Friday Harbor Marine Health Observatory
2012 Annual Report on Health of the Harbor
February 2013

The Friday Harbor Marine Health Observatory (fridayharbormho.org) is a volunteer community-science program of Kwiaht that monitors biodiversity on the Friday Harbor waterfront in cooperation with the Port of Friday Harbor. Our research goals are to understand the Friday Harbor ecosystem and monitor its health. The longevity of the project has also created a legacy of baseline data for future research.

Since March 2010, the focus of our research has been the invertebrate populations living on the docks. Each month, six volunteer teams identify and count the crabs, anemones, echinoderms and nudibranchs at specific locations in the Port of Friday Harbor. They also measure water temperature, depth, and visibility. A seventh team collects the same data at the University of Washington's Friday Harbor Laboratories, a control site in deeper waters at a distance from the town and its chemical impacts.

Our monitoring sites were chosen to represent different environmental conditions. One site is near two potential sources of petroleum pollution: the fuel pumps and the Town of Friday Harbor’s storm water outfall. Another (E-dock) is nearest the Town’s nutrient rich wastewater outfall. We intentionally chose deep spots and shallow spots, sheltered locations and ones near the mouth of the harbor.

Our data reflect these environmental conditions. Species diversity, total invertebrate population and echinoderm populations are all lowest near the fuel dock and highest at E-dock (Fig 1,2,3). Crabs follow a similar pattern, except that they are also more abundant at the shallower and more sheltered sites generally (Fig 4).

Anemones are most frequently observed at the far end of H-dock (Fig 5), where natural water circulation is highest. It should be noted that we do not count the abundant white anemones (*Metridium spp*), which may prefer other parts of the Friday Harbor waterfront and crowd out other anemone species wherever they thrive. Unlike other anemones, *Metridium* is most common on docks and pilings as opposed to natural substrates, and is reputed to benefit from prop wash. This possibility may merit future study.

Winter is the best season for finding nudibranchs in Friday Harbor (Fig 7) as elsewhere in the islands, and sometimes we are lucky enough to see an aggregation like five large Golden Dironas seen on the fuel dock in December.

We have identified 16 different species of nudibranchs thus far in Friday Harbor. The diversity and the infrequent appearance of each species suggest that they are not residents, but seasonal visitors. We have rarely seen them mating or depositing egg ribbons in the harbor, while Kwiaht's Indian Island Marine Health Observatory routinely sees mating and eggs on rocky tidepools at winter minus tides. Nudibranchs may simply be swept into Friday Harbor by winter tides and currents; circulation patterns and a lack of competition could explain why they are sometimes abundant even at the fuel dock and at the near-shore end of H-dock where other invertebrates are few (Fig 6).

Crabs also visit the bay seasonally. Their breeding cycles are sensitive to water temperature. They are abundant in warm shallow areas of the harbor (Fig 4), and during warm months of the year (Fig 8) and most common when the surface water temperature is in the range of 10-14˚C (Fig 9, 10,11). The crab population spiked later in 2011 than in 2012 (Fig 8), reflecting a cooler spring and late summer. Water temperatures have been cooler overall for the last few years (La Niña) and are predicted to warm again in 2013.

Temperature has a significant effect on most marine invertebrates. All the invertebrates we monitor were less abundant in 2011 than 2010 or 2012 (Fig 12). Species diversity was also lower in 2011 (Fig 13).

It is important to be able to distinguish between annual variations driven by weather oscillations (ENSO) and long-term trends that may reflect climate change or other environmental factors. We have barely begun to understand why we find animals when and where we do, and the patterns we do see have not yet reached statistical significance. In 2013, we will continue adding to existing datasets and hope to measure more independent variables.

For example, our volunteers recently adopted a new method for sampling petroleum oils in seawater. Monthly collection of water samples was tried in 2011-2012 but detected no significant differences in oil concentrations from different parts of the harbor. This year we began hydrophobic polypropylene fabric "pom-poms" floating in the water to collect floating oils for a month at a time. Preliminary results are promising: some parts of the harbor do seem to be oilier than others, at least at some times of the year. Full details will be included in our 2014 annual report.

Our volunteers have also begun monitoring the plankton population by using a hand net and identifying both phytoplankton and zooplankton under a microscope. Plankton species can tell us about dissolved oxygen levels and other water quality issues.

Boat traffic levels could also be affecting the animal populations, either by increasing petroleum pollution or by creating physical disturbance to the habitat of the dock. Port-use records may correlate with some of our animal and hydrocarbon data.

Bathymetry and water circulation affect the distribution of everything in the bay, including the animals. To fit the scale of this study, they should be measured at high resolution, but they would not need to be continually monitored. We are looking into possible study methods, such as side-scan sonar and biodegradable dyes.

