Final Report to the Northeast Consortium for the project:

Examining Fishing Practices of Divers in the Maine Sea Urchin Fishery

2008 Cooperative Research Award 09-019

for the period: August 6, 2008 thru June 30, 2011

September 30, 2011

Photo by Kerry Lyons, 4/15/09

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ABSTRACT

Maine's valuable sea urchin fishery is conducted primarily by divers, who use both size-selective and non-size-selective ("straight raking") harvesting techniques. Straight raking generally results in high bycatch of small, sub-legal urchins, which are later culled from the catch. Whether the culled urchins survive is unknown. In a collaborative controlled experiment we compared harvest culling rates for the two fishing methods, and tested whether straight-raking negatively impacted the abundance of small, sub-legal-sized urchins, over the short and long terms, as compared with size-selective fishing. Reductions in urchin abundance can also result in an increase in the algae upon which they feed, which in turn can harbor urchin predators and negatively affect urchin recruitment. The project tested whether straight-raking impacts algal cover, as compared with size-selective fishing. Although the results were mixed, size-selective harvesting resulted in fewer short- and long-term negative impacts.

The illegal-sized urchins that were harvested during this experiment were replanted on a nearby site and monitored for survival. They survived well for over four months, but abundance had declined by 75% a year later, and the surviving urchins were still not big enough to be harvested legally.

We recommend the voluntary adoption of size-selective fishing as a best practice.

INTRODUCTION

The near-shore coast of Maine supports a valuable green sea urchin (*Strongylocentrotus droebachiensis*) fishery, but landings have declined steadily since the mid 1990s, from a high of 18,900 mt in 1993 valued at $26.8 million to 1,010 mt in 2010 valued at $4.5 million (ME DMR). The decline in the fishery has been linked to a decline in stock abundance due to fishing (Harris and Tyrell 2001; Chen and Hunter, 2003; Steneck et al 2004, Grabowski et al. 2005).

About 60% of the catch is made by divers, the rest by draggers. There is a legal minimum size limit of $2^{1}/_{16}$ inches (52.4 mm) and a maximum size limit of 3 inches (76.2 mm). The size limits do not prevent the taking of small and over-sized urchins – harvesters are allowed to take an illegal animal as long as it is "culled on board immediately after harvesting and is liberated alive into the marine waters" (Maine Title 12, Ch. 623, §6749-A). Divers often pick up sub-legal and over-sized urchins, sending them in bags to the surface where they are culled from the fishing vessel, which may be anchored over deeper, non-productive bottom.

The fate of the (mostly small) urchins that are culled (bycatch) from catches is not known. There is evidence that green sea urchins exposed to extremes of air temperature or rough handling may not survive (Robinson and MacIntyre, 1995). Temperature extremes are common during this fishery's season, conducted inshore between September and March. Even if they survive exposure and handling, urchins that are culled from a vessel anchored in deeper water away from the urchin beds, where the bottom generally lacks feed, may be lost from the system.

Some divers harvest selectively, and take very little of this bycatch, while others harvest non-selectively ("straight-raking") and take extensive bycatch, mostly undersized, which is later culled overboard.

Studies have shown the importance of maintaining a minimum density of urchins, to ensure their reproductive success (Wahle and Peckham 1999, Harris et al. 2001). Maintaining an adequate density also prevents loss of sea urchin habitat. Sea urchins – important herbivores – play a determining role in controlling community structure in the rocky subtidal zone (reviewed by Scheibling and Hatcher, 2007). In Maine, due to fishing, hard bottom that was once carpeted with grazing sea urchins has become open to successional processes (Harris and Tyrell, 2001) and is now dominated by kelp and other macroalgae, including invasive species, which thrive when sea urchins are no longer there to remove them. These algal beds are home for small crabs (*Cancer* sp., *Hyas* sp.) and other urchin predators (McNaught 1999, Steneck et al. 2004). This means that once an urchin bed is gone it is very difficult for urchins to reestablish themselves in an environment that has become inhospitable (Scheibling et al. 1999, reviews in Andrew et al. 2002 and Scheibling and Hatcher, 2007). This algal-dominated community becomes an alternate stable state (Scheibling 1986, Steneck et al. 2004). The decline of urchin stocks, the loss of urchin habitat, and increasing algal cover have been documented on the western Maine coast (McNaught 1999; Harris and Tyrell 2001; Vavrinec 2003) and are advancing eastward (Vavrinec 2003; Hunter et al. 2005).

One approach to rebuilding depleted stocks is to transplant culled urchins onto nearby depleted sites, which would serve to both increase stock density at the new site, and provide algal grazing that might reverse the loss of urchin habitat. Divers have told us they have experimented with reseeding favorite fishing spots or depleted areas with their culls, with success. Others say the urchins don't survive, or just aren't there when the diver returns. There have been several documented attempts to transplant green sea urchins in Maine. Leland (2002) successfully moved large urchins to a site at Cape Elizabeth, handling them very carefully, but they were consumed by *Cancer* crabs a few months later. Gaudette et al. (2006) had similar results in Boothbay Harbor, although the cause of the decline of the transplanted population is unknown. Russell (2001) found poor survival of transplanted urchins that had been dragged in bulk from deep sites in Cobscook Bay, but Harris (2003) had more success there when the animals were dragged from shallower sites in smaller quantities and handled more carefully. There have been successful translocations of other sea urchin species in other places (see Andrew et al. 2002 for review).

PROJECT OBJECTIVES AND SCIENTIFIC HYPOTHESES

Project Objectives

In this project, working collaboratively with industry divers, we planned to:

1) Evaluate impacts of non-size-selective harvesting by divers, or "straight raking", as compared with size-selective harvesting practices, or "culling on bottom", by simulating harvest methods observed in the current fishery and then comparing long-term effects with control areas,

2) Increase the number of industry divers who have been trained in field assessment techniques,
3) Evaluate the effectiveness of translocating (replanting) culled urchins, using techniques available to any harvester,
4) Inform industry members, managers, and the public of our findings.

We hoped to add to our understanding of sustainable commercial fishing practices in Maine's sea urchin fishery, and find out whether the decline of Maine's sea urchin stock may have been due in part to destructive fishing practices, and, if so, to explore possible solutions. By addressing the urchin bycatch issue, it may be possible to halt potential stock declines and begin rebuilding this valuable fishery without further reductions in fishing effort.

Scientific Hypotheses

We conducted a controlled experiment that compared the impact of size-selective harvesting by divers to non-size-selective harvesting (straight raking). Impacts measured were reductions in urchin densities, and increases in understory ("turfing") and canopy algal cover, compared with control sites. We tested the scientific hypothesis that there is no significant difference in either sea urchin density or algal cover between selectively fished sites, non-selectively fished sites, and control (unfished) sites about five months and one year after harvesting. We also conducted a translocation (replanting) experiment to learn whether using culled urchins to restock depleted areas can be successful. Success was measured in terms of the percentage of urchins that survived the translocation for one year, and significant reductions in algal cover.

Companion Project

In addition to evaluating the effects of non-size-selective fishing, it is important to learn the prevalence of this practice, in order to estimate its overall impact. In a related project, we evaluated the extent of harvest culling during the 2010-11 fishing season, by estimating the number of culled vs. kept urchins from commercial catches, using our existing port-sampling and harvester interview process (Hunter et al. 2010) with a new interview question.

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  - Greg Brown, commercial diver
  - Pearly MacLean, second boat captain and tender
  - Dale Wright and Andrew Preston, cullers
  - Kerry Lyons and Robert Russell (diver), Maine DMR

METHODS

We compared the impacts of straight raking with size-selective fishing, by applying each fishing method as a treatment, along with an untouched control treatment, replicated at three study sites in a standard Before-After Control-Impact (BACI) design (Smith, 2002). The non-legal-sized urchins harvested from the study sites were used for a translocation experiment, simulating a commercial harvest-replant strategy.

Design summary:

Three small sites with harvestable populations of sea urchins in Maine's urchin management Zone 2 were selected by the commercial diver, marked, and split roughly into three lanes (plots) each, for a total of nine experimental plots. Each lane was evaluated for urchin density and size, and algal cover during April 2009. At each site, one of the three lanes was randomly assigned to be harvested size-selectively, one was straight-raked (non-size-selective), and the third served as a control, untouched plot. Immediately after harvest, the six harvested lanes were re-evaluated for urchin density. A fourth nearby site, chosen for its lack of urchins and its isolation from other urchin populations, was evaluated for urchin density and size, and algal cover. All non-legal-sized (mostly under-sized) urchins from the harvested plots were dropped onto this site from the surface. Legal-sized urchins were moved to an undisclosed site further away. The replanted site was evaluated for urchin mortality about one week after the transfer. An area at this site just outside the replanted area was selected as a control. All sites were evaluated for urchin density and algal cover after about 2½ months (early July, 2009), and again after another 2 months (early September 2009). During the initial April and the September evaluations, all urchins from three 1-m^2 quadrats in each plot were collected and measured for test diameter.

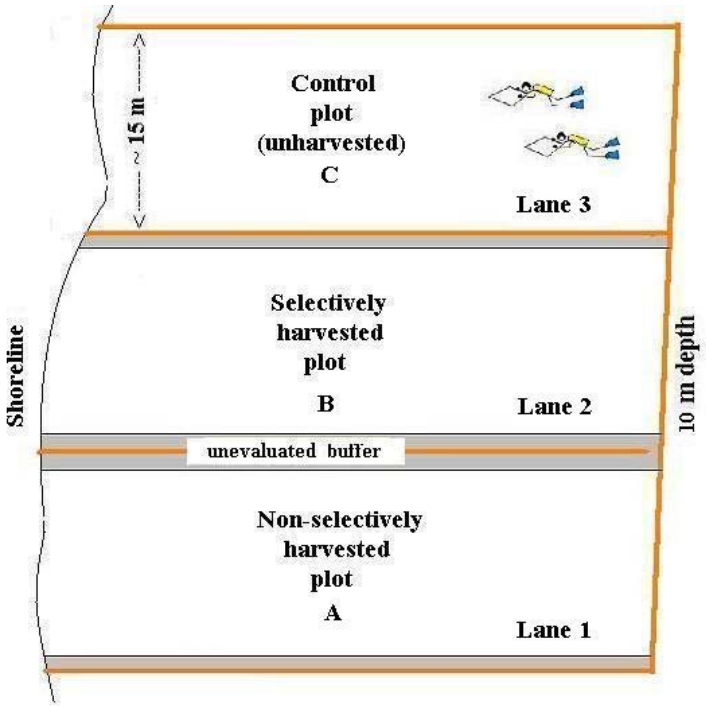

Diagram of one of the three experimental sites, not to scale.

The sea-urchin fishing season was closed throughout the first five months of the experiment (April to early September 2009). The sites were not closed to fishing when the urchin fishing season reopened in September 2009. If the sites were disturbed by fishing, it should be evident at the control plots, when the sites were evaluated again in late June 2010.

Changes from original proposal

- We originally proposed monitoring the harvested and replanted sites for 6 months, but changed that to 5 months, because the 2009-2010 fishing season opened in the study area

- We were able to add additional site visits and evaluations in late June 2010, almost exactly a year after the July 2009 evaluations, and 14 months after the harvest treatments.
- We had also planned to divide the harvest treatment sites into depth strata of 0-5, 5-10, and 10-15 m, the same depth stratification used in the annual Maine spring sea urchin survey, but the sites chosen for the experiment only had urchins to depths of about 10 m. so depth stratification was not employed here.
- We proposed evaluating algal cover using the same three categories used by the annual Maine spring sea urchin survey – encrusting, understory or turfing, and canopy (Vavrinec 2003; Steneck and Dethier 1994) – but decided to further subdivide the turfing category into green, red filamentous, and red fleshy, in order to provide more detailed information on algal type.

Site Selection and Marking: During late March, 2009, divers explored several near-shore sites in the Winter Harbor (Hancock County, Maine) area, and selected three sites for the experimental harvest treatments (Winter Harbor, Hancock Point, and Frazer Point) and one site (Bean Island Ledge) for the translocation (replanting) experiment (Figure 1).

The three harvest treatment sites were roughly rectangular areas spanning about 45 m (150 ft) of shoreline and extending out to about 10 m (30 ft) depth, or about 75 m (250 ft) from shore. Each site was selected to have commercially-harvestable densities of legal-sized urchins with a good mix of under-sized urchins, distributed as uniformly as possible (but see discussion below). The sites were sloping with no steep drop-offs (which are difficult to evaluate) or other large irregular features. To minimize the chance of disturbance, known urchin, scallop, quahog, mussel, and sea cucumber dragging areas were avoided. Each of the three harvest treatment sites were split roughly into three plots or lanes running perpendicular to shore, each lane with about 15 m along the shore, out to about 10 m depth (see diagram above). The plots were permanently marked by eye-bolts on the corners on shore and submerged anchors and floats on the off-shore corners. The underwater boundaries of the plots were marked by temporary ground lines.

A fourth site was selected to receive the translocated urchins. It was near the harvest sites but with few urchins present and isolated from other urchin populations (by sand bottom) to minimize urchin immigration and emigration. It was a fished-out site previously known to have commercial densities of urchins, lying along a shallow (about 2-6 m) depth contour. It was marked by two buoys (one at each end) with a ground line running between them. An area just beyond (east of) this line served as a control and was separated from the treatment site by sand. Sea urchins are less likely to be found on sand substrate than on hard bottoms (Brady and Scheibling, 2005)

Site evaluation

During April 6th to 11th, 2009, shortly after the annual fishing season had closed, all sites were marked and evaluated for urchin abundance and algal cover. Two industry divers were trained in urchin and algal cover evaluation techniques by working side-by-side with the DMR staff diver prior to the experiment. The nine experimental harvest plots were evaluated for sea urchin density and algal cover by the three divers prior to harvesting. Two of the divers, each carrying

1x1 meter square frames made of ¾-inch diameter PVC pipe, began at the deep end of a lane, about 5 meters apart, and swam a compass course toward the shoreline boundary of the plot (swimming two roughly parallel transects, see diagram above). They each counted urchins and evaluated algal cover in 30 haphazard (blind toss) 1x1 meter quadrats, for a total of 60 m^2 quadrats per lane. All urchins 10 mm or larger in each quadrat were counted. Percent algal cover for each of five functional groups (encrusting, turfing green, turfing fleshy red, turfing filamentous red, and canopy) in each quadrat were recorded. Each diver also collected all the urchins in 3 of their 30 quadrats, for test diameter measurement later. The protocols for urchin and algal evaluation are the same as those used by the annual Maine sea urchin dive survey (Hunter et al. 2010; Grabowski et al. 2005) except for the addition of algal turfing (understory) sub-categories.

The replant site was also evaluated for urchin density and algal cover using the same methods, with the divers swimming on either side of the ground line, from one marker buoy to the other.

A total of 10 dives were made by each of the two divers during this period (three at each of the three harvest sites and one at the transplant site), and each diver evaluated 30 quadrats during each dive, for a grand total of 600 quadrats evaluated.

All lanes at all sites were also video-taped under water.

Harvest treatments

Treatments were designated A=straight raking (non-size-selective), B=size-selective fishing (bottom culling), and C=control (unfished). The lane arrangements ABC, CAB, and BCA (left to right when looking at the lanes from the sea toward shore – see figure above for the ABC arrangement) were randomly assigned to the three experimental sites, which turned out to be Hancock Point, Winter Harbor, and Frazer Point respectively.

The harvest treatments were applied April 15 (Winter Harbor) and April 16 (Hancock Point and Frazer Point), 2009. At the size-selective plots (B), one of the two industry divers (Marcus) began at the deep end of the lane and made his way to shore, harvesting mostly only the legal-sized sea urchins, using the techniques of size-selective divers. At the non-selective plots (A), the other industry diver (Greg) harvested all sea urchins that a straight-raker would take. That is, clumps of urchins that all appeared too small were passed over, but groups that contained at least one urchin that might be legal were entirely harvested. The third plot (C) at each site was untouched. The divers were video-taped to document the two fishing styles. Standard 2¼-inch stretch mesh catch bags were used throughout.

Counting, Measuring, and Replanting

Harvested urchins were picked up by the fishing vessel (a 38-ft lobster-type boat with only 3.5 ft draft). On the vessel, all harvested urchins were separated by treatment and size (sub-legal, legal, over-sized), counted, and put in 80-lb (36 kg) plastic fish totes. The determination of size was made by an experienced commercial sea urchin culler (see Photos 8-9). Test

diameters were also measured for forty urchins chosen at random from each tote. The totes were only filled to about two-thirds full (about 50-60 lbs) to minimize crushing and spine puncture, and periodically hosed with sea water.

When harvesting was finished each day, sub-legal and over-sized urchins were moved to the replanting site at Bean Island Ledge and dropped onto it from the surface, over the ground line between the two marker buoys (see photo, above). The replanted sea urchins had been out of the water about 6-7 hours at most. Legal-sized urchins were returned to the sea at an undisclosed site well away from any of the experimental sites.

Post-harvest site evaluations in April, 2009

After harvest (later the same day), the harvested plots were re-evaluated for urchin density as above. The replanted site was also re-evaluated for urchin density as above at the end of the second day of replanting (April 16, 2009).

On April 24, a little over a week after translocating, the replanted site (Bean Island Ledge) was evaluated for urchin density, and for urchin mortality by counting healthy-appearing urchins and moribund or broken ones in 60 random quadrats.

After re-evaluation, the groundlines were removed from each site.

Re-evaluations in July, 2009

On July 1, 2009, the two industry divers re-evaluated the harvest and control lanes at the Winter Harbor and Frazer Point sites, using the same methods described above, except that no urchins were collected for measurement. First, ground lines were laid to mark the three lanes at each site, using buoyed anchors and bolts left behind during the last visit. On July 2, they marked and re-evaluated the harvest and control lanes at the Hancock Point site and the replanted and control areas at Bean Island. Then the ground lines were removed from all sites. A total of 11 dives were made by each of the two divers during this period (three at each of the three harvest sites and two at the transplant site), and each diver evaluated 30 quadrats during each dive, for a grand total of 660 quadrats evaluated for urchin counts and algal cover, including about 66 from which urchins were removed and measured on the boat.

Re-evaluations in September, 2009

On September 1 and 2, 2009, just before the fishing season opened, the four sites were marked and evaluated in the same manner again, including collecting urchins for measurement. All lanes at all the sites were also videotaped under water. Then the ground lines were removed from all sites.

Re-evaluations in June, 2010

On June 29 and 30, 2010, after the fishing season had closed, the four sites were marked, evaluated, and videotaped in the same manner again. Then the ground lines were removed for the last time.

Unexpected difficulties

The divers sometimes forgot to record the depth of each quadrat, and also the depth correction for the dive (to correct observed depths to depth from Mean Low Water). Depth corrections were estimated, by comparing corrected beginning and ending depths from the April 11, 2009 evaluations with uncorrected ones and assuming they should be about the same. Missing or estimated depth data did not cause serious problems.

They also forgot to evaluate the control area at Bean Island Ledge prior to replanting. It was assumed that urchin abundance and algal cover at the control area were about the same as the replanted area (near the control area) prior to replanting.

The Hancock Point site had an interesting band of sea urchins at high-density at shallow depths. Because the width of the shallow rocky area increased across the lanes from left to right (1 to 3 when facing shore, because of the way the point juts out), the mean pre-harvest urchin density in lane 3 (treatment C) was much higher than in lane 1 (treatment A) – see Table A18 for a visual. To correct for this, we defined the band area based on quadrat depth. To determine the boundary depth for the band, we identified the depth (corrected) where there seemed to be a transition from high to low sea urchin abundance for each lane for each date, then averaged these for each lane over all the dates. On average, 12 ft was the deepest depth with urchins and 13 ft was the average shallowest depth without urchins, for Lane 1, so < 13 ft became the defining depth range for the band for Lane 1 (A). For Lane 2 (B), it was < 14 ft and for Lane 3 (C) it was < 15 ft. Most of our analyses were conducted on data from the band only.

Our most important difficulty was in finding suitable sites with enough sea urchins to conduct this experiment with replication. See below for further discussion.

Data and Statistical Analyses

Mean sea urchin abundances (counts$\cdot m^{-2}$) for each experimental lane, for each date and site, were calculated. Mean algal cover (%) was calculated for each of the three categories: crusting, total turfing, and canopy. Turfing and canopy covers were added together for analysis. Note that these could total more than 100%, if canopy cover overlaid turf. Median urchin test diameters were calculated for each experimental lane. Means and medians were plotted over time, to compare pre-harvest conditions with post-harvest, and identify short and long term trends. Two-sample t-tests were performed selectively to test for differences between two treatment abundances, or before-after comparisons. One-way ANOVA and the Tukey test were used when multiple range testing was required. Mann-Whitney rank testing was used to test for differences in algal cover (Zar 1999).

Data from the project were submitted to the NEC with this report.

RESULTS

Macroalgal assemblages at all sites were dominated by *Agarum cribrosum*, *Laminaria longicruris* and *Polysiphonia sp*. Other common algae included: the crustose corallines

Lithothamnium sp. and *Clathomorphum sp*.; the Chlorophycophytes: *Ulva lactuca*, *Spongomorpha sp*.,and *Cladophora sp*.; Phaeophycophytes: *Chorda tomentosa*, *Laminaria digitata*, *Ascophyllum nodosum*, *Fucus spiralis* and *Fucus vesiculosus;* and the Rhodophycophytes: *Porphyra sp*., *Chondrus crispus*, *Rhodemenia palmata* and *Corallina officinalis*. There were also a number of additional unidentified filamentous Rhodophycophytes.

Initial Site Evaluation: See Tables 1-3 for summaries, and Appendix tables for details of the pre-harvest site evaluations for sea urchin density and algal cover. In general, sea urchin densities at the plots to be harvested varied from about 10 to 20·m^{-2}, and 11 to 24% were legal-sized (Figures 8-10).

At the replanting site at Bean Island Ledge, mean sea urchin density before replanting was low (1.77·m^{-2}, Table A1) and algal cover was high – mean encrusting algal cover was 72%, mean turfing algal cover (mostly fleshy reds) was 40%, and mean canopy cover was 54% (Table A1). Median sea urchin size was 33 mm (Table 3 and Figure 7, top row).

At the harvest treatment site at Frazer Point, before harvest, mean urchin density varied among the three lanes, from 7.70 to 18.3·m^{-2} (Table 1 and A9). Mean encrusting algal cover varied from 74-83%, turfing cover from 11-32%, and canopy cover from 15-29% (Table A10). Median urchin sizes varied among the three lanes from 34-42 mm (Table 3 and Figure 8, top row).

At the third harvest treatment site, at Winter Harbor, initial mean urchin density for each of the three lanes ranged from 10.48-16.58·m^{-2} with highest densities occurring in 5m depth or shallower (Table A27). Mean encrusting algal cover was 70-80%, turfing cover was 22-31%, and canopy cover was 13-18% (Table A28). Median urchin size ranged from 36-41 mm among the three lanes (Table 3 and Figure 10, top row).

At the Hancock Point harvest site, initial mean urchin density ranged from 2.64-7.63·m^{-2} with a band of high-density (>20·m^{-2}) at the shallowest depths. This band was narrowest in Lane 1 and widest in Lane 3, as discussed above (Table A18; see darker shaded areas). Mean encrusting algal cover varied from 18-42%, turfing cover from 5-10%, and canopy cover from 6-9%. Note that in the high-density urchin band (which had densities 14.8 - 20.1·m^{-2}), encrusting algal cover was higher (>51%) than in the low-density urchin area of each lane, where encrusting algal cover was usually less than 25% (Table A19). Median urchin size ranged from 36-41 mm among the three lanes (Table 3 and Figure 10, top row)

Harvest Treatments – Counts and Measurements: See the table below for a summary of the number of sea urchins harvested at each site, by size category as determined by the commercial urchin culler on board (Undersized , Legal, and Oversized), where treatment A=straight raking (non-size-selective), B=size-selective fishing, and C=Control (unfished). Data on the sizes of the urchins measured are presented in Figure 6. 12,988 undersized, 4,459 legal, and 34 oversized urchins were harvested, as sorted by the commercial culler.

Number of sea urchins harvested by size category										
	Frazer Point			Hancock Point			Winter Harbor			Totals
Treatment	A	B	C	A	B	C	A	B	C	
Lane	3	1	2	1	2	3	2	3	1	
Diver	Greg	Marcus		Greg	Marcus		Greg	Marcus		
Size										
Legal	1,222	603		206	222		1,082	1,124		4,459
Oversized	5	9		0	0		9	11		34
Undersized	4,072	15		1,071	12		7,765	53		12,988
Totals	5,299	627	0	1,277	234	0	8,856	1,188	0	17,481
% Undersized	77%	2%		84%	5%		88%	4%		
Number of trays	10.5	2		2.5	0.5		14	4		

Treatment A = Straight-Raked (by Greg, not size-selective)
Treatment B = Size-Selectively Harvested (by Marcus)
Treatment C = Control (not harvested)

Note that the size-selective diver (treatment B) harvested 2-5% undersized urchins, while the non-size-selective diver (treatment A) harvested 77-88% undersized, by count. At Hancock Point and Winter Harbor, the two divers harvested similar numbers of legal urchins. At Frazer Point, the non-size-selective diver harvested about twice as many legal urchins as the size-selective diver. The initial total density of urchins was higher in his lane ($18.3 \cdot m^{-2}$ vs $14.3 \cdot m^{-2}$, Table 1), and the proportion of legal-sized urchins was about twice that of the size-selectively fished lane (Figure 8, top row).

