You don't call, you don't write: Connectivity in marine fish populations

March 25 2009

Children of baby boomers aren't the only ones who have taken to setting up home far from where their parents live. A new study published this week in the *Proceedings of the National Academy of Sciences* documents how larval dispersal connects marine fish populations in a network of marine protected areas - information that is critical for fisheries managers.

"What this study does for the first time is to demonstrate that a percentage of larvae spawned on one marine reserve actually make it to another marine reserve up to 35 km away," says Simon Thorrold, co-author of the study and a senior scientist in the Biology Department of Woods Hole Oceanographic Institution.

Thorrold and his colleagues from the French National Center for Scientific Research and James Cook University in Australia studied the clownfish (*Amphiprion percula*) in Kimbe Island, New Britain, Papua New Guinea. This coral reef fish is the same species as Disney's famed Nemo, but real clownfish have a far different life history than animated ones. Clownfish parents live in a particular sea anemone and spawn eggs that are attached to the seafloor. About a week later, larvae hatch from the eggs and spread their fins, making their way into the great, open ocean.

Until now, the question of just how far and wide these larval fish travel, or disperse, has been the subject of much theoretical modeling, but very little empirical evidence. After about two weeks, juvenile clownfish find a comfortable-looking sea anemone, set up housekeeping, and settle in with a mate for the rest of their lives.

Using a technique related to DNA fingerprinting called DNA parentage analysis, Thorrold and his colleagues studied genetic markers in more than 500 potential clownfish parents from Kimbe Island and 400 newly settled juveniles from Kimbe Island and surrounding marine reserves. Astonishingly, they were able to identify the parents of 30 percent of the juveniles. Thorrold adds, "It is by far the biggest application of DNA parentage analysis on fish populations in the marine environment."

This DNA parentage analysis allowed Thorrold and his colleagues to map and calculate the dispersal of 122 clownfish with detail never before achieved in the marine fish populations. Because they knew the exact locations of both the natal anemone and the anemone in which the juvenile settled, dispersal was simply the distance between those two hosts. According to Thorrold, "Our accuracy of dispersal is as accurate as the GPS measurements of the anemones."

Thorrold and his colleagues found juveniles as far away as 35 km from their natal lagoons. These wayward offspring play an important role in the ecosystem, contributing to the resilience of populations in distant reserves. The propensity for long-distance travel affects more than just a few meandering larvae: long-distance dispersers accounted for up to 10 percent of the populations they joined.

The study also showed surprising consistency in the proportion of juveniles returning to the lagoon where they were spawned. Regardless of time of year, species of anemone, or natal lagoon, 40 percent of the juveniles seemed somehow hardwired to settle close to their parents, the literal apple not falling far from the tree. These offspring also play a key role in population dynamics, sustaining the populations in the lagoons where they were spawned.

The research has significant implications for management of marine protected areas (MPAs), which are regions where fishing is prohibited. Implementation of MPA networks are widely recommended by policy makers as a way to conserve biodiversity in marine environments and as a hedge against over-fishing. However, as Thorrold points out, "Honestly, the policy has gotten a bit ahead of the science. What's important about this study is that it brings a scientific and quantitative understanding to the design of marine protected areas."

In the ecological terms, connectivity doesn't refer to how many wireless devices one owns, but rather the exchange of individuals among geographically separated populations. Setting up MPA networks to optimize connectivity is something policymakers grapple with. Thorrold describes this as The Goldilocks Effect. Create an MPA that's too small and too few larvae settle within the MPA to sustain the population. Create an MPA that's too big and all the juveniles remain in the reserves, out of the bounds of commercial fisheries. The trick is to create an MPA network that's just right.

Based on the accurate dispersal data from the study and the distances between marine preserves in Kimbe Bay, Thorrold notes, "This is the first indication that networks of marine preserves might actually function as we hoped." He adds, "Connectivity in the marine environment is such a hot topic because you really need to know [dispersal] information for effective conservation, but we have not had it up to now."

Thorrold and his colleagues are currently expanding their work to include species that spawn eggs directly into the pelagic ocean, like the commercially important groupers and snappers. Thorrold also recognizes that the DNA parentage analysis that he and his colleagues have performed around Kimbe Island is custom made for addressing fundamental questions about the evolutionary factors that established dispersal patterns in marine fish.

Hold the phone line, your kids may not be calling, but Thorrold and his colleagues are dialing in answers.

Source: Woods Hole Oceanographic Institution

Citation: You don't call, you don't write: Connectivity in marine fish populations (2009, March 25) retrieved 5 May 2024 from https://phys.org/news/2009-03-dont-marine-fish-populations.html