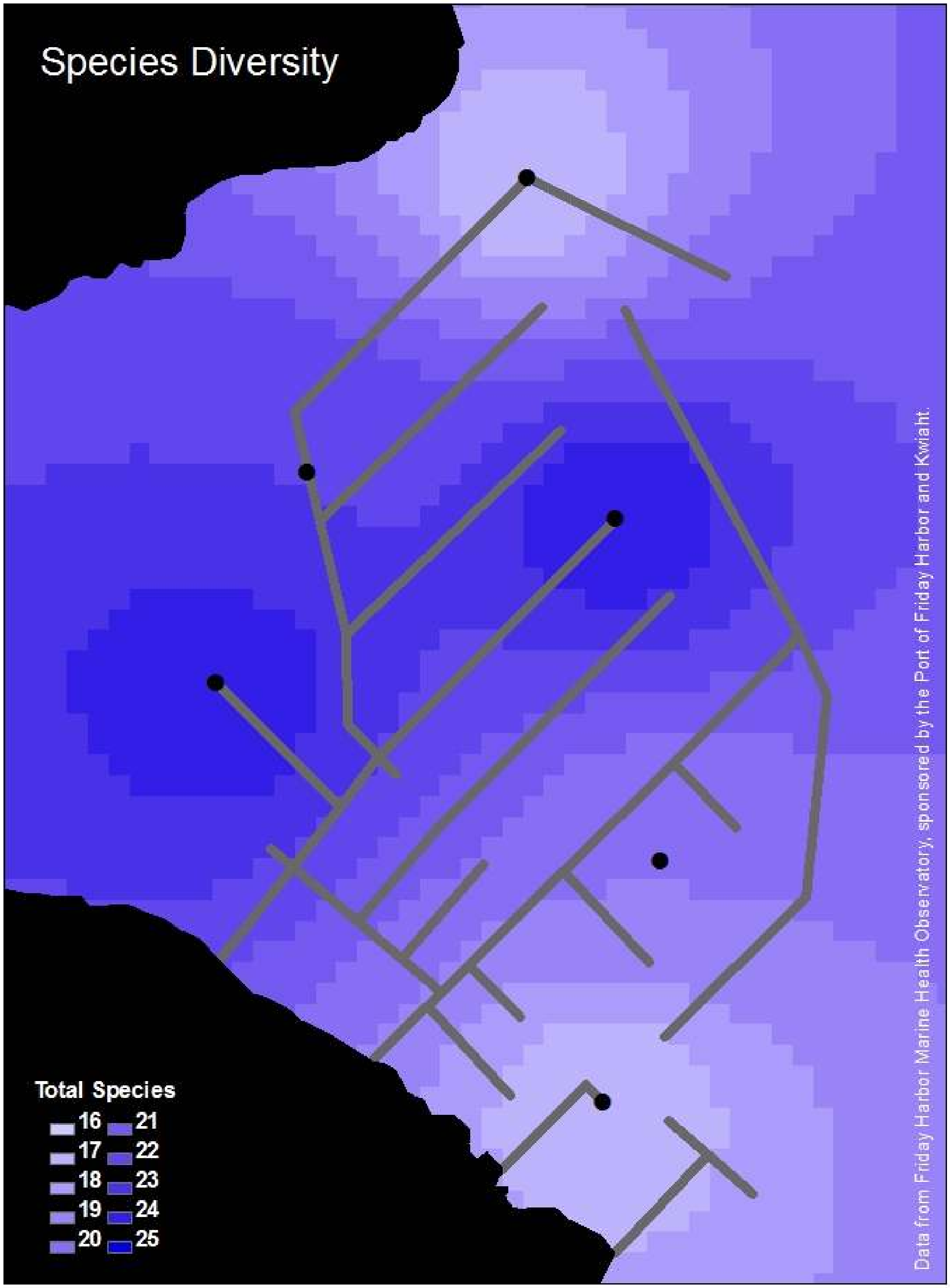

Figure 1: Map of total species diversity (extrapolated using inverse distance weighting)

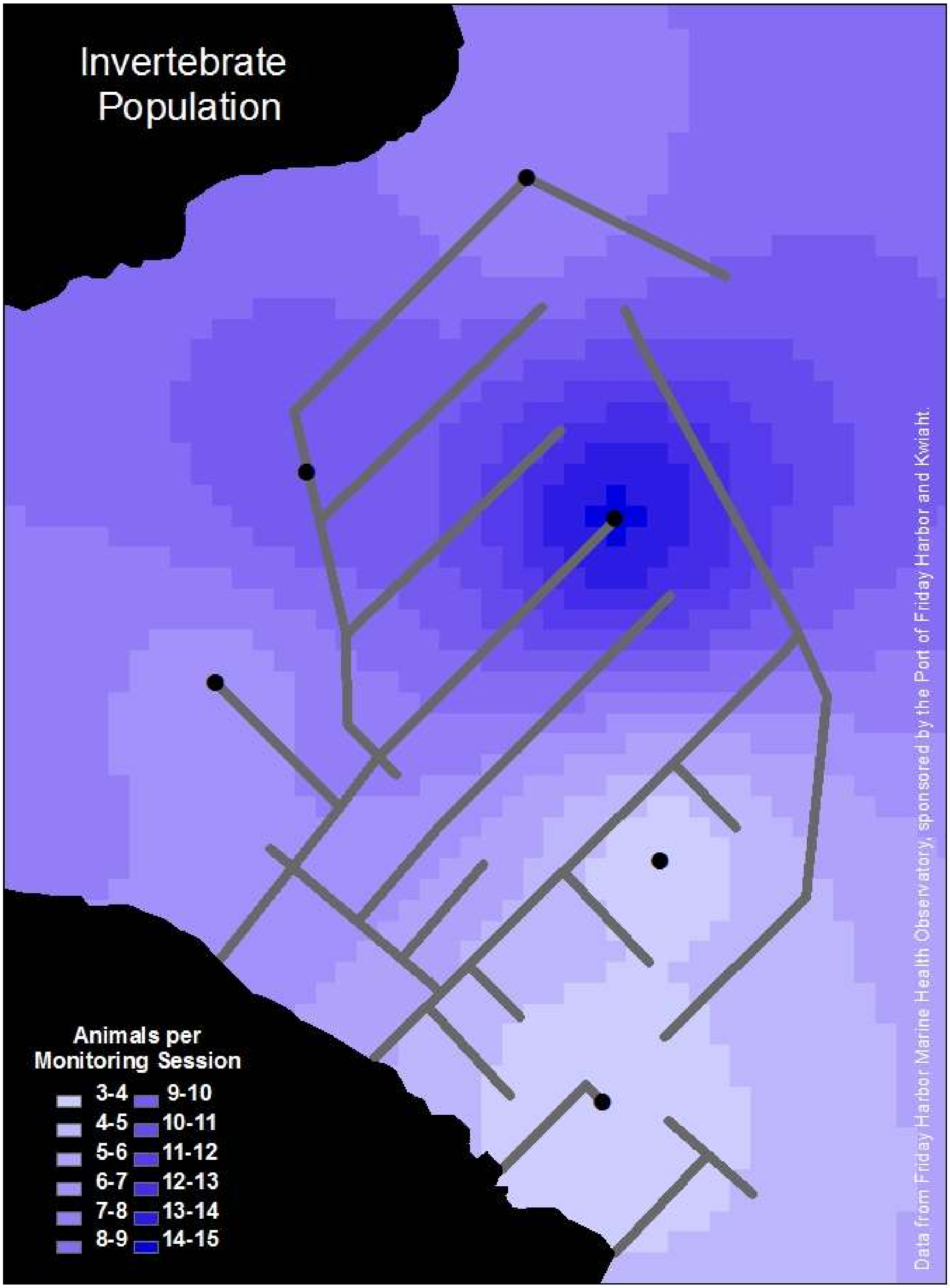

Figure 2. Map of total monitored invertebrates (extrapolated using inverse distance weighting; counts normalized by the number of monitoring sessions)

