs were most numerous and diverse at FHL, the Fuel Dock, and dock H, which does not admit to a simple explanation.

1A: Nudibranch abundance and diversity by month 2010

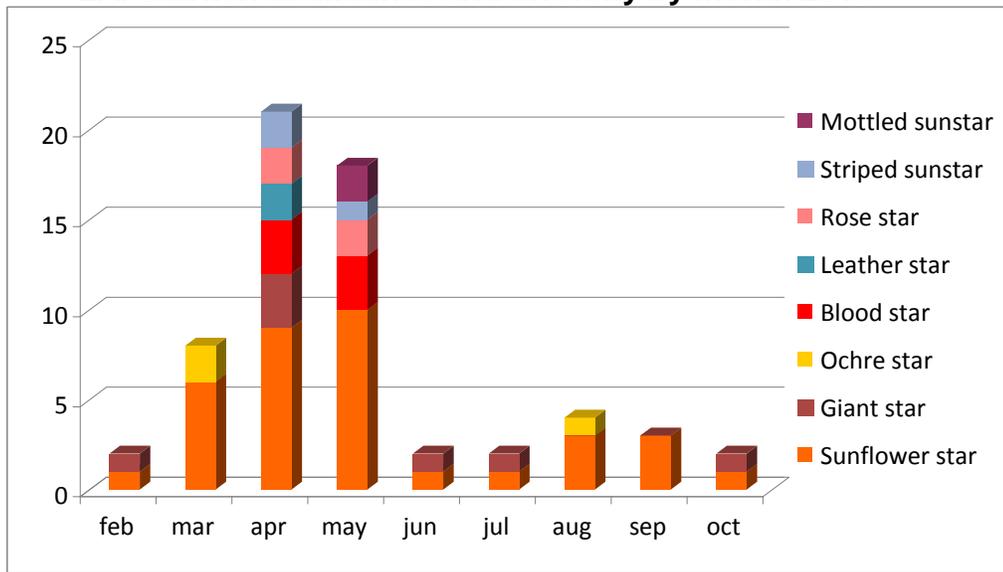


1B: Nudibranch abundance and diversity by location 2010

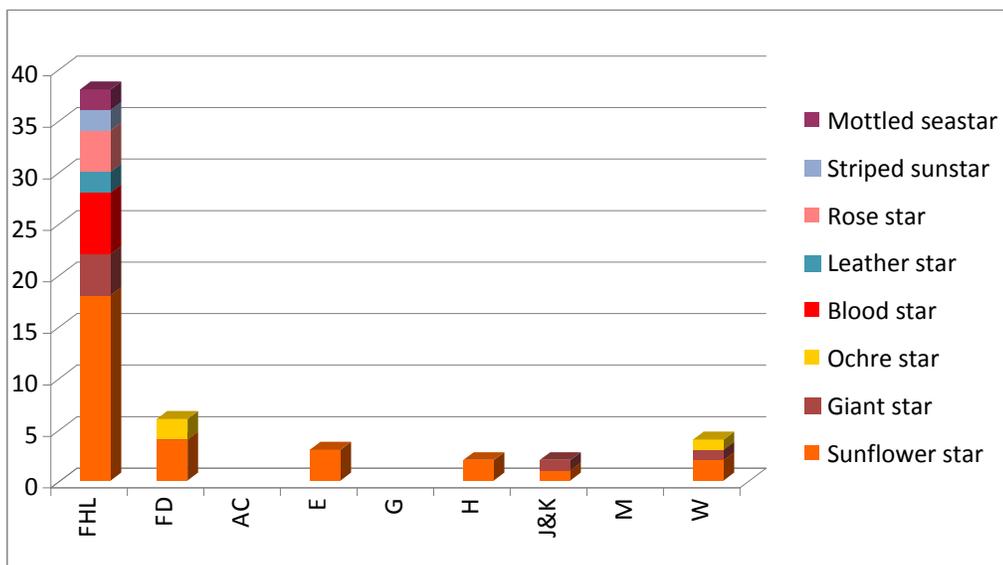


2. **Starfish (Asteroidea)** were most abundant and diverse in the spring, increasing in March, about a month after the peak in nudibranch abundance. The voracious and highly mobile Sunflower star, *Pycnopodia helianthoides*, was the most commonly seen throughout the year, and is probably a year-round resident of the bay. Friday Harbor Labs was *much* richer in starfish than any of the port docks. It is possible that this is due, at least in part, to disposal of animals by researchers at the Labs—but also plausible that deeper, rockier habitats near the Labs afford more prey for starfish, most of which prefer bivalves.

