
MAMERN'07 INVITED SPEAKER

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Dynamics and Migrations of Schools of Fish

The migrations of schools of fish, flocks of birds and herds of mammals can be simulated on computers and computational clusters and analyzed using dynamical systems theory and methods from the emerging theory of complex systems in biology. The recent discovery of migratory, stationary and swarming solutions of models that describe the interactions between individuals can now be used to construct global migrations including environmental effects. These solutions describe migratory, stationary and swarming phases of the schools, flocks and herds. The current focus is on how the animals switch from one phase (say migratory) to another (say stationary) and how environmental and internal effects can implement these changes. Fluctuations in the migratory patterns can be analyzed, and how the migratory patterns are influenced by variations in the environment. These methods are used to study the schools of capelin, a pelagic fish, that have a very extensive (hundreds of kilometres) migration in the North Atlantic. Newly found solutions that describe very large schools with millions of individuals, based on complex solutions of the Kuramoto model, can be simulated and the results compared to existing data. This data has been collected since the 1970s and shows the spatial distribution of the fish both by acoustic measurements and tagging. Other species of fish for example the herring in the North Atlantic and sardines and anchovies migrating in the Pacific can be simulated using similar methods. These methods can also be used to study the flocking of birds and herding of other animals.