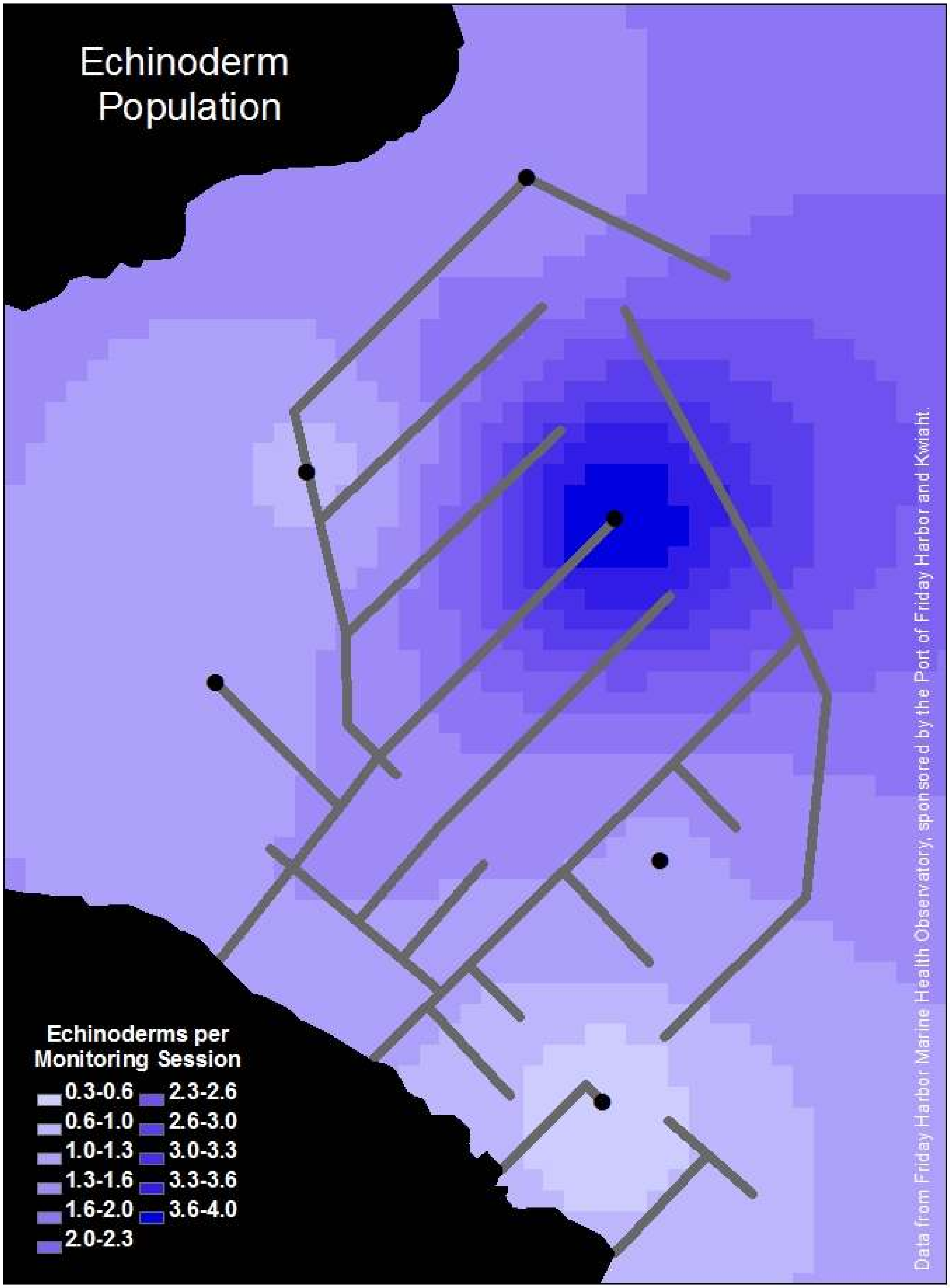

Figure 3: Map of echinoderm distribution (extrapolated using inverse distance weighting; counts normalized by the number of monitoring sessions)

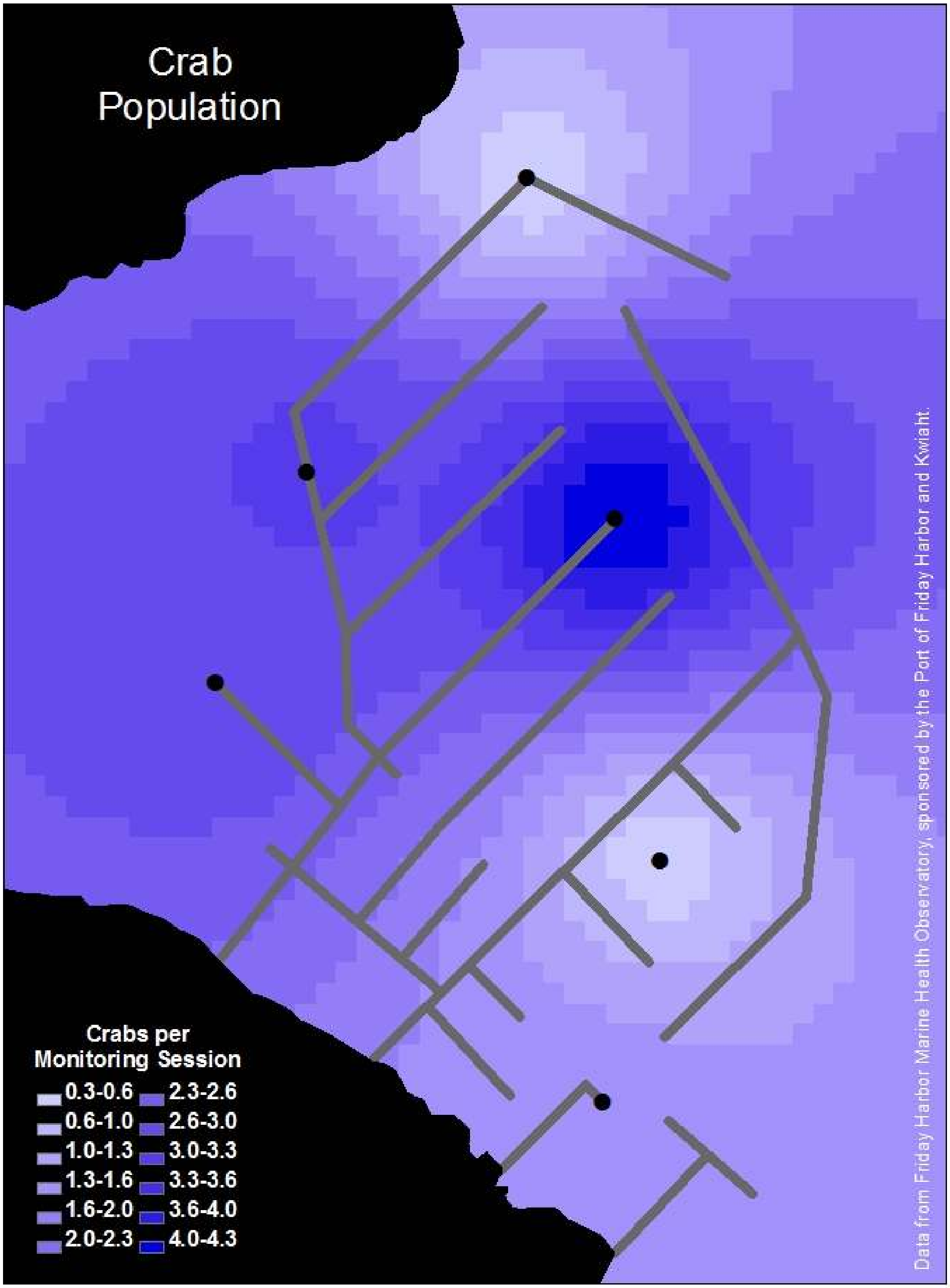

Figure 4. Map of crab distribution (extrapolated using inverse distance weighting; counts normalized by the number of monitoring sessions)

