# THE RELATIONSHIP BETWEEN FISHERIES AND COASTAL RESTORATION

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QUESTION 4

## WHAT WILL BE THE FATE OF GULF FISHERIES WITHOUT RESTORATION IN LOUISIANA?

Gulf of Mexico fisheries, worth hundreds of millions of dollars, largely depend on Louisiana's wetlands as nursery grounds. We considered whether large scale restoration efforts would benefit gulf fisheries or whether, as some suggest, it is already too late to save this resource.

## OUR ANALYSIS

We may be shooting at a moving target as we seek to understand a complex ecosystem that is experiencing large scale and rapid changes in fish habitat (much of which is human induced) against the backdrop of longer time scale changes caused by climate change and natural delta cycles. That said, a few thorough reviews on the subject allowed us to speculate about how the loss of habitat in Louisiana may impact fisheries production. We believe, as do the authors of reviews we considered, that it is not useful to consider the impacts of coastal wetland loss independently from other habitats in the estuarine ecosystem. Instead, it is important to view impacts on fisheries through the lens of the estuary as a whole.

## WHAT THE SCIENCE SAYS

Perhaps the most perplexing aspect of the Mississippi River Delta ecosystem, given environmental insults that the system continues to endure, is the apparently robust state of the region's fisheries. One potential hypothesis proposes that marsh edge is critical habitat for many species, and that fisheries will not decline until the quantity of marsh edge declines. During marsh loss, the amount of marsh edge initially increases and then declines as healthy marsh is converted to open water. The temporary increase in marsh edge, which occurs as the marsh breaks up, may mask the immediate impacts of habitat loss on fisheries landings. Another related hypothesis considers that marsh edge is not the critical habitat per se, but serves as the essential conduit for essential fisheries food sources. Under either hypothesis, it is possible that marsh loss is actually having a positive impact, at least for now.

It is difficult to predict how fisheries productivity in Louisiana and the northern Gulf will change in response to environmental conditions. However, examples from Europe and our own research experience suggest that failure to stop wetland loss will have big impacts not just on wetlands but on the overall estuary. Today, the estuary provides a complex mixture of habitats. More than 75 percent of the species that support fisheries in Louisiana are estuarine resident or dependent, meaning that these species need the combinations of habitats found in the estuary to support their life cycles. Continued wetland loss is likely to convert this web of diverse estuarine habitats into a system dominated by a few marine species. These species would use the estuary as a feeding ground but would not depend on it to complete their life cycles. If loss is not addressed, therefore, it is likely to end badly for the fisheries of the Sportman's Paradise.

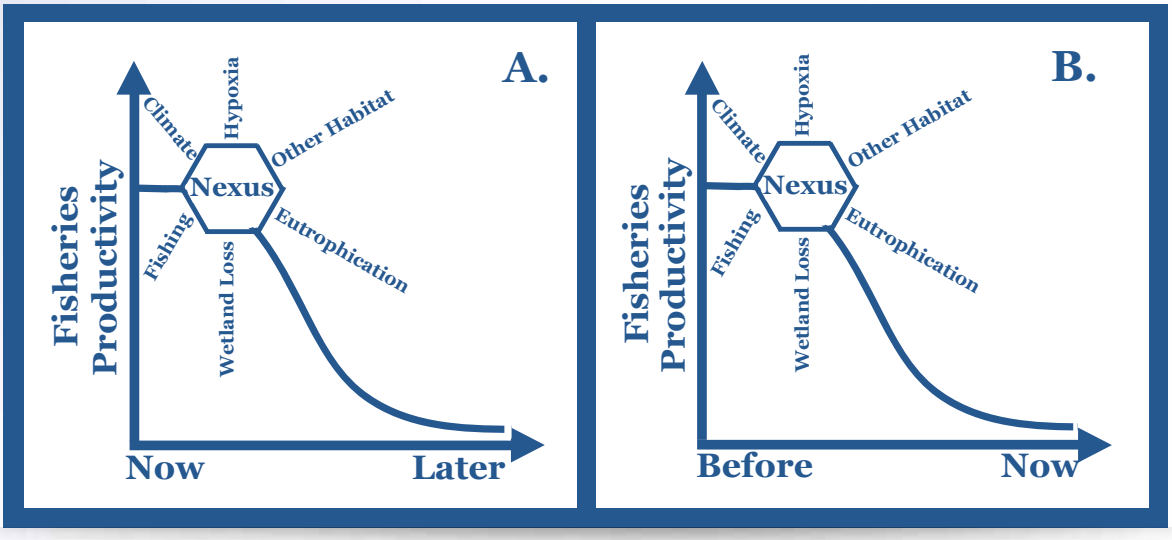


**Figure 1**: The history or, perhaps, future of fisheries productivity in Louisiana, and presumed causes for change. Panel A assumes that the fisheries remain intact and near historical highs, but that we may be headed toward a steep decline if cumulative impacts reach a tipping point. Panel B assumes that Louisiana fisheries have already declined below historically higher levels because of overfishing. Author drawn graphs (Scenario A and B), Cowan et al., 2008.

We may have reached, or are approaching, an important nexus in the history and/or future of fisheries productivity in the northern Gulf of Mexico (Figure 1).

If Panel B is true, the path forward may simply be more conservative fishing regulations. If Panel A is correct and future declines in fisheries productivity are inexorably linked to further declines in the Mississippi River ecosystem's ability to provide a complex web of habitats, the path forward will much more complicated. It is the latter possibility (Panel A) that we believe is most likely if restoration does not take place and if fisheries reach a tipping point of habitat loss and water quality decline.

