

How do oil spills impact fiddler crabs?


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Abstract

Crude oil – which is used to make gasoline, fuel oils, asphalt, and some plastic products – can be toxic for many coastal and marine animals and plants when spilled in the environment. That’s why oil spills in the ocean can be a problem. We wanted to know what impact a large spill might have on fiddler crabs. These small crabs play a big role in their coastal salt marsh ecosystem, so if something harms them, other parts of the ecosystem could suffer.

We analyzed data collected by five different studies over a 4-year period in the Gulf of Mexico after the *Deepwater Horizon* oil spill. We saw that the oil spill reduced the number of fiddler crabs, likely killed many of them directly, and changed the species of fiddler crabs present in the marsh for years after the spill. Changes in fiddler crab populations may have affected other parts of the ecosystem, including marsh plant growth, soils, and predators of fiddler crabs.

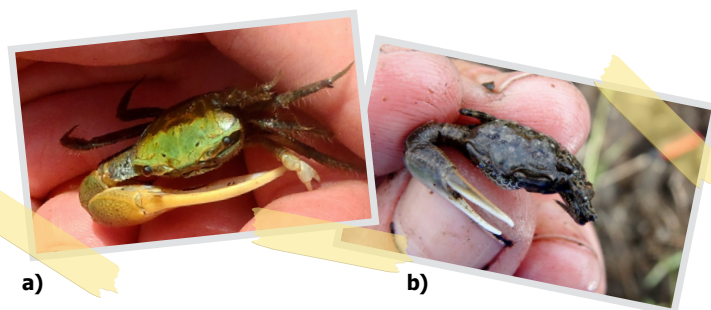
Introduction

Do you remember the *Deepwater Horizon* oil spill in 2010 in the Gulf of Mexico? It was the biggest marine oil spill in U.S. history, and one of the biggest in the world. Over 130 million gallons of *crude oil* gushed into the ocean after an accidental blowout on an *oil rig*. That’s nearly 200 Olympic size swimming pools filled with oil. When oil reaches the coast, it pollutes shoreline habitats and damages coastal vegetation and animal life. The oil from the *Deepwater Horizon* spill covered over 2,000 km (1,300 miles) of coastline.

We wanted to know how fiddler crabs living in salt marshes along the coast were impacted by the oil spill. Fiddler crabs are fairly small crabs (about the size of a quarter) that have an outstanding feature: the male crab has one claw that is much bigger than the other (Fig. 1). Although they are small in size, they have significant ecological importance:

- They live in burrows that they dig into the soil. This helps *aerate* the soil and improve plant growth.
- Crab feeding and burrowing mixes nutrients into the soil, which is also good for plants.

- Finally, the crabs are important food for many predators, such as the blue crab, fish, turtles, birds, and raccoons.



Fun fact: do you know how Fiddler crabs got their name? The name “fiddler crab” comes from the large claw of the male crab, which looked to some English colonists in America like a fiddle being held under the chin by a violinist or fiddle player.

Figure 1:

The two species of fiddler crabs:

- a)** Gulf Marsh Fiddler Crab (*Uca longisignalis*) also known by some locals as Tou-la-lou (from Louisiana French) and
b) Spined Fiddler Crab (*Uca spinicarpa*).

Methods

To understand how fiddler crabs were impacted by the *Deepwater Horizon* oil spill, we examined records from crab ecology studies along the Gulf Coast for four years after the spill.