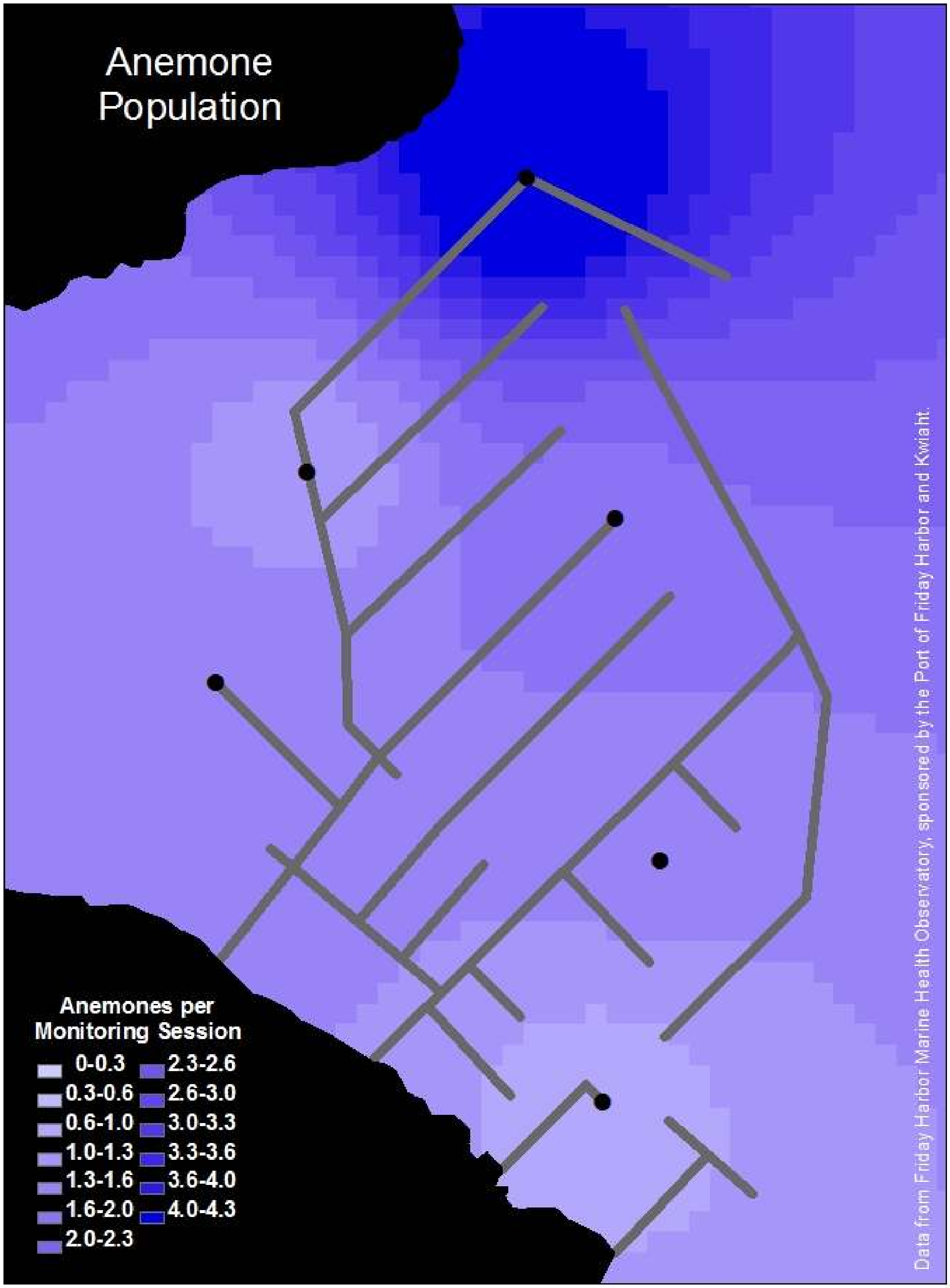

Figure 5. Map of sea anemone distribution excluding *Metridium* (extrapolated using inverse distance weighting; counts normalized by the number of monitoring sessions)

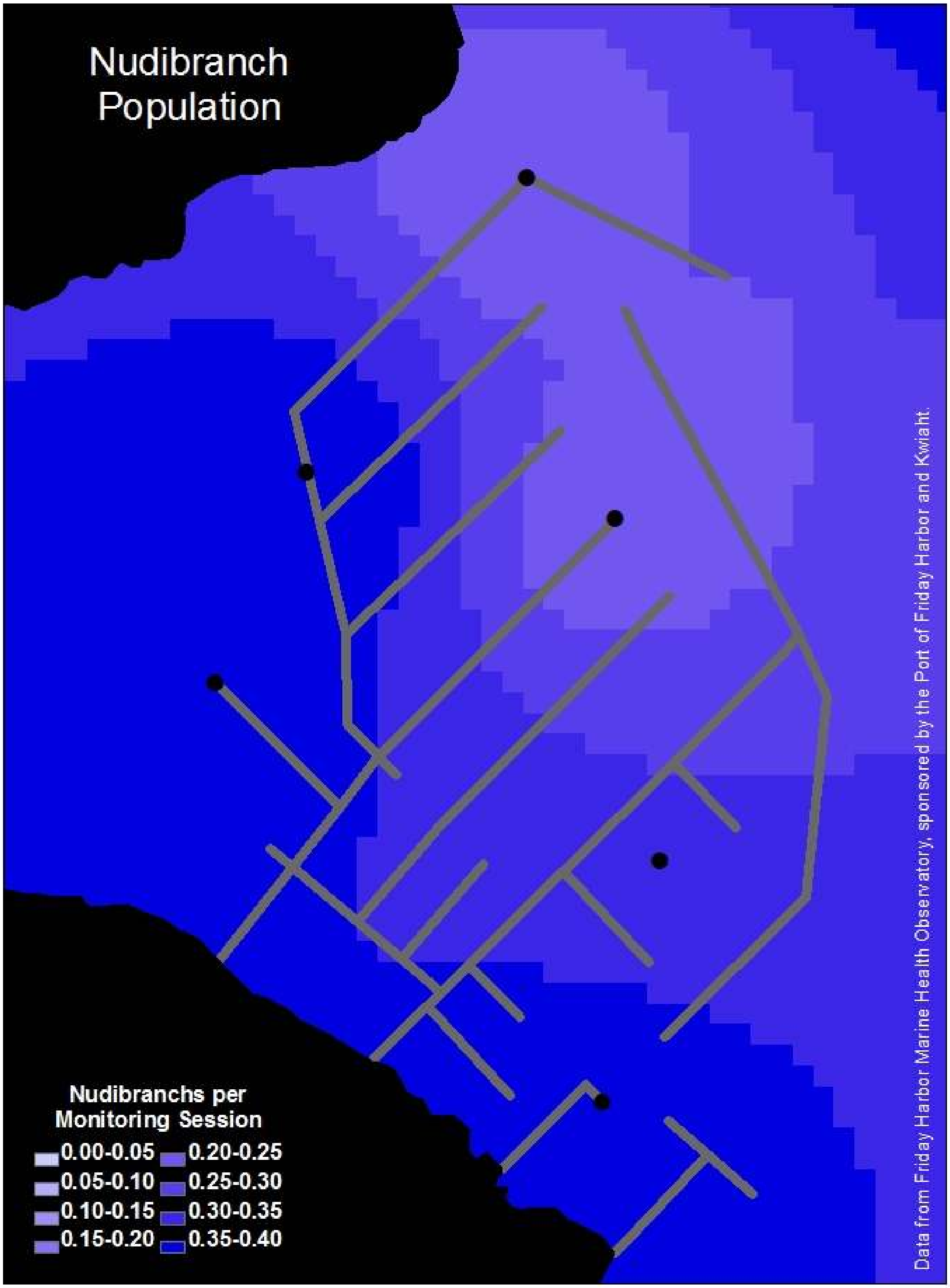

Figure 6: Map of nudibranch distribution (extrapolated using inverse distance weighting; counts normalized by the number of monitoring sessions).

