Team 19

Barranca Mesa Elementary Effect of Oil Spills on Marine Life Anna Zerkle, Jing Xie, Eliana Riciputi

Problem statement

We want to see how marine life is affected by oil spills and what sorts of things can change the result of an oil spill. We want to learn about what happens to various animals in marine life including birds. One of the main reasons we chose this topic is because we are worried about marine life. We want to find out how the affected marine life can be helped and how much time there is to do it before the marine life all dies. For example, does it matter how long it takes to clean up oil out of the water? We have done research on how marine life is affected and how different ways can be used to clean it up, like containment booms and oil skimmers.

We hope to learn if marine life is affected most by direct poisoning from the oil or poisoning from the food they eat that has been tainted by the oil. We also want know what part of the food chain is mostly hurt by oil spills. We would like to research past oil spills and their impact, different plant and animal effects, and past clean-up efforts and effects. We will study the internet for information about marine life, including fish, plants, birds, and mammals.

We will use StarLogo TNG to try to model all this and get results. We would like to learn about programming as we go along.

Oil spills can harm the fish, making them not able to reproduce, so their species could die off. Birds feathers could get really slimy, making them not being able to fly.

Persistent oils contain a good amount of heavy fractions or high-boiling materials, and has toxicity to marine animals. Shoreline cleanup has to be well organized or the situation could turn out to be worse. It is usually carried out in stages, starting with removing the heaviest of the oil. Containment is when you put out booms in the water to keep the oil from spreading. The environment cleans only ten to fifteen percent of the oil spill naturally by evaporation, dispersion, dissolution, and sedimentation.

Computational and Mathematical Agent-based Model

We model the oil spill and marine life using StarLogo TNG. The model has agents for the oil, the fish, the birds, and the plankton. We have one island in our model, surrounded by ocean. The oil spill happens right by the island. Here are the basic rules for the agents in our model:

- birds always fly near the island.
- birds stay alive so long as they don't touch too much oil.
- birds can be rescued if they get oil on them.
- oil spreads out on the surface of the ocean.
- oil can be contained near the island.
- oil can be removed from the ocean near the island.
- plankton swim around in the ocean.

- plankton die when they touch oil, then sink to the bottom.
- plankton reproduce continuously.
- fish swim around in the ocean losing energy.
- fish eat plankton.
- fish gain energy when they eat healthy plankton.
- fish lose energy when they eat plankton killed by oil.
- fish lose energy when they touch oil.
- fish reproduce if they have enough energy.

By varying parameters for these rules in our model, we could learn what affects the animal agents, what kills them, or how they can be saved.

<u>Code</u>

We wrote our computer program using StarLogo TNG. We found two projects on the Starlogo TNG website that will help us get started; the epidemic simulation, and the fish and plankton simulation. The epidemic simulation did not help very much, but we use parts of the fish and plankton code in our model. We had to add birds and oil and all the rules.

🔅 StarLogo TNG: StarLogoBlocks - Oil Spill3		
File Edit Options Window	Help	
Factory My Blocks	Edit Breeds	Search blocks
Setup and Run		Fish BirdsPlan(Oil 18
Fish Birds Forever Plankton	Spread Oil test abs xcor max abs ycor ≥ 55 then ifelse set heading towards ycor 0 0	
Oil Tree	else set heading random 360 forward steps 0.5	
seos Fish Birds	oil Remove Oil	
Movement	random 50 = 1 and abs xcor max abs ycor //	
Traits		
Logic		

Figure 1 StarLogo screen with the oil spreading and removal Procedures.



Figure 2 StarLogo screen showing the Forever loops.

Figure 1 shows an example of the oil agent procedures. The first one is for oil spreading, and shows how it can be contained. It is contained if the IF test has a number less then 50, so the oil stays in a box near the middle of the space where

the island is. Figure 2 shows the Forever loop that tells all the agents what Procedures to do.

Results and Conclusions

We ran a whole bunch of cases to see what things matter the most. To start we just let the fish swim around eating plankton with no oil. There were about 300-400 fish alive after things settled down. Next we let the oil spread around and poison plankton, but not fish or birds. All the fish eventually died because they didn't have enough plankton to eat. Next we let the fish be poisoned by touching oil and eating poisoned plankton. All the fish still died, only faster. Next we contained the oil to a box 30 x 30 near the island. all the fish still died, but it took pretty long. We made the box smaller (14x14), and then the fish survived, but had a smaller number alive, which was about 200-250. If we contained the oil in a 30 x 30 box, then skimmed oil out of the box, the fish survived and went back up to 300-400 after all the oil was gone. If we just let the oil spread around, but removed it near the island, the fish survived at a small number for a while, then ended up back at 300-400. If you don't remove the oil fast enough, all the fish still die.

Trying to rescue the birds did not work. If there is still oil around, the birds still die. We have to clean off every bird all the time to keep them alive. Containing the oil doesn't help. The birds stay near the island anyway, and get slimed. The only way to save the birds was to remove the oil pretty fast, and rescue them right away.