

Distribution of rockfish species along environmental gradients in Gulf of Alaska and Aleutian Islands bottom trawl surveys

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Environmental variability affects the distributions of most marine fish species. In an analysis of rockfish (*Sebastes* spp.) in Alaska, five species assemblages were defined based on similarities in their distributions along environmental gradients (Figure 33). Data from 14 bottom trawl surveys of the Gulf of Alaska and Aleutian Islands ($n = 6,767$) were used. The distinct assemblages of rockfish were defined by geographical position, depth, and temperature (Rooper 2008). The 180 m and 275 m depth contours were major divisions between assemblages inhabiting the shelf, shelf break, and lower continental slope. Another noticeable division was between species centered in southeastern Alaska and those found in the northern Gulf of Alaska and Aleutian Islands.

In this time-series, the mean-weighted distribution of six rockfish species along the three environmental gradients (depth, temperature, and position) was calculated for the Gulf of Alaska and Aleutian Islands. Position is the distance of each trawl haul from Hinchinbrook Island, Alaska. A weighted mean value for each environmental variable was computed for each survey as:

$$Mean = \frac{\sum (f_i x_i)}{\sum f_i},$$

where f_i is the CPUE of each rockfish species group in tow i and x_i is the value of the environmental variable at tow i . The weighted standard error (SE) was then computed as:

$$SE = \frac{\sqrt{\left(\sum (f_i x_i^2) \right) - \left(\left(\sum f_i \right) * mean^2 \right)}}{\sqrt{\left(\sum f_i \right) - 1}},$$

where n is the number of tows with positive catches. Details of the calculations and analyses can be found in Rooper (2008).

There were no definitive trends in distribution over the time series for position or depth in the Aleutian Islands (Figure 34). Mean-weighted temperature distributions for all species were within about 1°C over the entire time series. There was high variability in the mean-weighted variables in the 1991 Aleutian Islands survey, but after that the time series was remarkably stable. This is in contrast to the trends in rockfish distribution in the Gulf of Alaska.

There were no trends in distribution over the time series for depth or temperature in the Gulf of Alaska, although the distributions of rockfish species across temperatures were more contracted in 2007 than in previous years (Figure 35). However, there did appear to be a continued movement of the mean-weighted distribution towards the north and east (as indicated by the position variable). This may indicate a change in rockfish distribution around the Gulf of Alaska and is especially apparent in the distribution of juvenile POP.