2A: Starfish abundance and diversity by month 2010

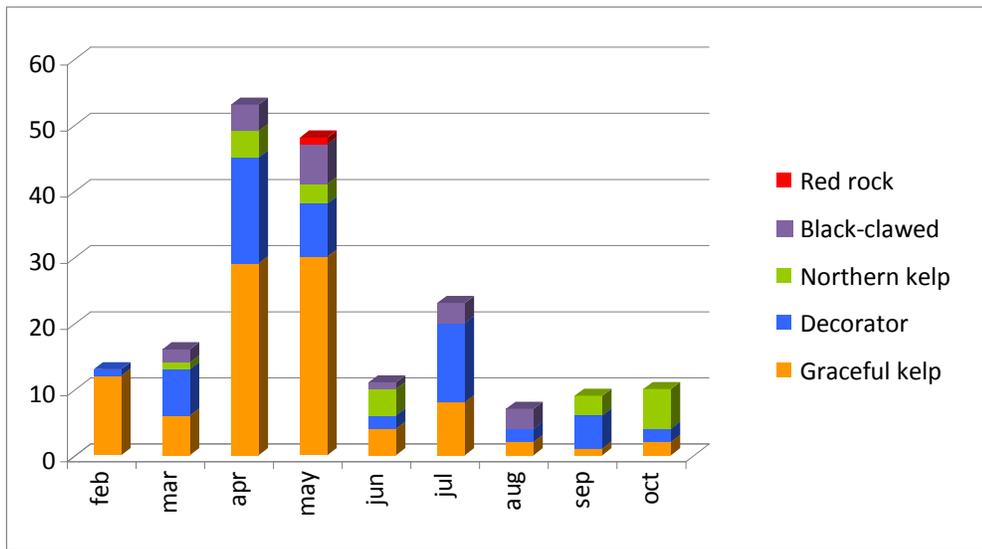


2B: Starfish abundance and diversity by location 2010

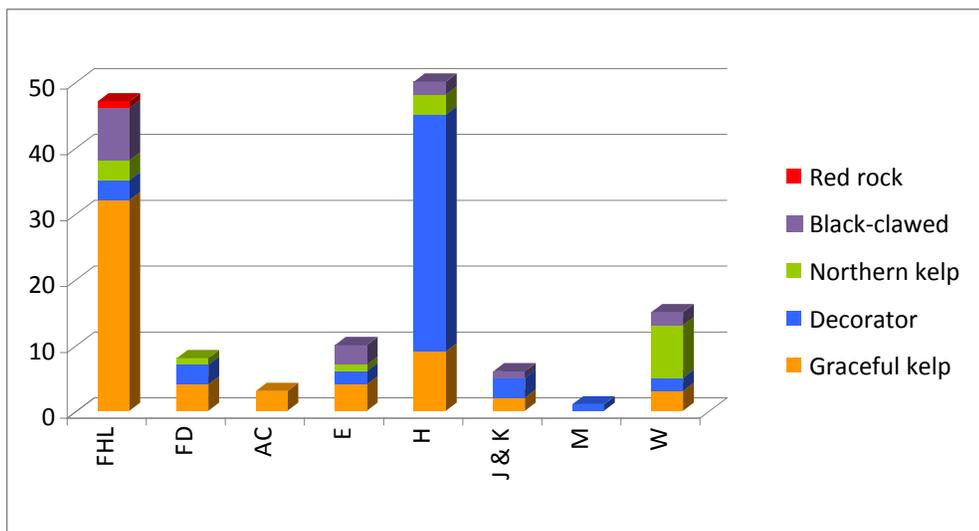


3. **Crabs (Decapoda):** are highly mobile scavengers and can be predators of smaller invertebrates. Many crab species migrate seasonally to shallows for reproduction, and this may help explain why crabs were so much more abundant around the port in spring to early summer (April-July). Many juvenile crabs were seen, as well as some adults carrying eggs. Graceful kelp crabs (*Pugettia producta*) and decorator crabs (*Pugettia gracilis*), two closely related species, were most commonly seen. Abundance and diversity was greatest at Friday Harbor Labs as expected, but also very high at dock H. Note that the dominant species differed between these sites!