Replanting: All of the 12,988 undersized and 34 oversized sea urchins (see table above) that were harvested at the three harvest treatment sites were relocated to the Bean Island Ledge replant site.

April 2009 post-harvest site evaluations: See Table 1 and A2 for results of the post-harvest site evaluations for sea urchin density that were conducted shortly after the harvest treatments were applied in April 2009. Note that 9 sea urchins appeared to be dead at the Bean Island Ledge replanting site on April 24. The rest of the 2,969 urchins that were counted appeared to be alive, suggesting that initial mortality was low. As expected, the density of sea urchins at the other locations was consistently lowest in the lanes that had been straight-raked (treatment A).

July 2009, September 2009, and June 2010 post-harvest site evaluations: Because long-term results varied tremendously from site to site, each site is discussed separately below. In the short term (through September, 2009, 4½ months after harvest), survival of sea urchins at the Bean Island Ledge replant site continued to be high, and, at the harvest sites, urchin density continued to be lowest in the lanes that had been straight-raked (Table 1). Algal cover at almost all lanes and sites declined slightly between July and September, 2009, probably a seasonal effect (Figures 2-5).

Bean Island Ledge – Replant Site

The results for this site are summarized in Figure 2. Initial mean sea urchin abundance at this site was very low – fewer than 2 urchins per square meter. Replanting in April 2009 resulted in a very highly significant ($p<0.00001$) increase in the mean abundance, to $43 \cdot m^{-2}$ and it remained

high through September 2009, while the unplanted control area remained below $2 \cdot m^{-2}$ for the rest of the monitoring period. However, a year after planting, abundance at the replanted area had declined significantly ($p<0.001$) to a mean of $12 \cdot m^{-2}$, but still significantly higher than the control site ($p<0.00001$). About 75% of the urchins were gone, and the decline was apparent in urchins of all sizes. In September 2009, just before the fishing season opened, median urchin size was 40 mm, and only 5% were above the legal minimum of 52.4 mm. Since most were still sub-legal, it is unlikely they were harvested during the 2009-10 fishing season. It is also unlikely (but not impossible) that they were carried away by storm surge, since the site was in a protected area, on the north, lee side of Bean Island. Other explanations for their disappearance are emigration, crab predation, or other sources of natural mortality.

Initial algal cover at Bean Island Ledge was high, with mean turfing and canopy species cover together totaling about 94%, and staying high in the control area throughout the experiment. Total cover at the replanted area dropped and was still significantly lower ($p< 0.0005$) than the control area at the end of the experiment.

Despite the loss of the replanted urchins during the year, it is possible that the significant decline in algal cover might contribute to higher survival of new settlers in the longer term, which would not have been measurable until 2011 or later.

Frazer Point

The results for this site are summarized in Figure 3. Initial sea urchin abundance at this site averaged from 8 to 19 urchins$\cdot m^{-2}$ among the three experimental lanes. After an initial drop in the harvested lanes due to harvest, abundance increased in all lanes throughout the rest of the monitoring period. The increase was in urchins 5-20 mm, indicating either immigration onto the site, or recruitment of new settlers from 2008 into the surveys. Although there were initially (pre-harvest) a few more urchins in the straight-raked lane (A) than the size-selectively harvested lane (B), after harvest there were fewer in A, and, in June 2010, at the end of the monitoring period, there were still significantly fewer in A (straight-raked) compared with B (size-selectively fished) ($p<0.0001$), and fewer than the control but not quite significantly so ($p=0.09$).

Algal cover declined slightly over the monitoring period, except in the straight-raked lane (A). Algal cover in Lane A was lower than in the size-selectively harvested lane (B) during the pre-harvest evaluation, but it was significantly higher ($p<0.025$) by the end of the monitoring period (June 2010).

Winter Harbor

The results for this site are summarized in Figure 4. Initial abundance at this site averaged from 10 to 17 urchins$\cdot m^{-2}$ among the three experimental lanes. The straight-raked harvest treatment (Lane A) exhibited a significant drop in abundance ($p<0.00001$) due to harvest, was still significantly lower than the control ($p<0.001$) in September 2009, but had returned to slightly above its starting value, and the control value, by June 2010. The size-selectively harvested treatment lane (Lane B) showed an unexpected significant increase ($p=0.044$) in mean abundance immediately after harvest. This was due in part to a highly dense patch of small urchins, $322 \cdot m^{-2}$, that was sampled after harvest but not before. However, median values were also higher after harvest ($22 \cdot m^{-2}$) than they were before ($16 \cdot m^{-2}$). This may demonstrate a

problem in sampling patchy sea urchin distributions using the haphazard quadrat method, and warrants further investigation.

Mean algal cover (turfing+canopy) increased to a value significantly higher than the control ($p<0.0005$) in July 2009, but had declined to initial levels by June 2010.

Hancock Point, High-Density Shallow Band

The results for this site are summarized in Figure 5. Initial abundance at the band averaged from 15 to 21 urchins$\cdot m^{-2}$ among the three experimental lanes. The straight-raked harvest treatment (Lane A) abundance was significantly reduced by fishing, and remained low during the rest of the project. The size-selectively harvested treatment (Lane B) abundance was reduced by fishing, but not significantly so. During the summer, abundance at both the control and size-selectively fished lanes increased and then declined by September. At the last evaluation in June 2010, the straight-raked harvest treatment abundance was significantly lower than the control lane's ($p<0.05$), but the size-selectively harvested lane's was not.

Algal cover increased during the summer of 2009, and then declined at all lanes.

Harvest Treatment Summary

See the table below. At all sites, mean urchin abundance in the straight-raked lanes immediately after harvest was significantly lower than pre-harvest means (not unexpectedly), and by the end of the summer, was still significantly lower than the controls. At two out of three sites, it had returned to initial values, or was not significantly lower than the controls, by the following year, most likely due to urchins from outside the lanes moving in (immigration). Only at Hancock Point was the mean urchin density still significantly lower than the control in June 2010. Two of three straight-raked lanes exhibited short-term increases in algal cover and one was still higher than the control a year later.

In the size-selectively harvested lanes, the abundance was lower at two out of three sites after harvest, but not significantly so. At all sites, it had returned to, or exceeded initial values by the following year. None of the sites exhibited significant increases in algal cover over either the short or long term.

	Straight Raked			Size-Selective Harvested		
Short term negative effects (to Sept. 2009):	Frazer	Hancock	Winter H	Frazer	Hancock	Winter H
Significant decline in abundance, relative to control?	Yes	Yes	Yes	No	No	No
Significant increase in algal cover, relative to control?	Yes	No	Yes	No	No	No
Long term negative effects (to June 2010):						
Significant decline in abundance, relative to control?	Not quite	Yes	No	No	No	No
Significant increase in algal cover, relative to control?	Yes	No	No	No	No	No

RELATED PROJECTS

As a companion project, during our routine port sampling, we asked harvesters to estimate the number of totes of urchins they had culled from their catches at sea. We did this during the 2010-11 fishing season, in order to estimate the prevalence of non-size-selective harvesting. Of

the 138 divers interviewed, 113 were able to estimate their culling rate for us. It ranged from 0% to 78% of the total catch by volume, and averaged 37%. Frankly, this was higher than we expected. Since a tote of small urchins contains more individuals than if it were filled with large ones, this rate would be even higher if measured by count instead of volume.

CONCLUSIONS, IMPACTS, AND APPLICATIONS

The replanting experiment was successful in the short term, with a high survival rate for 4½ months, but this was not enough time for the urchins to grow to harvestable size. A year later, only about 25% were still present. Assuming the others died, this mortality rate was probably higher than that suffered by the urchins that were left at their original sites, and higher than that calculated for other areas of the Maine coast (Chen and Hunter, 2003). It may have been better to leave them alone. However, for the urchins culled by divers who catch significant numbers of small urchins, whose fate after culling is not known, replanting may present an improvement in survival rate. There is also the undetermined (by this experiment) effect of reduced algal cover possibly enhancing future natural recruitment.

It is currently illegal for sea urchin divers to retain their undersized urchins and replant them later in the day; according to Maine law, they must be liberated immediately. Rather than change this law, we recommend the adoption of voluntary size-selective fishing as a best practice, or at least returning culls to the beds from which they were taken as soon as possible.

Although the results of the harvest treatment comparisons were mixed, size-selective harvesting resulted in fewer negative short- and long-term effects than straight-raking.

These effects differed greatly from site to site, and may have been masked by unexplained increases and decreases in urchin abundance and algal cover across entire sites. The biggest problem was probably immigration onto the treatment lanes from outside. It would be interesting to learn whether urchin abundances would have recovered in the middle of the lanes after harvesting, if the experimental lanes had been bigger (wider). We would be reluctant to conduct a larger, potentially destructive experiment however. To control for immigration, a smaller experiment might be conducted in a more isolated area, such as a ledge surrounded by soft bottom, but we were unable to find such a site (and replicates) with harvestable urchin densities for this project.

We were also unable to find enough suitable areas of high urchin density to mimic the impacts of straight raking in the early years of the fishery.

PARTNERSHIPS

This project was suggested by the partnering commercial diver, Marcus Jones, who also selected the study sites, recommended the sizes of the sites, provided the vessel, and hired the other commercial diver and boat crew (tender and cullers). Marcus is a member of the Maine Sea Urchin Zone Council. The two commercial divers did all of the harvesting and most of the site

evaluations, after training by DMR diver Robert Russell. Robert also designed and built the lane marking systems. DMR scientist Kerry Lyons measured and counted urchins on the boat and took photos. Dr. Larry Harris, University of NH and Maine Sea Urchin Zone Council member, advised us on algal cover evaluation categories.

STUDENT PARTICIPATION

No students participated in this project.

PUBLICATIONS AND PRESENTATIONS

No publications or formal presentations have been made yet. A brief verbal description of the project was given to the Maine Sea Urchin Zone council at its June 18, 2009 meeting. We plan to make a presentation to the council in the coming year. This final report will be available on the DMR website at http://www.maine.gov/dmr/rm/seaurchin/research.htm.

FUTURE RESEARCH

Further research should continue to explore the sea urchin culling/bycatch problem, including determining the mortality of culled urchins, the long-term ecological impact of straight-raking, incentives for size-selective harvest, and possible gear modifications, for both the drag and dive fisheries.

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Table 1. Number of sea urchins counted and mean abundance (count·m^{-2}) at each site and treatment lane, for each evaluation date.

			Pre-harvest	Post-harvest →				
Location	**Treatment**	**Data**	**11-Apr-09**	**15,16-Apr-09**	**24-Apr-09**	**1,2-Jul-09**	**1,2-Sep-09**	**29,30-Jun-10**
Bean Island Ledge	C - Control	Total Counted				56	72	96
		Number of Quadrats				60	60	60
		Mean Abundance				0.93	1.20	1.60
		Abundance Std Err				0.32	0.45	0.55
	R - Replanted	Total Counted	106	2,601	2,960	3,416	3,396	757
		Number of Quadrats	60	60	60	60	60	60
		Mean Abundance	1.77	43.35	49.33	56.93	56.60	12.62
		Abundance Std Err	0.57	8.95	9.73	7.18	7.95	2.10
Frazer Point	A - Straight Raked	Total Counted	1,130	457		802	885	1,321
		Number of Quadrats	60	60		60	60	60
		Mean Abundance	18.83	7.62		13.37	14.75	22.02
		Abundance Std Err	2.80	1.07		2.59	2.97	2.56
	B - Size Selectively Harvested	Total Counted	857	769		1,091	1,411	2,193
		Number of Quadrats	60	60		56	60	60
		Mean Abundance	14.28	12.82		19.48	23.52	36.55
		Abundance Std Err	2.02	1.69		2.69	3.21	2.62
	C - Control	Total Counted	462			1,415	1,552	1,646
		Number of Quadrats	60			60	60	60
		Mean Abundance	7.70			23.58	25.87	27.43
		Abundance Std Err	0.94			3.53	3.30	3.00
Hancock Point	A - Straight Raked	Total Counted	157	79		78	139	137
		Number of Quadrats	60	60		60	60	60
		Mean Abundance	2.62	1.32		1.30	2.32	2.28
		Abundance Std Err	0.94	0.40		0.36	0.59	0.55
	B - Size Selectively Harvested	Total Counted	338	332		331	167	373
		Number of Quadrats	60	60		60	60	60
		Mean Abundance	5.63	5.53		5.52	2.78	6.22
		Abundance Std Err	1.52	1.40		1.55	0.73	1.16
	C - Control	Total Counted	434			565	262	509
		Number of Quadrats	60			60	60	60
		Mean Abundance	7.23			9.42	4.37	8.48
		Abundance Std Err	1.17			1.85	1.13	1.56
Hancock Point Band	A - Straight Raked	Total Counted	147	78		62	138	132
		Number of Quadrats	8	16		18	21	21
		Mean Abundance	18.38	4.88		3.44	6.57	6.29
		Abundance Std Err	3.68	1.12		0.83	1.26	1.15
	B - Size Selectively Harvested	Total Counted	329	312		327	163	371
		Number of Quadrats	16	18		14	22	34
		Mean Abundance	20.56	17.33		23.36	7.41	10.91
		Abundance Std Err	3.70	3.18		3.83	1.58	1.65
	C - Control	Total Counted	400			560	261	509
		Number of Quadrats	27			24	21	32
		Mean Abundance	14.81			21.54	12.43	15.91
		Abundance Std Err	1.56			3.01	2.40	2.22
Winter Harbor	A - Straight Raked	Total Counted	747	247		512	289	988
		Number of Quadrats	60	60		60	60	60
		Mean Abundance	12.45	4.12		8.53	4.82	16.47
		Abundance Std Err	1.60	0.70		1.37	0.97	1.39
	B - Size Selectively Harvested	Total Counted	995	1,587		1,451	1,188	752
		Number of Quadrats	60	60		60	60	60
		Mean Abundance	16.58	26.45		24.18	19.80	12.53
		Abundance Std Err	1.89	5.39		2.70	2.88	1.49
	C - Control	Total Counted	629			1,032	962	794
		Number of Quadrats	60			60	60	60
		Mean Abundance	10.48			17.20	16.03	13.23
		Abundance Std Err	1.34			2.13	1.98	1.17

Table 2. Mean percent algal cover (total turfing+canopy) at each site and treatment lane, for each evaluation date.

		Pre-harvest	Post-harvest →		
Location	**Treatment**	**11-Apr-09**	**1,2-Jul-09**	**1,2-Sep-09**	**29,30-Jun-10**
Bean Island Ledge	C - Control		70.1	68.5	105.4
	R - Replanted	93.5	39.9	24.3	33.1
Frazer Point	A - Straight Raked	39.0	48.1	28.0	43.8
	B - Size Selective	60.7	47.2	44.7	29.7
	C - Control	34.1	35.0	28.3	23.6
Hancock Point	A - Straight Raked	49.1	55.9	18.8	4.4
	B - Size Selective	46.8	52.9	17.5	12.9
	C - Control	13.8	22.9	12.7	13.8
Hancock Point Band	A - Straight Raked	49.1	55.9	18.8	4.4
	B - Size Selective	46.8	52.9	17.5	12.9
	C - Control	40.5	28.1	27.7	31.5
Winter Harbor	A - Straight Raked	47.2	62.7	44.3	31.7
	B - Size Selective	40.4	41.7	40.7	28.8
	C - Control	40.5	28.1	27.7	31.5

Table 3. Median sea urchin size (test diameter in mm) at each site and treatment lane, for each evaluation date.

		Pre-harvest	Post-harvest →	
Location	**Treatment**	**11-Apr-09**	**1,2-Sep-09**	**29,30-Jun-10**
Bean Island Ledge	C - Control		45	49
	R - Replanted	33	40	48
Frazer Point	A - Straight Raked	42	15.5	20
	B - Size Selective	34	20	19.5
	C - Control	40.5	22	24
Hancock Point	A - Straight Raked	47	32	53
	B - Size Selective	32	31	51.5
	C - Control	42	36	46
Winter Harbor	A - Straight Raked	36	44	43
	B - Size Selective	36.5	40	38
	C - Control	41	39	51

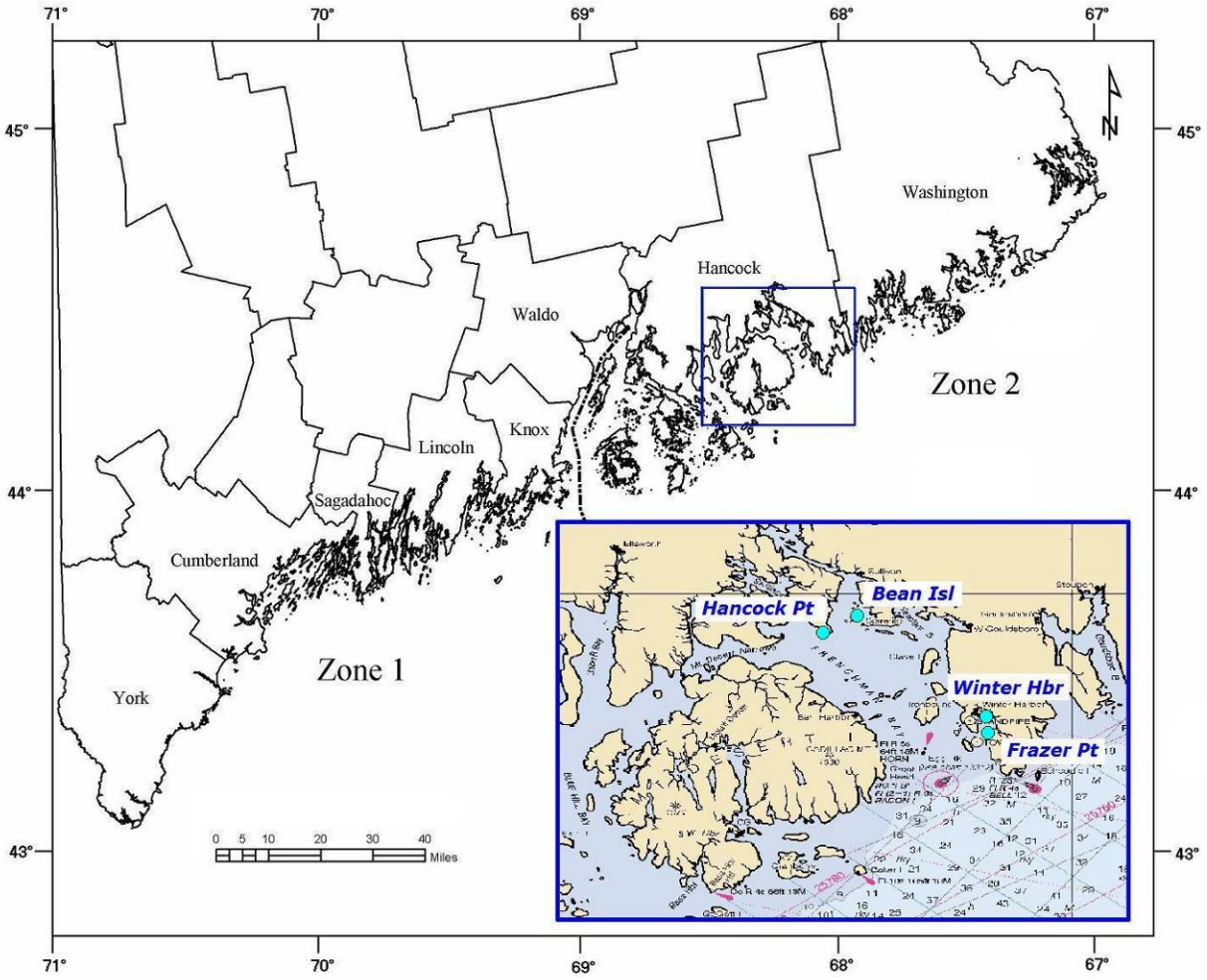


Figure 1. Map of coastal Maine with the two sea urchin management zones and an inset of the project area.

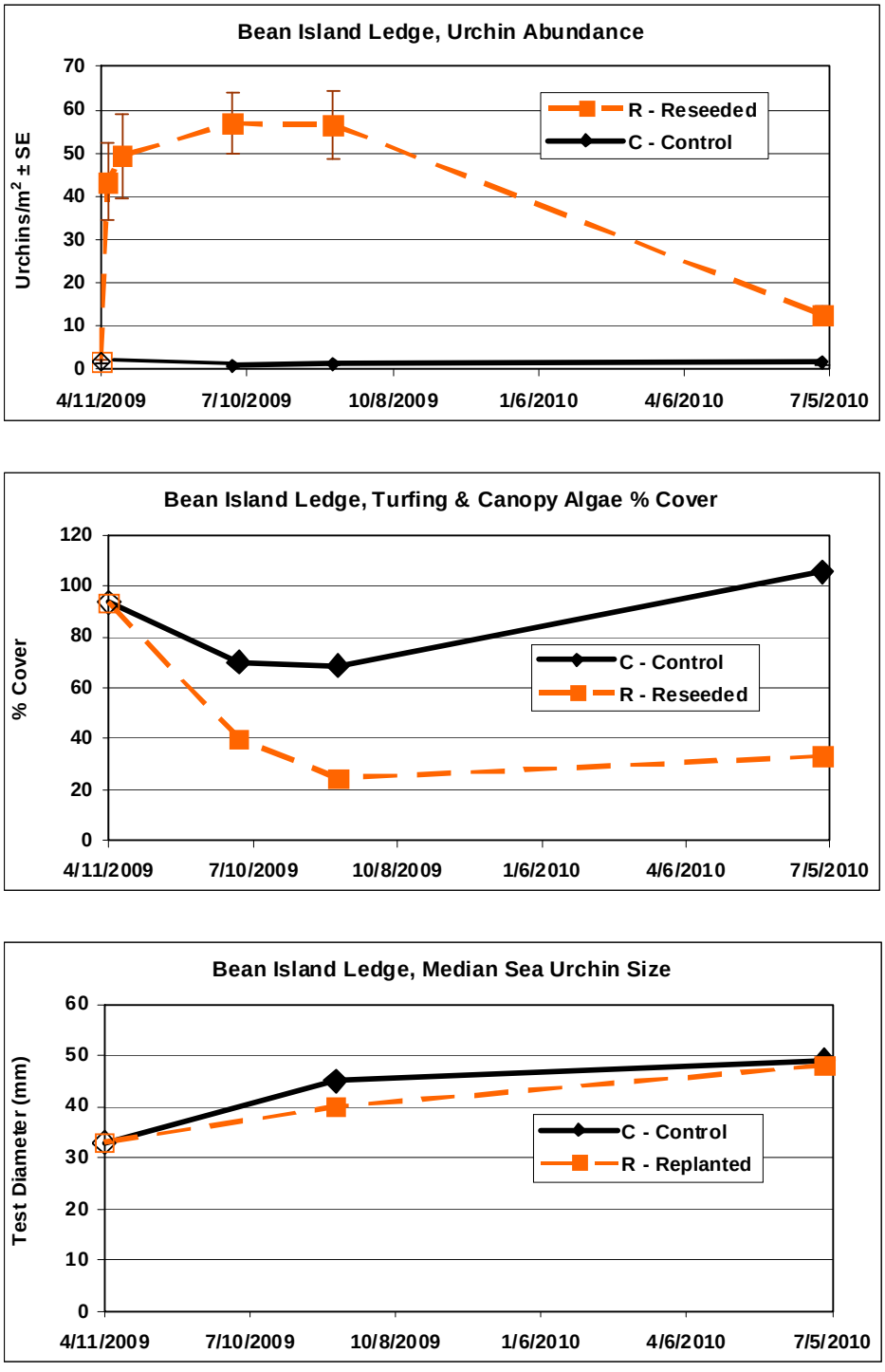


Figure 2. Mean sea urchin abundances (±std.err.) (top), mean total of turfing+canopy algal cover (%) (middle), and median test diameters (mm) (bottom), at Bean Island Ledge. The open symbols indicate starting values.