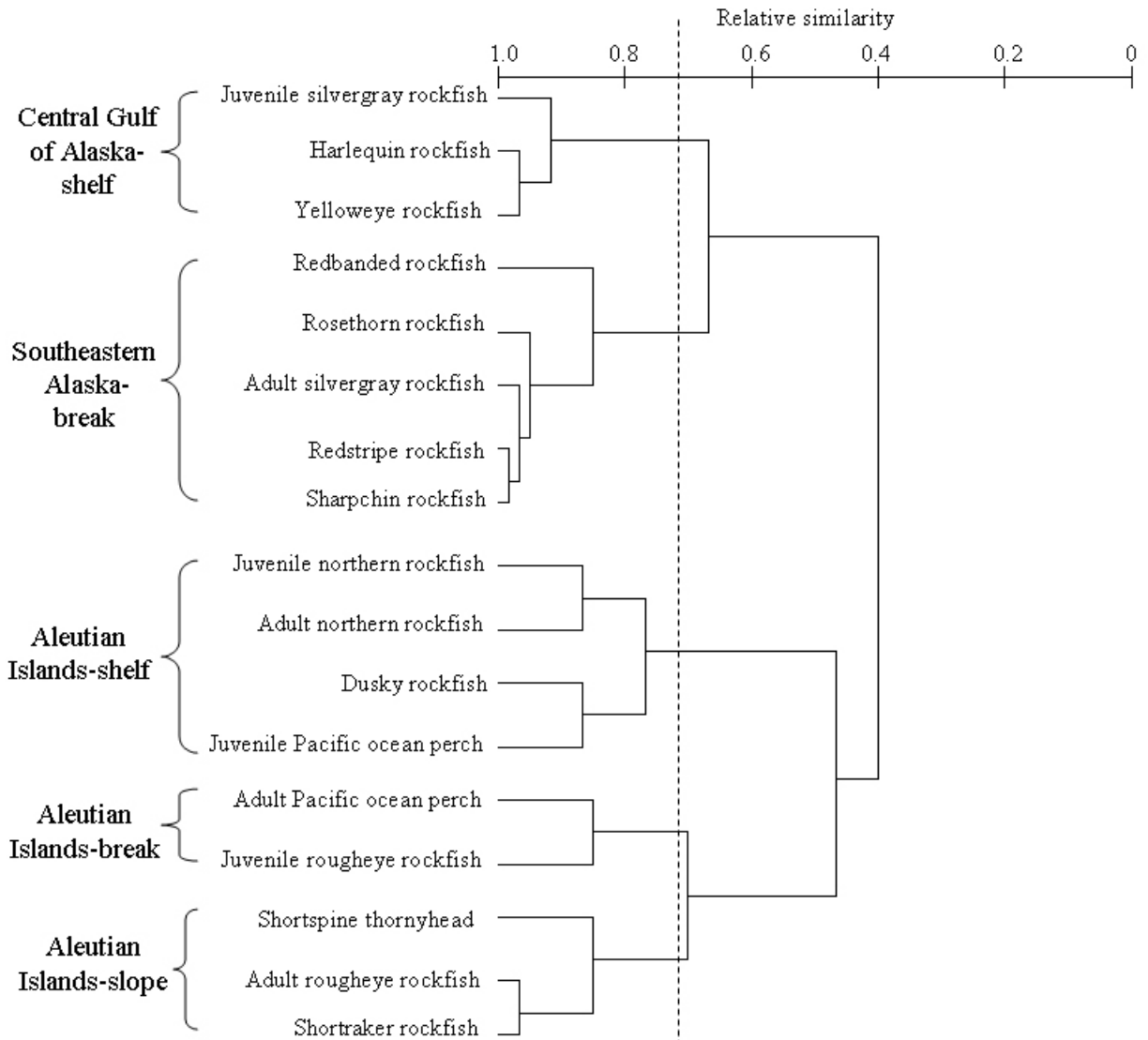


Figure 33. The results of cluster analysis of rockfish showing relative similarity amongst species-subgroups. The x-axis shows the relative similarity among species derived from the multinomial overlap indices among species-group pairs along the three environmental gradients (depth, position, and temperature). The dashed line (0.73) is where rockfish species assemblages were defined based on a similarity of 0.9 across the three environmental gradients (reprinted from Rooper (2008)).

