Artificial Recruitment Modules (ARMs)

Purpose

To conduct standardized invasive size frequency sampling for selected indicator species to identify and monitor recruitment cohorts

Materials

6 stainless steel vernier calipers, 220 mm, minimum of one per dive team
7-15 large regular mesh collection bags (7 mm mesh size)
3 - 8 small mesh collection bags (5 mm mesh size)
7-15 fine mesh collection bags for small animals (1 × 2 mm mesh size)
7-15 small dive slates and pencils
7-15 ARM size frequency data sheets (Appendix K)
6 pair shears, minimum of one per diver team
5-10 dozen cable ties, number actually needed will vary

Personnel

2-6 SCUBA divers, at least one diver from each team should be experienced in this protocol as well as the identification and search image needed for species listed in Table 12.

Description of ARMs

The ARMs are constructed as described in Davis (1995). Each module consists of a wire cage made of 2" × 4" plastic coated mesh wire (Figure 12). Each cage is filled with 20 bricks, which are placed in the ARM in five layers with four bricks per layer. Brick layers are placed around the inside perimeter of the ARM, leaving an opening in the center of each row. Each layer is rotated 90° from the subsequent layer. The bricks are made by cutting a concrete cinder block in half longitudinally to produce 2 bricks each with a cross section shaped like a lower case "m" (Figure 12).

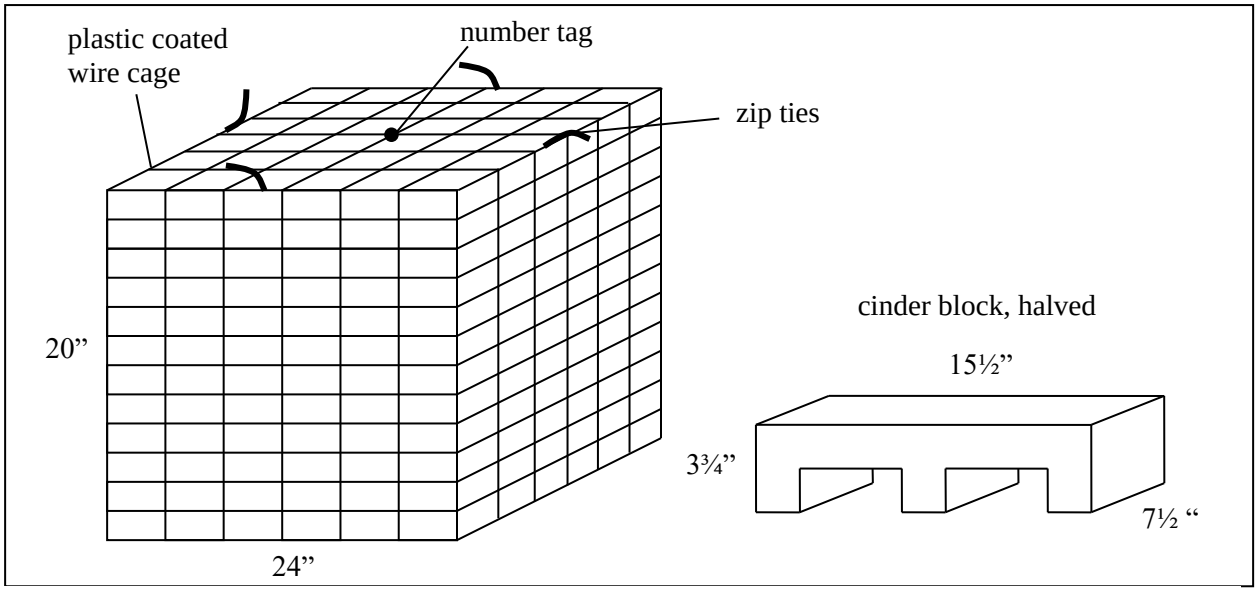

Figure 12. Example of an artificial recruitment module (ARM).

Methods

The number and location of ARMs varies at each site (Table 2) and not all sites have ARMs. Where the ARMs have been constructed, there are typically 5 -15 per site grouped together with 2 - 7 cages per group. ARM groups are located at each end of the transect line with an occasional group in the middle. ARMs are positioned far enough off the transect so as to not interfere with the other sampling protocols.

To monitor an ARM, each pair of divers should be equipped with several large mesh collection bags and a small mesh collection bag containing dive slates, pencils, shears, vernier calipers, cable ties, and a fine mesh bag. Locate the stainless steel number tag on the top of the ARM (Figure 15) and write the ARM number on a slate (a separate slate should be available for each ARM sampled). Use the shears to cut the cable ties holding the lid shut and slowly open it.