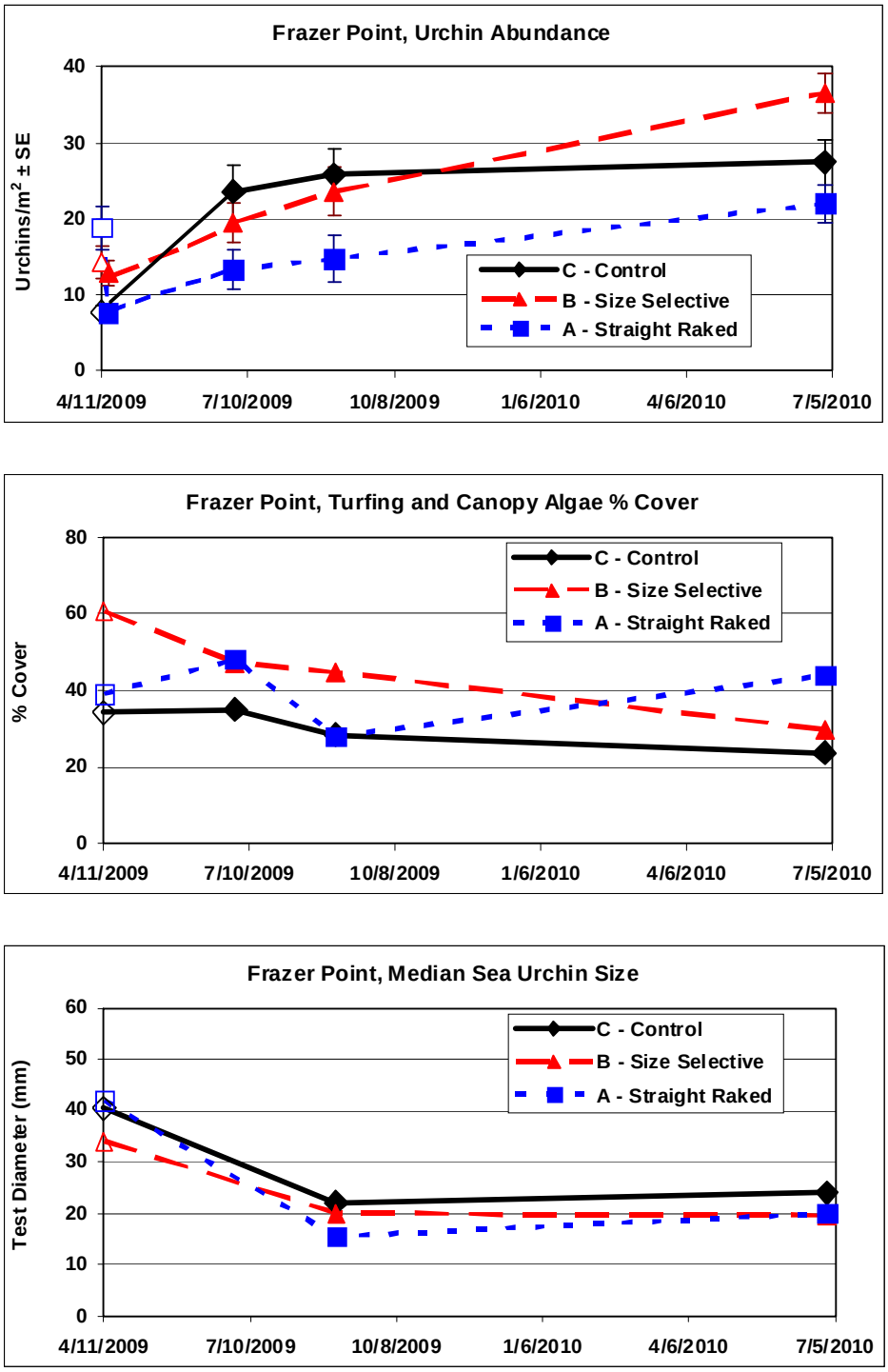


Figure 3. Mean sea urchin abundances (±std.err.) (top), mean total of turfing+canopy algal cover (%) (middle), and median test diameters (mm) (bottom), at Frazer Point. The open symbols indicate starting values.

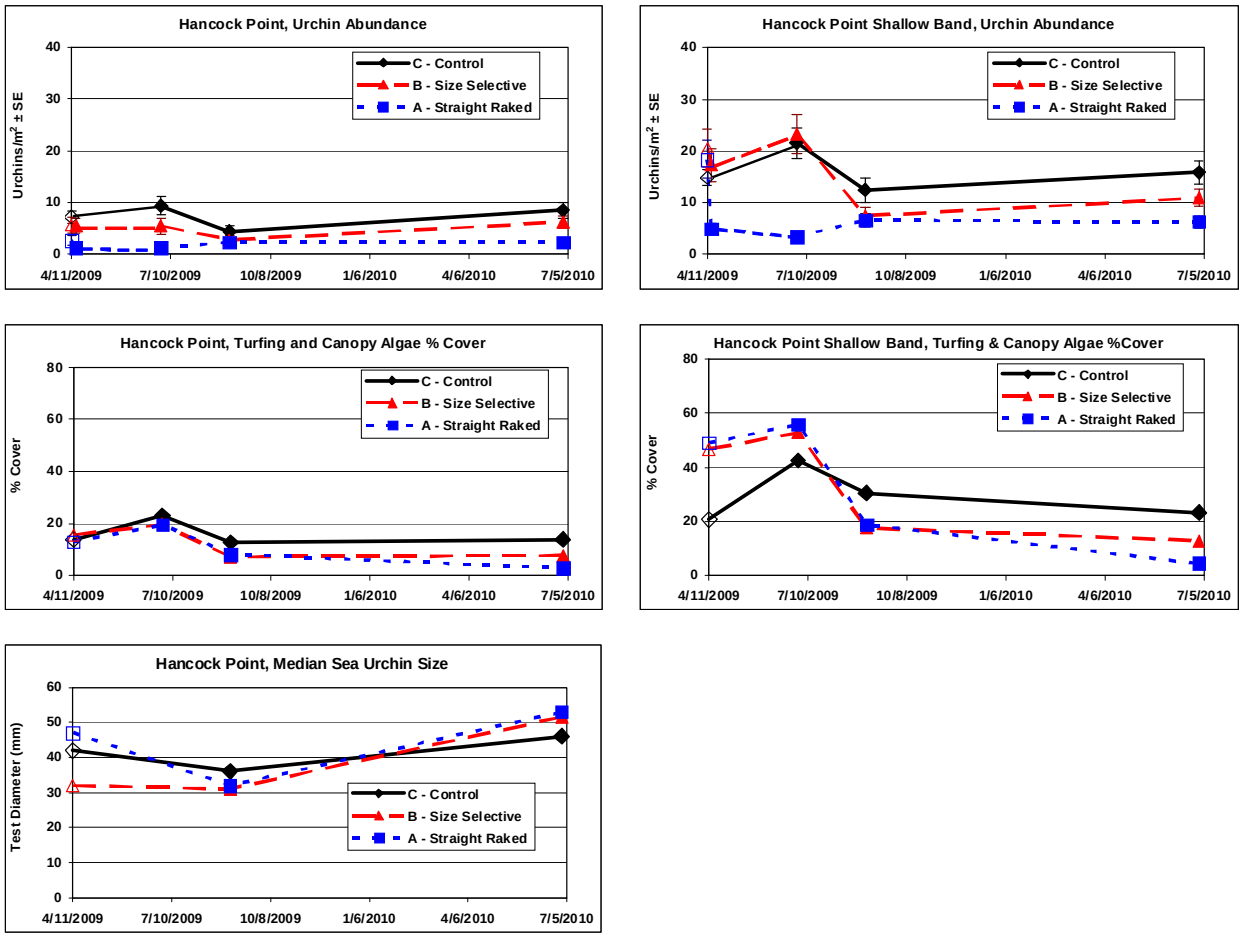


Figure 4. Mean sea urchin abundances (±std.err.) (top), mean total of turfing+canopy algal cover (%) (middle), and median test diameters (mm) (bottom), at Hancock Point (left), and at the Hancock Point shallow band only (right). The open symbols indicate starting values.

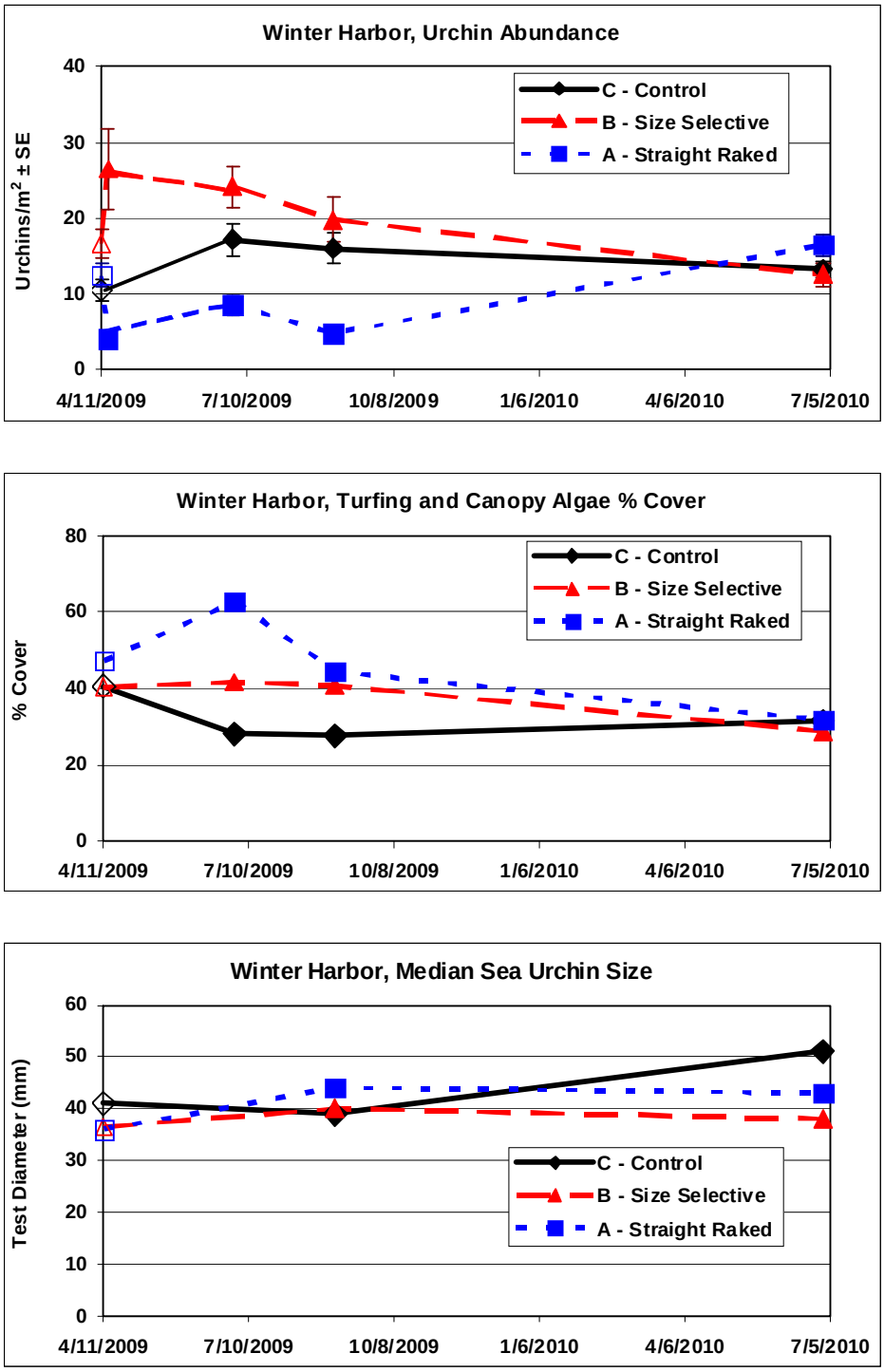
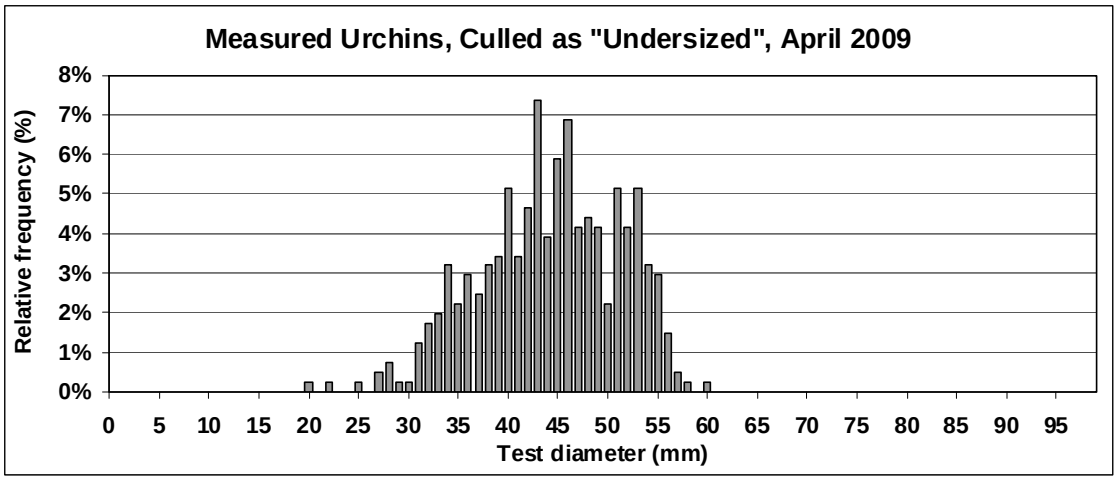
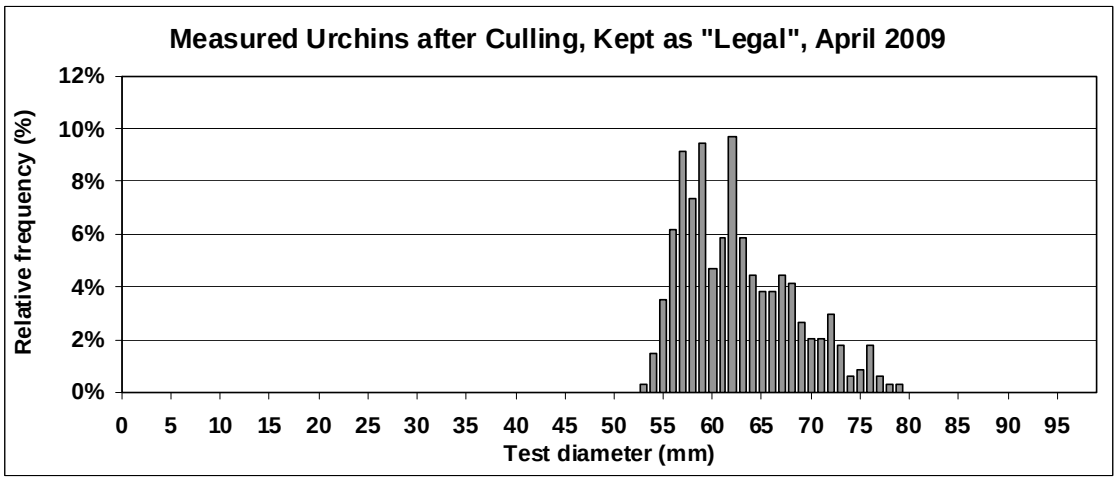


Figure 5. Mean sea urchin abundances (±std.err.) (top), mean total of turfing+canopy algal cover (%) (middle), and median test diameters (mm) (bottom), at Winter Harbor. The open symbols indicate starting values.





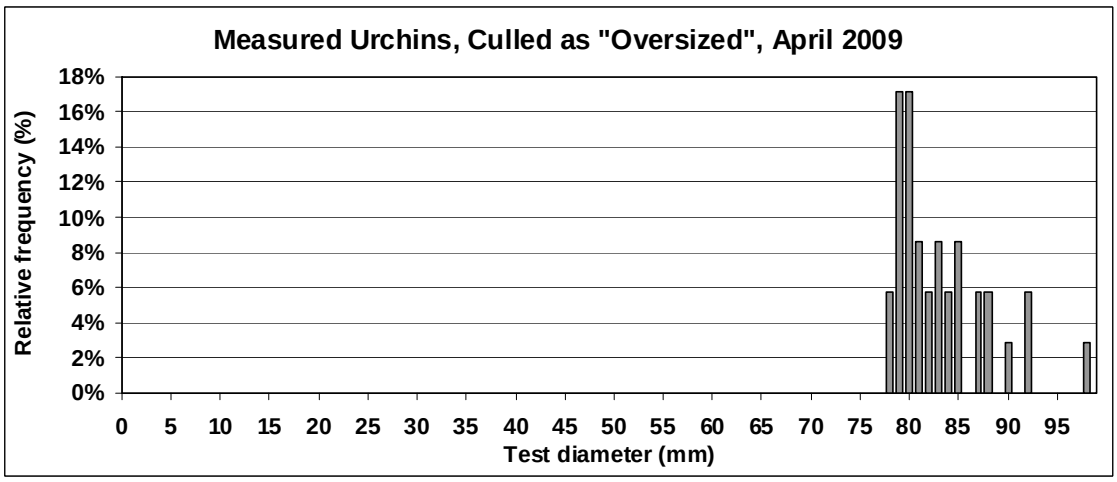


Figure 6. Relative size distributions (test diameter, mm) of the sea urchins measured from the April 15-16 2009 harvests. The urchins culled, not kept, (top and bottom) were transplanted to Bean Island Ledge. The legal minimum size is 52.4 mm; the legal maximum is 76 mm. 12,988 undersized, 4,459 legal, and 34 oversized urchins were harvested, as sorted by the commercial culler.

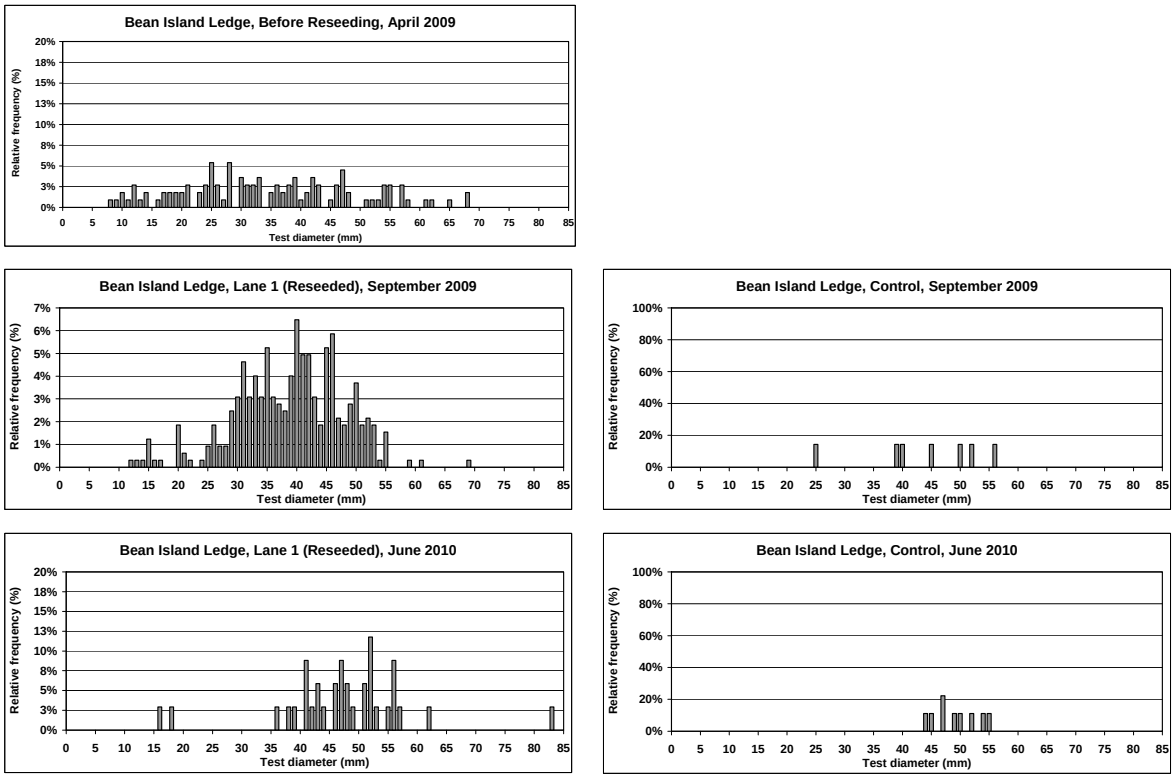


Figure 7. Relative size distributions (test diameter, mm) of the sea urchins measured from the Bean Island Ledge site evaluations, replanted area (left) and control area (right).

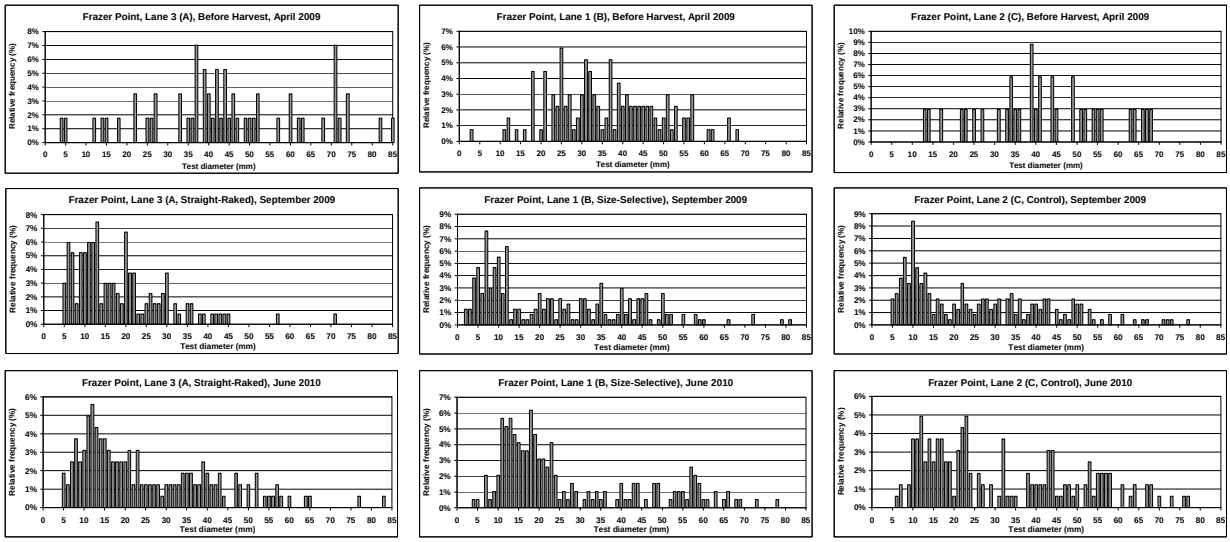


Figure 8. Relative size distributions (test diameter, mm) of the sea urchins measured from the Frazer Point site evaluations, straight-raked lane (left), size-selectively harvested lane (center), and control lane (right), April 2009 (pre-harvest, top), July 2009 (middle), June 2010 (bottom).

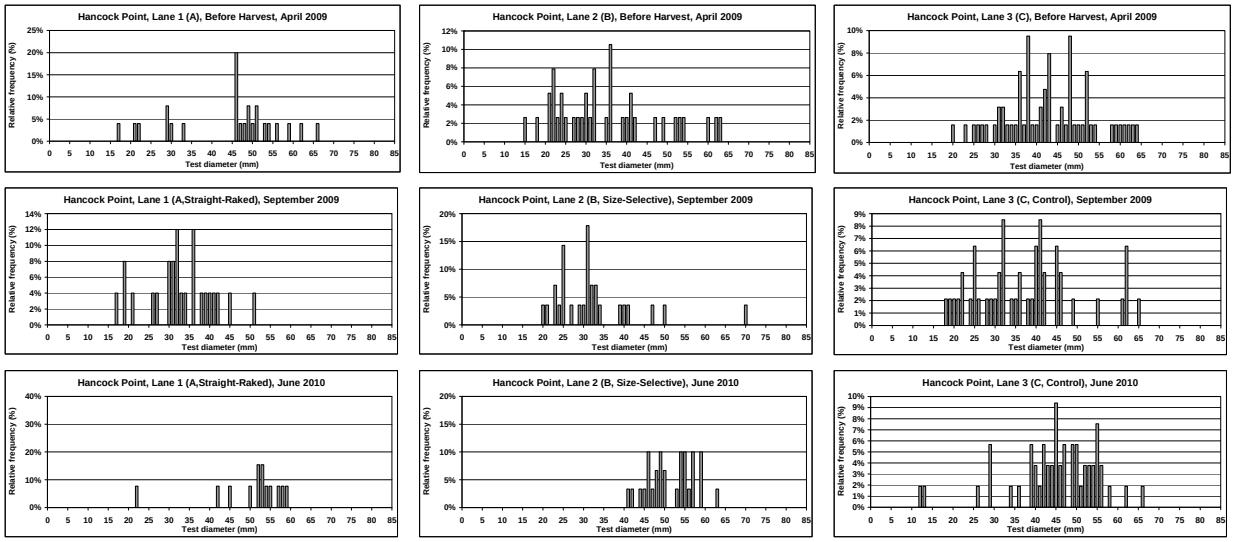


Figure 9. Relative size distributions (test diameter, mm) of the sea urchins measured from the Hancock Point site evaluations, straight-raked lane (left), size-selectively harvested lane (center), and control lane (right), April 2009 (pre-harvest, top), July 2009 (middle), June 2010 (bottom).

