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METHODS USED TO ESTIMATE ABUNDANCE IN NUMBERS OF YOUNG-OF-THE-YEAR (YOY) BOCACCIO AROUND OIL AND GAS PLATFORMS IN THE SANTA BARBARA CHANNEL: 2003

Volumes of the insides of the platform jackets and of the one shell mound we surveyed are given in Table A1.

Density estimates:

We assumed that transect lengths were equal to the perimeter of the platform at the depth of the survey, because only fish associated with the structure were counted. We used the following equation to estimate transect volume at depth D:

TV(D) = TW(D)*TH(D)*TL(D),

where

TV(D) = Transect Volume,
TW(D) = Transect Width,
TH(D) = Transect Height, and
TL(D) = Transect Length.

We expressed YOY bocaccio density (YOYDEN(D)) as:

YOYDEN(D) = YOY(D)/TV(D),

where

YOY(D) = count of YOY bocaccio at depth D.

Transect lengths and cross section areas when schematics available:

We have copies of platform schematics for platforms A, B, C, Gail, Gilda, Grace, and Holly. The schematics show length and width at the top and bottom of each platform and depths below the surface for each horizontal beam. Love et al. (2003) provided bottom measurements for all of the platforms and surface dimensions for Gail, Grace, and Holly. Examination of the schematics revealed that the surface dimensions were actually for tops of the platforms, which were several meters above mean low water (MLW). We used linear interpolation to estimate lengths and widths for each horizontal beam depth, including MLW, from the top and bottom dimensions:

Di(D) = Di(B) + (T-D)*(Di(T)-Di(B))/(T-B)

where

Di(D) = Dimension (Length or Width) at Depth D,
T = Depth of top of platform,
B = Depth of bottom of platform, and
D = Depth or distance from mean low water (positive for above MLW and negative for below MLW).

We estimated TL(D) as:

TL(D) = 2*(L(D)+W(D)) = periphery at depth D

where,

L(D) = platform length at depth D, and
W(D) = platform width at depth D.

We estimated platform cross section area at depth D as:

$$A(D) = L(D)*W(D).$$

Transect lengths and cross section areas when schematics not available:

We do not have schematics for platform Hillhouse. Analysis of data for platforms with schematics and adequate transect data (Gail, Grace, and Holly) indicated that the following procedure provides good approximations of transect length at depth and we used it:

1. Calculate median transect time for each depth over the surveys taken at the platform.

2. Estimate slope and intercept of transect time as function of depth using linear regression.

3. Estimate transect time that would have occurred at bottom of platform if submersible had traveled at mid-water velocity using regression results and depth at bottom of platform.

4. Estimate m/min of surveys at bottom of platform using estimated transect time from 3. and transect length for bottom of platform from Love et al. (2003).

5. Estimate transect lengths at mid-water depths from estimated m/min from 4. and median transect times from 1.

6. Mid-water transect depths are estimated as the medians of the survey estimates.

It was necessary to take this approach because only the bottom transect lengths and mid-water transect times were reliably known, and bottom speed was lower than mid-water speed. While divers reliably measured transect time, they were not able to estimate meaningful transect lengths when surveying the platforms. Fish were only counted when associated with the structure. The submersible sometimes drifted away from the structure because of currents or when turning. Thus the actual distance traveled was not the appropriate distance to use for calculating fish densities.

In addition to the above estimates of transect lengths it was necessary to estimate L(D) and W(D) to estimate A(D). We assumed that L and W changed linearly with depth. The rates of change of L and W with depth were either the same or very similar for the platforms with known dimensions. We assumed that the rates of change of L and W with depth were the same for platform Hillhouse. Thus

$$TL(D) = 2*(L(B) + W(B) + 2*S*(D-B)),$$

where

S = the rate of change.

It follows that solving the above for S results in

$$S = (TL(D) - 2*(L(B) + W(B))/(2*(D-B)),$$

and

$$L(D) = L(B) + S*(D-B), \text{ and}$$
$$W(D) = W(B) + S*(D-B).$$

We next estimated water volumes within each vertical segment of the platforms, i.e. volume contained between mean low water and the first horizontal beam, volume between first and second horizontal beams,……and volume between last horizontal beam and bottom as follows:

V(D1,D2) = (D1-D2)*(A(D1)+A(D2))/2,

where

V(D1,D2) = volume between depth 1 and depth 2.

Bocaccio Young-of-the-Year Abundance:

We assumed that the YOY densities estimated from transects about the periphery of the platforms at the bottom and horizontal beam depths were representative of densities within the periphery and between horizontal beam depths. YOY abundance for a segment, YOYABUND(D1,D2), was estimated by multiplying the average density at D1 and D2 by V(D1,D2):

YOYABUND(D1,D2) =V(D1,D2)*(YOYDEN(D1) + YOYDEN(D2))/2

If a survey was not made at D, YOYDEN(D) was assumed to be 0. We then summed YOYABUND(D1,D2) over all depth intervals to obtained total abundance associated with a platform.

Shell Mound

Density estimates:

Transect length was then estimated by multiplying velocity by transect time. We used the following equation to estimate transect volume:

TV = TW*TH*TL,

where

TV = Transect Volume,
TW = Transect Width,
TH = Transect Height, and
TL = Transect Length.

We expressed YOY bocaccio density (YOYDEN) as:

YOYDEN = YOY/TV,

where

YOY = count of YOY bocaccio.

Shell mound volume:

Our observations indicated that YOY bocaccio occupied the water column within 3 m of the surface of the shell mound. Thus volume was estimated by multiplying the area of the shell mound by 3.

Shell mound area:

The shell mound appears to be an ellipse. The area of an ellipse (A) is give by:

A = Π*(L/2)*(W/2),

where

L = Length, and
W = Width.

The shell mound ellipse included the platform base. Since YOY abundance was already estimated for the platform base, the area used for the shell mound YOY abundance was estimated by subtracting the area of the platform base from the area of the ellipse.

While the plot of the survey tract was somewhat jagged, we assumed that if was a rectangle because the operator attempted to keep a constant distance from the rectangular platform base.

We divided the shell mound into inner and outer segments separated by the rectangular survey tract and calculated the volume of water within 3 m of the bottom in each segment.

Bocaccio Young-of-the-Year Abundance:

We assumed that the density of YOY in the inner segment was equal to the average of the density of YOY estimated for the bottom of the platform and the density of YOY estimated from the shell mound survey, and multiplied average density times the volume to obtain YOY abundance. We assumed that the density of YOY in the outer segment was equal to the average of the density of YOY estimated from the shell mound survey and 0 at the edge of the mound, and multiplied average density times the volume to obtain YOY abundance. We then added abundance for the two segments to obtain total abundance of YOY bocaccio for the shell mound.