# Use of a disjunctive kriging to model areas of high pelagic fish density in acoustic fisheries surveys

Schooling fish may aggregate in very high densities covering very small areas. Thus the probability of hitting such high-density spots during a large-scale sampling is very low. The sampling fluctuations of the tail of the histogram are thought to be very significant. The stock biomass estimate and its precision rely greatly on how precisely the tail of the histogram can be sampled. In order to acquire elements for improving survey designs and abundance estimators wc study here the relation in space that the high values have with the other values. A disjunctive kriging approach is used. Different quantiles of the histogram are coded by indicators. The spatial structure of each indicator and its spatial covariation with the others are studied by computing experimental indicator variograms and cross-variograms. Such analysis is applied to dissect finely the spatial structure of a Norwegian herring stock sampled acoustically. It is shown that when going from low-density areas to high-density ones, intermediate values are not necessarily crossed. Thus a particular disjunctive kriging model with no transition in space is well adapted to the herring data. The model is based on the regressions of each indicator on the one immediately below it. In the model one can estimate the probability for the fish density to trespass a given cut-off at a given location when knowing that the density trespasses lower cut-offs at surrounding points. It is shown on the data that the high densities are structured and show small aggregations. Then it is shown that having trespassed a certain cut-off, i.e. inside the corresponding areas in space, the high-density aggregations can be considered to be positioned independently from the other values. These areas, where the structuring of the high values is not correlated to the structuring of the other values, are mapped using the fitted disjunctive kriging model. The implications for survey designing of the existence of such areas and of their geometry are discussed. Also discussed is the possibility of stratifying the data in spatially uncorrelated boxes when deriving the biomass estimate and its precision, on the basis of an observed spatial non-correlation property between the spatial distribution of different quantiles.

**Auteurs du document :** Pierre Petitgas
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