Carefully remove any of the indicator species that are on top of the bricks and place them in the large mesh bag (animals on and outside of the cage are not sampled). If there are any animals less than 5 mm (assuming you are using a dive bag made by Clay Creek and the mesh <5mm), place them in the fine mesh bag. Begin removing the bricks cautiously while watching for any animals that are dislodged or may swim away (juvenile rock scallops swim rapidly, juvenile abalone crawl rapidly!). The bricks often "stick" or are "cemented" together by encrusting ivertebrates and/or algae. As a result one often has to jerk the bricks and it this jerking action that often dislodges indicator species. The divers need make a concerted effort to look for dislodged indicator species on the bricks that they remove as well as their partners. Place all of the animals in their appropriate mesh bags and neatly stack each brick outside the cage next to the ARM so they can be easily replaced. Creating a neat stack of bricks will greatly facilitate placing back in the ARMs.

Measure any *Haliotis* spp., *Megathura crenulata* and *Pycnopodia helianthoides* carefully and place them back on the bricks that have already been sampled. These species are easily killed when placed in a bag full of sea urchins. Enumerate the *Parastichopus parvimensis* into categories of less than 10 cm and greater than 10 cm, and record this on the slate (estimate the sizes when they are in a relaxed state). Once these are estimated they can be placed next to the ARM, not in the bag where they will be damaged by urchin spines.

****IT IS VERY IMPORTANT TO WORK SLOWLY, AND MAKE SURE YOU CAREFULLY SEARCH EACH BRICK THOROUGHLY FOR SMALL INDIVIDUALS OF ALL THE INDICATOR SPECIES****

If *Strongylocentrotus purpuratus* or *S. franciscanus* are very abundant, not all of the ARMs need to be sampled for these two species. If there are 200+ per ARM of one of these species, only sample *S. purpuratus* and/or *S. franciscanus* in 3-4 ARMs at a site with seven ARMs. If a site has 15 ARMs, attempt to sample sea urchins from two of the five ARMs in each group. Make sure to indicate at the top of the slate that ALL or PART of the list of indicator species were monitored in EACH ARM. This information will be transferred to the appropriate space on the data form (Appendix I). This step is very important, without this information it will not be possible to calculate the number of a particular species found per ARM for analysis. Also, write down any interesting notes about the ARM, such as *Octopus* spp. present or if the bricks were covered with a species of sponge, etc.

After sampling all of the bricks, place the slate labeled with the ARM number into the bag with the animals and close it so the animals do not escape. Replace all of the bricks into the ARM in the same alternating stacks, so that the arrangement of bricks is the same as when they were removed. Leave the top open, as the animals will be placed back in their appropriate ARM after they have been measured at the surface. Go on to the next ARM if you have enough bottom time and air to complete it; do not start a new ARM, unless you are sure you can finish sampling it. If there are few animals in the ARMs, and you have sufficient bottom time, you may measure the animals at the ARM and record their sizes on the slate. The animals can then be returned to the ARM once all the bricks have been replaced, and the top can be closed with cable ties.

At the surface, it is best to keep the animals in the water, as it may be several hours before they are returned to the ARMs. Hang a few lines off the stern of the vessel with clips for this purpose. Measuring the animals at the surface typically takes at least three people; two to measure and one to record. On an ARMs size frequency datasheet (Appendix J), fill in all of the blanks at the top and the number of *Parastichopus parvimensis* at the bottom. If no ARM number was present or other important notes were made on the slate, record this in the comment section on the bottom of the datasheet. Those measuring should work on the same species and be sure the recorder is aware of what species they are recording. The recorder will place the corresponding letter code by the size measurement on the data sheet. The recorder must make sure they are using the correct letter code.

Once the animals are measured, place them back into the mesh bag and hang them in the water until they can be returned to the ARM from which they came. Be sure to place the slate in the appropriate mesh bag so the animals can be returned to the correct ARM.

Time Required

Depending on the depth, number of modules and abundance of species to be measured, the amount of time and number of divers required to sample the ARMs will vary. At any given site, a pair of divers will work on one ARM at a time, however depending on the site and the experience of the divers, they may be able to work on separate ARMs if they are next to each other.

Table 13. Organisms sampled in ARMs.

Species Name	Measurement
Tethya aurantia	Max. diameter, mm
Haliotis rufescens	Max. shell length, mm
Haliotis corrugata	Max. shell length, mm
Haliotis fulgens	Max. shell length, mm
Haliotis sorenseni	Max. shell length, mm
Haliotis assimilis	Max. shell length, mm
Cypraea spadicea	Max. shell length, mm
Kelletia kelletii	Max. shell length, mm
Megastraea (Astraea) undosa	Max. shell diameter, mm
Lithopoma (Astraea) gibberosa	Max. shell diameter, mm
Megathura crenulata	Max. shell length, mm
Crassadoma (Hinnites) gigantea	Max. shell length, mm
Patiria (Asterina) miniata	Length of the longest ray, mm
Pisaster giganteus	Length of the longest ray, mm
Pycnopodia helianthoides	Length of the longest ray, mm

Lytechinus anamesus	Max. test diameter, mm
Strongylocentrotus franciscanus	Max. test diameter, mm
Strongylocentrotus purpuratus	Max. test diameter, mm
Parastichopus parvimensis	Estimated size, < or > 10 cm
Centrostephanus coronatus	Max. test diameter, mm
Tegula regina	Max. shell diameter, mm