Appendix E. Survey Methods

E.1 Timed Search Surveys

Timed-diver searches in appropriate habitat are used to find, measure, and count abalone, collect information about abalone aggregations, document the presence of withering syndrome (WS), and collect abalone shell data. The key information collected includes:

- Relative abundance of abalone, expressed in terms of abalone encountered per unit search time (number per hr.)
- The size frequency distribution of abalone in a given location
- A count of the number and size of abalone aggregations.

A timed-search survey is conducted by a two or three person dive team. Multiple dive teams may conduct surveys within a given location at different depth ranges.

A survey starts with a dive team recording the GPS point of reference on the water surface just prior to the start of the dive. Then the dive team descends to the bottom and begins swimming in a specific compass direction, usually along a depth contour. All abalone encountered during the swim are measured to the nearest millimeter and counted. Abalone that cannot be measured due to inaccessibility or other reasons are only counted. Abalone counts and measurements are recorded by species. Abalone aggregations (two or more abalone within a meter of each other) are counted and the number of individuals in the group are noted. Any abalone exhibiting signs of disease, such as WS, is noted. At the end of the survey the total time spent searching for abalone is noted prior to ascending to the surface.

One problem with this method is the lack of comparability between surveys due to variability among divers' ability to find abalone; some divers are much better and will find more abalone per unit time than other divers, given the same density of abalone. Also, the higher the abalone density, the more time spent removing, measuring, and examining abalone and recording information, which is not accounted for in the recorded search time. These problems can also make the calibration of timed surveys with unit area surveys difficult.

E.2 Transect Surveys

Since density-based transect surveys will not be employed until after criterion 1 levels occur, it is expected that new methods will modify current density-based surveys in the future. In the interim, the current transect methodology used in management of the northern California red abalone fishery is described for use in these recovery surveys.

There are two types of transects that are used. The first type, called emergent transects, are long (30 x 2 m) and target animals greater than 50 mm. The second type, invasive transects, are smaller (5 x 2 m) and are used to assess the density of cryptic juvenile invertebrates.

Dive teams are deployed at target locations and depths using GPS and sonar devices (either hand-held or boat-mounted). Transect tapes are stretched out by divers on rocky substrate (more than 50% rock substrate) and the ends of the tapes are

secured. Divers swim transect lines roughly north-south, following the targeted depth contour. Each diver collects information from one side of the transect (1 x 30m) either to the right or the left side. Transects are marked every 5 meters.

Emergent transects are used to collect abundance and size frequency data for animals visible on the surface of rocks, in rock crevices, and on the underside of rocks. The substrate (including rocks and sea urchins) is not moved during emergent surveys. Divers conducting invasive transect surveys collect abundance and size frequency data by moving rocks and sea urchins, searching with flashlights and within foliose algae, looking specifically for juveniles (young-of-the-year), in addition to recording emergent animals. Invasive transects are deployed from one end of an emergent transect.

E.3 Detailed Habitat Survey

The objective of the detailed habitat survey is to quantify habitat characteristics in areas where abalone occur. The goal is to identify optimal habitat for the abalone species. A description of the optimal habitat will be beneficial in selecting areas for recovery actions and in refining abundance estimates.

The detailed habitat survey is conducted in different ways depending on the type of survey equipment involved. In the case of white abalone, habitat surveys involve the use of video recordings from either ROV or manned submersible searches in deeper white abalone habitat. For green and pink abalone, which occur at shallower depths, a SCUBA diver tracking and information recording system such as the Dive Tracker could be used to quantify habitat.

For ROV or submersible surveys, the video record for each dive will be post-processed for habitat typing. Technicians will quantify habitat by watching the video and recording data by a standard time interval. Algal cover including a selected list of species, the number of abalone by species, depth, habitat type, and substrate relief will also be recorded. The habitat data with the time interval and the recorded GPS track data for the ROV or submersible can be used in constructing community maps in a Geographic Information System.

The SCUBA diving surveys which use a diver tracking system will work in a similar manner to the ROV/submersible surveys except that the data can be collected and recorded in real time rather than post-processed from a video recording. The diver tracking system records the diver's movement, which can be used in mapping. The diver can also enter habitat data into a key pad which stores the data for downloading to a computer at the end of the dive.

E.4 Intertidal Surveys

Intertidal surveys are designed for measuring and counting black abalone populations. Surveys are conducted during negative tide periods. Timed searches in appropriate habitat are used to find, measure, and count abalone, collect information about abalone aggregations, document the presence of WS, and collect abalone shell data. The key information collected includes:

- Relative abundance of abalone, expressed in terms of abalone encountered per
- Unit search time (number per hr.)
- A size frequency distribution of abalone in a given location

- A count of the number and size of abalone group aggregations.
- To conduct a survey, personnel search all available rocky crevice habitat in a given area for 30 minutes. Within this time interval all abalone encountered are measured to the nearest millimeter and counted. Abalone that cannot be measured for various reasons are just counted. Abalone aggregations (two or more abalone that are within a meter of each other) are counted and the number of individuals in the group are noted. Any abalone exhibiting signs of sickness, such as WS, is noted.

E.5 Remotely-operated Vehicle (ROV) Surveys

ROVs are useful tools for assessing populations of abalones in nearshore waters deeper than 5 m. ROVs have few operational depth and bottom-time limits, making them a useful alternative to SCUBA and manned submarine surveys. ROVs allow the investigation of hazardous habitat that would otherwise remain unsurveyed.

Surveys using ROVs provide much information about the ecology, distribution, and available habitat of California's invertebrates, including abalones. In addition to collecting data on abalones, information on community structure is also collected. This peripheral information provides insight into the community associations that greatly influence abalone. ROV-collected videos generate detailed descriptions of available habitat, which are necessary for monitoring species-specific habitat loss over time. Since all ROV dives are tracked by a Global Positioning System based tracking system, these communities can be easily located on a map, providing further monitoring information.

ROVs typically include:

- A GPS-based tracking system to facilitate track placement on a map
- A high quality video recording of the track to verify and identify individual abalone, associated plants, and substrate type
- A means to record depth along the track
- A minimum of two parallel mounted lasers, which provide a means of measuring animal size and generating estimated transect width
- A form of artificial lighting to illuminate the transect

Following an ROV dive, technicians view the video to record data on the species of abalones present, their sizes and numbers, other species present, and the habitat in which they occur. The data and comments are entered into a database record which is linked to a time code and GPS position from the dive. From this record, the specific locations of each abalone, along with its community associates and habitat, can be mapped.