science summary

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River fish habitat inventory. Phase III. Multi-species models

Summary SC040028/SS

Environment Agency researchers have utilised two statistical models to probe the relationship between fish abundance and the physical characteristics of rivers. The first model relates the prevalence and abundance of coarse fish, such as pike and roach, to geographic location and environmental variables such as river width and altitude. The second model provides insights into the various processes that govern these relationships.

This work makes up the third phase of the River Fish Habitat Inventory (RFHI) project, which is intended to provide information about the expected and observed abundance and prevalence of fish in English and Welsh rivers. The first phase of the RFHI comprised a scoping study, while the second phase involved developing a model to link the abundance and prevalence of salmon and trout to the physical characteristics of English and Welsh rivers. In this third phase, the model is being extended to cover the abundance and prevalence of coarse fish.

The RFHI model builds on the Fisheries Classification Scheme. This classifies fish species in rivers based on both their observed abundance and relative abundance, which compares the observed abundance with that expected for the specific type of river. The RFHI model adds rigour to this classification scheme by introducing an explicit definition of expected abundance, which is the product of the average abundance and the probability that the fish species will be present in a river of that type. The RHFI model then relates these classifications for individual fish species to geographical locations and environmental variables.

To extend this model to coarse fish, the researchers entered nationwide abundance data for 23 coarse fish species, such as pike and roach, which was collected in 2004 and held on the National Fish Population Database. The model was then able to reveal some clear trends for specific species. For example, it showed that the prevalence of pike increases with increasing river width but decreases with increasing altitude and that pike are most prevalent and abundant in central and south-east England.

To find out more about the specific processes that underlie these trends, the researchers then turned to a Population Dynamics model (PDM), which had been specifically developed to investigate patterns in fundamental biological processes from routine fish population survey data. The researchers fed this model with data on fish abundance and prevalence collected from eight sub-catchments along the river Stour in East Anglia between 1980 and 2003. They then used the model to investigate spatial and temporal patterns in the recruitment (defined in this context as number of juvenile fish surviving until the end of their first summer), growth and survival of three common coarse fish species: chub, dace and roach.

This revealed some broad patterns, such as a general inverse relationship between recruitment and survival rate. But it also uncovered more specific patterns for individual species in particular sub-catchments, which could then be related to the physical characteristics of that sub-catchment. For example, the model showed that the survival of all three species and the growth of dace and chub were low in the Stratford/Flatford reach. This is probably a result of the fact that this sub-catchment is affected by nearby large-scale abstractions of water, which cause drastic fluctuations in flow and water level, occasionally leaving some areas of the river bed exposed for long periods. Only roach gained some benefit from these conditions, showing high levels of recruitment and growth, perhaps due to increased amounts of plankton acting as an abundant supply of food.

This study has shown that the two models can provide detailed information and predictions on fish abundances and characteristics, allowing ‘expected’ levels of abundance to be estimated purely from habitat measurements. This kind of information is required under the EU Water Framework Directive and can also be used to identify pressures on fish populations and guide the development of appropriate remediation measures.

This summary relates to information from Science Project SC040028 reported in detail in the following output(s):-

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