

Two-dimensional line transect methods for active acoustic surveys of pelagic fish populations

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Abstract:

Active underwater acoustics, or echosounding, is a fisheries-independent method that is widely employed to estimate the biomass of commercially and ecologically important pelagic species. Typically, acoustic instruments look vertically downwards into the water column and are unable to detect animals above some minimum depth. They therefore miss that part of the target population that is above this depth. In addition animals may exhibit avoidance behaviour by the time they come abeam of the survey vessel and hence be missed by the echosounder. Neglecting these effects results in density estimates that are negatively biased by some unknown amount.

Animals at shallow depths can be surveyed by a horizontally scanning sonar. We develop two-dimensional line transect methods for the analysis of such data (the dimensions being forward as well as perpendicular distances). The models can be viewed as a type of survival model or as an extension of the ideas on which the hazard rate models of Hayes and Buckland (1982) were based. We develop two-dimensional line transect density estimators for animals that are too shallow to be detected by conventional echosounders, using data from horizontally scanning sonar, and investigate their properties, including their ability to accommodate avoidance behaviour without substantial bias. The methods are illustrated with data from a pelagic fish population survey.

References

Hayes, R. J. and Buckland, S. T. (1983). Radial distance models for the line transect method. *Biometrics* 39, 29-42.