3A: Abundance and diversity of crabs by month 2010

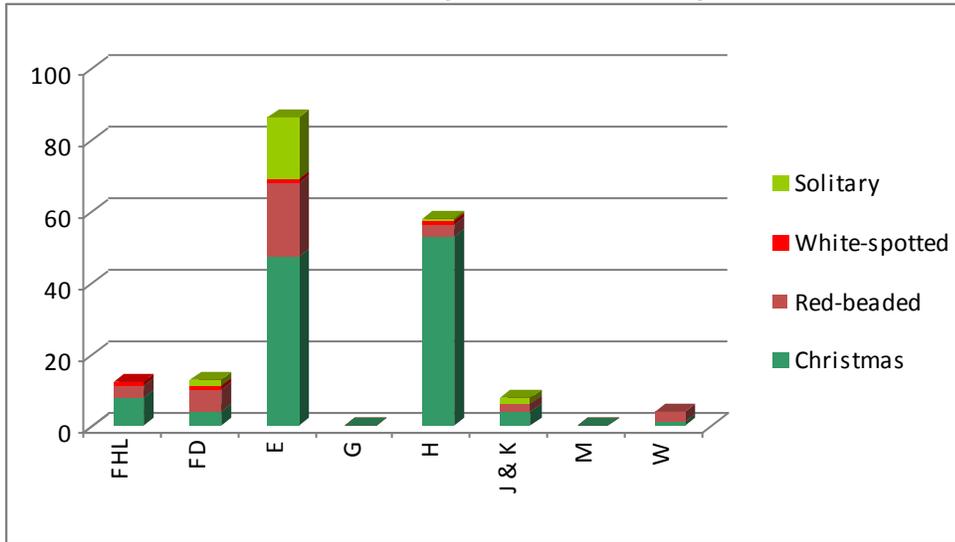


3B: Abundance and diversity of crabs by location 2010

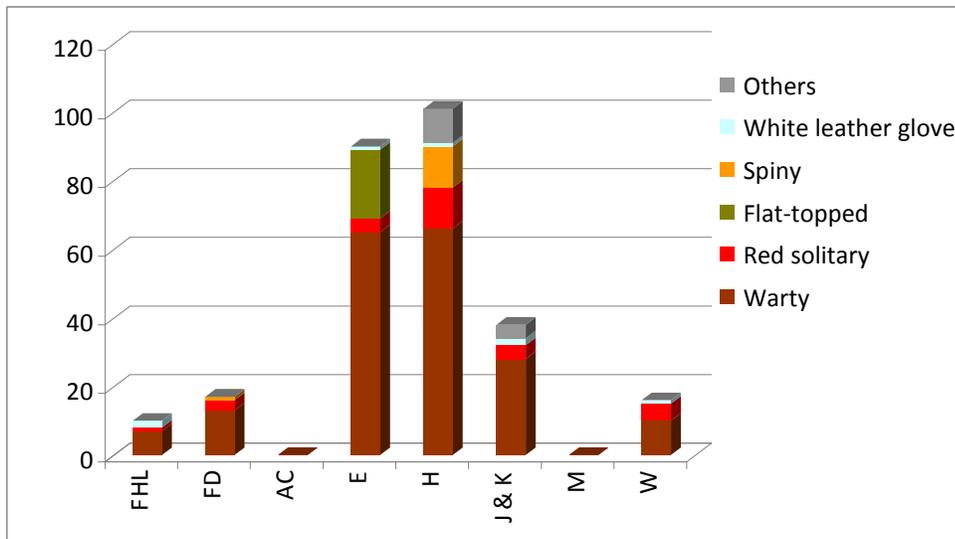


4. **Anemones** (Actinaria): are sessile although some can detach and “swim” to safety when threatened by a predator. As suspension feeders, they should thrive in areas of high nutrient inputs and strong circulation. Two closely related white species, *Metridium farcimen* and *Metridium senile*, are so abundant in the port that there is no practical way of counting them. Instead, we focused on several less common species. Interestingly they appear to favor docks E and H.

4: Abundance and diversity of anemones by location 2010



5. **Ascidians** (sea squirts, tunicates): are also sessile suspension feeders. We found a dozen species on the docks, including the invasive Flat-topped ascidian *Pyura hastor*, but many are inconspicuous and difficult to count reliably. Ascidians seem to thrive on docks E and H, like anemones.



6. Sediment quality

Sediments

Map of sites?