EBM Toolbox: Avoiding tipping points for ocean ecosystems

Tipping points are critical points in a situation, process, or system after which a "significant and often unstoppable effect or change takes place." Passing tipping points in human societies can lead to both desirable and undesirable outcomes. However, passing tipping points in marine ecosystems generally has devastating consequences for overall ecosystem health and function, and therefore for the human communities that depend on those ecosystems.

A classic example of an ocean ecosystem reaching a tipping point is the transformation of Southern California kelp forests into "urchin barrens." In the 1800s, humans hunted sea otters in the region to near-extinction for their furs. The decline of the otter population, a major predator of sea urchins, enabled sea urchin populations to surge. The urchins then overgrazed the kelp, denuding the kelp forests that had previously supported large fish populations. Other examples where multiple factors such as excess nutrient or sediment runoff and overfishing led to tipping points include the eutrophication of and resulting dead zones in the Chesapeake Bay in the eastern United States, the collapse of coral reefs in Discovery Bay, Jamaica, and a massive seagrass die-off in Florida Bay in the southeastern United States.

So how do you know when an ocean ecosystem is nearing a tipping point, and how do you avoid them? And what can you do if you’ve already tipped?

The Ocean Tipping Points collaborative, a team of researchers from around the world, has been working on these questions for the past five years. According to Carrie Kappel – the project’s principal investigator, based at the National Center for Ecological Analysis and Synthesis at the University of California Santa Barbara – it’s not always straightforward to determine whether an ecosystem is about to cross a tipping point. But her team’s research has found that certain indicators are frequently associated with tipping points. Ecological changes, such as a dramatic decrease in fish density or a significant shift in the ratio of coral cover to algae, can indicate a looming tipping point.

Social factors can also provide clues and therefore warrant attention. "Oftentimes social or economic shifts - such as a dramatic increase in fishing effort due to the introduction of a new technology or the opening of a new market for a species - can foreshadow the collapse of a fished species and ecosystem resilience in advance of ecological shifts," warns Kappel.

And what if an ecosystem has already "tipped"? Kappel notes that in places where managers have introduced threshold-based measures to better monitor and limit fishing and runoff from nearby agricultural and urban areas, they have seen some success in restoring ecosystem health. She cautions that "it’s an uphill battle once you’ve crossed that tipping point, however."

New tools and resources for dealing with tipping points

To help marine managers predict, prevent, and recover from dramatic ecosystem changes, the Ocean Tipping Points collaborative has just launched a new web portal with a wide range of tools and resources covering scientific, policy, and legal aspects of ocean tipping points. Some key resources include:

- A short primer on what tipping points are
- A guide for incorporating ocean tipping points knowledge into management, including guidance specific to water quality management, fisheries management, restoration efforts, and ecosystem-based management
- Analytical tools for detecting regime shifts and analyzing early warning indicators
- In-depth case studies where scientists and managers are applying these tools and resources
- Scientific research publications on ocean tipping points.

In addition, the Ocean Tipping Points collaborative has started a new community of practice that allows ocean conservationists and managers to post questions and connect with colleagues to share knowledge and resources.

Future work

In the coming months the collaborative will be publishing more of its work on drivers of change in coral reef ecosystems and the role of effective monitoring to avoid tipping points. Also, from November 1-3, 2017, in Santa Barbara, California, they will be hosting an all-expenses-paid workshop to help practitioners start applying tipping points science and tools in local systems and management contexts. [Learn more about the workshop and how to apply.]

Learn more about Ocean Tipping Points on October 19

Learn more about ocean tipping points and the Ocean Tipping Points collaborative’s tools in a webinar on Thursday, October 19, at 1 pm EDT/10 am PDT/5 pm UTC. Learn more about the webinar and register at https://attendee.gotowebinar.com/register/3527183109379841891.