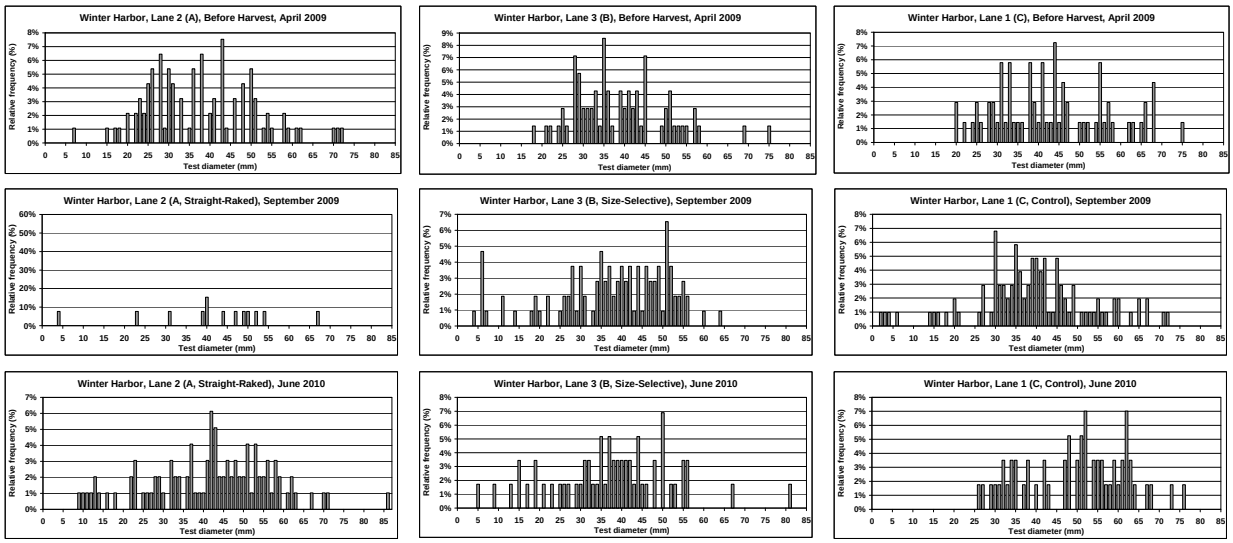
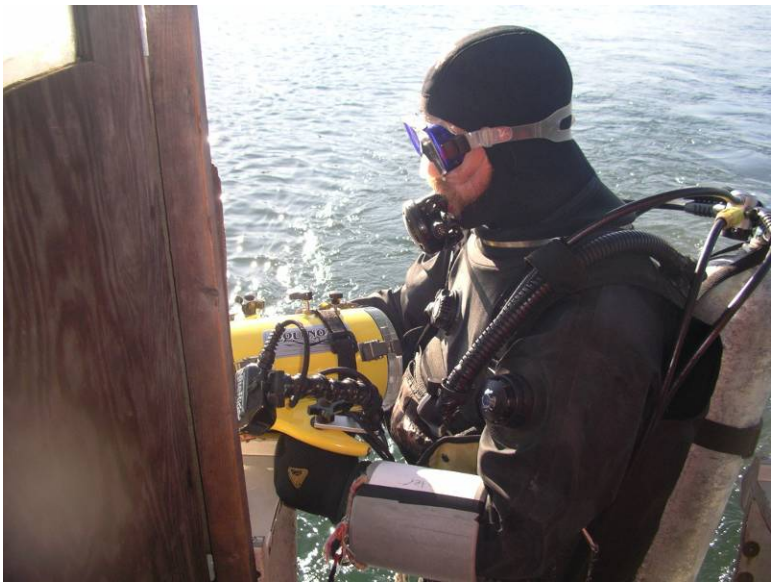


Figure 10. Relative size distributions (test diameter, mm) of the sea urchins measured from the Winter Harbor site evaluations, straight-raked lane (left), size-selectively harvested lane (center), and control lane (right), April 2009 (pre-harvest, top), July 2009 (middle), June 2010 (bottom).

All photos by Kerry Lyons, Maine DMR.

Photos 1-2. Loading SCUBA tanks (above), and marking the Bean Island Ledge site (below).

Photos 3-5. DMR diver Robert Russell with video camera housing (yellow) and recording cylinder on sleeve (above), commercial divers Marcus Jones (left) and Greg Brown (right).



Photos 6-7. Size-selective catch above and non-size-selective catch (straight-raked) below.

Photos 8-9. Commercial cullers sorting the catch.

Photos 10-11. Above: Size-selective catch with 4 totes of legal product (right) and a few over- and undersized urchins (left).
Below: Non-size-selective (straight-raked) catch with 4 totes of legal product (left) and 10 totes of over- and undersized urchins (back and right).

Appendix

Table A1. Sea urchin abundance (count·m^{-2}, left) and percent algal cover (right) by quadrat, with depth (ft), for two diver evaluations at **Bean Island Ledge**, April 11, 2009, prior to urchin relocation. "Cru"=Encrusting, "Tur"=Turfing, "Can"= Canopy.

Names indicate the diver doing the evalution.

	Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth
1	10	0	0	15
2	11	0	0	13
3	8	0	0	13
4	8	3	0	15
5	7	1	2	13
6	7	7	0	12
7	7	2	6	12
8	7	19	0	12
9	11	3	1	12
10	11	19	0	15
11	8	0	2	16
12	8	0	0	18
13	8	18	0	18
14	9	0	0	20
15	11	0	0	19
16	11	0	0	19
17	12	1	0	19
18	10	0	0	19
19	8	0	0	18
20	6	0	2	18
21	6	0	0	18
22	8	0	0	10
23	10	2	0	10
24	10	0	0	10
25	12	0	0	9
26	13	0	0	8
27	19	0	8	8
28	17	0	0	8
29	18	0	0	8
30	16	0	10	8
Totals		75	31	
Mean	10.23	2.50	1.03	13.77
Median	10	0	0	13
Variance		32.26	6.24	
N		30	30	
Both divers				
Total		106		
Mean		1.77		
Median		0		
Variance		19.47		
N		60		

	Greg			Marcus			
Quadrat	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth
1	10	90	40	60	95	21	40	15
2	11	50	30	50	100	50	95	13
3	8	90	40	50	50	40	90	13
4	8	80	65	60	90	10	100	15
5	7	50	60	20	90	10	90	13
6	7	70	40	35	90	10	100	12
7	7	45	35	25	90	10	75	12
8	7	30	10	50	95	30	95	12
9	11	70	35	60	95	50	100	12
10	11	80	40	50	95	20	95	15
11	8	80	35	90	95	40	70	16
12	8	80	35	90	90	40	80	18
13	8	85	45	80	95	50	80	18
14	9	75	50	70	100	50	50	20
15	11	70	30	30	90	60	10	19
16	11	30	15	30	95	50	10	19
17	12	30	25	30	95	50	20	19
18	10	45	55	20	75	30	50	19
19	8	80	65	25	75	20	75	18
20	6	85	55	40	90	40	50	18
21	6	55	85	30	90	20	90	18
22	8	75	50	70	60	10	50	10
23	10	50	40	40	60	20	20	10
24	10	40	40	65	30	10	30	10
25	12	30	40	70	75	30	30	9
26	13	20	30	35	70	50	90	8
27	19	15	15	15	80	70	30	8
28	17	90	40	30	70	80	30	8
29	18	80	60	15	70	90	70	8
30	16	80	50	15	70	60	70	8
Mean	10.23	62	42	45	82	37	63	13.77
Median	10	70	40	40	90	40	70	13
N			30			30		
Both divers		Cru	Tur	Can				
Mean		72	40	54				
Median		80	40	50				
N			60					

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Algal Cover Legend		
Crust % cover	Turf % cover	Canopy % cover
0%	0%	0%
1 - 25%	1 - 25%	1 - 25%
26 - 50%	26 - 50%	26 - 50%
51% +	51% +	51% +

Table A2. Sea urchin abundance (count·m^{-2}) by quadrat, with depth (ft), for two diver evaluations at **Bean Island Ledge**, April 16, 2009, just after urchin relocation in Lane 1 (replanted), and a few days later, April 24, 2009. Sea urchins appeared to be alive except where noted.

April 16

	Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth
1	7	0	30	20
2	9	28	75	18
3	11	55	70	16
4	12	15	160	18
5	17	22	34	16
6	16	51	125	
7	11	74	250	
8	7	4	105	
9	7	0	110	
10	9	24	51	
11	11	11	26	
12	14	0	110	16
13	17	86	95	
14	16	48	11	8
15	15	104	50	8
16	11	14	5	8
17	9	13	22	9
18	7	0	3	11
19	7	0	1	10
20	9	2	0	9
21	9	8	0	9
22	12	1	9	17
23	15	3	10	18
24	17	426	25	17
25	12	23	1	11
26	9	5	45	9
27	7	0	50	9
28	7	0	14	9
29	9	0	0	6
30	14	88	9	6
Totals		1,105	1,496	
Mean	11.10	36.83	49.87	12.09
Median	11	12	28	10
Variance		6,322.07	3,378.67	
N		30	30	
Both divers				
Total		2,601		
Mean		43.35		
Median		19		
Variance		4,811.35		
N		60		

April 24

	Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth
1	9	26	41	17
2	11	3	7	17
3	14	6	14	17
4	18	25	120	17
5	18	33,+3 dead	150	17
6	17	2,+1 dead	260	15
7	15	90	180	15
8	10	37	80	17
9	9	9	280	15
10	7	0	310	15
11	7	0	110	18
12	5	31	75	18
13	9	0	180	15
14	9	1	2, +4 dead	17
15	15	26	3	17
16	20	257	82	15
17	16	48	90	15
18	15	5	41	9
19	11	18	2	9
20	9	0	0	7
21	7	0	36	2
22	7	0	0	2
23	8	8	10	5
24	9	1	0	7
25	10	9	66,+1 dead	8
26	12	0	20	8
27	14	23	1	10
28	16	12	8	13
29	16	32	59	14
30	17	6	25	15
Total alive		708	2,252	
Mean	12.00	23.60	75.07	12.87
Median	11	9	41	15
Variance		2,327.56	7,849.86	
Total dead		4	5	
N		30	30	
Both divers				
Total alive		2,960		
Mean		49.33		
Median		19		
Variance		5,675.89		
Total dead		9		
N		60		

Abundance Legend	
count/m^2	
	0
	1 - 10
	11 - 20
	21+

Table A3. Sea urchin abundance (count·m^{-2}) by quadrat, with depth (ft), for two diver evaluations in each lane, at **Bean Island Ledge**, July 2, 2009.

	Lane 1 (Replanted)					Lane 2 (Control)			
	Greg		Marcus			Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth		Depth	Abundance	Abundance	Depth
1		18	86	10			0	0	17
2		140	37	10			0	0	16
3		63	70	10			0	0	16
4		68	42	15			0	0	16
5		27	35	15			0	0	17
6		5	32	18			0	0	17
7		0	3	16			0	6	17
8		18	0	16			1	0	16
9		23	35	18			0	5	17
10		66	25	18			0	0	16
11		82	21	16			0	0	17
12		118	12	16			0	0	17
13		92	64	17			0	0	17
14		72	1	16			0	0	17
15		156	0	14			0	0	15
16		70	8	13			0	0	13
17		32	28	11			0	1	11
18		13	95	8			0	0	11
19		10	72	7		8	2	0	9
20		0	77	6			0	0	8
21		43	91	6			0	0	8
22		15	103	5			0	0	7
23		171	210	3			0	3	7
24		58	175	3		4	7	0	6
25		3	109	3			1	0	6
26		15	140	2		2	7	0	4
27		10	242	4			0	2	3
28		36	33	6			0	0	2
29		1	10	7			0	0	2
30		33	102	5			8	13	1
Totals		1,458	1,958				26	30	
Mean		48.60	65.27	10.47		4.67	0.87	1.00	11.53
Median		32.5	39.5	10		4	0	0	14
Variance		2,270.52	3,885.03				5.02	7.38	
N		30	30				30	30	
Both divers									
Total		3,416					56		
Mean		56.93					0.93		
Median		36					0		
Variance		3,096.23					6.10		
N		60					60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A4. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Bean Island Ledge**, July 2, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy.

	Lane 1 (Replanted)									Lane 2 (Control)								
	Greg					Marcus				Greg					Marcus			
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30		10	0	10	10	60	0	50	50			40	25	40	65	50	20	70	90	
29		30	10	25	35	70	0	50	50			40	20	25	45	70	60	50	110	
28		35	0	10	10	70	0	70	70			40	40	70	110	80	20	70	90	
27		45	10	10	20	50	0	70	70			40	40	60	100	50	60	70	130	
26		45	20	20	40	60	0	70	70			30	20	15	35	50	30	80	110	
25		25	20	5	25	25	5	20	25			35	20	20	40	30	40	70	110	
24		20	15	5	20	70	5	25	30			30	20	20	40	30	40	70	110	
23		50	25	25	50	80	40	20	60			15	10	10	20	30	15	60	75	
22		55	20	15	35	10	10	20	30			20	15	10	25	50	10	50	60	
21		50	20	20	40	0	5	0	5			20	20	25	45	20	0	70	70	
20		50	10	25	35	80	10	10	20			10	5	5	10	20	10	30	40	
19		50	15	25	40	70	0	5	5			15	20	15	35	20	10	30	40	
18		40	0	15	15	25	5	30	35			10	10	5	15	5	0	10	10	
17		30	0	15	15	10	10	70	80			10	15	20	35	5	10	30	40	
16		50	10	5	15	50	55	25	80			10	0	5	5	20	10	90	100	
15		50	15	15	30	80	30	10	40			5	10	15	25	20	10	80	90	
14		55	25	20	45	80	25	20	45			20	20	80	100	40	20	70	90	
13		50	20	35	55	80	0	10	10			10	10	20	30	30	20	80	100	
12		55	35	20	55	90	0	20	20			30	20	35	55	40	50	80	130	
11		50	30	10	40	90	5	20	25			30	25	80	105	60	20	80	100	
10		50	20	30	50	80	5	50	55			35	25	60	85	30	10	80	90	
9		35	15	35	50	90	0	10	10			30	20	40	60	30	10	90	100	
8		30	10	20	30	40	0	20	20			40	40	80	120	40	20	90	110	
7		40	15	10	25	50	0	30	30			40	35	60	95	30	10	95	105	
6		20	25	20	45	70	0	60	60			30	20	30	50	40	10	95	105	
5		30	30	50	80	80	0	10	10			40	15	25	40	50	10	90	100	
4		30	20	50	70	70	0	50	50			20	20	5	25	40	10	90	100	
3		35	20	15	35	70	20	70	90			20	20	15	35	30	10	70	80	
2		40	30	10	40	70	20	80	100			20	25	5	30	10	10	60	70	
1		10	10	5	15	70	10	70	80			30	20	60	80	30	20	70	90	
Mean		39	17	19	36	61	9	36	44			26	20	32	52	35	19	69	88	
Median		40	18	18	35	70	5	25	43			30	20	23	40	30	10	70	95	
N		30				30						30				30				
Both divers		Cru	Turf	Can	T+Can							Cru	Turf	Can	T+Can					
Mean		50	13	27	40							30	20	50	70					
Median		50	10	20	38							30	20	60	78					
N		60										60								

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A5. Sea urchin abundance (count·m^{-2}) by quadrat, with depth (ft), for two diver evaluations in each lane, at **Bean Island Ledge**, September 1, 2009.

	Lane 1 (Replanted)					Lane 2 (Control)			
	Greg		Marcus			Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth		Depth	Abundance	Abundance	Depth
1	5	18	70	9		11	0	0	15
2	6	73	40	10		11	0	0	16
3	7	72	11	12		8	0	0	17
4	7	67	3	14		9	5	0	17
5	8	14	30	15		9	0	0	17
6	12	0	7	16		8	0	0	16
7	13	2	1	17		9	0	0	17
8	15	2	45	18		10	0	0	17
9	8	24	10	18		10	0	0	16
10	4	31	1	18		11	0	0	15
11	4	167	50	18		10	0	0	14
12	4	163	20	17		9	0	0	14
13	5	54	5	16		7	5	0	13
14	5	47	3	16		6	0	2	13
15	1	108	13	10		7	0	1	12
16	2	32	1	10		6	0	0	11
17	6	6	54	8		5	0	0	11
18	9	9	48	8		6	0	0	10
19	13	13	67	8		6	10	0	9
20	15	20	171	7		5	20	2	9
21	11	18	200	7		4	0	4	8
22	9	14	170	5		5	0	1	7
23	5	58	81	5		5	0	2	6
24	4	173	130	4		4	0	15	6
25	4	148	255	4		3	2	0	4
26	5	84	150	5		4	0	0	4
27	10	26	110	5		7	0	0	4
28	11	6	130	6		8	0	0	4
29	15	33	10	7		9	0	2	4
30	14	3	25	9		11	0	1	4
Totals		1,485	1,911				42	30	
Mean	7.90	49.50	63.70	10.73		7.43	1.40	1.00	11.00
Median	7	28.5	42.5	9.5		8	0	0	11.5
Variance		2,796.53	4,815.18				17.08	7.93	
N		30	30				30	30	
Both divers									
Total		3,396					72		
Mean		56.60					1.20		
Median		32					0		
Variance		3,792.62					12.33		
N		60					60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A6. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Bean Island Ledge**, September 1, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy.

	Lane 1 (Replanted)								Lane 2 (Control)							
	Greg				Marcus				Greg				Marcus			
Quadrat	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth
1	5	10	5	0	60	40	20	9	11	50	10	80	30	20	70	15
2	6	10	5	5	70	25	20	10	11	50	15	65	20	30	70	16
3	7	30	5	10	10	0	10	12	8	60	30	60	60	40	50	17
4	7	40	5	15	70	60	30	14	9	60	25	60	70	35	50	17
5	8	60	5	15	70	2	30	15	9	60	15	70	70	35	70	17
6	12	30	10	0	10	2	20	16	8	60	15	70	70	55	70	16
7	13	30	10	5	70	40	50	17	9	60	10	50	20	50	70	17
8	15	30	15	5	20	1	10	18	10	65	15	25	50	51	70	17
9	8	60	15	5	5	1	0	18	10	50	20	50	20	10	50	16
10	4	60	10	5	70	40	40	18	11	50	20	40	10	10	70	15
11	4	60	5	10	40	10	20	18	10	40	5	45	20	10	70	14
12	4	50	0	0	70	30	60	17	9	50	20	15	20	10	70	14
13	5	40	0	0	70	40	30	16	7	40	25	20	1	1	10	13
14	5	50	0	0	70	10	10	16	6	45	15	50	40	10	70	13
15	1	50	5	5	80	20	10	10	7	45	25	40	40	10	30	12
16	2	60	5	10	50	10	40	10	6	50	25	50	20	10	70	11
17	6	50	15	5	70	0	10	8	5	60	20	60	40	10	50	11
18	9	60	5	15	80	10	20	8	6	50	20	35	40	30	50	10
19	13	50	15	5	60	0	10	8	6	60	15	20	60	10	50	9
20	15	15	5	10	60	0	30	7	5	30	25	15	60	20	60	9
21	11	45	10	10	80	0	0	7	4	25	10	30	50	30	40	8
22	9	50	10	20	70	0	0	5	5	30	30	5	50	50	40	7
23	5	60	10	15	60	0	0	5	5	20	20	15	70	40	20	6
24	4	60	0	0	70	0	5	4	4	40	50	15	70	10	20	6
25	4	50	5	15	60	0	5	4	3	55	35	40	30	40	30	4
26	5	60	5	10	70	15	10	5	4	60	25	15	60	20	40	4
27	10	60	10	20	70	0	20	5	7	50	15	40	30	21	30	4
28	11	50	10	25	70	15	30	6	8	50	20	50	30	31	60	4
29	15	50	5	10	30	2	40	7	9	60	25	40	60	20	40	4
30	14	40	5	5	20	0	40	9	11	50	20	30	60	40	40	4
Mean	7.9	46	7	9	57	12	21	10.7	7.4	49	21	40	42	25	51	11.0
Median	7.0	50	5	8	70	2	20	10	8	50	20	40	40	21	50	12
N		30			30					30			30			

Both divers	Cru	Tur	Can
Mean	51	9.7	15
Median	60	5	10
N	60		

Both divers	Cru	Tur	Can
Mean	46	23	46
Median	50	20	50
N	60		

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A7. Sea urchin abundance (count·m^{-2}) by quadrat, with depth (ft), for two diver evaluations in each lane, at **Bean Island Ledge**, June 30, 2010.

	Lane 1 (Replanted)				Lane 2 (Control)			
	Marcus		Robert		Marcus		Robert	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	8	18	15	9	8	6	0	11
29	9	18	22	11	7	9	0	14
28	10	15	8	11	8	25	0	15
27	8	32	5	12	9	1	1	14
26	7	41	14	11	9	18	0	13
25	8	27	36	13	9	1	0	13
24	8	25	0	15	10	6	0	14
23	7	71	0	14	12	0	0	11
22	7	67	0	15	12	2	3	12
21	7	70	1	15	12	5	0	12
20	10	15	0	15	13	0	0	14
19	11	10	1	16	13	0	1	14
18	12	10	2	16	13	0	0	15
17	13	18	5	9	13	0	5	16
16	16	2	0	9	14	0	0	16
15	17	2	0	21	14	1	0	15
14	19	1	0	19	14	2	0	16
13	19	2	1	19	18	0	0	16
12	20	2	2	18	16	0	0	16
11	21	1	8	14	16	0	1	15
10	21	21	6	13	17	0	0	15
9	21	2	8	13	17	0	0	15
8	21	2	11	11	18	0	0	14
7	22	17	12	11	18	0	0	14
6	22	19	16	11	18	0	2	13
5	21	1	19	13	19	0	0	12
4	20	2	12	13	22	0	0	16
3	20	2	10	13	22	0	0	13
2	19	3	12	13	19	7	0	14
1	17	0	15	13	18	0	0	14
Totals		516	241			83	13	
Mean	14.70	17.20	8.03	13.53	14.27	2.77	0.43	14.07
Median	16.5	12.5	7	13	14	0	0	14
Variance		426.58	70.65			33.01	1.22	
N		30	30			30	30	
Both divers								
Total		757				96		
Mean		12.62				1.60		
Median		8				0		
Variance		265.77				18.21		
N		60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A8. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Bean Island Ledge**, June 30, 2010. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy

	Lane 1 (Replanted)										Lane 2 (Contorl)									
	Marcus					Robert					Marcus					Robert				
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	8	90	40	10	50	95	5	5	10	9	8	70	30	90	120	70	10	90	100	11
29	9	80	40	1	41	95	5	0	5	11	7	50	50	50	100	60	5	90	95	14
28	10	90	0	10	10	90	0	0	0	11	8	50	40	95	135	50	0	95	95	15
27	8	90	0	0	0	85	0	10	10	12	9	90	40	95	135	65	0	95	95	14
26	7	90	0	10	10	90	0	15	15	11	9	90	10	90	100	60	5	100	105	13
25	8	80	0	0	0	90	0	10	10	13	9	70	40	95	135	55	5	90	95	13
24	8	80	0	0	0	80	0	40	40	15	10	70	50	95	145	65	5	90	95	14
23	7	90	10	0	10	85	0	65	65	14	12	80	40	95	135	60	5	95	100	11
22	7	90	20	0	20	80	5	45	50	15	12	80	40	95	135	65	10	90	100	12
21	7	90	30	0	30	80	5	70	75	15	12	80	40	90	130	70	5	95	100	12
20	10	95	0	0	0	85	0	70	70	15	13	70	15	95	110	60	0	100	100	14
19	11	70	0	0	0	85	5	40	45	16	13	50	10	95	105	65	5	90	95	14
18	12	90	10	10	20	90	5	30	35	16	13	70	40	90	130	70	0	100	100	15
17	13	90	10	40	50	90	5	60	65	9	13	60	30	90	120	65	0	95	95	16
16	16	90	20	30	50	80	5	70	75	9	14	70	30	95	125	50	0	100	100	16
15	17	90	40	10	50	85	10	80	90	21	14	70	25	95	120	40	0	100	100	15
14	19	90	30	30	60	90	0	70	70	19	14	80	30	95	125	35	0	100	100	16
13	19	90	40	30	70	90	5	50	55	19	18	20	0	90	90	60	0	100	100	16
12	20	90	40	30	70	90	20	35	55	18	16	30	10	90	100	60	0	90	90	16
11	21	90	40	30	70	90	5	20	25	14	16	30	20	90	110	65	0	95	95	15
10	21	70	20	0	20	90	5	10	15	13	17	80	10	95	105	50	0	100	100	15
9	21	90	40	20	60	90	5	30	35	13	17	60	10	95	105	55	0	90	90	15
8	21	90	20	20	40	90	5	10	15	11	18	80	10	50	60	45	5	75	80	14
7	22	30	10	0	10	95	0	0	0	11	18	70	20	95	115	50	0	100	100	14
6	22	40	20	0	20	95	10	0	10	11	18	70	10	95	105	40	0	95	95	13
5	21	90	10	30	40	90	5	0	5	13	19	80	20	95	115	55	0	95	95	12
4	20	70	20	30	50	95	5	0	5	13	22	80	10	95	105	50	0	90	90	16
3	20	10	5	0	5	90	10	5	15	13	22	80	10	90	100	85	0	100	100	13
2	19	70	10	30	40	90	5	20	25	13	19	70	20	95	115	90	0	90	90	14
1	17	70	10	70	80	85	0	20	20	13	18	70	10	95	105	90	0	95	95	14
Mean	14.7	80	18	15	33	89	4	29	34	13.5	14.3	67	24	91	115	60	2	94	96	14.1
Median	17	90	15	10	35	90	5	20	25	13	14	70	20	95	115	60	0	95	95	14
N		30				30						30				30				

Both divers	Cru	Tur	Can	T+Can
Mean	84	11	22	33
Median	90	5	13	28
N	60			

Both divers	Cru	Tur	Can	T+Can
Mean	64	13	92	105
Median	65	10	95	100
N	60			

Algal Cover Legend

Crust % cover	Turf % cover	Canopy % cover
0%	0%	0%
1 - 25%	1 - 25%	1 - 25%
26 - 50%	26 - 50%	26 - 50%
51% +	51% +	51% +

Table A9. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, April 11, 2009, prior to urchin harvest.