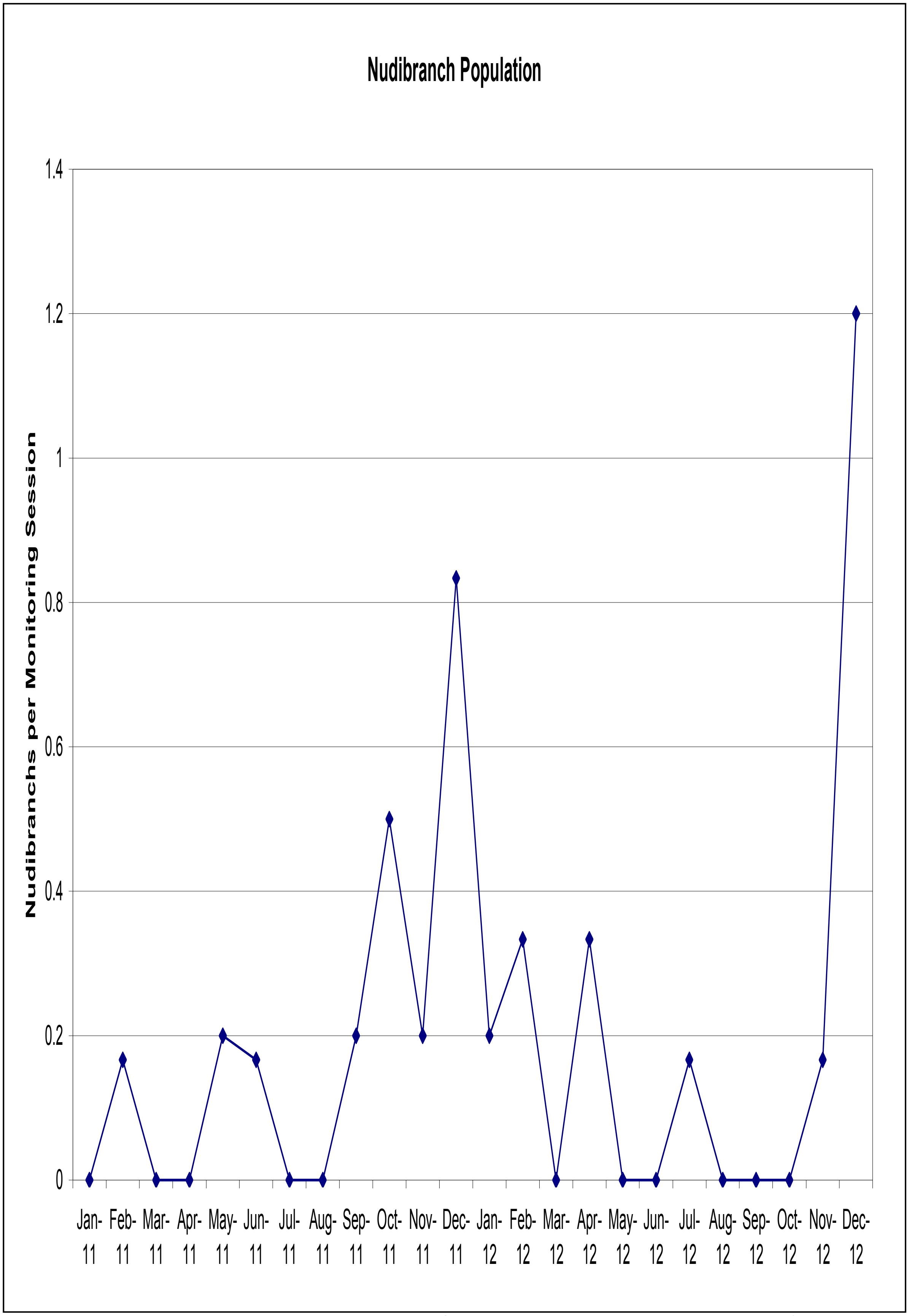

Figure 7: Nudibranch abundance by month (counts normalized by number of monitoring sessions; data recorded outside the Port of Friday Harbor excluded)

