McKee & Rooth

Global Change Biology (2008)

Runtime: 4:52 min

[scene: mangrove-salt marsh]

McKee>> So we're here in coastal Louisiana, which is in the Mississippi River Delta. And we're in a mangrove-salt marsh plant community. This is a wetland that is dominated by two saline species…that is plants that can tolerate salt water. And what we have here is the black mangrove…and it is a tropical tree and it occurs at its northernmost limit in here in North America, here in Louisiana at this location. And it's growing intermixed with a salt marsh species, which is a temperate plant, which is called Spartina alterniflora, or smooth cordgrass. In this location, the two species, their distributions converge, and here the two species are competing for space.

[animation]

Voice-over>>Air and sea-surface temperatures determine the distributional limits of coastal plants such as temperate salt marsh grasses and tropical mangroves. Where such vegetation types overlap are key locations to study effects of climate change and elevated CO_2, particularly where the overlapping species are C3 versus C4 types. And that's the case with this salt marsh-mangrove community in the Mississippi River Delta.

[photo montage]

Voice-over>>We hypothesized that as atmospheric CO2 concentrations increase in the future, Avicennia, which is a C3 species more responsive to CO2, will have an advantage compared to Spartina, a C4 grass that is less responsive. We further predicted that increased nutrient input to these wetlands would favor mangroves by enhancing their capacity to respond to CO2. The effect would be to shift the competitive advantage in favor of the black mangrove, leading to a shift in dominance from Spartina to Avicennia.

[photo montage]

Voice-over>>We tested these predictions in a controlled greenhouse experiment in which we subjected mesocosms containing the two species alone and in mixture to ambient or elevated CO2, as well as to low or high soil nitrogen.

We found that CO_2 stimulated *Avicennia*'s growth, as predicted, but this occurred only when grown alone and when soil nitrogen was high. Mangrove growth was strongly suppressed in the presence of *Spartina*, and CO_2 and N enrichment could not reverse this suppression—at least not under the conditions of this experiment. We confirmed this suppression by Spartina under natural conditions by transplanting mangrove seedlings exposed to higher CO2 back into the field.

[photo montage]

Voice-over>>So our findings were contrary to our initial predictions and showed that higher CO2 by itself will not likely cause a shift in species dominance in this plant community…such a vegetation change will require other factors such as disturbance that reduces or removes the competing species.

Both small-scale and large-scale disturbances occur in salt marshes. For example, the deposition of dead plant material, called wrack, can smother *Spartina*, creating bare patches where mangroves can get established. Periodic droughts and other climate-related events can also cause widespread mortality of Spartina, allowing expansion of mangroves. In addition, a warmer climate will favor mangroves by reducing the frequency of killing freezes and lengthening the growing season.

[photo montage]

Voice-over>>We can see then that simple models may not accurately predict what will happen in a real world setting. They provide a starting point, however. As more experiments are conducted, such basic models can be improved to better reflect the complexity of natural ecosystems and their response to change.