	Lane 1 (B)				Lane 2 (C)				Lane 3 (A)			
	Greg		Marcus		Robert # 1		Robert # 2		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	4	0	12	1	-1	4	2	1	4	0	2	0
29	5	0	6	4	1	3	6	0	5	3	2	1
28	5	0	8	5	1	5	3	-1	5	19	0	2
27	8	6	25	6	3	10	15	-1	5	24	1	3
26	9	8	6	6	4	14	0	-2	5	1	3	3
25	9	33	22	9	6	5	1	-2	8	16	10	3
24	12	25	0	9	8	0	0	-2	12	11	30	5
23	12	43	24	10	10	3	1	2	12	24	6	6
22	12	24	10	10	7	7	3	3	14	16	31	10
21	12	0	68	10	8	20	10	5	15	3	13	10
20	13	0	6	10	10	6	5	4	16	2	9	11
19	13	5	17	11	10	0	0	6	16	0	84	13
18	15	5	13	11	11	16	1	6	16	0	16	13
17	15	3	27	14	12	18	18	7	17	15	29	15
16	17	20	59	14	13	10	18	8	16	35	89	15
15	17	6	55	16	14	15	13	8	16	39	52	16
14	18	6	30	17	13	7	20	9	18	10	77	16
13	18	30	16	21	14	6	24	9	19	22	36	18
12	19	29	2	22	15	19	27	10	20	2	8	18
11	20	15	6	22	16	16	20	11	23	19	9	21
10	22	1	22	24	17	5	12	12	24	56	3	22
9	23	16	24	24	19	0	1	16	24	3	28	22
8	23	0	0	25	20	1	14	17	24	4	14	23
7	27	47	4	26	20	3	1	18	25	10	52	22
6	28	1	18	26	20	1	2	19	26	9	27	23
5	28	0	12	26	21	8	2	21	27	65	40	24
4	28	8	12	28	21	5	0	21	27	1	23	25
3	28	4	1	26	20	2	12	22	28	0	20	26
2	29	9	6	29	20	0	8	22	28	0	3	29
1	30	2	0	29	19	14	0	23	29	0	4	29
Totals		346	511			223	239			409	721	
Mean	17.30	11.53	17.03	16.37	12.40	7.43	7.97	9.07	17.47	13.63	24.03	14.80
Median	17	6	12	15	13	5.5	4	8	16.5	9.5	15	15.5
Variance		185.43	297.76			39.29	68.52			278.65	622.79	
N		30	30			30	30			30	30	
Both divers												
Total		857				462				1130		
Mean		14.28				7.70				18.83		
Median		8				5				10.5		
Variance		245.19				53.06				470.58		
N		60				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A10. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, April 11, 2009, prior to urchin harvest. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy.

	Lane 1 (C)								Lane 2 (A)							Lane 3 (B)							
	Greg				Marcus				Robert #1				Robert #2			Greg				Marcus			
Quadrat	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth
30	4	80	85	30	95	100	40	1	-1	90	11	40	80	25	60	1	4	80	70	20	80	100	10	0
29	5	80	90	30	90	90	20	4	1	85	16	5	75	45	40	0	5	80	80	20	75	100	50	1
28	5	85	60	90	90	60	40	5	1	90	10	5	80	26	50	-1	5	80	60	30	80	100	70	2
27	8	80	60	90	90	40	30	6	3	95	5	15	65	30	30	-1	5	80	60	10	75	100	70	3
26	9	80	25	40	90	40	10	6	4	95	1	10	50	125	0	-2	5	80	60	20	90	100	80	3
25	9	80	35	60	90	40	40	9	6	95	1	50	70	45	40	-2	8	90	35	20	90	81	50	3
24	12	50	15	30	50	20	50	9	8	80	6	25	85	35	80	-2	12	90	40	10	80	40	30	5
23	12	80	15	10	80	70	40	10	10	75	1	5	95	46	55	2	12	80	30	15	90	11	10	6
22	12	90	105	70	90	10	40	10	7	90	1	10	90	20	60	3	14	80	40	35	90	60	10	10
21	12	90	60	90	95	21	20	10	8	95	1	5	95	15	80	5	15	70	30	10	95	10	10	10
20	13	90	50	90	95	60	75	10	10	95	1	0	90	10	80	4	16	40	20	5	95	20	10	11
19	13	90	60	90	95	60	10	11	10	80	1	0	90	21	55	6	16	15	10	0	90	0	0	13
18	15	90	50	80	95	20	50	11	11	90	6	15	90	11	30	6	16	5	0	0	90	0	10	13
17	15	90	30	60	95	20	1	14	12	95	0	5	90	10	5	7	17	60	0	0	90	0	0	15
16	17	90	35	30	90	2	20	14	13	90	1	30	95	6	5	8	16	80	5	5	80	0	0	15
15	17	90	35	20	90	30	10	16	14	95	10	15	95	5	10	8	16	90	10	20	95	0	10	16
14	18	70	50	5	95	0	10	17	13	90	10	0	90	1	20	9	18	80	5	15	95	0	10	16
13	18	90	35	10	95	0	10	21	14	95	5	20	95	0	40	9	19	80	10	5	90	0	10	18
12	19	90	15	0	70	0	10	22	15	90	5	10	90	1	5	10	20	80	10	5	95	0	20	18
11	20	90	5	10	80	0	10	22	16	80	11	20	95	5	10	11	23	90	5	0	95	10	10	21
10	22	70	15	30	80	10	20	24	17	90	0	60	95	5	0	12	24	70	15	10	90	0	0	22
9	23	80	25	35	95	0	1	24	19	80	1	50	20	10	1	16	24	60	5	5	50	10	10	22
8	23	15	15	0	45	1	1	25	20	60	0	80	90	5	1	17	24	40	10	15	70	0	0	23
7	27	40	10	30	95	11	1	26	20	55	1	20	90	5	0	18	25	30	15	10	90	0	10	22
6	28	30	15	30	95	10	0	26	20	50	1	35	85	1	10	19	26	70	10	10	100	0	10	23
5	28	40	5	25	95	10	0	26	21	65	0	30	15	5	10	21	27	30	10	10	100	0	10	24
4	28	60	15	60	90	20	20	28	21	70	0	10	50	1	10	21	27	15	20	10	100	10	10	25
3	28	80	25	0	90	30	0	26	20	90	1	0	95	1	15	22	28	10	15	5	95	0	10	26
2	29	90	20	10	90	20	10	29	20	95	2	15	90	0	10	22	28	15	15	10	95	0	20	29
1	30	90	20	0	90	20	0	29	19	80	1	15	95	10	0	23	29	10	5	0	95	10	0	29
Mean	17.3	76	36	39	88	27	20	16.4	12.4	84	4	20	81	18	27	9.1	17.5	59	23	11	88	25	18	14.8
Median	17	80	28	30	90	20	10	15	13	90	1	15	90	10	13	8	16.5	75	15	10	90	5	10	15.5
N		30			30					30			30				30			30			
Both divers		Cru	Tur	Can						Cru	Tur	Can					Cru	Tur	Can				
Mean		82	32	29						83	11	24					74	24	15				
Median		90	21	20						90	5	15					80	10	10				
N		60								60							60						

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A11. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in the two harvest treatment lanes, shallow to deep, at **Frazer Point**, April 16, 2009, immediately after the harvest treatments were applied.

	Lane 1 (B)				Lane 3 (A)			
	Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	3	2	10	3	2	7	1	2
29		0	9			5	0	2
28		6	5	5		0	2	5
27		25	27			4	0	
26		45	24			26	6	
25		9	17			2	9	
24		12	0			9	1	7
23		23	1			13	10	9
22		0	11	9		18	12	9
21		0	2			13	8	12
20		0	0			0	11	11
19		24	3			1	2	
18		35	5	12		0	0	
17		3	18			0	1	
16		24	34	13		11	2	
15		12	29	15		12	2	
14		4	44	14		22	9	
13		7	4	15		8	8	
12		2	0	15		8	8	
11		22	60	20		2	7	
10		9	7			45	2	
9		2	21			12	11	
8		12	5			7	0	
7		0	17			13	5	
6		1	11			13	12	
5		0	20	23		30	3	
4		16	17	25		16	15	
3		1	18	26		9	0	
2		4	13	28		0	1	
1	29	6	31	28	29	0	3	27
Totals		306	463			306	151	
Mean		10.20	15.43			10.20	5.03	
Median		6	12			8.5	3	
Variance		136.03	198.46			105.75	20.72	
N		30	30			30	30	
Both divers								
Total		769				457		
Mean		12.82				7.62		
Median		9				7		
Variance		171.37				68.95		
N		60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A12. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, July 1, 2009.

	Lane 1 (B)				Lane 2 (C)				Lane 3 (A)			
	Greg		Marcus		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	2	3	6	2	4	5	3	1	2	0	0	2
29	2	0	10	4	5	0	4	1	2	0	8	4
28	5	5	19	5	5	5	28	2	4	5	16	6
27	8	15	17	6	5	4	2	4	5	0	0	8
26	8	18	10	5	5	3	1	5	5	0	2	9
25	9	0			7	34	0	5	5	2	2	11
24	9	30			8	21	1	6	7	6	2	11
23	9	4			9	18	7	7	8	7	1	13
22	9	18			9	9	21	8	10	3	1	14
21	9	0	1	9	10	0	13	8	11	0	1	14
20	10	14	28	10	10	9	38	10	12	1	32	14
19	10	35	37	10	11	38	30	11	14	2	7	15
18	12	15	20	10	13	9	23	13	14	2	19	16
17	13	19	77	13	14	45	82	13	14	0	0	16
16	17	22	17	12	14	7	0	13	14	1	92	16
15	18	77	9	14	15	1	21	14	15	19	62	17
14	19	0	31	15	17	13	118	14	15	14	7	18
13	19	1	66	17	17	31	74	14	18	18	15	20
12	20	27	86	18	17	33	68	16	18	2	9	21
11	21	7	34	20	18	29	10	17	19	15	20	22
10	21	45	1	21	20	13	71	20	19	45	0	22
9	22	0	4	22	21	12	17	21	20	83	5	23
8	22	33	3	23	21	22	105	21	21	28	5	23
7	25	5	29	23	23	3	45	24	21	9	43	23
6	25	24	31	24	27	52	2	25	21	34	46	23
5	26	13	35	25	27	14	54	25	22	13	52	24
4	26	12	21	27	27	1	50	28	25	4	20	26
3	26	0	36	27	28	3	2	28	28	5	3	27
2	27	3	10	30	28	9	3	29	29	7	4	27
1	27	7	1	30	29	73	6	29	29	0	3	29
Totals		452	639			516	899			325	477	
Mean	15.87	15.07	24.58	16.23	15.47	17.20	29.97	14.40	14.90	10.83	15.90	17.13
Median	17.5	12.5	19.5	16	14.5	10.5	19	13.5	14.5	4.5	6	16.5
Variance		286.13	511.77			312.72	1122.24			307.45	496.58	
N		30	26			30	30			30	30	
Both divers												
Total		1091				1415				802		
Mean		19.48				23.58				13.37		
Median		15				13				5		
Variance		406.40				746.76				401.73		
N		56				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A13. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, July 1, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy.

	Lane 1 (B)										Lane 2 (C)										Lane 3 (A)									
	Greg					Marcus					Greg					Marcus					Greg					Marcus				
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	2	50	40	60	100	20	80	80	160	2	4	50	20	20	40	20	40	40	80	1	2	35	20	35	55	10	91	70	161	2
29	2	60	20	50	70	20	80	70	150	4	5	50	20	25	45	20	10	70	80	1	2	30	20	30	50	40	71	80	151	4
28	5	55	20	50	70	30	80	60	140	5	5	45	20	20	40	20	60	50	110	2	4	30	35	20	55	60	60	70	130	6
27	8	60	30	50	80	30	60	70	130	6	5	45	0	5	5	30	65	60	125	4	5	40	15	10	25	20	85	70	155	8
26	8	65	20	35	55	40	50	90	140	5	5	40	10	10	20	30	65	30	95	5	5	40	25	40	65	30	75	30	105	9
25	9	60	20	30	50						7	40	10	20	30	30	60	20	80	5	5	55	25	40	65	30	110	50	160	11
24	9	60	15	10	25						8	40	5	10	15	20	75	10	85	6	7	30	15	50	65	30	100	40	140	11
23	9	60	20	10	30						9	30	10	10	20	50	75	5	80	7	8	35	20	50	70	50	100	70	170	13
22	9	60	20	40	60						9	20	5	10	15	50	35	5	40	8	10	35	15	80	95	50	80	40	120	14
21	9	60	20	35	55	40	80	90	170	9	10	5	0	5	5	50	90	10	100	8	11	30	15	60	75	60	60	30	90	14
20	10	65	20	25	45	70	10	70	80	10	10	10	0	0	0	70	50	30	80	10	12	20	10	25	35	60	60	10	70	14
19	10	60	15	30	45	20	10	30	40	10	11	50	5	10	15	50	50	50	100	11	14	10	15	5	20	30	40	10	50	15
18	12	60	10	25	35	60	20	30	50	10	13	40	5	10	15	50	20	30	50	13	14	20	10	10	20	30	10	5	15	16
17	13	60	0	15	15	60	20	20	40	13	14	30	5	10	15	60	40	0	40	13	14	5	5	0	5	5	10	0	10	16
16	17	60	10	25	35	60	20	5	25	12	14	30	10	5	15	70	40	10	50	13	14	50	10	0	10	80	0	10	10	16
15	18	60	25	15	40	70	15	10	25	14	15	5	0	0	0	80	60	0	60	14	15	60	5	5	10	90	0	10	10	17
14	19	70	30	50	80	70	15	20	35	15	17	55	0	20	20	80	10	20	30	14	15	60	0	5	5	80	40	20	60	18
13	19	30	20	30	50	80	5	30	35	17	17	50	0	5	5	80	10	0	10	14	18	65	5	0	5	80	40	0	40	20
12	20	15	10	5	15	70	10	20	30	18	17	60	10	0	10	70	60	10	70	16	18	60	0	5	5	80	20	10	30	21
11	21	60	10	5	15	80	15	30	45	20	18	60	15	5	20	70	40	10	50	17	19	60	5	15	20	40	10	20	30	22
10	21	70	10	10	20	60	25	10	35	21	20	60	5	10	15	70	0	20	20	20	19	55	0	5	5	30	0	20	20	22
9	22	20	10	10	20	80	10	30	40	22	21	40	0	10	10	50	10	20	30	21	20	50	5	5	10	10	10	0	10	23
8	22	50	5	10	15	80	5	30	35	23	21	50	5	5	10	70	10	20	30	21	21	50	5	0	5	80	0	0	0	23
7	25	70	0	0	0	60	5	20	25	23	23	50	10	20	30	50	0	20	20	24	21	50	10	0	10	80	10	40	50	23
6	25	70	0	5	5	80	10	5	15	24	27	25	10	15	25	40	10	20	30	25	21	50	5	5	10	80	0	40	40	23
5	26	60	0	10	10	80	5	5	10	25	27	10	0	0	0	30	10	10	20	25	22	50	5	5	10	80	15	20	35	24
4	26	60	10	10	20	70	40	30	70	27	27	15	0	15	15	30	10	5	15	28	25	30	5	0	5	90	0	20	20	26
3	26	60	0	0	0	80	10	10	20	27	28	15	0	10	10	40	0	5	5	28	28	25	5	20	25	70	10	70	80	27
2	27	60	5	5	10	70	0	20	20	30	28	20	0	15	15	30	0	5	5	29	29	15	5	0	5	70	10	70	80	27
1	27	60	5	0	5	70	0	5	5	30	29	10	0	10	10	20	0	20	20	29	29	0	0	0	0	70	0	1	1	29
Mean	15.9	57	14	22	36	60	26	34	60	16.2	15.5	35	6	10	16	48	34	20	54	14.4	14.9	38	11	18	28	54	37	31	68	17.1
Median	17.5	60	13	15	33	70	15	30	38	16	15	40	5	10	15	50	38	20	50	14	15	38	8	5	15	60	18	20	50	17
N		30				26						30				30						30				30				

Both divers	Cru	Turf	Can	T+Can
Mean	58	20	28	47
Median	60	15	23	35
N	56			

Both divers	Cru	Turf	Can	T+Can
Mean	41	20	15	35
Median	40	10	10	20
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	46	24	24	48
Median	50	10	18	30
N	60			

Algal Cover Legend

Crust % cover	
	0%
	1 - 25%
	26 - 50%
	51% +

Turf % cover	
	0%
	1 - 25%
	26 - 50%
	51% +

Canopy % cover	
	0%
	1 - 25%
	26 - 50%
	51% +

Table A14. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, September 2, 2009.

	Lane 1 (B)				Lane 2 (C)				Lane 3 (A)			
	Greg		Marcus		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	5	2	1	5	5	0	2	8	3	4	0	6
29	5	4	1	6	6	16	4	10	7	0	0	10
28	7	43	5	7	9	25	5	12	8	2	0	11
27	8	10	8	8	11	37	26	13	9	0	0	11
26	11	21	5	8	13	17	0	15	10	0	0	12
25	10	8	4	8	11	0	10	15	11	1	0	13
24	11	0	1	12	12	21	51	14	12	0	30	13
23	11	1	20	13	13	66	31	14	13	0	1	14
22	10	16	21	13	14	12	87	15	16	0	64	15
21	10	13	63	14	15	47	29	17	15	25	29	15
20	11	10	5	15	16	43	12	18	15	29	70	16
19	12	24	19	16	16	9	115	18	18	93	74	17
18	14	9	10	18	16	65	67	19	19	22	1	17
17	16	79	35	18	17	5	42	19	19	0	15	19
16	16	0	3	17	18	27	5	20	20	8	19	20
15	17	68	34	17	19	36	14	22	20	0	0	21
14	18	31	17	17	20	87	31	23	21	0	1	21
13	19	13	60	21	21	18	10	24	21	14	1	21
12	19	15	44	21	22	29	2	24	22	1	30	21
11	20	37	50	22	23	24	70	25	23	1	69	22
10	21	8	15	23	23	33	10	26	24	14	75	23
9	22	14	27	25	23	29	5	28	26	0	48	24
8	24	0	52	25	25	18	3	28	24	6	29	24
7	28	4	23	25	26	17	48	28	26	2	2	25
6	28	0	70	24	26	27	46	28	27	7	8	25
5	28	6	30	25	27	65	0	31	28	21	20	28
4	27	8	72	26	28	2	0	31	31	0	25	29
3	27	118	48	26	29	6	4	31	31	4	2	31
2	28	1	13	28	31	27	1	32	32	17	1	31
1	29	40	52	28	31	6	8	32	33	0	0	31
Totals		603	808			814	738			271	614	
Mean	17.07	20.10	26.93	17.70	18.87	27.13	24.60	21.33	19.47	9.03	20.47	19.53
Median	16.5	10	20.5	17.5	18.5	24.5	10	21	20	1.5	5	20.5
Variance		725.06	507.93			462.74	864.87			326.38	681.57	
N		30	30			30	30			30	30	
Both divers												
Total		1411				1552				885		
Mean		23.52				25.87				14.75		
Median		15				18				2		
Variance		617.91				654.19				528.67		
N		60				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A15. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, September 2, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy.

	Lane 1 (B)								Lane 2 (C)								Lane 3 (A)							
	Greg				Marcus				Greg				Marcus				Greg				Marcus			
Quadrat	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth
30	5	50	20	10	40	80	30	5	5	30	35	30	10	80	10	8	3	50	45	25	20	55	40	6
29	5	45	35	30	30	90	20	6	6	40	20	25	60	50	50	10	7	35	45	30	30	75	80	10
28	7	60	30	30	30	70	50	7	9	50	15	25	60	50	30	12	8	40	45	50	40	40	40	11
27	8	50	25	20	60	60	40	8	11	45	5	15	70	30	30	13	9	50	25	30	30	65	70	11
26	11	45	15	30	70	50	30	8	13	40	20	30	5	0	10	15	10	40	20	25	50	60	30	12
25	10	40	20	20	70	40	70	8	11	40	25	25	40	10	10	15	11	30	5	15	60	45	5	13
24	11	50	25	20	70	60	70	12	12	40	15	20	80	10	20	14	12	15	15	5	70	40	5	13
23	11	60	30	40	80	50	40	13	13	45	0	15	80	20	10	14	13	5	0	0	80	15	5	14
22	10	50	40	30	80	10	60	13	14	55	5	15	80	0	5	15	16	5	0	0	70	0	0	15
21	10	60	30	40	90	0	30	14	15	45	0	10	80	10	10	17	15	60	0	5	80	0	0	15
20	11	50	30	50	90	20	5	15	16	50	0	10	40	15	5	18	15	60	10	5	90	30	10	16
19	12	60	20	40	90	10	20	16	16	60	5	10	80	10	5	18	18	60	10	5	90	15	20	17
18	14	60	20	30	70	15	30	18	16	60	0	5	70	0	5	19	19	60	10	5	90	15	20	17
17	16	60	10	20	80	10	20	18	17	70	5	5	80	20	10	19	19	40	0	5	80	20	10	19
16	16	60	10	15	70	80	20	17	18	50	5	5	80	30	5	20	20	40	10	15	80	10	20	20
15	17	70	5	5	80	50	30	17	19	50	10	20	70	10	30	22	20	35	5	5	90	0	10	21
14	18	70	5	5	80	40	30	17	20	60	5	5	60	25	30	23	21	25	5	0	30	0	0	21
13	19	70	5	0	80	10	30	21	21	50	5	10	80	10	30	24	21	20	10	0	30	10	0	21
12	19	65	5	10	80	0	20	21	22	30	5	5	60	70	0	24	22	20	0	0	90	0	0	21
11	20	50	10	40	80	10	10	22	23	50	5	10	70	10	10	25	23	45	15	0	90	10	30	22
10	21	60	10	20	80	10	30	23	23	45	5	5	60	10	30	26	24	20	5	15	90	0	5	23
9	22	50	10	20	70	10	30	25	23	35	10	10	60	25	30	28	26	10	0	5	90	0	5	24
8	24	60	20	5	60	0	20	25	25	30	5	5	30	10	30	28	24	10	0	5	80	10	20	24
7	28	25	20	20	80	0	10	25	26	30	10	5	90	0	5	28	26	5	0	5	80	30	20	25
6	28	5	5	10	90	1	10	24	26	30	5	5	90	0	10	28	27	20	0	0	80	10	20	25
5	28	20	5	10	80	0	20	25	27	50	10	15	40	10	30	31	28	10	0	15	80	11	30	28
4	27	20	5	15	80	2	5	26	28	40	5	10	50	10	20	31	31	5	0	0	70	10	30	29
3	27	40	5	10	90	0	10	26	29	50	5	0	70	0	20	31	31	15	0	5	90	1	10	31
2	28	30	5	5	80	10	10	28	31	40	5	5	60	0	40	32	32	10	0	5	90	0	0	31
1	29	25	5	0	80	15	0	28	31	40	5	5	70	0	30	32	33	5	0	0	90	2	5	31
Mean	17.1	49	16	20	74	27	27	17.7	18.9	45	8	12	63	18	19	21.3	19.5	28	9	9	71	19	18	19.5
Median	17	50	13	20	80	10	25	17.5	19	45	5	10	70	10	15	21	20	23	5	5	80	10	10	20.5
N		30			30					30			30					30			30			

Both divers	Cru	Tur	Can
Mean	61	21	23
Median	60	10	20
N	60		

Both divers	Cru	Tur	Can
Mean	54	13	15
Median	50	10	10
N	60		

Both divers	Cru	Tur	Can
Mean	50	14	14
Median	48	10	5
N	60		

Algal Cover Legend

Crust % cover	
	0%
	1 - 25%
	26 - 50%
	51% +

Turf % cover	
	0%
	1 - 25%
	26 - 50%
	51% +

Canopy % cover	
	0%
	1 - 25%
	26 - 50%
	51% +

Table A16. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, June 29, 2010.

