

Average local species richness and diversity of the groundfish community

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Description of indices: This section provides indices of local species richness and diversity based on standard bottom trawl surveys in the western (west of 147°N) Gulf of Alaska (GoA) and Eastern Bering Sea (EBS). The average number of fish and major invertebrate taxa per haul and the average Shannon index of diversity (Magurran 1988) by haul were computed. The latter was based on CPUE (by weight) of each species (or taxon). Indices were based on a total of 53 taxa in the GoA (contact author for list of species) and 46 taxa in the EBS (Table 1 in Mueter & Litzow, in press). Taxa were included at the lowest possible taxonomic level, i.e. at a level that was consistently identified throughout all surveys. Indices were computed following Mueter & Norcross (2002). Briefly, annual average indices of local richness and diversity were estimated by first computing each index on a per-haul basis, then estimating annual averages by modeling haul-specific indices as a function of geographic location, depth, date of sampling, area swept, and year.

Status and trends: Average species richness and diversity of the groundfish community in the Gulf of Alaska increased from 1990 to 1999 with both indices peaking in 1999 and sharply decreasing between 1999 and 2001 (Figure 73). Species richness and diversity on the Eastern Bering Sea shelf have undergone significant variations from 1982 to 2006 (Figure 74). The average number of species per haul has increased by one to two species since 1995, while the Shannon Index increased from 1985 through 1998 and decreased sharply in 1999.

Factors causing observed trends: The average number of species per haul depends on the spatial distribution of individual species (taxa). If species are, on average, more widely distributed in the sampling area the number of species per haul increases. Spatial shifts in distribution from year to year lead to high variability in local species richness in certain areas, for example along the 100m contour in the Eastern Bering Sea. These shifts appear to be the primary drivers of changes in species richness. Local species diversity is a function of how many species are caught in a hauls and how evenly CPUE is distributed among the species. In the GoA both average species diversity and local richness showed very similar trends, suggesting that relative species composition (evenness) was relatively stable. In contrast, trends in species diversity in the EBS differed markedly from those in richness. For example, low species diversity in the EBS in 2003 occurred in spite of high average richness, primarily because of the high dominance of walleye pollock, which increased from an average of 18% of the catch per haul in 1995-98 to 30% in 2003, but decreased again to an average of 21% in 2004. The increase in species richness, which was particularly pronounced on the middle shelf, has been attributed to subarctic species spreading into the former cold pool area as the extent of the cold pool has decreased over recent decades (Mueter & Litzow, in press). However, species diversity has been low in recent years, compared to the 1990s, which suggests that species remain patchily distributed such that a given haul may be dominated by one or a few species.

The effect of fishing on species richness and diversity are poorly understood at present. Because fishing primarily reduces the relative abundance of some of the dominant species in the system, species diversity is expected to increase relative to the unfished state. However, changes in local species richness and diversity are strongly confounded with natural variability in spatial distribution and relative abundance.

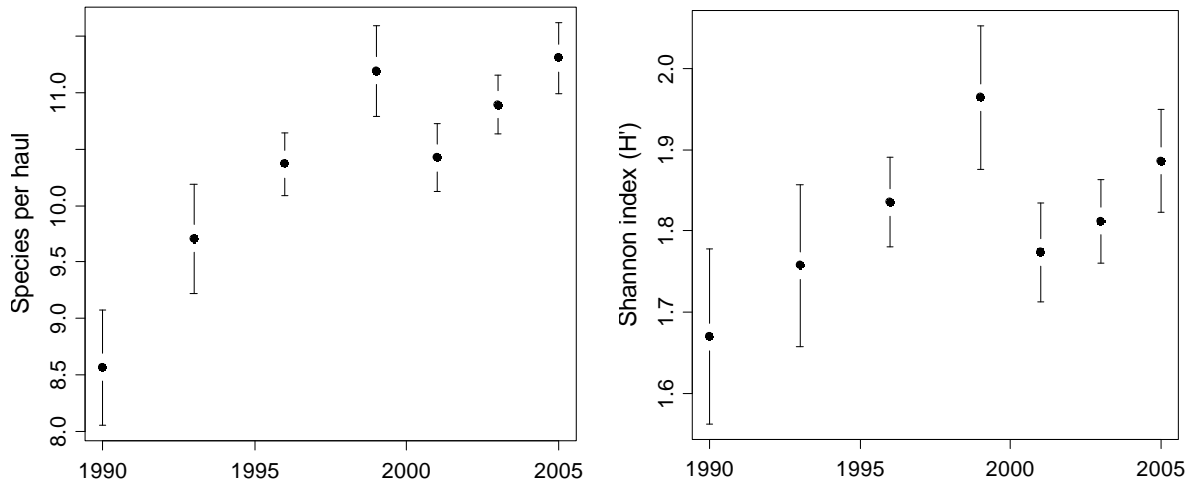


Figure 73. Model-based annual averages of species richness (average number of species per haul), and species diversity (Shannon-Wiener index) in the western Gulf of Alaska, 1990-2005, based on 55 fish taxa collected by standard bottom trawl surveys with 95% confidence intervals. Model means were adjusted for differences in area swept, depth, date and time of sampling, and geographic location among years.

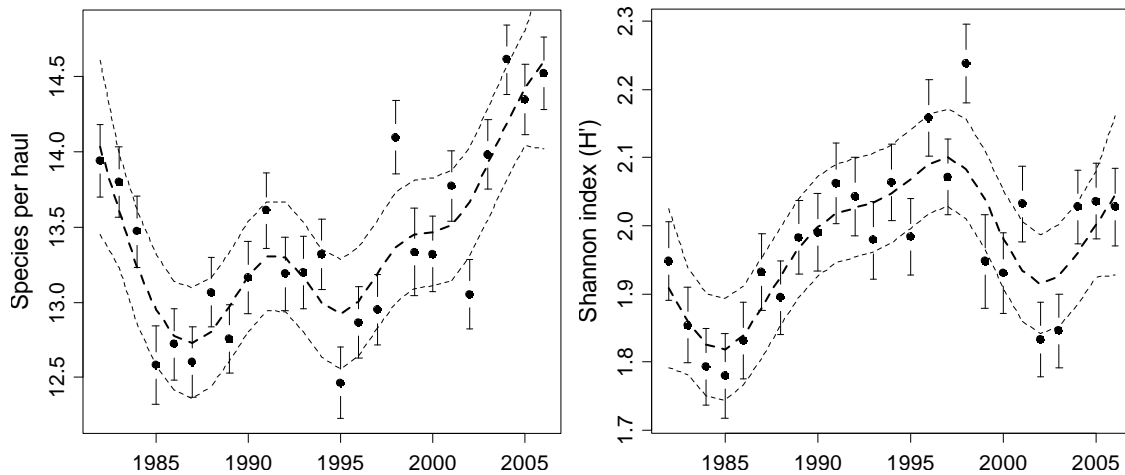


Figure 74. Model-based annual averages of species richness (average number of species per haul), and species diversity (Shannon-Wiener index) in the Eastern Bering Sea, 1982-2006, based on 47 fish taxa collected by standard bottom trawl surveys with 95% confidence intervals. Model means were adjusted for differences in area swept, depth, date of sampling, bottom temperature, and geographic location among years.