Given the importance to fisheries of stopping wetland loss, the basic question remains: can we steer a degraded ecosystem towards some alternate steady state that resembles an historical baseline? It is possible, we believe, that restoration activities that are being proposed in Louisiana, including large scale sediment diversions, may be able to do just that. We base this assertion on the ability of large scale reintroduction of Mississippi River sediments to significantly shift the ecological baseline back toward more robust conditions in the short term, and toward less degraded baseline conditions in the longer term.

As we consider how Louisiana's coast/delta will react to restoration, two futures are possible. We could consider that Louisiana's delta is experiencing bottom up changes. Bottom up refers to those attributes of the ecosystem that affect fisheries productivity, such as loss of habitat and changes in food availability. When these bottom up changes occur, the ecosystem experiences a regime shift that affects a wide variety of species. One future could be that the Louisiana coastal ecosystem experienced a bottom up regime shift when large scale levees were built on the Mississippi River, and when oil and gas exploration began in earnest.

Perhaps the most well studied example of this type of regime shift is the eastern Pacific Ocean's response to changes in climate. These changes affect Pacific coastal ecosystems such that during cold regimes anchovies are favored, and during warmer periods sardines are favored. After each shift, the ecosystem reverts to an alternate steady state, followed by the system's recovery to nearly the state it had prior to the climate change. If the Louisiana coastal ecosystem responds to restoration as has the north Pacific to climate variability, restoration efforts may be able to restore ecosystem goods and services, including fisheries productivity.

A second future would be more difficult to manage. This future is one in which Louisiana continues to experience top down changes brought about by humans, such as fishing, habitat modifications, and pollution. In such cases, the altered ecosystems do not always return to their pre-disturbance condition, even when restoration actions are undertaken. In effect, these top down disturbances change the very baseline of the ecosystem. If this is the path Louisiana's coastal ecosystem takes, it does not bode well for fisheries.

Georges Bank in the North Atlantic represents the most notable example of a shift in the ecological baseline of a fisheries ecosystem. Long term overfishing of ground fish stocks spurred a reorganization of the Georges Bank food web, and more desirable species were replaced. Despite a concerted, ten year reduction in fishing pressure, the Georges Bank fishery has failed to recover overall, although the level of recovery is highly species specific.

In degraded systems, like Louisiana's delta, species often react differently to restoration actions. Some species, or even groups of species do not respond as expected. Will the Louisiana coastal ecosystem and its related fisheries respond to restoration efforts as if the region has experienced a bottom up regime shift? Or will the ecosystem respond as if it had experienced a top down shift in the ecological baseline?

We have reason to be optimistic even though we expect some components of the ecosystem to recover more slowly then others as wetlands are restored. Our optimism is based upon the premise that the current degraded condition of Louisiana's coastal wetlands, although driven by human activities from the top down, reflects changes that mimic a natural and short (less than 100 year) interruption in a cycle of delta creation and decay that normally takes hundreds to thousands of years to complete. As such, large scale restoration efforts to divert Mississippi River sediments back into degraded areas should begin the delta cycle anew and help the system reset to prior conditions. Delaying restoration efforts could reduce the likelihood and expected rates of ecosystem recovery.

## IMPLICATIONS FOR POLICY MAKERS

There is much uncertainty about how the various factors affecting fisheries, including restoration actions, will interact. We do know that different species will react in different ways to landscape changes. However, our analysis supports the claim that the large scale sediment diversions being considered for Louisiana's coast have a good chance of supporting a future of fisheries productivity because they may allow the ecosystem to reset to a more sustainable baseline. The status quo, on the other hand, will likely lead to a reduction in gulf fisheries productivity and the many human communities that depend on them.

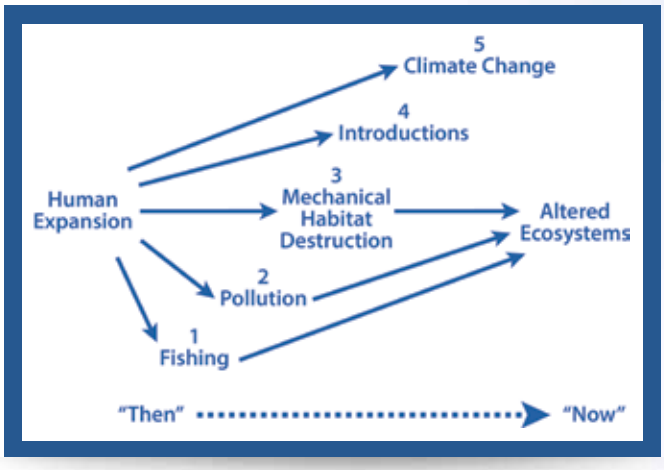


**Figure 2**: Examples of top down controls induced by human expansion resulting in altered ecological baselines. From Jackson et al. 2001; reprinted with permission from AAAS.

- Because it could eliminate most coastal wetlands, climate change poses a severe threat to fisheries. Practically all intertidal habitat used by fishery species will likely be gone by the end of the 21st century without an aggressive restoration program. Large scale restoration will cause shifts in the locations of the major fisheries, but it may be the only hope for maintaining sustainable fisheries.

- Rising fuel costs are already affecting fishing, and continued increases may make fishing as presently carried out unsustainable. It is unclear how the fishing industry can adapt to these challenges. It may be that fisheries will have to change to more energy efficient methods such as butterfly nets versus trawling. Increased energy costs may increase the price of imports compared to local fisheries. For example, when oil prices reached nearly $150 a barrel, the U.S. steel industry became competitive with Chinese imports because of increased shipping costs.