	Lane 1 (B)				Lane 2 (C)				Lane 3 (A)			
	Marcus		Robert		Marcus		Robert		Marcus		Robert	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	1	5	11	2	4	2	2	4	1	3	0	4
29	3	12	40	6	6	16	25	8	1	1	1	5
28	3	10	24	8	7	32	41	9	3	4	9	7
27	4	32	29	8	9	25	27	11	3	1	2	9
26	5	42	19	9	12	15	52	12	4	16	8	10
25	7	31	25	9	13	14	30	12	7	0	12	11
24	8	31	20	10	13	6	16	12	11	25	10	12
23	9	33	44	10	14	19	28	13	12	25	12	13
22	10	49	17	11	14	55	12	15	14	10	30	15
21	10	35	58	11	15	64	18	15	15	46	15	16
20	10	37	22	11	16	51	24	15	17	71	24	17
19	10	42	30	12	16	48	22	16	17	28	19	17
18	11	30	25	13	18	52	18	17	18	65	26	17
17	14	47	38	14	19	9	34	17	18	60	47	18
16	14	85	48	15	19	118	19	19	19	70	29	19
15	16	56	29	16	20	113	61	18	20	35	34	21
14	16	60	41	16	20	47	43	20	21	81	36	23
13	16	91	23	17	22	30	39	21	21	44	20	24
12	17	90	26	18	24	5	6	23	23	12	52	24
11	19	59	6	18	24	23	11	24	23	15	39	25
10	21	20	17	20	24	0	35	24	25	3	33	26
9	20	59	32	22	24	35	21	25	26	27	12	27
8	22	36	20	22	25	32	8	25	28	4	26	28
7	21	85	48	22	25	6	1	26	31	1	19	29
6	22	80	23	23	24	32	6	26	31	1	28	29
5	23	42	13	24	26	42	2	27	32	14	21	30
4	23	23	21	25	27	15	20	27	32	4	2	31
3	23	51	39	26	28	14	14	29	32	10	6	31
2	25	45	36	26	28	16	10	30	33	5	23	34
1	26	17	34	27	29	47	18	30	33	35	10	34
Totals		1335	858			983	663			716	605	
Mean	14.30	44.50	28.60	15.70	18.83	32.77	22.10	19.00	19.03	23.87	20.17	20.20
Median	15	42	25.5	15.5	19.5	27.5	19.5	18.5	19.5	14.5	19.5	20
Variance		564.19	145.63			815.29	222.02			607.57	185.04	
N		30	30			30	30			30	30	
Both divers												
Total		2193				1646				1321		
Mean		36.55				27.43				22.02		
Median		33				22				18		
Variance		413.17				538.79				393.07		
N		60				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A17. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Frazer Point**, June 29, 2010. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy.

	Lane 1 (B)										Lane 2 (C)										Lane 3 (A)									
	Marcus					Robert					Marcus					Robert					Greg					Marcus					
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	1	30	95	30	125	90	25	90	115	2	4	80	22	95	117	95	45	80	125	4	1	10	100	30	130	70	100	10	110	4
29	3	50	71	95	166	90	5	75	80	6	6	70	20	90	110	90	20	10	30	8	1	10	105	10	115	85	40	60	100	5
28	3	60	71	90	161	90	5	15	20	8	7	80	10	40	50	90	5	5	10	9	3	70	50	50	100	90	15	90	105	7
27	4	70	10	80	90	90	20	5	25	8	9	90	6	30	36	90	10	15	25	11	3	50	80	70	150	90	15	50	65	9
26	5	70	20	70	90	85	15	10	25	9	12	85	11	10	21	90	5	30	35	12	4	50	61	70	131	85	20	60	80	10
25	7	80	40	20	60	90	5	5	10	9	13	80	40	10	50	90	0	15	15	12	7	50	52	80	132	90	10	80	90	11
24	8	80	51	20	71	95	0	5	5	10	13	50	10	10	20	90	0	20	20	12	11	80	30	90	120	85	5	90	95	12
23	9	80	0	10	10	90	0	10	10	10	14	50	10	10	20	95	5	5	10	13	12	80	40	40	80	90	10	70	80	13
22	10	80	0	5	5	90	0	0	0	11	14	95	0	10	10	90	0	10	10	15	14	80	30	10	40	85	0	65	65	15
21	10	80	0	0	0	95	5	30	35	11	15	95	0	10	10	95	0	5	5	15	15	30	10	20	30	80	5	10	15	16
20	10	90	0	0	0	95	5	0	5	11	16	90	0	0	0	95	5	0	5	15	17	70	0	0	0	85	0	5	5	17
19	10	90	0	1	1	95	5	10	15	12	16	90	0	10	10	95	0	0	0	16	17	70	0	10	10	80	0	10	10	17
18	11	90	1	30	31	95	0	15	15	13	18	70	0	0	0	95	0	0	0	17	18	95	0	10	10	95	0	0	0	17
17	14	80	10	40	50	95	0	10	10	14	19	90	0	75	75	95	0	5	5	17	18	90	0	30	30	90	0	20	20	18
16	14	90	0	30	30	90	0	10	10	15	19	90	0	70	70	90	5	10	15	19	19	80	1	30	31	95	0	5	5	19
15	16	70	0	10	10	90	5	20	25	16	20	90	0	0	0	95	0	0	0	18	20	90	1	30	31	90	0	10	10	21
14	16	90	0	1	1	95	0	5	5	16	20	95	0	5	5	95	0	0	0	20	21	95	0	0	0	80	0	5	5	23
13	16	80	0	0	0	95	0	5	5	17	22	80	10	50	60	95	0	0	0	21	21	95	0	0	0	85	0	10	10	24
12	17	80	0	30	30	95	0	5	5	18	24	70	35	10	45	80	0	25	25	23	23	80	0	30	30	80	0	15	15	24
11	19	80	0	0	0	90	0	25	25	18	24	50	10	10	20	90	0	40	40	24	23	90	0	30	30	85	0	20	20	25
10	21	80	0	5	5	90	0	10	10	20	24	40	0	10	10	95	0	10	10	24	25	70	0	80	80	90	0	15	15	26
9	20	90	0	0	0	80	5	20	25	22	24	70	0	30	30	80	0	15	15	25	26	80	10	10	20	85	0	50	50	27
8	22	90	0	10	10	85	0	10	10	22	25	50	0	30	30	95	0	10	10	25	28	80	0	0	0	90	0	20	20	28
7	21	90	0	10	10	70	5	20	25	22	25	30	0	20	20	90	0	20	20	26	31	50	0	20	20	80	0	65	65	29
6	22	80	0	10	10	40	0	35	35	23	24	60	0	10	10	95	0	5	5	26	31	50	10	0	10	70	0	50	50	29
5	23	50	0	20	20	50	5	40	45	24	26	80	0	30	30	90	0	30	30	27	32	50	10	0	10	80	0	20	20	30
4	23	20	0	20	20	60	0	10	10	25	27	75	0	30	30	85	0	25	25	27	32	50	0	10	10	85	0	40	40	31
3	23	70	0	30	30	60	5	30	35	26	28	95	0	1	1	80	0	5	5	29	32	40	0	10	10	70	0	10	10	31
2	25	60	0	30	30	85	0	15	15	26	28	95	0	1	1	90	0	0	0	30	33	70	0	30	30	85	0	15	15	34
1	26	70	10	30	40	90	0	20	20	27	29	80	0	20	20	80	0	10	10	30	33	80	0	30	30	90	0	20	20	34
Mean	14.3	74	13	24	37	85	4	19	23	15.7	18.8	76	6	24	30	91	3	14	17	19.0	19.0	66	20	28	47	85	7	33	40	20.2
Median	15.0	80	0	20	20	90	0	10	15	16	20	80	0	10	20	90	0	10	10	19	20	70	1	25	30	85	0	20	20	20
N		30				26						30				30						30				30				

Both divers	Cru	Turf	Can	T+Can
Mean	80	8	21	30
Median	85	0	13	18
N	56			

Both divers	Cru	Turf	Can	T+Can
Mean	83	5	19	24
Median	90	0	10	15
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	75	14	30	44
Median	80	0	20	30
N	60			

Algal Cover Legend						
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A18. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, April 11, 2009, prior to urchin harvest. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)				Lane 2 (B)				Lane 3 (C)			
	Greg		Marcus		Greg		Marcus		Robert # 1		Robert # 2	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	6	9	13	9	7	5	16	5	7	14	5	4
29	7	30	28	9	7	1	35	5	7	29	7	4
28	11	26	25	11	8	37	3	6	5	10	20	6
27	12	1	15	12	9	27	28	7	4	8	6	6
26	13	0	0	14	10	26	11	7	6	24	12	7
25	14	0	0	15	12	24	43	10	6	14	14	7
24	14	0	0	15	14	2	47	11	7	32	2	8
23	16	0	0	16	14	0	9	11	7	16	1	8
22	16	0	0	17	15	0	9	12	8	19	14	9
21	17	0	0	18	15	0	8	13	9	8	22	10
20	17	0	0	19	15	0	0	14	11	21	6	12
19	18	0	0	19	16	1	4	16	12	18	21	12
18	18	0	0	20	16	0	0	17	14	26	12	13
17	19	0	0	20	17	0	0	17	15	15	19	14
16	19	0	0	21	19	0	0	17	16	9	9	16
15	20	0	0	21	19	0	0	19	17	1	0	17
14	20	0	0	21	19	0	0	19	19	0	0	18
13	20	0	1	22	20	0	0	20	20	0	0	20
12	20	0	0	22	21	0	1	20	20	0	0	21
11	20	0	0	22	21	0	0	21	22	0	0	22
10	21	0	0	23	22	0	1	22	23	0	0	23
9	23	0	0	23	22	0	0	23	23	0	0	23
8	23	0	9	23	23	0	0	23	24	0	0	25
7	23	0	0	25	24	0	0	24	25	0	0	25
6	24	0	0	26	24	0	0	24	26	0	0	27
5	24	0	0	27	24	0	0	25	27	0	0	28
4	25	0	0	27	25	0	0	26	27	0	0	29
3	25	0	0	27	26	0	0	26	28	0	0	28
2	27	0	0	27	26	0	0	27	28	0	0	29
1	27	0	0	27	26	0	0	27	29	0	0	30
Totals		66	91			123	215			264	170	
Mean	18.63	2.20	3.03	19.93	17.87	4.10	7.17	17.13	16.40	8.80	5.67	16.70
Median	19.5	0	0	21	19	0	0	18	16.5	4.5	0.5	16.5
Variance		52.17	55.48			99.20	177.80			106.99	56.37	
N		30	30			30	30			30	30	
Both divers												
Total		157				338				434		
Mean		2.62				5.63				7.23		
Median		0				0				1		
Variance		53.09				138.54				82.79		
N		60				60				60		
Shallow band		Less than 13 ft				Less than 14 ft				Less than 15 ft		
Total		147				329				400		
Mean		18.38				20.56				14.81		
Median		20				20				14		
Variance		108.55				219.33				65.77		
N		8				16				27		

Abundance Legend	
count/m^2	
	0
	1 - 10
	11 - 20
	21+

Table A19. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, April 11, 2009, prior to urchin harvest. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)										Lane 2 (B)										Lane 3 (C)									
	Greg					Marcus					Greg					Marcus					Robert # 1					Robert # 2				
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	6	60	45	60	105	90	50	20	70	9	7	70	55	30	85	50	60	1	61	5	7	90	5	1	6	95	1	5	6	4
29	7	80	14	30	44	90	20	20	40	9	7	70	35	50	85	80	80	1	81	5	7	85	21	5	26	95	6	0	6	4
28	11	90	21	40	61	90	11	40	51	11	8	70	30	20	50	70	31	1	32	6	5	85	30	0	30	90	15	0	15	6
27	12	10	0	0	0	75	2	20	22	12	9	80	5	10	15	70	41	1	42	7	4	95	1	1	2	95	11	0	11	6
26	13	20	1	0	1	20	30	0	30	14	10	80	5	40	45	70	20	10	30	7	6	90	15	0	15	90	25	0	25	7
25	14	25	1	15	16	20	20	1	21	15	12	80	10	40	50	90	20	30	50	10	6	80	25	10	35	25	30	0	30	7
24	14	10	2	0	2	40	30	0	30	15	14	5	5	0	5	90	20	10	30	11	7	85	15	20	35	60	30	0	30	8
23	16	1	2	0	2	10	11	0	11	16	14	5	5	0	5	80	11	20	31	11	7	80	10	10	20	75	15	0	15	8
22	16	5	1	0	1	5	1	0	1	17	15	10	5	15	20	60	11	10	21	12	8	60	1	5	6	50	10	5	15	9
21	17	5	0	1	1	10	1	0	1	18	15	5	5	10	15	75	30	10	40	13	9	85	5	10	15	90	5	5	10	10
20	17	5	0	0	0	20	20	0	20	19	15	5	0	0	0	10	1	0	1	14	11	90	0	25	25	85	0	40	40	12
19	18	10	2	3	5	50	30	10	40	19	16	10	5	0	5	30	11	0	11	16	12	90	1	50	51	90	1	10	11	12
18	18	5	6	2	8	20	21	0	21	20	16	5	5	0	5	10	1	0	1	17	14	85	0	30	30	85	0	20	20	13
17	19	5	6	0	6	20	11	0	11	20	17	5	5	0	5	10	1	0	1	17	15	75	5	40	45	90	1	30	31	14
16	19	15	2	1	3	20	10	0	10	21	19	5	0	0	0	10	10	0	10	17	16	80	0	35	35	85	6	25	31	16
15	20	10	2	1	3	10	1	0	1	21	19	5	5	0	5	20	1	0	1	19	17	60	0	40	40	20	1	15	16	17
14	20	15	2	1	3	10	11	0	11	21	19	5	0	0	0	10	1	0	1	19	19	0	0	1	1	1	1	1	2	18
13	20	5	2	0	2	10	2	10	12	22	20	5	0	0	0	10	1	0	1	20	20	0	0	1	1	1	0	5	5	20
12	20	20	2	2	4	10	10	1	11	22	21	5	0	0	0	10	11	0	11	20	20	0	0	5	5	1	1	0	1	21
11	20	10	2	0	2	10	0	0	0	22	21	5	0	0	0	10	1	0	1	21	22	0	0	5	5	0	5	0	5	22
10	21	1	2	10	12	1	1	0	1	23	22	5	5	0	5	10	2	0	2	22	23	0	0	1	1	1	0	10	10	23
9	23	1	10	0	10	1	1	0	1	23	22	5	5	0	5	1	2	0	2	23	23	0	5	0	5	0	0	10	10	23
8	23	5	1	0	1	1	1	0	1	23	23	5	0	0	0	20	1	0	1	23	24	0	0	1	1	1	0	1	1	25
7	23	10	1	0	1	0	1	0	1	25	24	5	5	0	5	10	20	0	20	24	25	5	2	5	7	0	0	1	1	25
6	24	25	0	20	20	1	1	0	1	26	24	5	5	0	5	10	2	0	2	24	26	0	0	1	1	0	0	1	1	27
5	24	0	1	0	1	0	1	0	1	27	24	5	0	0	0	1	1	0	1	25	27	1	0	5	5	0	0	5	5	28
4	25	0	1	0	1	0	1	0	1	27	25	10	0	10	10	10	10	0	10	26	27	0	0	5	5	0	0	0	0	29
3	25	0	1	0	1	0	10	0	10	27	26	10	0	10	10	10	1	0	1	26	28	1	0	5	5	0	0	1	1	28
2	27	0	1	1	2	0	5	0	5	27	26	5	0	0	0	1	1	0	1	27	28	0	0	5	5	0	0	1	1	29
1	27	0	1	0	1	10	0	25	25	27	26	5	0	0	0	1	0	0	0	27	29	0	0	10	10	0	0	1	1	30
Mean	18.6	15	4	6	11	21	10	5	15	19.9	17.9	20	7	8	15	31	13	3	17	17.1	16.4	44	5	11	16	41	5	6	12	16.7
Median	19.5	8	2	0	2	10	8	0	11	21	19	5	5	0	5	10	6	0	6	18	17	60	0	5	7	23	1	1	10	17
N		30				30						30				30						30				30				

Both divers	Cru	Turf	Can	T+Can
Mean	18	7	5.6	13
Median	10	2.0	0	4
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	25	10	5.5	16
Median	10	5	0	5
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	42	5	8.7	14
Median	38	1	5	9
N	60			

Shallow band	Less than 13 ft			
	Cru	Turf	Can	T+Can
Mean	73	20	29	49
Median	85	17	25	48
N	8			

Shallow band	Less than 14 ft			
	Cru	Turf	Can	T+Can
Mean	74	29	18	47
Median	73	25	10	44
N	16			

Shallow band	Less than 15 ft			
	Cru	Turf	Can	T+Can
Mean	82	10	10	21
Median	85	6	5	20
N	27			

Algal Cover Legend						
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A20. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in the two harvest treatment lanes, shallow to deep, at **Hancock Point**, April 16, 2009, immediately after the harvest treatments were applied. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)				Lane 2 (B)			
	Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30		2	0	7		2	0	5
29		11	2			11	11	
28		13	2			9	1	
27		5	2			2	10	
26		13	10			10	29	7
25		6	2	9		25	27	
24		1	4			26	42	
23		0	5			39	30	11
22		0	0	14		29	9	
21		0	0			15	1	14
20		0	0	17		1	0	
19		0	0			0	2	16
18		0	0			0	0	
17		0	0			0	0	
16		1	0			0	0	
15		0	0			0	0	
14		0	0			1	0	
13		0	0			0	0	
12		0	0			0	0	
11		0	0			0	0	
10		0	0	23		0	0	22
9		0	0			0	0	
8		0	0			0	0	
7		0	0			0	0	
6		0	0			0	0	
5		0	0			0	0	
4		0	0			0	0	
3		0	0			0	0	
2		0	0			0	0	
1	26	0	0	29	28	0	0	28
Totals		52	27			170	162	
Mean		1.73	0.90			5.67	5.40	
Median		0	0			0	0	
Variance		15.03	4.58			111.61	126.46	
N		30	30			30	30	
Both divers								
Total		79				332		
Mean		1.32				5.53		
Median		0				0		
Variance		9.81				117.03		
N		60				60		
Shallow band		Less than 13 ft				Less than 14 ft		
Total		78				312		
Mean		4.88				17.33		
Median		3				11		
Variance		20.12				182.47		
N		16				18		

Table A21. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, July 2, 2009. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)				Lane 2 (B)				Lane 3 (C)			
	Greg		Marcus		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	3	0	1	3		22	33	6	0	24	47	0
29	3	8	0	3		47	40	7		44	42	1
28	4	8	1	4		47	28	7		30	12	4
27	5	4	0	5		22	11	9		41	27	5
26	5	1	5	5		26	2	10		20	32	5
25	7	1	6	7	10	10	18	12		42	31	5
24	11	9	2	11		10	11	13		13	3	6
23	12	8	0	12		1	3	16		8	27	7
22	12	8	0	12		0	0	16		8	23	7
21	13	4	0	13	18	0	0	18		0	24	8
20	15	11	0	15		0	0	18		7	31	9
19	16	0	0	16		0	0	19		3	6	12
18	17	0	0	17		0	0	19		1	14	14
17	18	0	0	18		0	0	20	16	0	1	15
16	19	0	0	19		0	0	20		0	0	16
15	19	0	0	19	22	0	0	22		0	0	17
14	20	0	0	20		0	0	22		0	0	17
13	20	0	0	20		0	0	22		0	0	17
12	21	0	0	21		0	0	23		0	1	18
11	22	0	0	22		0	0	23		0	0	18
10	22	0	0	22		0	0	23		0	0	19
9	23	0	0	23		0	0	24		0	0	19
8	23	0	0	23		0	0	25		0	0	20
7	23	0	0	23		0	0	25		0	1	20
6	24	0	0	24		0	0	26	21	1	0	21
5	24	0	1	24		0	0	27		0	1	22
4	25	0	0	25		0	0	27		0	0	23
3	26	0	0	26		0	0	28		0	0	23
2	26	0	0	26		0	0	28		0	0	23
1	27	0	0	27	28	0	0	29	23	0	0	22
Totals		62	16			185	146			242	323	
Mean	16.83	2.07	0.53	16.83	19.50	6.17	4.87	19.47	15.00	8.07	10.77	13.77
Median	19	0	0	19	20	0	0	21	18.5	0	1	16.5
Variance		12.55	2.05			176.63	115.22			195.24	220.46	
N		30	30			30	30			30	30	
Both divers												
Total		78				331				565		
Mean		1.30				5.52				9.42		
Median		0				0				1		
Variance		7.77				143.88				206.18		
N		60				60				60		
Shallow band		Less than 13 ft				Less than 14 ft				Less than 15 ft		
Total		62				327				560		
Mean		3.44				23.36				21.54		
Median		2				22				24		
Variance		12.26				205.17				216.74		
N		18				14				24		

Abundance Legend	
count/m^2	
	0
	1 - 10
	11 - 20
	21+

Table A22. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, July 2, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)									
	Greg					Marcus				
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	3	20	15	15	30	10	60	10	70	3
29	3	25	20	10	30	20	81	20	101	3
28	4	30	25	15	40	20	100	5	105	4
27	5	20	15	30	45	20	70	10	80	5
26	5	10	20	5	25	30	70	30	100	5
25	7	10	10	5	15	40	70	10	80	7
24	11	30	10	5	15	40	90	30	120	11
23	12	30	10	20	30	20	60	20	80	12
22	12	50	15	20	35	10	5	0	5	12
21	13	50	20	20	40	10	10	5	15	13
20	15	35	10	15	25	10	20	0	20	15
19	16	10	0	15	15	5	0	0	0	16
18	17	5	0	5	5	10	0	0	0	17
17	18	0	0	0	0	5	0	0	0	18
16	19	0	0	0	0	5	0	0	0	19
15	19	0	0	0	0	10	0	0	0	19
14	20	0	0	0	0	25	10	20	30	20
13	20	0	0	0	0	5	10	0	10	20
12	21	0	0	0	0	5	0	0	0	21
11	22	0	0	0	0	5	0	0	0	22
10	22	0	0	0	0	5	0	0	0	22
9	23	0	0	0	0	5	0	0	0	23
8	23	0	0	0	0	0	0	0	0	23
7	23	5	0	5	5	0	0	0	0	23
6	24	0	0	0	0	10	0	0	0	24
5	24	0	0	0	0	0	0	0	0	24
4	25	0	0	0	0	0	0	0	0	25
3	26	0	0	0	0	0	0	0	0	26
2	26	0	0	0	0	0	0	0	0	26
1	27	0	0	0	0	0	0	0	0	27
Mean	16.8	11	6	6	12	11	22	5	27	16.8
Median	19.0	0	0	0	0	8	0	0	0	19
N		30				30				
Both divers		Cru	Turf	Can	T+Can					
Mean		11	14	5.8	20					
Median		5	0	0						
N		60								
Shallow band		Less than 13 ft								
		Cru	Turf	Can	T+Can					
Mean		24	41	14	56					
Median		20	23	13	43					
N		18								

	Lane 2 (B)									
	Greg					Marcus				
Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	
	45	20	20	40	50	70	5	75	6	
	40	10	10	20	50	40	5	45	7	
	40	5	10	15	60	30	10	40	7	
	50	20	20	40	50	65	10	75	9	
	50	20	15	35	30	60	20	80	10	
10	40	20	10	30	30	40	40	80	12	
	40	25	40	65	20	60	40	100	13	
	25	25	40	65	20	20	50	70	16	
	10	5	10	15	10	20	30	50	16	
18	0	0	0	0	0	10	0	10	18	
	0	0	0	0	5	5	0	5	18	
	0	5	0	5	5	10	0	10	19	
	0	0	0	0	5	10	0	10	19	
	0	0	0	0	5	25	0	25	20	
	5	5	5	10	5	10	0	10	20	
22	0	0	5	5	1	10	0	10	22	
	5	5	5	10	5	10	0	10	22	
	0	0	0	0	5	15	0	15	22	
	0	0	0	0	5	10	0	10	23	
	0	0	0	0	0	10	0	10	23	
	0	5	5	10	5	10	5	15	23	
	0	0	0	0	0	10	0	10	24	
	0	0	0	0	5	10	0	10	25	
	0	0	0	0	5	15	0	15	25	
	0	0	0	0	5	11	0	11	26	
	0	0	5	5	0	1	0	1	27	
	0	0	0	0	0	1	0	1	27	
	0	0	0	0	0	0	0	0	28	
	0	0	0	0	0	0	0	0	28	
28	0	0	0	0	0	0	0	0	29	
19.5	12	6	7	12	13	20	7	27	19.5	
20	0	0	0	3	5	10	0	10	21	
	30				30					
	Cru	Turf	Can	T+Can						
	12	13	6.9	20						
	5	10	0	10						
	60									
	Less than 14 ft									
	Cru	Turf	Can	T+Can						
	43	34.64	18	53						
	43	28	13	43						
	14									

	Lane 3 (C)									
	Greg					Marcus				
Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	
0	25	15	0	15	5	5	0	5	0	
	30	5	0	5	25	25	10	35	1	
	20	10	5	15	30	20	10	30	4	
	30	15	15	30	40	60	20	80	5	
	30	10	10	20	40	20	10	30	5	
	35	15	10	25	40	15	10	25	5	
	35	10	0	10	50	15	10	25	6	
	40	20	5	25	40	45	10	55	7	
	30	20	20	40	70	40	10	50	7	
	50	15	30	45	40	90	10	100	8	
	35	15	40	55	60	60	20	80	9	
	30	15	50	65	50	30	70	100	12	
	20	15	35	50	30	30	60	90	14	
16	5	5	10	15	20	50	40	90	15	
	0	5	0	5	5	10	0	10	16	
	0	0	0	0	5	0	0	0	17	
	0	0	0	0	1	10	0	10	17	
	0	0	0	0	5	10	0	10	17	
	0	0	0	0	10	5	0	5	18	
	0	0	0	0	10	10	5	15	18	
	0	0	0	0	5	15	0	15	19	
	0	0	0	0	5	10	0	10	19	
	0	0	0	0	0	10	0	10	20	
	0	0	0	0	5	5	0	5	20	
21	0	0	0	0	5	5	0	5	21	
	0	0	0	0	5	10	0	10	22	
	0	0	0	0	0	15	5	20	23	
	0	0	0	0	5	10	0	10	23	
	5	5	5	10	5	5	0	5	23	
23	5	0	5	5	5	5	0	5	22	
15.0	14	7	8	15	21	21	10	31	13.8	
19	5	5	0	5	8	13	3	15	17	
	30				30					
	Cru	Turf	Can	T+Can						
	17	14	9	23						
	5	10	0	10						
	60									
	Less than 15 ft									
	Cru	Turf	Can	T+Can						
	36	24	18	43						
	35	15	10	33						
	26									

