Baseline-transect method for conducting abalone surveys.

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**Background**

Our work with white abalone in southern California has required that we revise traditional subtidal monitoring survey techniques to adequately assess the numbers of white abalone that occur at a particular site. Our surveys suggest that white abalone densities in Southern California are typically less than one per 100m2 with inter-abalone distances often exceeding the length of a traditional subtidal transect (e.g., 50 meters). Our goal was to develop an approach that systematically searches a rectangular area using a series of parallel transects as opposed to the traditional band transect that surveys roughly 4 x 50 meter area (e.g., PISCO, Reef Check, CRANE). In addition, we wanted to have a mechanism for distributing our effort to reduce or eliminate the degree to which dive teams search the same area, which is a problem with timed search methodology. The Band Transect and the timed search methods are advantageous because they are more efficient for a small group of divers to implement underwater, and they are both quite affective in areas where abalone densities are relatively high, such as the red abalone populations in northern California. In cases where abalone are patchy in distribution, or if they are very rare, we believe that our revised technique provides more information about the status of the abalone in the area. This method also allows the surveyors to map the locations of abalone within the area after-the-fact and estimate nearest neighbor distances or calculate aggregation indices.

**Method Description:**

The survey design involves the deployment of a baseline transect from which perpendicular survey transects are deployed (Figure 1).



Figure Site Layout for abalone baseline-transect survey.

This survey is implemented via the following protocol.

1. The dive boat is anchored on the survey site and the GPS coordinates for the site are recorded.
2. Prior to the first dive, each dive team is assigned a transect number. Transect numbers are identified by the meter mark on the baseline transect from which they originate (Figure 1).
3. One dive team enters the water ahead of the remaining teams and deploys the baseline transect. If time allows, the initial team can also deploy and search a survey transect.
4. The remaining teams enter the water, swim to their assigned baseline meter mark, deploy a survey transect tape, search 3 meters on one side as they swim back toward the baseline, then search 3 meters on the other side as they swim back toward the end of the survey transect. Once they have completed the survey, the transect is retrieved and (if time allows) a second transect is deployed in the opposite direction as the first transect. An option that we often take is to mark all abalone that we find with surveyor chalk to eliminate the possibility of double-counting if survey areas overlap.
5. If all transects are not completed during the first dive, additional dives are made to complete the remaining transects.

While we try to standardize this approach to maximize comparability, it can be scaled up or down in a number of ways to adjust for factors such as number of divers available or bottom time limitations due to depth.

1. The number of survey transects can be adjusted by varying the length of the baseline. For example, if a 100-meter baseline is deployed, then 16 survey transects would be available (8 transects on either side of the baseline) and a 96 x 100 meter area would be searched. If a 60-meter baseline is deployed, then 10 transects would be searched and a 60 x 100 meter area would be searched. In a situation where only one dive team is conducting the survey, the protocol can be scaled down to one team deploying a single transect and searching 3 meters on either side (i.e., a traditional band transect).
2. Shorter survey transects (e.g., 25 meter vs 50 meters) could be deployed. This is often what we do in deeper water (>25 meter/80 feet) where time limitations make it hard to complete a 50 meter transect in one dive.
3. It is also possible to search only one side of the baseline transect, effectively cutting the total number of transects in half.

**Data collection**

**Site data** – the site datasheet (attached) is kept on the boat. On this data sheet, the date, site name, latitude and longitude for the anchor location and any relevant notes are recorded.

**Transect data** – the transect data sheet (attached) is filled in by each buddy team. This sheet can either be carried by one member of the team during the dive or filled out between dives. Metadata for each completed transect are recorded on this sheet (date, site, baseline heading length, survey transect meter mark, heading and length and the amount of time it took to complete the transect).

**Abalone location and size data** – both members of a buddy team should carry with them an abalone location and size data sheet (attached). This sheet is where the divers record information regarding the abalone they find. We typically record location and size information for all white abalone observed. We do not record location information on other species of abalone and only record size information for the first 5 individuals found on each transect. The location information for white abalone is recorded as the meter mark on the survey transect and an estimate of how far the abalone is from the meter mark (offset). The offset is recorded as negative on the right side of the transect tape and positive on the left side (see data sheet for diagram). The advantage of recording the location data is that the distribution of the abalone within the survey block can be mapped to visualize the degree to which the animals are clumped or dispersed.

**Habitat Characterization Data –** Each dive team completes a habitat data sheet (attached) for every transect that they complete. This is done topside after the dive team exits the water, so it is not necessary for the datasheet to be carried by the divers during the dive. The purpose of this datasheet is to provide a qualitative characterization of some of the more important features of the habitat. The habitat datasheet references the scoring protocols for each of the categories: algae, invertebrates, relief, substrate, rock type, and quality of abalone habitat. The last of these is a subjective assessment based on the experience of the diver. Empty shells are collected during the dive and are measured and recorded on this datasheet as well.

**Survey equipment and datasheet checklist** – the following survey gear is needed to implement this protocol.

|  |  |  |  |  |  |  |
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| Equipment needed | | |  |  |  |  |
|  | 100 meter tape | | At least 1 | |  |  |
|  | 50 meter tape | | Equal to the number of dive teams | | | |
|  | data slates/pencils | | Equal to the number of divers | | | |
|  | Calipers | | Equal to the number of divers | | | |
|  | Mesh Bags | | Equal to the number of divers | | | |
|  | Chalk for marking abalone | | Equal to the number of divers | | | |
| Data sheets | |  |  |  |  |  |
|  | Transect | | One sheet is all that's needed, all teams can log their transects on the same sheet | | | |
|  | Site | | One sheet is all that's needed | | | |
|  | Size |  | At least 1 per diver | | |  |
|  | Habitat |  | At least 2 per dive team | | |  |