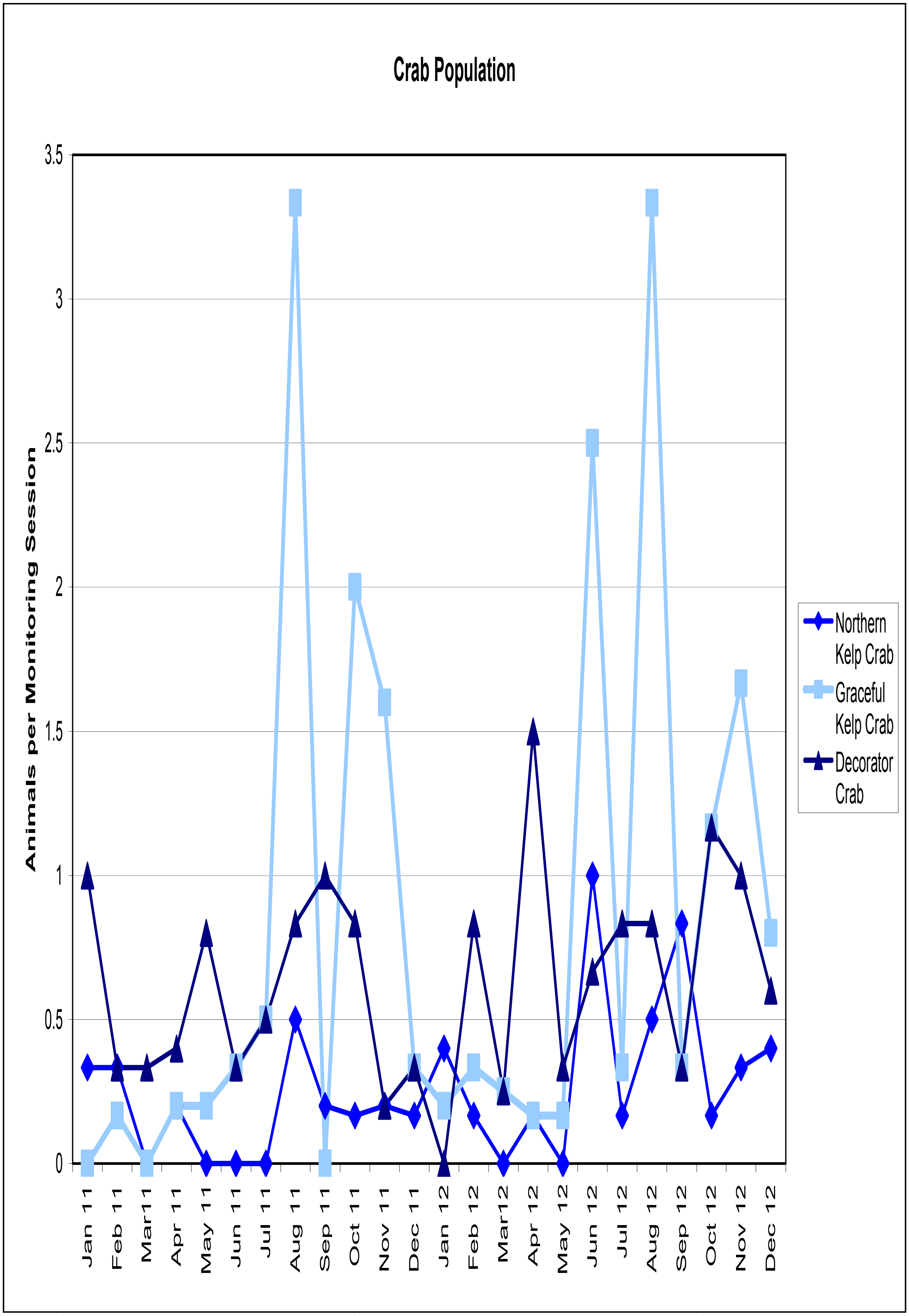

Figure 8: Crab abundance by month (counts normalized by number of monitoring sessions; data recorded outside the Port of Friday Harbor excluded)

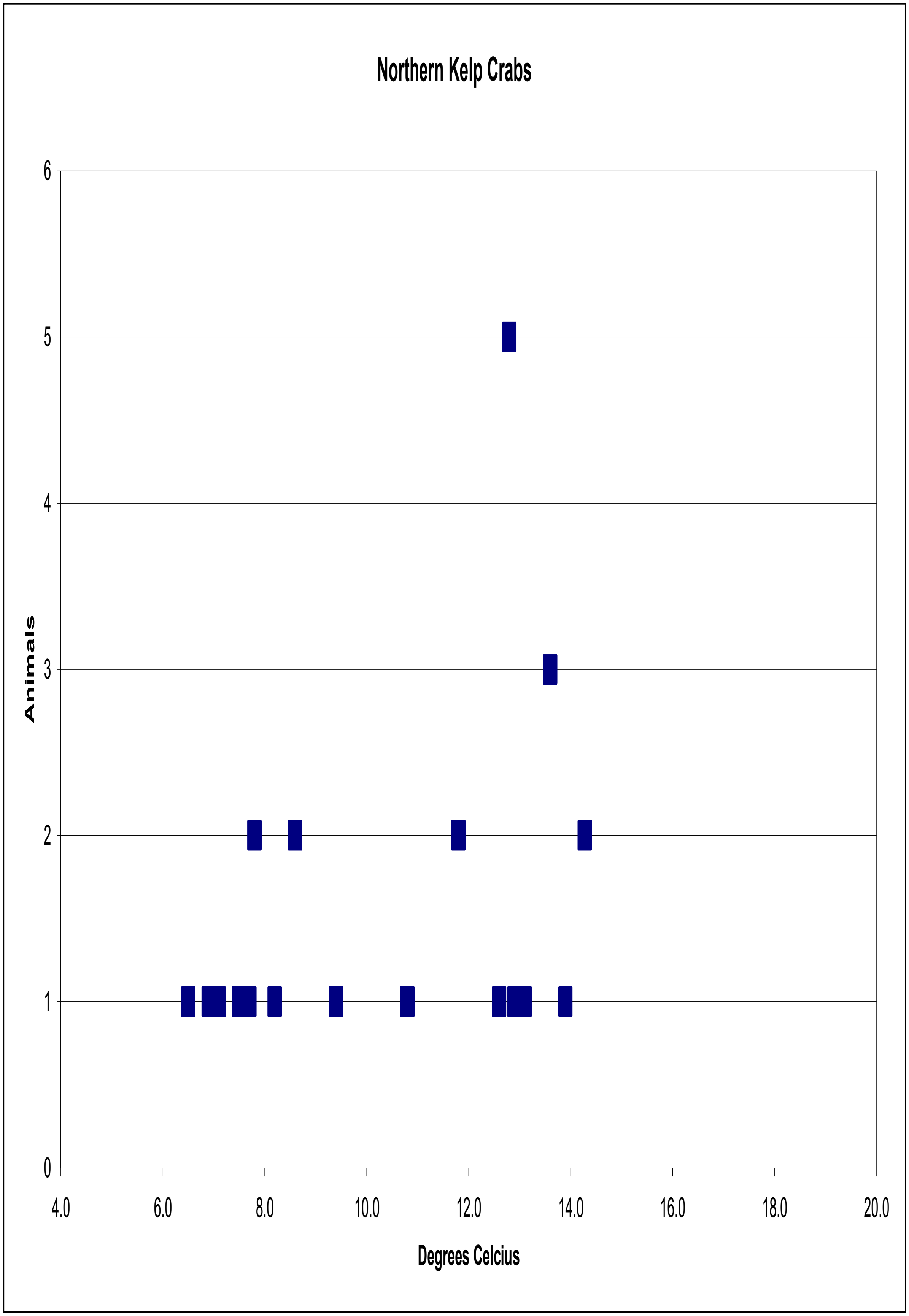

Figure 9: Northern kelp crab abundance as a function of surface water temperature (data recorded outside in the Port of Friday Harbor excluded)