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A23. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, September 1, 2009. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)				Lane 2 (B)				Lane 3 (C)			
	Greg		Marcus		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	2	1	8	2	2	1	12	4	3	14	26	3
29	2	11	4	3	3	0	3	5	4	8	31	5
28	2	5	0	4	3	5	16	6	5	32	14	5
27	2	5	4	5	3	11	16	6	6	24	6	7
26	3	21	5	6	6	12	11	6	7	12	35	9
25	5	9	10	7	6	8	12	9	8	14	5	9
24	6	6	14	9	8	2	28	9	9	7	4	11
23	7	11	9	11	9	0	11	10	11	1	3	12
22	10	15	0	15	10	2	13	13	13	0	4	14
21	11	0	0	15	10	0	0	14	14	0	7	14
20	11	0	0	16	11	0	0	14	15	0	14	14
19	12	0	0	17	12	0	0	14	15	0	0	15
18	12	0	0	18	13	0	0	15	16	0	0	17
17	16	0	1	18	14	0	0	16	16	0	0	18
16	18	0	0	18	14	0	1	17	17	0	0	18
15	19	0	0	18	15	0	0	17	17	0	0	18
14	20	0	0	19	16	0	0	18	19	0	1	18
13	21	0	0	20	16	0	0	19	19	0	0	19
12	21	0	0	20	17	0	3	20	20	0	0	20
11	22	0	0	20	17	0	0	20	21	0	0	21
10	22	0	0	21	18	0	0	21	21	0	0	22
9	22	0	0	22	18	0	0	22	22	0	0	22
8	23	0	0	23	18	0	0	22	22	0	0	23
7	23	0	0	23	18	0	0	23	22	0	0	24
6	23	0	0	23	20	0	0	23	22	0	0	25
5	24	0	0	24	20	0	0	24	23	0	0	25
4	24	0	0	24	21	0	0	24	23	0	0	25
3	25	0	0	24	22	0	0	24	24	0	0	25
2	25	0	0	25	22	0	0	25	25	0	0	26
1	25	0	0	25	24	0	0	25	25	0	0	26
Totals		84	55			41	126			112	150	
Mean	15.27	2.80	1.83	16.50	13.53	1.37	4.20	16.17	16.13	3.73	5.00	17.00
Median	18.5	0	0	18	14.5	0	0	17	17	0	0	18
Variance		28.99	13.73			10.59	51.20			63.17	91.59	
N		30	30			30	30			30	30	
Both divers												
Total		139				167				262		
Mean		2.32				2.78				4.37		
Median		0				0				0		
Variance		21.24				32.41				76.47		
N		60				60				60		
Shallow band		Less than 13 ft				Less than 14 ft				Less than 15 ft		
Total		138				163				261		
Mean		6.57				7.41				12.43		
Median		5				7				8		
Variance		33.36				55.21				120.56		
N		21				22				21		

Abundance Legend	
count/m^2	
	0
	1 - 10
	11 - 20
	21+

Table A24. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, September 1, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)										Lane 2 (B)										Lane 3 (C)									
	Greg					Marcus					Greg					Marcus					Greg					Marcus				
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	2	10	10	5	15	10	50	5	55	2	2	30	10	5	15	25	10	0	10	4	3	30	10	5	15	60	15	0	15	3
29	2	15	10	5	15	5	30	5	35	3	3	20	5	5	10	25	10	0	10	5	4	30	5	5	10	50	21	10	31	5
28	2	20	10	15	25	10	5	10	15	4	3	25	5	5	10	50	15	5	20	6	5	40	5	0	5	50	2	0	2	5
27	2	15	5	5	10	40	10	0	10	5	3	40	5	5	10	60	10	0	10	6	6	60	15	0	15	70	11	0	11	7
26	3	25	0	5	5	60	10	5	15	6	6	40	10	10	20	80	10	15	25	6	7	50	20	0	20	80	20	10	30	9
25	5	40	10	5	15	70	10	10	20	7	6	55	10	10	20	80	20	10	30	9	8	30	5	10	15	80	20	10	30	9
24	6	50	5	5	10	80	20	20	40	9	8	25	15	10	25	80	20	5	25	9	9	25	5	10	15	80	60	20	80	11
23	7	60	10	10	20	25	30	30	60	11	9	25	5	10	15	60	20	10	30	10	11	25	5	20	25	40	50	10	60	12
22	10	50	5	10	15	5	5	0	5	15	10	30	5	15	20	70	30	10	40	13	13	20	10	10	20	60	40	50	90	14
21	11	40	5	10	15	5	10	0	10	15	10	25	5	20	25	5	0	0	0	14	14	10	5	5	10	50	20	50	70	14
20	11	5	0	0	0	5	10	0	10	16	11	15	5	10	15	5	0	0	0	14	15	5	0	5	5	80	20	50	70	14
19	12	5	0	0	0	5	5	0	5	17	12	0	0	0	0	5	10	0	10	14	15	0	0	0	0	40	20	30	50	15
18	12	5	0	0	0	10	0	0	0	18	13	0	0	0	0	5	10	0	10	15	16	0	0	0	0	5	2	0	2	17
17	16	5	0	0	0	10	0	0	0	18	14	5	0	0	0	5	2	0	2	16	16	0	0	0	0	10	2	10	12	18
16	18	5	0	0	0	1	10	0	10	18	14	0	0	0	0	5	2	0	2	17	17	5	0	5	5	5	2	0	2	18
15	19	0	0	0	0	1	10	0	10	18	15	0	0	0	0	5	5	0	5	17	17	5	0	0	0	10	15	0	15	18
14	20	5	0	0	0	1	1	0	1	19	16	0	0	0	0	5	0	0	0	18	19	5	0	0	0	10	6	0	6	18
13	21	5	0	5	5	1	2	0	2	20	16	5	0	0	0	5	1	0	1	19	19	0	0	0	0	5	2	5	7	19
12	21	5	0	0	0	1	2	0	2	20	17	0	0	0	0	5	0	0	0	20	20	0	0	0	0	5	2	1	3	20
11	22	0	0	0	0	1	1	0	1	20	17	0	0	0	0	5	2	0	2	20	21	0	0	0	0	5	2	0	2	21
10	22	5	0	0	0	0	2	0	2	21	18	5	0	0	0	5	2	0	2	21	21	0	0	0	0	0	0	0	0	22
9	22	0	0	0	0	1	2	0	2	22	18	0	0	0	0	1	2	0	2	22	22	0	0	0	0	1	2	0	2	22
8	23	0	0	0	0	1	2	0	2	23	18	0	0	0	0	1	0	0	0	22	22	0	0	0	0	10	2	0	2	23
7	23	0	0	0	0	1	20	0	20	23	18	0	0	0	0	1	2	0	2	23	22	0	0	0	0	0	0	0	0	24
6	23	5	0	5	5	0	1	0	1	23	20	0	0	0	0	1	2	0	2	23	22	5	0	5	5	5	1	5	6	25
5	24	0	0	0	0	0	0	0	0	24	20	5	0	0	0	1	1	0	1	24	23	0	0	0	0	0	0	0	0	25
4	24	0	0	0	0	1	1	0	1	24	21	0	0	0	0	1	1	0	1	24	23	0	0	0	0	0	0	0	0	25
3	25	5	0	0	0	1	0	0	0	24	22	0	0	0	0	1	0	0	0	24	24	5	0	0	0	0	0	0	0	25
2	25	0	0	0	0	0	0	0	0	25	22	5	0	0	0	1	0	0	0	25	25	0	0	0	0	0	0	0	0	26
1	25	5	0	0	0	5	0	0	0	25	24	0	0	0	0	0	0	0	0	25	25	0	0	0	0	0	0	0	0	26
Mean	15.3	13	2	3	5	12	8	3	11	16.5	13.5	12	3	4	6	20	6	2	8	16.2	16.1	12	3	3	6	27	11	9	20	17.0
Median	18.5	5	0	0	0	3	4	0	4	18	15	5	0	0	0	5	2	0	2	17	17	5	0	0	0	10	2	0	6	18
N		30				30						30				30						30				30				

Both divers	Cru	Turf	Can	T+Can
Mean	12	5	3	8
Median	5	1	0	2
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	16	4	3	7
Median	5	2	0	2
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	19	7	6	13
Median	5	2	0	3
N	60			

Shallow band	Less than 13 ft			
	Cru	Turf	Can	T+Can
Mean	30	11	8	19
Median	25	10	5	15
N	21			

Shallow band	Less than 14 ft			
	Cru	Turf	Can	T+Can
Mean	39	10	7	18
Median	30	10	8	18
N	22			

Shallow band	Less than 15 ft			
	Cru	Turf	Can	T+Can
Mean	49	17	13	30
Median	50	15	10	20
N	21			

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A25. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, June 30, 2010. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)				Lane 2 (B)				Lane 3 (C)			
	Marcus		Robert		Marcus		Robert		Marcus		Robert	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	4	8	9	2	1	18	12	6	0	33	20	2
29	5	13	15	2	1	25	21	2	0	26	14	2
28	6	5	7	3	2	6	7	3	1	32	16	4
27	6	4	6	4	2	16	12	3	3	34	12	2
26	12	1	12	4	3	17	20	4	4	31	8	4
25	12	1	11	4	4	36	31	5	4	51	21	3
24	13	1	17	5	5	12	11	5	4	8	37	3
23	14	0	7	6	7	12	8	6	5	13	10	4
22	15	0	9	7	8	29	17	5	5	5	22	5
21	16	0	6	9	9	10	3	5	7	5	17	5
20	17	0	0	11	10	1	7	6	11	30	10	4
19	17	0	0	11	11	0	14	6	14	0	6	5
18	18	0	1	11	12	0	9	6	15	0	3	5
17	18	0	0	12	13	0	8	7	16	0	12	6
16	19	0	0	12	13	0	4	7	17	0	7	8
15	19	2	0	14	13	0	5	11	17	0	11	9
14	20	0	0	15	14	0	0	12	18	0	4	11
13	20	0	0	16	14	0	0	12	18	0	0	11
12	21	0	0	17	15	0	0	14	19	0	8	13
11	22	0	1	17	16	0	0	15	19	0	3	14
10	22	0	0	18	16	0	2	16	20	0	0	15
9	23	0	0	19	17	0	0	16	20	0	0	18
8	23	1	0	20	18	0	0	16	20	0	0	19
7	24	0	0	21	18	0	0	17	21	0	0	20
6	24	0	0	21	19	0	0	17	21	0	0	20
5	25	0	0	21	20	0	0	18	21	0	0	21
4	25	0	0	22	21	0	0	19	22	0	0	22
3	25	0	0	23	21	0	0	21	22	0	0	22
2	26	0	0	25	22	0	0	22	23	0	0	24
1	27	0	0	26	23	0	0	22	24	0	0	23
Totals		36	101			182	191			268	241	
Mean	17.93	1.20	3.37	13.27	12.27	6.07	6.37	10.80	13.70	8.93	8.03	10.80
Median	19	0	0	13	13	0	3.5	9	17	0	6.5	8.5
Variance		8.23	26.65			101.79	63.48			217.10	81.21	
N		30	30			30	30			30	30	
Both divers												
Total		137				373				509		
Mean		2.28				6.22				8.48		
Median		0				0				2		
Variance		18.34				81.26				146.83		
N		60				60				60		
Shallow band		Less than 13 ft				Less than 14 ft				Less than 15 ft		
Total		132				371				509		
Mean		6.29				10.91				15.91		
Median		6				10				12		
Variance		27.91				92.75				157.57		
N		21				34				32		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A26. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Hancock Point**, June 30, 2010. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy. Gray shading indicates the "shallow band" referred to in the text.

	Lane 1 (A)										Lane 2 (B)										Lane 3 (C)									
	Marcus					Robert					Marcus					Robert					Marcus					Robert				
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	4	20	1	0	1	40	0	0	0	2	1	50	10	0	10	50	0	0	0	6	0	30	20	10	30	70	0	0	0	2
29	5	30	0	0	0	10	0	0	0	2	1	50	20	0	20	65	0	5	5	2	0	50	20	10	30	80	0	0	0	2
28	6	50	0	0	0	15	0	5	5	3	2	50	0	0	0	70	0	0	0	3	1	40	0	0	0	85	0	0	0	4
27	6	50	1	0	1	20	0	5	5	4	2	60	10	10	20	80	0	5	5	3	3	50	10	0	10	80	0	0	0	2
26	12	30	0	0	0	15	0	10	10	4	3	60	10	0	10	80	0	0	0	4	4	50	10	0	10	70	0	5	5	4
25	12	20	0	0	0	20	0	5	5	4	4	70	10	10	20	85	0	0	0	5	4	70	20	1	21	85	0	0	0	3
24	13	10	10	0	10	50	0	0	0	5	5	70	10	20	30	75	0	0	0	5	4	60	30	10	40	90	0	5	5	3
23	14	10	10	0	10	65	5	10	15	6	7	70	30	5	35	70	0	0	0	6	5	70	10	10	20	85	0	5	5	4
22	15	5	1	0	1	60	0	40	40	7	8	70	30	30	60	80	0	5	5	5	5	70	10	0	10	80	0	10	10	5
21	16	1	1	0	1	70	5	5	10	9	9	70	35	30	65	75	5	0	5	5	7	60	10	10	20	90	0	0	0	5
20	17	1	0	0	0	0	0	0	0	11	10	20	20	10	30	80	0	20	20	6	11	70	10	60	70	90	5	0	5	4
19	17	5	1	0	1	5	0	0	0	11	11	5	10	0	10	80	0	15	15	6	14	50	10	70	80	85	0	0	0	5
18	18	5	1	0	1	5	0	0	0	11	12	5	0	0	0	80	0	20	20	6	15	10	0	0	0	80	0	0	0	5
17	18	1	0	0	0	0	0	0	0	12	13	5	1	0	1	70	0	5	5	7	16	10	10	0	10	90	0	20	20	6
16	19	10	1	0	1	5	0	0	0	12	13	10	1	0	1	75	5	10	15	7	17	5	0	0	0	90	0	55	55	8
15	19	10	10	20	30	0	0	0	0	14	13	10	0	0	0	70	5	25	30	11	17	10	10	5	15	90	5	20	25	9
14	20	1	1	10	11	0	0	0	0	15	14	20	1	5	6	5	0	0	0	12	18	5	0	0	0	80	0	65	65	11
13	20	1	1	0	1	0	0	0	0	16	14	5	0	0	0	5	0	0	0	12	18	1	0	0	0	80	0	60	60	11
12	21	1	0	0	0	0	0	0	0	17	15	1	0	0	0	5	0	0	0	14	19	1	1	0	1	80	0	70	70	13
11	22	1	0	0	0	0	0	0	0	17	16	1	0	0	0	0	0	0	0	15	19	1	1	0	1	65	0	80	80	14
10	22	1	0	0	0	0	0	0	0	18	16	5	1	0	1	5	0	5	5	16	20	1	0	0	0	0	0	10	10	15
9	23	1	0	0	0	20	0	5	5	19	17	0	0	0	0	0	0	0	0	16	20	1	10	0	10	0	0	0	0	18
8	23	10	0	0	0	0	0	0	0	20	18	1	1	0	1	10	0	5	5	16	20	1	0	0	0	0	0	0	0	19
7	24	0	0	0	0	0	0	0	0	21	18	0	0	0	0	0	0	0	0	17	21	5	1	5	6	0	0	0	0	20
6	24	0	0	0	0	0	0	0	0	21	19	1	0	0	0	0	0	0	0	17	21	0	0	0	0	0	0	5	5	20
5	25	0	0	0	0	5	0	0	0	21	20	1	0	0	0	0	0	0	0	18	21	0	1	0	1	0	0	0	0	21
4	25	1	0	0	0	0	0	0	0	22	21	0	0	0	0	0	0	0	0	19	22	0	0	0	0	0	0	15	15	22
3	25	0	0	0	0	0	0	0	0	23	21	1	1	0	1	0	0	0	0	21	22	5	1	0	1	0	0	0	0	22
2	26	0	0	0	0	0	0	0	0	25	22	1	1	0	1	0	0	0	0	22	23	0	0	0	0	0	0	5	5	24
1	27	0	0	0	0	0	0	0	0	26	23	1	1	0	1	0	0	0	0	22	24	0	1	0	1	0	0	0	0	23
Mean	17.9	9	1	1	2	14	0	3	3	13.3	12.3	24	7	4	11	41	1	4	5	10.8	13.7	24	7	6	13	55	0	14	15	10.8
Median	19	1	0	0	0	3	0	0	0	13	13	5	1	0	1	58	0	0	0	9	17	8	1	0	4	80	0	3	5	8.5
N		30				30						30				30						30				30				
Both divers		Cru	Tur	Can	T+Can							Cru	Tur	Can	T+Can							Cru	Tur	Can	T+Can					
Mean		11	1	2	3							32	4	4	8							40	3	10	14					
Median		1	0	0	0							10	0	0	1							45	0	0	5					
N		60										60										60								
Shallow band		Less than 13 ft										Less than 14 ft										Less than 15 ft								
		Cru	Turf	Can	T+Can							Cru	Turf	Can	T+Can							Cru	Turf	Can	T+Can					
Mean		28	1	4	4							55	6	7	13							72	5	18	23					
Median		20	0	0	0							70	0	0	5							80	0	5	10					
N		21										34										32								

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A27. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, April 11, 2009, prior to urchin harvest.

	Lane 1 (C)				Lane 2 (A)				Lane 3 (B)			
	Robert # 1		Robert # 2		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	4	28	6	2	4	30	47	2	-1	31	30	1
29	5	24	31	2	4	13	16	5	1	14	20	2
28	4	6	26	3	5	30	18	5	1	38	54	3
27	4	40	8	3	5	6	13	4	1	20	39	3
26	5	27	5	3	5	45	9	4	2	26	47	3
25	5	15	16	5	5	43	5	4	2	31	42	4
24	0	10	20	5	5	14	25	4	2	16	18	4
23	5	26	5	6	6	10	33	4	2	17	32	6
22	5	8	13	4	6	17	13	4	2	20	34	6
21	5	12	7	4	7	5	12	4	3	7	23	7
20	6	7	7	5	7	5	12	9	4	25	17	7
19	6	18	4	5	8	1	5	10	4	14	33	7
18	6	6	12	6	9	32	27	10	3	23	21	7
17	6	3	30	6	9	12	12	8	7	7	45	7
16	7	21	6	7	10	11	4	8	8	16	21	8
15	8	20	10	7	10	4	36	8	8	15	4	6
14	9	11	17	8	10	15	9	9	12	5	7	7
13	9	3	16	8	12	18	13	9	12	3	15	8
12	10	14	10	9	12	13	22	9	12	3	44	9
11	12	17	27	12	13	4	14	12	12	19	10	9
10	14	2	29	17	14	7	34	12	12	35	4	9
9	15	0	1	16	13	2	1	13	13	16	3	9
8	16	0	1	16	14	2	5	13	12	4	16	10
7	17	0	2	17	15	1	11	13	12	0	0	13
6	16	0	0	17	17	0	1	15	13	1	4	16
5	19	0	0	18	18	0	1	17	14	0	0	16
4	19	0	0	19	18	7	0	19	18	2	0	20
3	18	0	0	20	20	0	0	19	19	0	0	20
2	17	2	0	19	20	0	0	20	20	0	3	20
1	16	0	0	20	21	0	2	21	20	0	1	21
Totals		320	309			347	400			408	587	
Mean	9.60	10.67	10.30	9.63	10.73	11.57	13.33	9.80	8.33	13.60	19.57	8.93
Median	7.5	7.5	7	7	10	7	12	9	8	14.5	17.5	7
Variance		117.33	101.53			160.25	150.02			133.42	281.91	
N		30	30			30	30			30	30	
Both divers												
Total		629				747				995		
Mean		10.48				12.45				16.58		
Median		7				11				16		
Variance		107.61				153.30				213.20		
N		60				60				60		

Abundance Legend	
count/m^2	
	0
	1 - 10
	11 - 20
	21+

Table A28. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, April 11, 2009, prior to urchin harvest. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy.

	Lane 1 (C)								Lane 2 (A)							Lane 3 (B)							
	Robert # 1				Robert # 2				Greg				Marcus			Greg				Marcus			
Quadrat	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth
30	4	85	5	20	95	5	70	2	4	70	5	5	95	70	10	2	-1	90	20	0	95	20	0	1
29	5	90	0	0	90	10	10	2	4	80	10	10	90	10	10	5	1	70	5	30	95	60	10	2
28	4	95	0	10	95	1	15	3	5	75	5	30	90	30	10	5	1	80	5	10	95	60	10	3
27	4	90	1	15	90	1	15	3	5	70	5	0	90	0	0	4	1	50	5	0	95	50	10	3
26	5	90	5	10	95	5	10	3	5	75	25	35	100	10	0	4	2	70	5	15	95	60	10	3
25	5	95	0	1	90	1	10	5	5	80	5	0	100	20	0	4	2	70	5	10	95	30	10	4
24	0	90	1	10	95	0	1	5	5	70	20	10	95	20	10	4	2	80	0	10	90	20	20	4
23	5	95	5	70	85	10	5	6	6	80	15	0	100	1	0	4	2	80	5	5	90	20	20	6
22	5	90	1	60	90	5	1	4	6	80	20	40	100	21	1	4	2	80	10	5	90	30	10	6
21	5	90	20	55	95	0	5	4	7	70	0	90	95	60	0	4	3	80	0	5	75	0	10	7
20	6	95	15	70	90	5	20	5	7	75	15	70	90	50	40	9	4	90	10	5	60	21	1	7
19	6	90	5	70	95	5	0	5	8	50	15	10	90	40	40	10	4	90	15	0	60	30	0	7
18	6	95	1	40	90	10	5	6	9	70	10	0	70	10	10	10	3	90	30	10	60	10	0	7
17	6	90	0	5	90	5	10	6	9	80	0	0	60	41	0	8	7	80	10	35	90	0	30	7
16	7	90	5	20	95	5	50	7	10	65	25	10	100	10	0	8	8	80	10	30	75	10	40	8
15	8	90	1	15	90	5	20	7	10	80	30	40	100	10	0	8	8	70	5	50	95	20	20	6
14	9	90	10	30	95	10	10	8	10	90	25	30	100	2	10	9	12	60	20	0	95	21	1	7
13	9	90	21	15	90	5	10	8	12	40	25	10	100	21	1	9	12	60	15	30	95	30	1	8
12	10	60	40	10	95	10	5	9	12	80	20	15	100	21	10	9	12	40	5	10	95	20	0	9
11	12	50	55	20	90	5	25	12	13	65	40	10	95	20	10	12	12	70	5	10	95	20	10	9
10	14	25	60	45	75	50	5	17	14	40	35	20	75	70	20	12	12	80	15	5	95	40	10	9
9	15	70	75	20	80	65	20	16	13	90	60	15	75	70	10	13	13	70	10	10	95	50	10	9
8	16	25	60	30	75	71	15	16	14	80	40	10	95	30	10	13	12	90	25	5	95	41	10	10
7	17	15	75	5	70	66	10	17	15	80	55	40	95	50	10	13	12	80	35	50	80	80	10	13
6	16	5	70	0	50	36	15	17	17	50	60	50	90	90	40	15	13	70	30	10	90	60	1	16
5	19	0	70	0	60	50	10	18	18	40	40	20	90	100	20	17	14	75	40	20	90	80	10	16
4	19	0	60	0	35	21	10	19	18	80	25	40	70	80	20	19	18	75	45	50	70	90	10	20
3	18	0	65	10	0	5	5	20	20	70	20	15	70	70	20	19	19	70	15	30	80	90	10	20
2	17	15	50	50	0	1	0	19	20	5	20	10	70	70	0	20	20	50	35	20	80	60	10	20
1	16	10	80	10	0	0	5	20	21	5	10	15	70	90	1	21	20	50	15	15	70	60	10	21
Mean	9.6	64	29	24	76	16	13	9.6	10.7	66	23	22	89	40	10	9.8	8.3	73	15	16	86	39	10	8.9
Median	7.5	90	13	15	90	5	10	7	10	73	20	15	93	30	10	9	8	75	10	10	90	30	10	7
N		30			30					30			30					30			30			
Both divers		Cru	Tur	Can						Cru	Tur	Can						Cru	Tur	Can				
Mean		70	22	18						77	31	16						80	27	13				
Median		90	5	10						80	21	10						80	20	10				
N		60								60								60						

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A29. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in the two harvest treatment lanes, shallow to deep, at **Winter Harbor**, April 15, 2009, immediately after the harvest treatments were applied. Note that depths for each quadrat were not recorded.