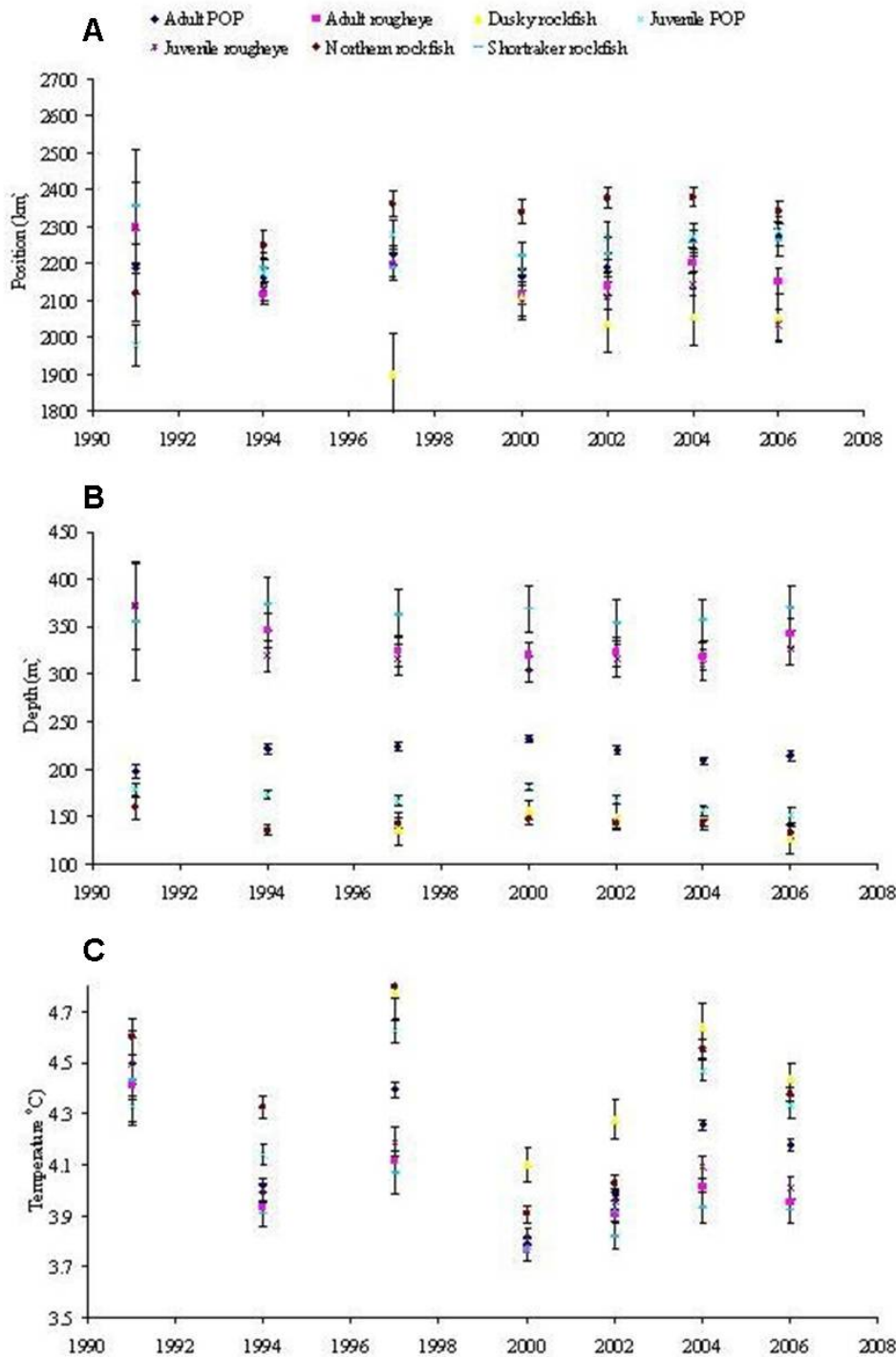


Figure 34. Plots of mean weighted (by catch per unit effort) distributions (and SEs) of seven rockfish species-groups along three environmental variables in the Aleutian Islands. Mean weighted distributions of rockfish species-groups are shown for A) position, B) depth, and C) temperature. Position is the distance from Hinchinbrook Island, Alaska, with positive values west of this central point in the trawl surveys and negative values in southeastward.

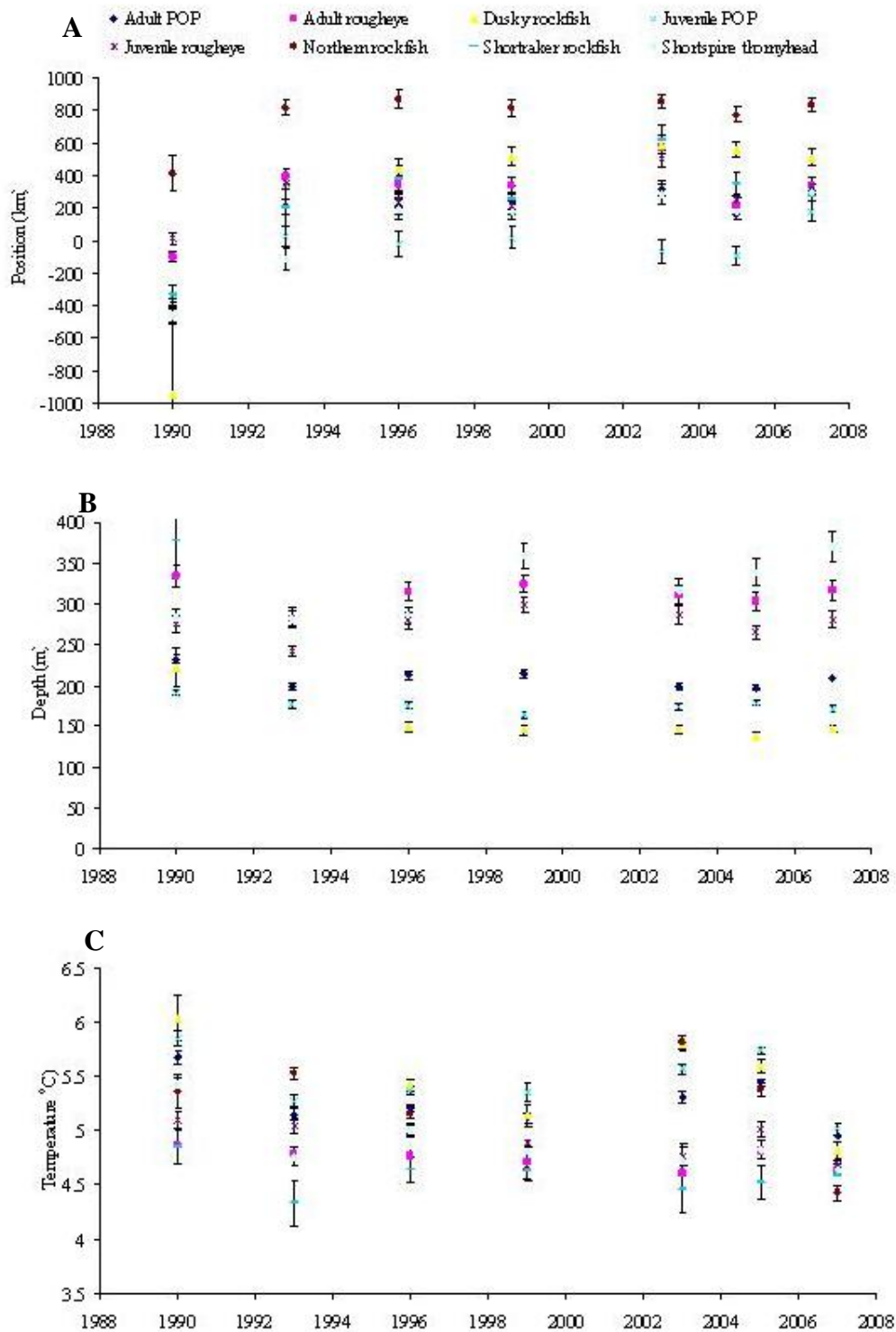


Figure 35. Plots of mean weighted (by catch per unit effort) distributions (and SEs) of seven rockfish species-groups along three environmental variables in the Gulf of Alaska. Mean weighted distributions of rockfish species-groups are shown for A) position, B) depth, and C) temperature. Position is the distance from Hinchinbrook Island, Alaska, with positive values west of this central point in the trawl surveys and negative values in southeastward.