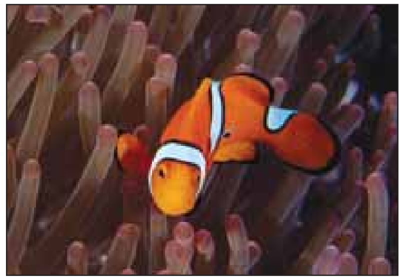
Ocean acidification causes fishy behavior

Virginia Gewin

As oceans absorb increasing atmospheric CO_2 emissions, waters become more acidic and may cause a wider range of problems for marine organisms than first anticipated. Scientists have documented how the lower saturation of calcium in low pH waters hinder shell-building in some species. Unexpectedly, though, it seems some organisms' brains are also altered by acidified seas.

At the Third Symposium on Oceans in a High CO_2 World, held during the last week of September in Monterey, CA, tropical reef biologist Philip Munday (James Cook University, Townsville, Australia) reported that marine fish exposed to high CO_2 levels exhibit impaired behavior and olfactory sensory performance. Reef fish raised in waters exposed to high CO_2 levels (at 850 microatmospheres [μatm]) take greater risks – such as venturing farther from corals or boldly re-emerging after a predator scare.



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Clownfish take greater risks in lower pH waters.

More worryingly, they even become attracted to predators.

Munday and colleagues hypothesize that the acidified waters disrupt neurotransmitter function in species that use bicarbonate and chloride ions to regulate their internal acid–base balance, potentially causing a flip from inhibitory to excitatory responses. Munday says the tipping point at which behavior problems occur appears to be around 700 parts per million CO_2 for many species. So far, his team has documented impacts on neurotransmitter function in two species – the orange clownfish (*Amphiprion percula*) and a damselfish (*Neopomacentrus azysron*) – but evidence suggests other species could also be affected.

Also at the conference, Tae Won Kim, a postdoctoral researcher at Monterey Bay Aquarium Research Institute (Moss Landing, CA), presented evidence of behavioral impacts of high CO_2 on hermit crabs. Kim exposed hermit crabs collected from the ocean floor to pH of either 7.1 or 7.6 and found the time to prey detection increased in the crabs exposed to lower pH conditions. Moreover, Kim says crabs exhibited higher O_2 consumption in low pH conditions, which might be related to acid–base regulation, a focus of his future research.

On a hopeful note, some species may be able to acclimate to acidifying conditions over time. Munday's postdoctoral student Gabrielle Miller (Townsville, Australia) presented evidence that juvenile cinnamon clownfish (*Amphiprion melanopus*) from parents reared under high CO_2 conditions (1000 μatm) had similar size and survivorship as compared with juveniles raised under control conditions (430 μatm). "Some species might have a greater capacity to adjust to ocean acidification than we previously thought possible", says Munday. ■

Are bigger turbines better?

Alison Gillespie

The wind industry is growing, and so are measurements of the turbines used to produce electricity. A study published in April (*Environ Sci Technol* 2012; doi:10.1021/es204108n) concludes that larger turbines may make "greener" power. Questions remain, however, about the turbines' impact on wildlife.

The study, led by Marloes Caduff of the Institute of Environmental Engineering in Zurich, Switzerland, first establishes that the average size of commercial turbines is increasing rapidly. Then, using a life-cycle analysis, her team concludes that the larger the towers become, the less global-warming impact they tend to cause. There are two reasons for this. New materials tend to make the large turbine blades more efficient without increasing their mass. Economic pressures also increase the general knowledge base across the entire wind energy sector, which leads to more effective designs.

Caduff's work did not address associated wildlife impacts, although there has been growing concern about that aspect of wind power in recent years. "The higher into the air you go, the closer you get to a really dense layer of bird migrations", notes Andrew Farnsworth, a researcher from the Cornell Lab of Ornithology (Ithaca, NY). Currently, the largest turbines measure approximately 90 m in diameter, but future units may stretch to as wide as 300 m.

"All turbines kill bats", says Ed Arnett from the Theodore Roosevelt Conservation Partnership (Fort Collins, CO). Big turbines may increase the puzzling and often fatal attraction that the animals seem to have for these structures. But the use of one big turbine instead of several smaller ones could not only decrease the overall mortality rate of bats but also generate the same amount of electricity across many hectares. However, only scant data are available on the topic, he cautions.

Caduff also warns against extrapolating her findings to make judgments about the giant turbines slated for the future. If those are built, she explains, there will likely be a need for a new analysis to include increases in blade size, foundations, and bases at each station, among other factors. "Forces acting on the turbines at that size may be extreme", she warns. ■