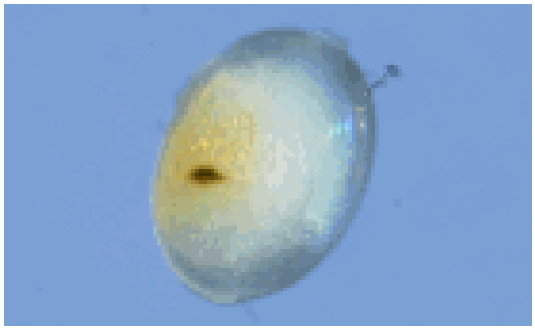
OIL IN ECOSYSTEMS

HOW OIL ENTERS FOOD WEBS

Some types of bacteria can consume and metabolize oil into its main components of carbon and hydrogen.

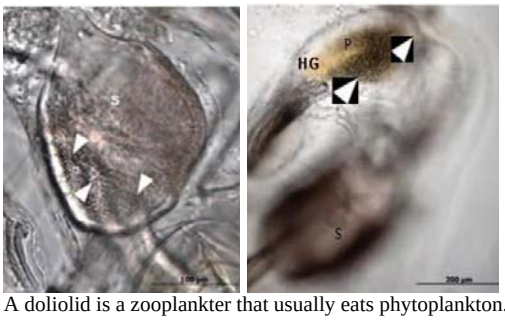
Dispersed oil is consumed faster by bacteria, but it also occurs in droplets small enough to be consumed by small animals mistaking it for food. These animals, including larvae or zooplankton such as copepods and doliolids, are eaten by larger organisms and carry oil up the food web.

During lab experiments dyed, dispersed oil was absorbed into grass shrimp eggs during their growth into larvae. It seems likely this oil will be retained in the grass shrimp through its life.



Grass shrimp egg. The dispersed oil is visible as the dark brown spot and the lighter brown color surrounding it (courtesy of Dr. Richard Lee, Skidaway Institute of Oceanography).

Small invertebrates may eat oil droplets directly. The dispersed oil droplets cannot be metabolized, so they pass through the stomach and digestive system and are deposited as feces.

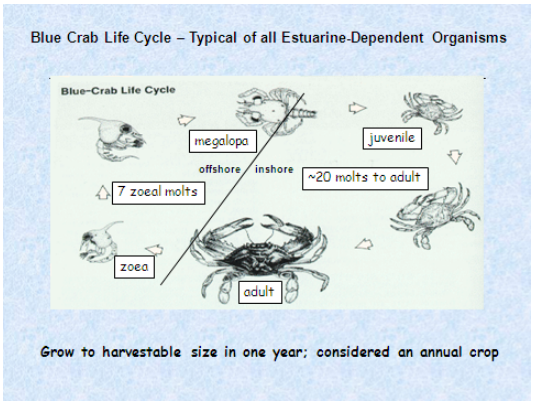


A doliolid is a zooplankter that usually eats phytoplankton. These photos show (left) the stomach of a doliolid containing oil droplets marked by arrows and (right) a fecal pellet containing oil droplets about to be released from the doliolid gut. The pellet is visible between arrows (Lee, *et al.* 2012).

From these entry points oil can move throughout ocean food webs. Fecal pellets fall to the bottom where worms, snails and crustaceans might consume them, allowing oil to be carried to both benthic (bottom dwelling) and pelagic (open water) food webs. Animals swimming in the water might be exposed to oil and dispersant and carry them to shore and into estuaries, or they may remain in the world's ocean.

INTO THE ESTUARY

Blue Crab



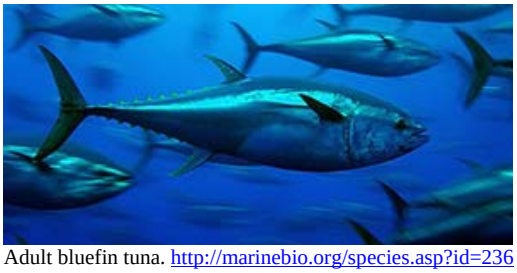
Blue crabs experience large changes in form as they develop from eggs to adults. The life stages occur in a predictable pattern as they move between estuary and offshore habitats (courtesy of Harriet Perry, GCRL).

Blue crab life stages are eaten by many organisms. The blue crab spawns (lays eggs) in the estuary near the ocean. Eggs develop into zoea and then megalopae as they float offshore. The megalopae might eat plankters that have consumed oil, or they might consume oil droplets directly. These megalopae move back into the estuary where they molt through the juvenile stages and grow to adults.

TO THE WORLD OCEAN

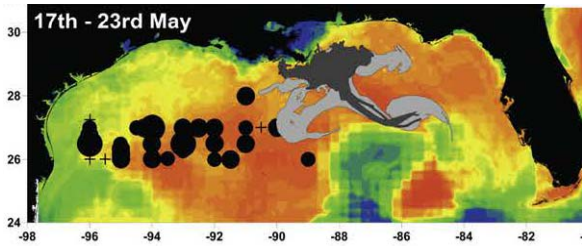
Bluefin Tuna

Atlantic bluefin tuna, an overfished species, move throughout the oceans of the world, but they only spawn in the Gulf of Mexico and the Mediterranean Sea.



Adult bluefin tuna. http://marinebio.org/species.asp?id=236

The tuna were spawning (black circles on the map below) when the oil spill occurred. Despite the likelihood that most spawning occurred outside of the areas affected by the oil spill, it is unclear whether young or adult tuna might have been affected by moving through contaminated areas.



The probability of larval tuna occurring in any Gulf location during this week in 2010 (red is high probability). The model was developed using larval tuna occurrence at known locations (shown in black dots). The oil spill is dark gray; water with a high probability of being contaminated is light gray. From Muhling *et al.* 2012.

Dr. Jim Franks of GCRL collected tuna larvae from an oiled area during the spill.

Sargassum, a brown alga that provides refuge for many fish and invertebrates, surrounded by oil during the oil spill, 2010 (courtesy of Jim Franks, GCRL).

Larval tuna collected in May 2010 (courtesy of Jim Franks, GCRL).

EATING SEAFOOD

We eat tuna, crab and finfish. Tuna and crab were directly exposed. Many fish eat crabs at all stages. Small fish eat larvae and zooplankton.

Scientific research shows oil and dispersant ingested or absorbed by small organisms can pass out through digestion (Lee *et al.* 2012). Therefore, the small food our seafood eats, with oil, is also passed through digestion.

Testing after the spill showed no oil in the muscles of any seafood we eat (Lubchenco *et al.* 2012).

Animals higher up in the food chain live longer, and it will take longer for us to know whether or how much they have been affected. There might also be long term, chronic effects that are difficult to understand.

REFERENCES

Lee, R.F., Koester, M., Paffenhofer, G., 2012. Ingestion and defecation of dispersed oil droplets by pelagic tunicates. *Journal of Plankton Research* 34:12:1058-1063.

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Muhling, B. A., Roffer, M. A., Lamkin, J. T., Ingram, G. W., Jr., Upton, M. A.,Gawlikowski, G., Muller-Karger, F., Habtes, S., Richards, W. J. 2012. Overlap between Atlantic bluefin tuna spawning grounds and observed Deepwater Horizon surface oil in the northern Gulf of Mexico. *Marine Pollution Bulletin* 64:4:679-687.

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