# Marine Science

# Brinkman

# Week 5 & 6

# Apr 27 – May 8

April 23, 2020

Hello Marine Science -

What a wild final quarter this is turning out to be? I now write this by candlelight as a Tornado has taken out my power at home. This Learning Packet is about marine reptiles and mammals. Thanks Mrs. Brinkman

| Assignment | Description |
|---|---|
| DBA-Schedule with "Lean-Marine Science" (or Call 850-601-5040) | Discussion-Based Assessment on FISH E. Unit (weeks 3+4) to go over Osteichthyes Questions |
| Q4 wk 5 #13 (pgs 3, 4 + 5) | Marine Reptiles: turtles + snakes pg 53 answer 8 questions. |
| Q4 wk 5 #14 (pgs 6 -10) | It's been ten years since the BP Deepwater Horizon oil rig spilled crude oil in our Gulf. Summarize this article. (Photos in the link.) |
| Q4 wk 6 #15 (pgs 11+12) | Killer Whale Research Summarize this article. |
| Q4 wk 6 #16 (pgs 13-15) | Watch and Summarize a Marine-Science related TED-talk You may choose the one I've included or include the link to one you find more interesting |

## Questions on Class Osteichthyes

1. Why are marine sturgeons considered to be one of the most primitive bony fishes?
2. What is the difference between a heterocercal tail and a homocercal tail?
3. What is the difference between cycloid or ctenoid scales and ganoid scales?
4. Which fins on a fish are paired? Which fins are not paired?
5. What is the main determinate of a fish's body shape?
6. Describe the following fish shapes, make a rough sketch if helpful: Fusiform, laterally compressed, flattened (also known as dorso-ventrally compressed), and globular.
7. What are chromatophores?
8. What is obliterative countershading? What types of fish have it?
9. What is disruptive coloration? Give two examples.
10. What is a swim bladder? Do all fish have swim bladders? If not, what types of fish don't?
11. What are three mechanisms fish have for eliminating excess salt?
12. Why do fish have to eliminate excess salt?
13. Most bony fish show what type of reproductive strategy?
14. Describe catadromous and anadromous fish. Give an example of each.

# Reproduction in Fish

1. What are claspers? What kinds of fish have claspers?
2. How does sperm get from the testes to the claspers?
3. How many ovaries do female sharks have? How does the egg get from the ovary to the uterus?
4. Where do the young develop in most species of sharks?
5. Describe viviparous, ovoviviparous, and oviparous reproduction.
6. What type of reproduction do most bony fish use?
7. Describe three strategies for reproduction in bony fish.
8. Describe how seahorses reproduce.
9. Describe the development of a larval fish.
10. When do fish stop growing?
11. What is hermaphroditism? Describe the two types of hermaphroditism.
12. What is the most common type of sequential hermaphroditism?

# 53
# MARINE REPTILES: TURTLES AND SEA SNAKES

In terms of both number of individuals and numbers of species, fishes are by far the most successful group of vertebrates in the sea. Reptiles, on the other hand, are represented by only a few species. Most of these are still tied to the land because they must lay their eggs on shore; three of the four reptiles discussed in this and the next plate share this requirement. Here two reptiles are introduced: the green sea turtle and the yellow-bellied sea snake.

**Begin by coloring the adult green sea turtles at the top of the page. Color the four illustrations of egg laying, hatching, and juveniles. Note that the broad tracks receive the same color as the forelimbs that created them.**

The green sea turtle, an endangered species of the Caribbean Sea and the Atlantic and Pacific oceans, is one of several species of turtle that spend their lives at sea. Others include such exotically-named species as the hawksbill, leatherback, and loggerhead. Turtles have roamed the seas since before the dinosaurs and were very successful until humans entered the picture. Many sea turtles feed on gelatinous marine zooplankton, jellyfish and such. The turtles mistake floating plastic bags and deflated helium balloons that have drifted out to sea for their prey. The inedible plastic and latex blocks the turtles' intestinal tracts and they starve to death. Many other sea turtles perish in the nets of shrimp fishermen, although a turtle exclusion device (TED) is available and effectively allows turtles to escape from the net.

Sea turtles nest on broad sandy beaches. Once every three years, an adult female green sea turtle undertakes a journey back to the beach where she was hatched to lay her own *eggs*. For some turtles, these migrations may be several hundred kilometers long. Males and females mate in the surf just offshore from the rookery. The male grasps the female with his large *forelimbs* and transfers his sperm to her, as shown in the upper drawing. After a few days, the female makes a nocturnal trip onto the beach. She pulls herself up the beach with her forelimbs, all the way to the dry sand of the upper beach. She digs a broad pit with her forelimbs and then delicately excavates a bottle-shaped *burrow* with her agile *hind limbs* (center illustration, far left). The female lays approximately 100 leathery-skinned eggs in the burrow and carefully covers them with sand. She buries the pit entirely and throws sand all about to disguise the location of the nest. Her job completed, the female returns to the sea. Her broad *tracks* left behind indicate the difficulty this turtle has in moving on land (center illustration, second from left). The forelimbs are modified into highly effective swimming flippers, but they cannot lift her bulk off the sand. Similarly, her *carapace* is much reduced and streamlined for swimming; it does not serve as a fortresslike retreat, unlike those of many freshwater and terrestrial turtles.