	Lane 2 (A)				Lane 3 (B)			
	Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30		2	0			322	68	
29		14	10			38	53	
28		10	2			44	45	
27		8	8			34	14	
26		11	6			42	33	
25		26	2			34	22	
24		2	0			41	25	
23		5	4			28	13	
22		14	0			35	27	
21		3	0			31	14	
20		5	0			39	35	
19		17	0			35	15	
18		4	15			29	24	
17		1	12			37	26	
16		6	1			18	32	
15		13	0			14	22	
14		1	1			18	12	
13		1	7			12	20	
12		3	1			26	5	
11		2	7			9	12	
10		4	6			37	3	
9		0	0			2	14	
8		0	3			10	16	
7		0	0			9	21	
6		0	6			28	2	
5		0	4			32	2	
4		0	0			3	0	
3		0	0			0	0	
2		0	0			0	1	
1		0	0			0	4	
Totals		152	95			1,007	580	
Mean		5.07	3.17			33.57	19.33	
Median		2.5	1			28.5	15.5	
Variance		41.10	16.90			3,174.53	261.47	
N		30	30			30	30	
Both divers								
Total		247				1,587		
Mean		4.12				26.45		
Median		2				22		
Variance		29.43				1,740.39		
N		60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A30. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, July 1, 2009.

	Lane 1 (C)				Lane 2 (A)				Lane 3 (B)			
	Greg		Marcus		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	0	56	33	1	-3	5	2	1	0	18	8	1
29	1	47	18	2	-3	0	5	1	1	86	78	1
28	2	63	49	3	-2	4	1	1	1	55	51	2
27	2	29	38	3	-2	1	2	1	2	27	88	2
26	4	33	31	3	-2	14	8	1	3	9	76	3
25	4	13	56	4	-1	1	8	1	3	38	44	4
24	4	43	36	4	-1	15	5	1	3	44	34	4
23	4	41	18	4	-1	17	11	2	3	35	40	5
22	4	16	10	4	-1	16	24	2	4	29	32	5
21	5	23	8	4	-1	22	9	2	4	23	28	5
20	2	20	15	5	-1	29	4	2	5	14	28	5
19	1	12	30	4	-1	19	27	1	5	22	34	4
18	1	19	20	4	0	21	23	1	4	9	15	5
17	1	27	25	5	0	32	9	2	4	32	16	5
16	1	12	10	5	1	27	4	3	4	11	4	5
15	1	17	21	6	1	4	3	3	4	20	29	5
14	3	1	16	6	1	0	0	4	4	14	11	6
13	4	18	29	6	3	2	3	4	4	3	21	6
12	4	8	10	7	2	8	1	5	4	19	9	6
11	6	3	17	8	2	1	12	5	5	38	3	7
10	8	8	3	9	2	21	0	6	5	25	21	7
9	12	6	14	10	2	53	0	6	5	10	5	8
8	13	0	5	11	4	2	10	6	6	13	0	9
7	14	0	3	12	4	9	6	7	6	21	5	9
6	15	0	2	15	4	7	1	8	6	13	6	9
5	16	0	0	16	4	4	0	9	7	47	2	10
4	16	0	0	17	7	0	0	10	8	14	41	10
3	16	0	0	18	8	0	0	10	9	5	14	11
2	16	0	0	18	11	0	0	11	9	6	4	13
1	16	0	0	18	11	0	0	12	10	3	1	18
Totals		515	517			334	178			703	748	
Mean	6.53	17.17	17.23	7.73	1.60	11.13	5.93	4.27	4.60	23.43	24.93	6.33
Median	4	12.5	15.5	5.5	1	6	3.5	3	4	19.5	18.5	5
Variance		325.94	229.29			160.53	54.48			322.46	568.06	
N		30	30			30	30			30	30	
Both divers												
Total		1032				512				1451		
Mean		17.20				8.53				24.18		
Median		15				4				20		
Variance		272.91				112.56				438.29		
N		60				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A31. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, July 1, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy.

	Lane 1 (C)									Lane 2 (A)									Lane 3 (B)								
	Robert # 1					Robert # 2				Greg					Marcus				Greg					Marcus			
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	4	75	20	35	55	60	10	30	40	5	1	50	35	90	125	70	45	30	75	5	-1	70	20	90	110	20	70	80	150	0
29	5	80	25	10	35	60	0	20	20	6	1	80	40	90	130	60	70	40	110	5	0	70	10	10	20	30	70	0	70	0
28	6	80	20	20	40	60	5	5	10	7	2	70	40	90	130	70	35	10	45	5	0	70	15	5	20	40	40	40	80	1
27	6	70	10	15	25	70	0	0	0	7	2	80	40	80	120	70	80	30	110	5	1	70	20	15	35	60	25	10	35	1
26	8	80	0	0	0	60	5	20	25	7	2	80	10	10	20	70	20	10	30	5	2	30	25	25	50	60	40	20	60	2
25	8	70	20	15	35	80	10	0	10	8	3	80	35	70	105	70	50	30	80	5	2	70	15	10	25	40	20	20	40	3
24	8	70	5	0	5	70	10	0	10	8	3	70	10	15	25	70	20	20	40	5	2	50	25	20	45	60	20	20	40	3
23	8	80	10	40	50	60	0	0	0	8	3	70	15	25	40	50	10	20	30	6	2	50	5	20	25	80	10	10	20	4
22	8	80	10	0	10	60	0	0	0	8	3	70	15	30	45	50	5	10	15	6	3	60	0	15	15	80	0	0	0	4
21	9	70	15	20	35	50	10	0	10	8	3	75	0	0	0	50	20	0	20	6	3	30	5	10	15	80	0	30	30	4
20	6	50	10	40	50	40	5	0	5	9	3	80	15	0	15	70	50	0	50	6	4	50	5	10	15	80	0	10	10	4
19	5	60	10	5	15	60	20	5	25	8	3	50	10	30	40	70	50	0	50	5	4	50	5	30	35	80	10	20	30	3
18	5	70	15	15	30	60	0	0	0	8	4	70	10	0	10	70	60	0	60	5	3	30	0	5	5	80	0	10	10	4
17	5	70	10	10	20	60	10	40	50	9	4	70	15	15	30	50	40	50	90	6	3	30	0	10	10	70	0	20	20	4
16	5	50	0	0	0	40	20	10	30	9	5	50	5	10	15	40	60	20	80	7	3	35	5	10	15	80	80	0	80	4
15	5	60	10	10	20	50	10	20	30	10	5	50	10	10	20	40	10	60	70	7	3	40	10	5	15	70	20	10	30	4
14	7	80	5	0	5	40	0	10	10	10	5	30	10	20	30	40	20	20	40	8	3	60	5	10	15	70	10	0	10	5
13	8	70	10	50	60	30	10	40	50	10	7	30	19	10	29	60	5	10	15	8	3	40	5	25	30	70	30	30	60	5
12	8	90	10	10	20	30	30	5	35	11	6	30	10	0	10	50	40	10	50	9	3	50	10	30	40	30	50	40	90	5
11	10	80	10	15	25	70	20	10	30	12	6	60	15	0	15	30	40	20	60	9	4	60	5	25	30	30	20	70	90	6
10	12	50	15	20	35	20	0	5	5	13	6	70	15	20	35	30	90	30	120	10	4	30	10	10	20	40	10	70	80	6
9	16	30	10	70	80	50	25	20	45	14	6	70	10	5	15	30	60	10	70	10	4	35	5	30	35	30	30	30	60	7
8	17	15	10	70	80	60	30	20	50	15	8	70	5	15	20	30	40	70	110	10	5	30	5	15	20	50	60	10	70	8
7	18	0	5	0	5	50	10	90	100	16	8	30	5	5	10	60	30	30	60	11	5	30	5	10	15	50	45	40	85	8
6	19	0	0	0	0	30	10	90	100	19	8	50	5	15	20	20	60	10	70	12	5	60	5	15	20	20	30	20	50	8
5	20	0	0	0	0	10	0	90	90	20	8	70	10	80	90	30	40	90	130	13	6	60	5	10	15	40	35	20	55	9
4	20	0	0	0	0	40	30	80	110	21	11	70	10	80	90	30	60	90	150	14	7	70	10	30	40	30	0	10	10	9
3	20	0	0	0	0	10	5	30	35	22	12	75	20	80	100	20	100	70	170	14	8	70	10	10	20	50	10	50	60	10
2	20	0	0	5	5	5	0	0	0	22	15	50	20	70	90	10	70	80	150	15	8	50	10	20	30	20	40	70	110	12
1	20	10	5	15	20	0	0	0	0	22	15	40	10	60	70	10	50	70	120	16	9	50	10	70	80	20	30	70	100	17
Mean	10.5	51	9	16	25	46	10	21	31	11.7	5.6	61	16	34	50	47	44	31	76	8.3	3.6	50	9	20	29	52	27	28	55	5.3
Median	8.0	70	10	10	20	50	10	10	25	10	5	70	10	18	30	50	43	20	70	7	3	50	5	15	20	50	23	20	58	4
N		30				30						30				30						30				30				

Both divers	Cru	Turf	Can	T+Can
Mean	49	9	19	28
Median	60	10	10	23
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	54	30	33	63
Median	60	20	20	50
N	60			

Both divers	Cru	Turf	Can	T+Can
Mean	51	18	24	42
Median	50	10	20	30
N	60			

Algal Cover Legend						
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A32. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, September 2, 2009.

	Lane 1 (C)				Lane 2 (A)				Lane 3 (B)			
	Greg		Marcus		Greg		Marcus		Greg		Marcus	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	3	26	20	3	1	7	22	3	3	23	43	2
29	3	33	9	4	2	8	6	3	3	52	76	2
28	3	5	7	5	2	5	13	3	4	39	73	2
27	4	17	10	5	2	1	2	3	3	21	19	2
26	4	26	30	5	2	7	3	3	5	34	77	2
25	5	16	26	6	2	0	34	3	5	18	78	3
24	6	20	4	5	2	2	29	4	4	15	33	6
23	6	21	5	6	3	0	3	4	4	44	31	7
22	5	7	13	6	4	16	2	5	5	12	1	7
21	2	16	34	7	2	4	2	7	5	4	15	8
20	3	16	22	7	2	0	0	8	5	5	4	8
19	3	54	3	7	2	16	0	8	5	13	20	8
18	4	1	11	7	3	10	0	8	5	20	8	8
17	4	36	0	7	3	10	0	8	4	3	1	7
16	5	19	30	7	4	0	2	8	5	21	1	7
15	6	39	63	7	5	0	18	8	5	4	35	7
14	5	30	60	7	6	1	20	9	6	62	7	7
13	5	22	26	8	7	8	10	9	7	31	45	7
12	9	34	15	8	7	0	3	8	7	56	13	7
11	10	29	11	10	6	6	1	8	8	8	11	9
10	11	17	25	12	8	2	0	9	9	13	12	10
9	12	7	23	13	8	10	0	9	10	45	0	15
8	13	8	13	14	8	1	0	13	10	14	0	15
7	15	0	0	16	9	0	0	16	11	4	0	16
6	17	0	0	17	11	0	0	16	11	24	0	16
5	18	3	0	18	13	4	0	17	14	0	0	18
4	18	0	0	19	14	0	0	17	17	0	0	19
3	19	0	0	20	15	1	0	17	18	0	0	19
2	20	0	0	20	16	0	0	18	18	0	0	19
1	20	0	0	20	17	0	0	18	19	0	0	21
Totals		502	460			119	170			585	603	
Mean	8.60	16.73	15.33	9.87	6.20	3.97	5.67	9.00	7.83	19.50	20.10	9.47
Median	5.5	16.5	11	7	4.5	1.5	1.5	8	5	14.5	9.5	7.5
Variance		203.44	274.02			23.14	89.33			332.26	679.27	
N		30	30			30	30			30	30	
Both divers												
Total		962				289				1188		
Mean		16.03				4.82				19.80		
Median		14				2				13		
Variance		235.19				56.02				497.28		
N		60				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A33. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, September 2, 2009. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy.

	Lane 1 (C)							Lane 2 (A)							Lane 3 (B)						
	Greg				Marcus			Greg				Marcus			Greg				Marcus		
Quadrat	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth	Depth	Cru	Tur	Can	Cru	Tur	Can	Depth
30	3	60	0	10	80	0	10	3	1	60	10	5	90	5	5	3	3	50	5	0	90	10	10	2
29	3	60	10	10	80	0	5	4	2	60	15	5	90	0	0	3	3	65	0	5	90	5	0	2
28	3	60	5	5	80	0	10	5	2	50	10	0	90	0	0	3	4	55	15	5	90	10	0	2
27	4	60	5	5	80	0	5	5	2	50	10	5	90	0	0	3	3	50	15	10	90	5	5	2
26	4	60	5	5	80	5	10	5	2	50	20	10	80	10	20	3	5	50	10	5	80	5	0	2
25	5	50	5	10	70	0	5	6	2	60	10	0	90	0	0	3	5	60	5	5	80	10	5	3
24	6	60	0	0	80	0	0	5	2	60	10	10	90	0	5	4	4	60	15	10	50	20	30	6
23	6	55	10	0	80	0	5	6	3	60	0	0	80	20	0	4	4	50	15	5	40	10	5	7
22	5	50	10	5	50	0	5	6	4	50	0	0	70	35	10	5	5	50	10	15	50	60	40	7
21	2	50	25	10	60	0	10	7	2	60	10	0	70	20	20	7	5	50	15	5	50	20	30	8
20	3	50	10	10	70	10	10	7	2	60	10	0	30	30	50	8	5	45	10	5	50	50	10	8
19	3	60	5	0	60	30	20	7	2	60	10	0	10	10	5	8	5	40	5	10	60	20	10	8
18	4	60	5	5	70	0	10	7	3	60	5	5	40	0	10	8	5	50	15	5	50	10	30	8
17	4	50	0	15	70	5	5	7	3	60	20	10	40	5	10	8	4	50	10	10	70	30	5	7
16	5	40	15	5	80	0	5	7	4	50	15	20	80	5	5	8	5	50	10	5	80	10	5	7
15	6	45	5	15	80	10	10	7	5	40	15	15	80	5	5	8	5	30	15	10	80	0	5	7
14	5	60	10	0	80	2	5	7	6	40	10	15	70	10	30	9	6	40	0	5	70	0	0	7
13	5	50	10	15	80	10	5	8	7	40	10	10	70	20	20	9	7	50	10	5	70	5	5	7
12	9	55	10	15	80	2	10	8	7	50	30	10	70	25	40	8	7	60	10	5	70	20	20	7
11	10	55	5	5	70	25	5	10	6	50	20	15	30	25	90	8	8	50	10	5	70	20	30	9
10	11	60	5	70	60	40	10	12	8	50	20	40	20	10	50	9	9	40	5	10	50	50	30	10
9	12	40	20	25	60	25	10	13	8	50	20	25	40	15	95	9	10	50	10	10	40	50	50	15
8	13	30	25	30	70	30	30	14	8	50	20	50	30	50	60	13	10	60	15	10	40	40	70	15
7	15	20	10	50	20	10	95	16	9	45	15	50	30	80	40	16	11	50	10	10	40	30	90	16
6	17	25	15	50	30	20	95	17	11	30	20	35	30	60	80	16	11	50	10	50	30	60	50	16
5	18	10	10	45	20	10	80	18	13	60	20	25	10	40	80	17	14	45	20	45	30	70	60	18
4	18	10	15	45	30	0	80	19	14	45	20	50	20	50	70	17	17	40	20	50	30	50	60	19
3	19	10	5	15	25	20	80	20	15	40	20	50	20	40	80	17	18	30	20	40	30	30	60	19
2	20	5	5	10	0	0	1	20	16	30	20	50	5	40	70	18	18	40	20	40	30	10	90	19
1	20	0	0	0	0	0	30	20	17	30	20	50	10	25	80	18	19	30	10	60	10	40	90	21
Mean	8.6	43	9	16	60	8	22	9.9	6.2	50	15	19	53	21	34	9.0	7.8	48	11	15	57	25	30	9.5
Median	6	50	8	10	70	2	10	7	5	50	15	10	55	18	20	8	5	50	10	10	50	20	25	7.5
N		30			30					30			30					30			30			

Both divers	Cru	Tur	Can
Mean	52	8.6	19
Median	60	5	10
N	60		

Both divers	Cru	Tur	Can
Mean	51	18	27
Median	50	15	15
N	60		

Both divers	Cru	Tur	Can
Mean	53	18	23
Median	50	10	10
N	60		

Algal Cover Legend					
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +

Table A34. Sea urchin abundance (count·m^{-2}) by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, June 29, 2010.

	Lane 1 (C)				Lane 2 (A)				Lane 3 (B)			
	Marcus		Robert		Marcus		Robert		Marcus		Robert	
Quadrat	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth	Depth	Abundance	Abundance	Depth
30	4	12	9	7	6	39	29	9	4	42	16	5
29	5	24	19	8	7	21	16	8	4	57	17	5
28	6	22	24	7	8	42	18	8	5	14	25	6
27	6	8	18	8	6	18	25	9	6	29	17	6
26	7	19	11	7	7	36	22	9	6	21	23	7
25	9	50	6	9	9	30	26	10	6	15	18	7
24	9	33	12	10	9	15	13	10	6	18	12	7
23	8	35	13	10	10	13	33	11	6	33	27	7
22	8	4	8	10	9	16	9	11	6	11	12	8
21	8	10	7	8	9	11	12	12	6	29	19	6
20	7	16	12	9	9	21	6	13	7	1	14	6
19	8	17	6	9	10	5	6	13	7	10	21	7
18	8	13	31	10	10	10	10	12	7	14	3	7
17	9	10	21	11	10	29	7	11	8	27	6	9
16	9	3	24	12	9	22	28	12	8	5	11	10
15	10	11	16	9	10	11	10	12	8	24	20	9
14	11	9	18	9	10	32	14	13	8	15	7	10
13	9	8	7	10	11	38	17	12	10	13	12	10
12	10	7	17	10	11	14	17	13	11	3	20	12
11	10	16	18	11	11	25	27	15	12	7	9	13
10	10	8	18	12	12	35	20	16	12	13	2	12
9	10	19	12	13	14	7	8	17	14	5	4	13
8	11	7	9	15	14	12	5	19	14	7	15	14
7	13	15	14	16	17	30	7	19	16	4	0	16
6	14	8	8	18	17	10	8	19	20	1	1	18
5	15	3	5	18	18	8	11	21	20	1	0	19
4	17	0	2	18	19	12	10	21	20	1	0	21
3	20	5	4	19	21	6	4	22	21	0	0	22
2	20	6	14	20	21	2	0	23	21	1	0	22
1	20	0	13	20	21	0	0	23	21	0	0	21
Totals		398	396			570	418			421	331	
Mean	10.37	13.27	13.20	11.77	11.83	19.00	13.93	14.10	10.67	14.03	11.03	11.17
Median	9	10	12.5	10	10	15.5	11.5	12.5	8	12	12	9.5
Variance		120.89	45.41			143.24	79.72			190.52	74.52	
N		30	30			30	30			30	30	
Both divers												
Total		794				988				752		
Mean		13.23				16.47				12.53		
Median		12				14				12		
Variance		81.74				116.12				132.56		
N		60				60				60		

Abundance Legend
count/m^2
0
1 - 10
11 - 20
21+

Table A35. Percent algal cover by quadrat, for two diver evaluations in each lane, by depth (ft), shallow to deep, at **Winter Harbor**, June 29, 2010. "Cru" = Encrusting, "Tur" = Turfing, "Can" = Canopy, "T+Can"= sum of Turfing + Canopy.

	Lane 1 (C)									Lane 2 (A)									Lane 3 (B)								
	Marcus					Robert				Marcus					Robert				Marcus					Robert			
Quadrat	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth	Depth	Cru	Tur	Can	T+Can	Cru	Tur	Can	T+Can	Depth
30	4	70	80	30	110	90	20	0	20	7	6	90	10	0	10	80	0	5	5	9	4	90	40	10	50	90	15	5	20	5
29	5	95	40	10	50	90	15	0	15	8	7	80	30	10	40	90	5	10	15	8	4	90	21	10	31	80	10	0	10	5
28	6	90	41	10	51	90	10	10	20	7	8	90	20	30	50	90	5	5	10	8	5	80	10	80	90	90	10	25	35	6
27	6	90	30	10	40	90	10	5	15	8	6	90	0	10	10	90	5	0	5	9	6	90	0	10	10	90	0	15	15	6
26	7	90	1	10	11	95	5	10	15	7	7	90	10	30	40	90	0	5	5	9	6	90	10	20	30	85	0	10	10	7
25	9	95	1	10	11	90	0	0	0	9	9	90	10	10	20	50	10	5	15	10	6	90	0	0	0	90	0	10	10	7
24	9	90	0	1	1	90	0	5	5	10	9	90	10	20	30	85	0	20	20	10	6	80	0	70	70	90	5	20	25	7
23	8	90	1	30	31	95	5	0	5	10	10	90	0	10	10	90	0	5	5	11	6	90	10	30	40	85	0	30	30	7
22	8	95	0	0	0	95	0	5	5	10	9	95	0	0	0	80	0	50	50	11	6	90	0	0	0	90	0	0	0	8
21	8	95	1	1	2	90	0	5	5	8	9	95	0	0	0	80	0	20	20	12	6	90	10	0	10	90	0	0	0	6
20	7	95	0	10	10	90	0	10	10	9	9	95	10	0	10	85	0	0	0	13	7	80	40	30	70	85	0	5	5	6
19	8	90	1	10	11	90	0	0	0	9	10	95	0	10	10	80	5	5	10	13	7	90	10	0	10	90	0	15	15	7
18	8	90	10	10	20	80	0	25	25	10	10	90	0	0	0	80	0	0	0	12	7	80	0	0	0	90	0	5	5	7
17	9	80	41	1	42	85	5	20	25	11	10	90	20	10	30	90	0	0	0	11	8	80	0	10	10	85	5	90	95	9
16	9	80	10	0	10	80	15	5	20	12	9	90	10	10	20	90	0	10	10	12	8	90	0	0	0	80	10	70	80	10
15	10	90	0	0	0	70	0	0	0	9	10	90	20	10	30	90	0	15	15	12	8	80	0	0	0	85	0	5	5	9
14	11	70	1	1	2	80	5	70	75	9	10	90	20	10	30	80	10	30	40	13	8	90	0	0	0	90	5	10	15	10
13	9	80	0	10	10	85	0	40	40	10	11	90	10	20	30	85	5	5	10	12	10	80	0	30	30	90	0	15	15	10
12	10	80	10	50	60	85	5	10	15	10	11	95	10	0	10	90	0	0	0	13	11	70	20	10	30	90	5	30	35	12
11	10	70	20	30	50	90	15	5	20	11	11	80	10	30	40	85	5	10	15	15	12	70	20	0	20	85	0	40	40	13
10	10	70	40	10	50	90	10	35	45	12	12	70	10	30	40	70	0	10	10	16	12	90	0	10	10	80	0	10	10	12
9	10	70	10	40	50	95	5	20	25	13	14	80	40	30	70	60	0	5	5	17	14	70	20	0	20	90	0	5	5	13
8	11	80	10	30	40	90	0	40	40	15	14	80	40	5	45	80	5	30	35	19	14	70	30	10	40	85	10	25	35	14
7	13	80	10	30	40	90	0	10	10	16	17	80	30	20	50	75	10	5	15	19	16	80	50	10	60	40	10	75	85	16
6	14	70	20	30	50	90	20	25	45	18	17	80	30	10	40	80	0	35	35	19	20	40	0	30	30	95	0	60	60	18
5	15	70	10	10	20	90	10	35	45	18	18	80	20	50	70	75	5	85	90	21	20	30	10	70	80	10	0	80	80	19
4	17	70	40	30	70	80	25	50	75	18	19	70	10	70	80	80	0	80	80	21	20	30	10	70	80	20	0	70	70	21
3	20	70	30	30	60	85	0	60	60	19	21	70	11	90	101	85	0	90	90	22	21	10	0	10	10	0	0	60	60	22
2	20	60	2	90	92	90	0	50	50	20	21	70	1	90	91	80	0	95	95	23	21	10	0	0	0	0	0	5	5	22
1	20	60	0	95	95	90	0	70	70	20	21	70	0	95	95	80	0	95	95	23	21	10	0	10	10	0	0	10	10	21
Mean	10.4	81	15	21	36	88	6	21	27	11.8	11.8	85	13	24	37	82	2	24	27	14.1	10.7	71	10	18	28	72	3	27	30	11.2
Median	9.0	80	10	10	40	90	5	10	20	10	10	90	10	10	30	80	0	10	15	13	8	80	5	10	20	88	0	15	15	10
N		30				30						30				30						30				30				

Both divers	Cru	Turf	Can	T+Can
Mean	84	11	21	31
Median	90	5	10	23
N	60			

	Cru	Turf	Can	T+Can
Mean	83	8	24	32
Median	85	5	10	20
N	60			

	Cru	Turf	Can	T+Can
Mean	72	7	22	29
Median	85	0	10	18
N	60			

Algal Cover Legend						
Crust % cover		Turf % cover		Canopy % cover	
	0%		0%		0%
	1 - 25%		1 - 25%		1 - 25%
	26 - 50%		26 - 50%		26 - 50%
	51% +		51% +		51% +