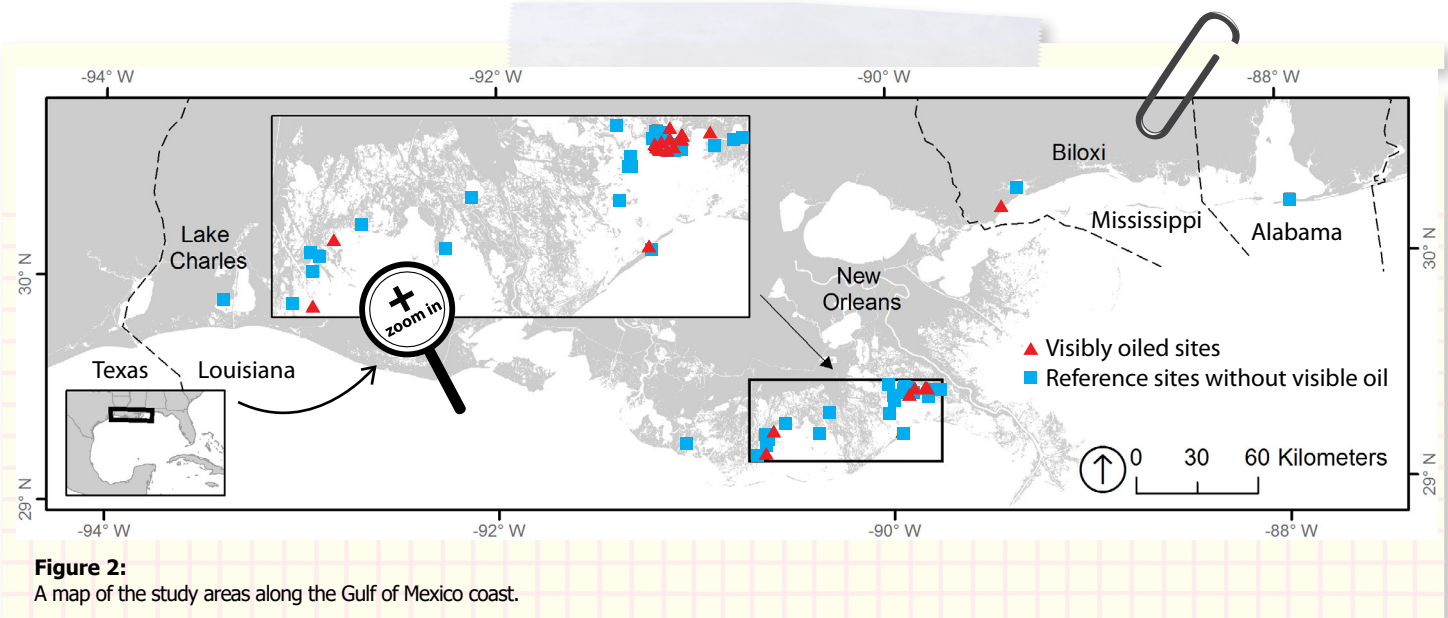
Our *hypothesis* was that the oil spill impacted three factors of fiddler crab ecology:

1. Number of burrows (which tells us the number of crabs);
2. Burrow size (which tells us the size of the crabs);
3. Crab *species composition* (how many of each different crab species are present).

For each factor, we compared data from sites that were visibly

oiled to reference sites without visible oil. All study sites were located in salt marshes in the Northern Gulf of Mexico, in the states of Louisiana, Mississippi, and Alabama (Fig. 2).

Counting burrows is a good way to estimate the number of crabs (their *abundance*). It's much harder to try to dig out and count every single crab – plus the process would destroy their burrows and damage the marsh. Therefore, in the studies which involved catching individual crabs and identifying them, the animals were caught mainly on the marsh surface or at the entrances of their burrows. Crabs in this study were returned to the marsh after they were identified and counted.



Results

Our analysis shows that the *Deepwater Horizon* oil spill harmed fiddler crabs living in the affected areas, which generally confirms our hypothesis (Fig. 3). The spill:

1. Reduced the number of crabs living in the salt marsh study areas by more than a third overall;
2. Reduced the size of the crabs for a short period;
3. Changed the types of crabs that were living in the area before the spill. The Gulf Marsh Fiddler Crab (*Uca longisignalis*) is normally the dominant crab in salt marshes, but after the spill, the Spined Fiddler Crab, (*Uca spinicarpa*)

was more common in oiled areas.

We found most of these changes not just along the seaward edge of the shoreline (where most oil from the spill occurred) but also 15 m (roughly 50 feet) inland into the marsh. The change in crab numbers and species composition persisted for at least three to four years after the spill.

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see Figure 3 on Page 3**

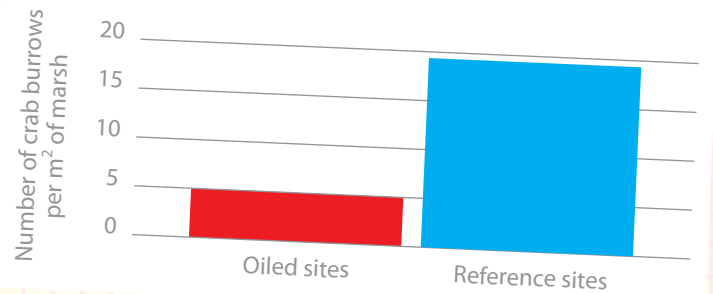


Figure 3:

Average burrow density (i.e. number of crab burrows per unit area) from a dataset collected in 2014 in Louisiana.