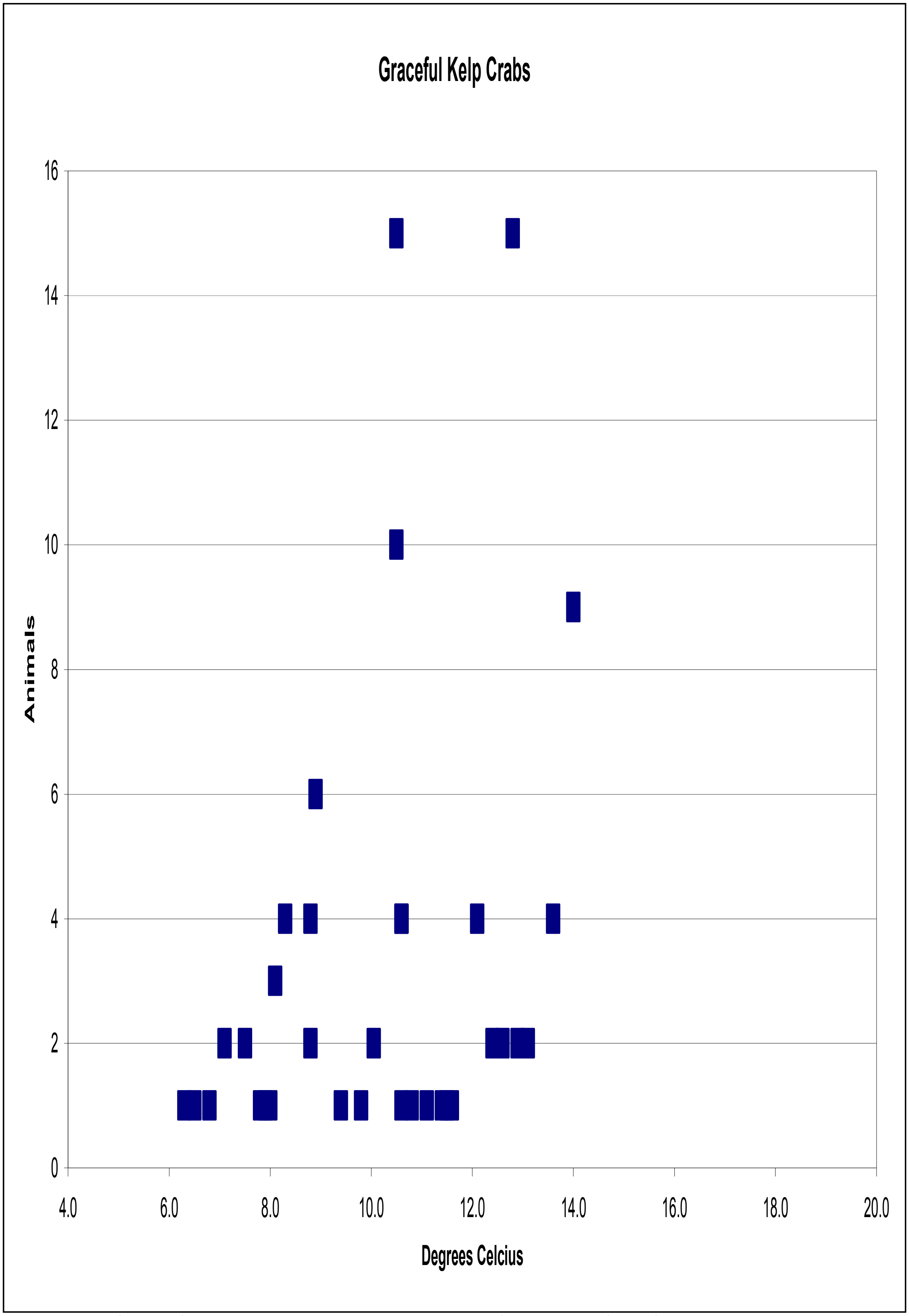

Figure 10: Graceful kelp crab abundance as a function of surface water temperature (data recorded outside the Port of Friday Harbor excluded)

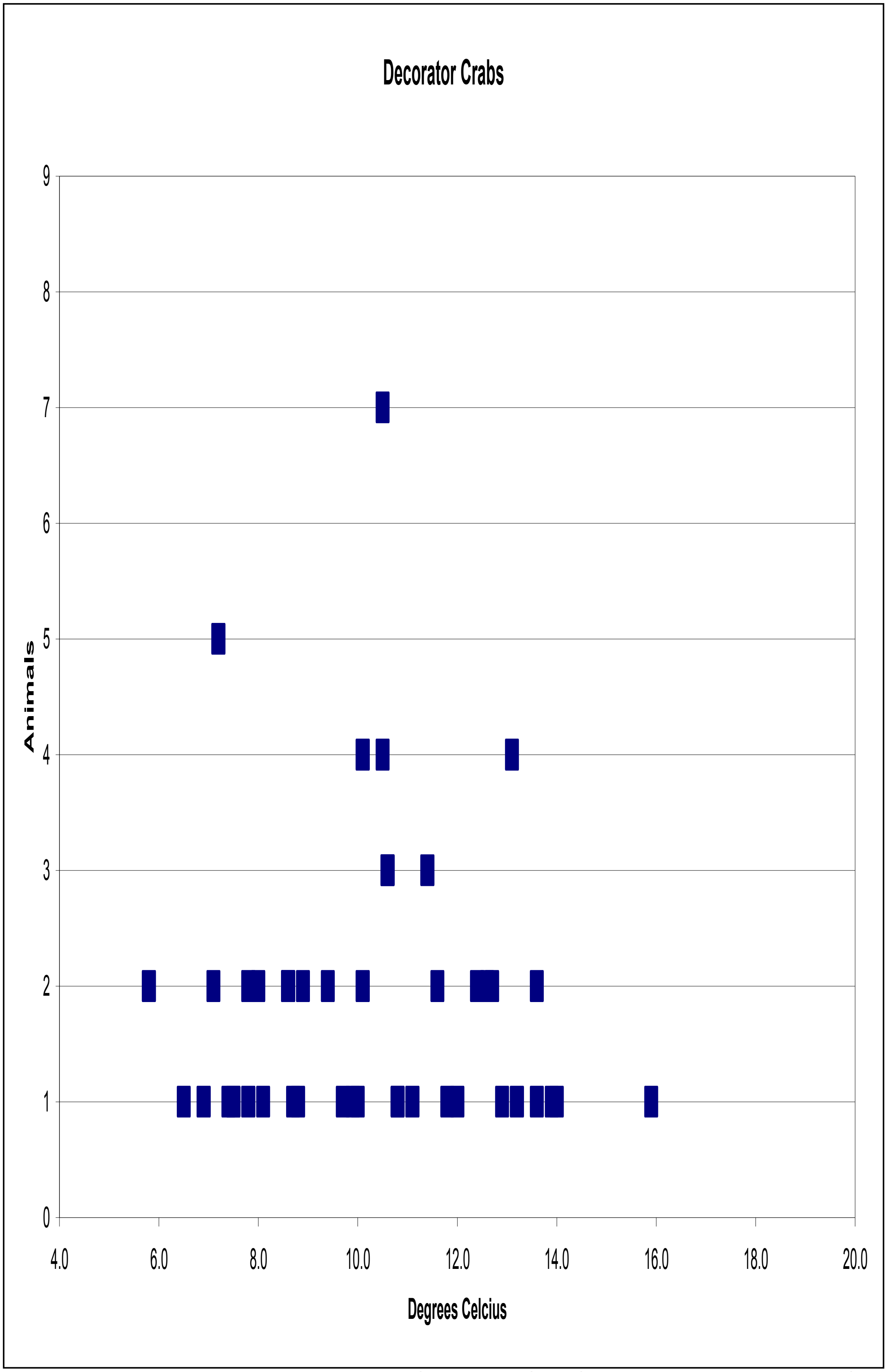

Figure 11: Decorator crab abundance as a function of surface water temperature (data recorded outside the Port of Friday Harbor excluded)

