Fish schools and krill swarms take on common shape

September 16 2010

When fish or tiny, shrimp-like krill get together, it appears they follow the same set of "rules." According to a new study published online on September 16th in *Current Biology*, shoals of fish and swarms of krill hang out in groups that take on the same overall shape; it's not a simple sphere, a cylinder, or ovoid, but something more akin to an irregular crystal, the researchers say.

"The fact that several species of fish and krill that live in very different locations -- from the tropics to polar oceans -- form shoals that are the same shape suggests that the same forces are at play in diverse ecosystems; there is a common 'rule' for shoal shape," said Andrew Brierley of the University of St Andrews in Scotland.

Of course, many types of animals live or travel in groups: deer herd, bees swarm, and birds flock, Brierley said. Marine animals do this too, but the details of their behavior have been much less known, given the difficulty of observing them in their undersea surroundings.

In the new study, Brierley and his colleague Martin Cox relied on multibeam sonar to record the three-dimensional structure of Antarctic krill swarms. Those studies showed that the krill maintained a fixed surface area:volume ratio (approximately 3.3 m?1), even as the overall size and density of the group varied greatly. Studies of fish, including sardines and anchovies, from diverse locations turned up the very same pattern.

That came as quite a surprise, Brierley said, because "there are not many 'rules' in biology, and straight-line relationships are not at all common."

In an attempt to work out why this shape emerges, the researchers turned to computer modeling. And the answer appears to be rather simple: That shoal shape can be explained by a model in which individual fish and krill juggle only their access to oxygen-rich water and their risk of being eaten by predators.

Brierley said that he expects this pattern will prove very general, although there will surely be exceptions. But changes are in store.

Oxygen availability is a major driver of shoal shape, and oxygen concentrations in the world ocean are declining as the ocean warms, Brierley explained. That means that shoals will have to adapt accordingly. Specifically, as oxygen dwindles, shoals would be expected to shrink in size or become less densely packed. And that may have practical consequences.

"The ease (or difficulty) with which fishermen can catch pelagic fish and crustaceans—catchability—can vary as a function of shoal size, so understanding the response of shoals to changing oxygen concentration will be of commercial as well as ecological importance," the researchers wrote.

Provided by Cell Press