

Application of a generalized additive model (GAM) to reveal relationships between environmental factors and distributions of pelagic fish and krill: a case study in Sendai Bay, Japan

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A generalized additive model (GAM) was applied to fishery-survey data to reveal the influences of environmental factors on the distribution patterns of Japanese anchovy (*Engraulis japonicus*), sand lance (*Ammodytes personatus*), and krill (*Euphausia pacifica*). Echosounder and physical-oceanographic data were collected in Sendai Bay, Japan, in spring 2005. A hierarchical model was used with two spatial strata: (i) presence and absence of each species; and (ii) biomass density of each species, given its presence; and six environmental covariates (surface water temperature, salinity, and chlorophyll, and near-seabed water temperature, salinity, and depth). The results indicate non-linear responses of the two indices to the environmental covariates. In addition, the biomasses estimated by the GAMs were comparable with estimates based on conventional, stratified-random sampling for each species. GAMs are very useful for (i) investigating the effects of environmental factors on the distributions of biological organisms, and (ii) predicting the distributions of animal densities in unsurveyed areas.

Keywords: abundance estimation, distribution model, echosounder, ecosystem, fish, GAM, habitat model, marine ecology.

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