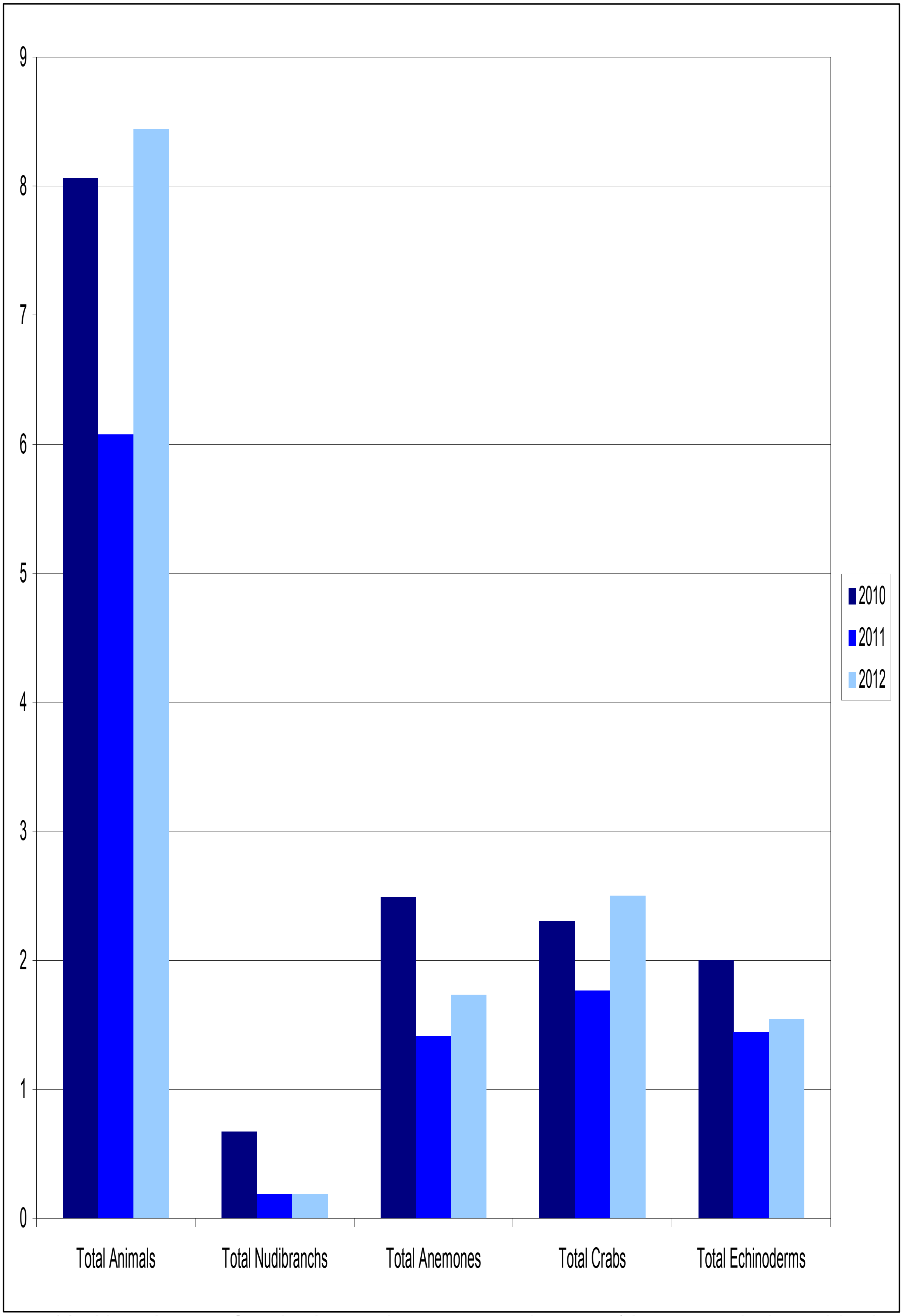

Figure 12: Abundance of major invertebrate groups by year (data recorded outside the Port of Friday Harbor excluded)

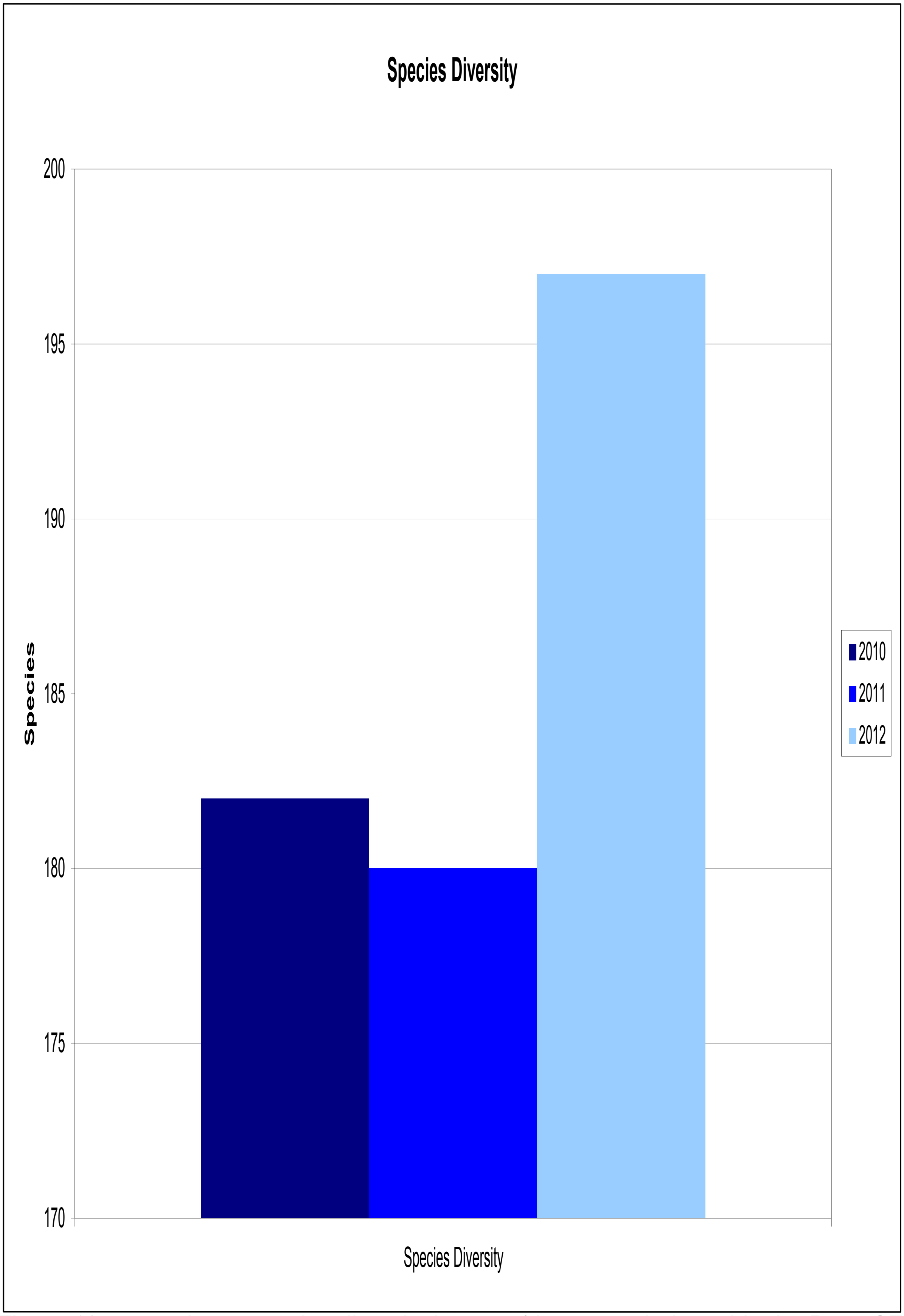

Figure 13: Invertebrate species diversity by year (data recorded outside the Port of Friday Harbor excluded)