What conclusion can you draw based on these data?

Discussion

The spilled oil that arrived at the marsh probably killed many fiddler crabs directly, by smothering and perhaps poisoning them. This reduced the number of crabs overall. In the years after, we'd expect to see younger, smaller crabs, which would grow up to adults over time. Indeed we saw smaller crabs (actually, smaller burrow sizes) in the oiled areas in the years directly after the spill. But this change was only temporary and burrow sizes went back to reference levels after the young crabs grew to their adult size. The increased dominance of

the Spined Fiddler Crab could be a result of changes in the habitat. We think that this species may prefer areas with less vegetation (like the oil-impacted marshes).

Because of fiddler crabs' important role in the marsh ecosystem, other things like plant growth or the crabs' predators could also be affected when the crabs are harmed. Therefore, the presence and well-being of fiddler crabs can serve as a good indicator of the general health of the marsh ecosystem.

Conclusion

Why should you care about fiddler crabs? Do you like to go fishing or do you enjoy seafood? Fiddler crabs and marshes are important to fish and shellfish that humans like to catch and that we use for food. Fiddler crabs also promote marsh plant growth that is important for the protection of coastal cities from hurricanes.

What can you do to protect marshes or reduce oil spills? Using less gasoline and plastic products made from crude oil could be one solution. The less oil we use, the less of it needs to be drilled from the ocean, and the less chance of spills.

REFERENCES

Scott Zengel, Steven C. Pennings, Brian Silliman, Clay Montague, Jennifer Weaver, Donald R. Deis, Michelle O. Krasnec, Nicolle Rutherford and Zachary Nixon (2016) *Deepwater Horizon* Oil Spill Impacts on Salt Marsh Fiddler Crabs (*Uca* spp.). *Estuaries and Coasts* 39:1154–1163.

<https://link.springer.com/article/10.1007/s12237-016-0072-6>

How does oil impact marine life? NOAA

<http://oceanservice.noaa.gov/facts/oilimpacts.html>

Learn more about the fiddler crabs!

http://www.chesapeakebay.net/fieldguide/critter/fiddler_crabs

<http://www.fiddlercrab.info/>

Glossary of Key Terms

Crude oil (or petroleum) – is a naturally occurring liquid found in geological formations beneath the Earth's surface, which can be turned into various types of products such as gasoline, fuel oils, asphalt, and some plastics. It is called a fossil fuel because it is formed by millions of dead organisms (fossils) that have been buried underground for a long time and under heavy pressure.

Oil rig – An oil rig is a platform standing or floating in the ocean which is used to drill underground to extract oil. The *Deepwater Horizon* oil rig was actually a semi-submersible vessel rather than a standing platform.

Salt marsh – a coastal grassy wetland that is flooded by salt water brought in by the tides, often mixed with freshwater runoff from rivers as well.

Abundance – the amount of a species (like the fiddler crab) in a given area.

Species composition – describes how many different species of animals (in this case: fiddler crabs) or plants live or grow in a certain area, and the abundance of these different species relative to the total number of animals present. (how many % of species x, and how many % of species y and z etc.).

Hypothesis – a proposed explanation for a phenomenon (an observed fact or observation). A scientific hypothesis needs to be able to be tested and disproved.

Aerate – introduce air or oxygen into something. For instance, the fiddler crabs burrow holes into the soil – this allows oxygen in the air and water to get deeper into the soils, making it easier for plants and associated microbes to grow. This is important because wetland soils that are frequently flooded can have low oxygen levels below ground where the plant roots are.

Check your understanding

1 Fiddler crabs are invertebrates. That means they do not have a backbone (that's made out of vertebrae). Does this mean they don't have a skeleton?

2 What important services do fiddler crabs provide for their ecosystem?

3 Why do you think adult male crabs have such a large claw? What could be the purpose of it? And can you think of any other animals that have structures with a similar purpose?

4 People are drilling for petroleum because we all use products that are made of it, like gasoline, heating oil, asphalt (for roads), and plastics. How could you personally reduce your petroleum consumption?