Before leaving the breeding grounds, the female may return to the beach to lay eggs as many as five times at 15-day intervals. The eggs incubate in the warm sand for about 60 days, and the young hatch all at once and begin to dig to the surface (center illustration, second from right). They emerge at night and instinctively find their way to the ocean (center illustration, far right). The green turtles are most vulnerable to predation during their time in the burrow and during their scramble to the sea.

The young turtles remain at sea and do not reappear in sea grass beds until at least one year later. When four to six years old, the females will return to the exact stretch of beach where they hatched and contribute to the next generation.

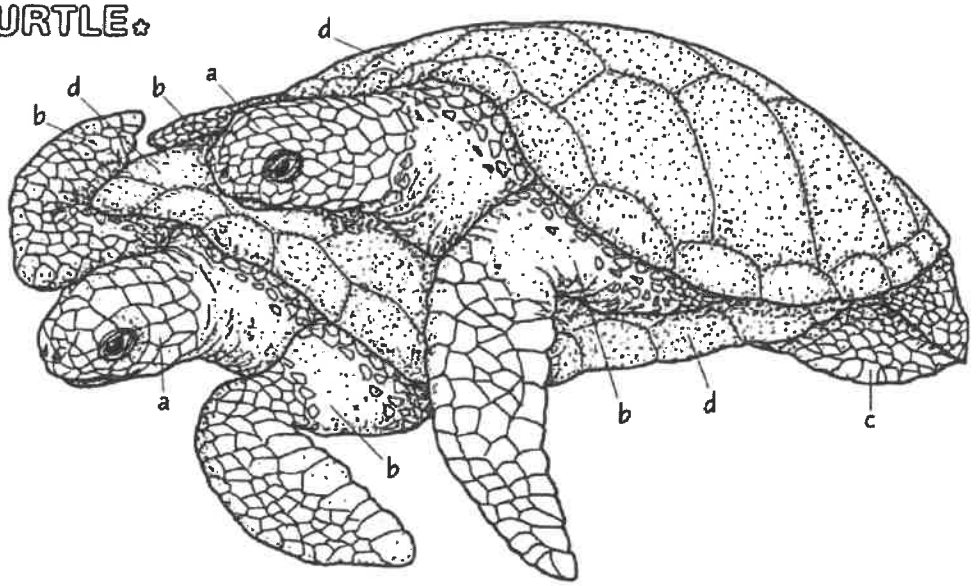
**Color the light portion of the yellow-bellied sea snake golden yellow and the dark pattern black. Note that the flattened tail receives a different color.**

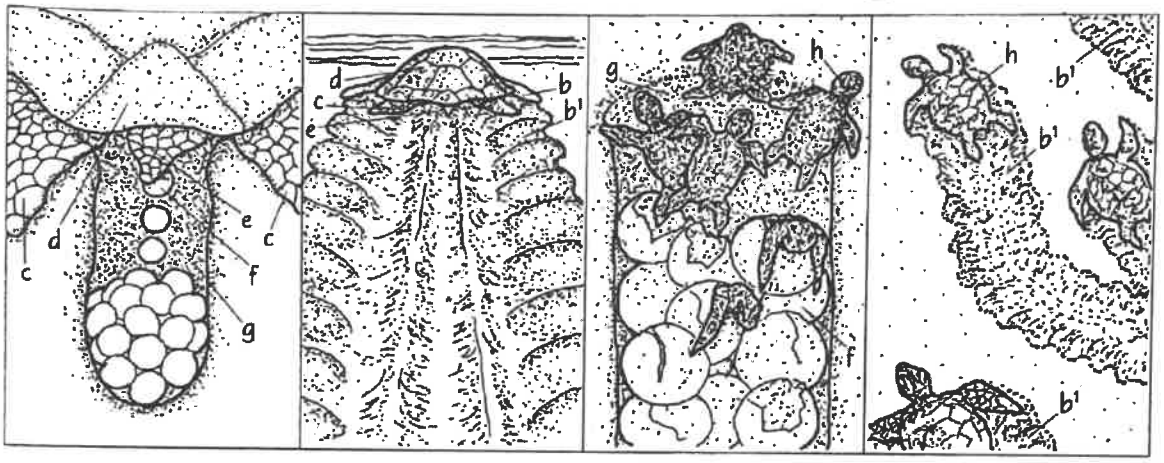
Most zoologists agree that snakes evolved from lizards and are the most modern of the reptile groups. Sea snakes are found in shallow tropical and subtropical waters. All are related to the cobra family. They have a potent venom that can cause severe injury to humans. The *yellow-bellied sea snake* is found in the Pacific off the coast from Panama to Mexico. It is commonly seen on the surface, often in aggregations of several hundred individuals.

Sea snakes are well adapted to a marine existence. Many give birth to the young alive at sea, and the newborn snakes can immediately swim on their own. The sea snake has a *flattened tail* used as a paddle in swimming. Sea snakes generally feed on fish, and can remain submerged for thirty minutes or longer between breaths. Most species are docile, although some attacks on divers have been reported. They are best appreciated from a distance.

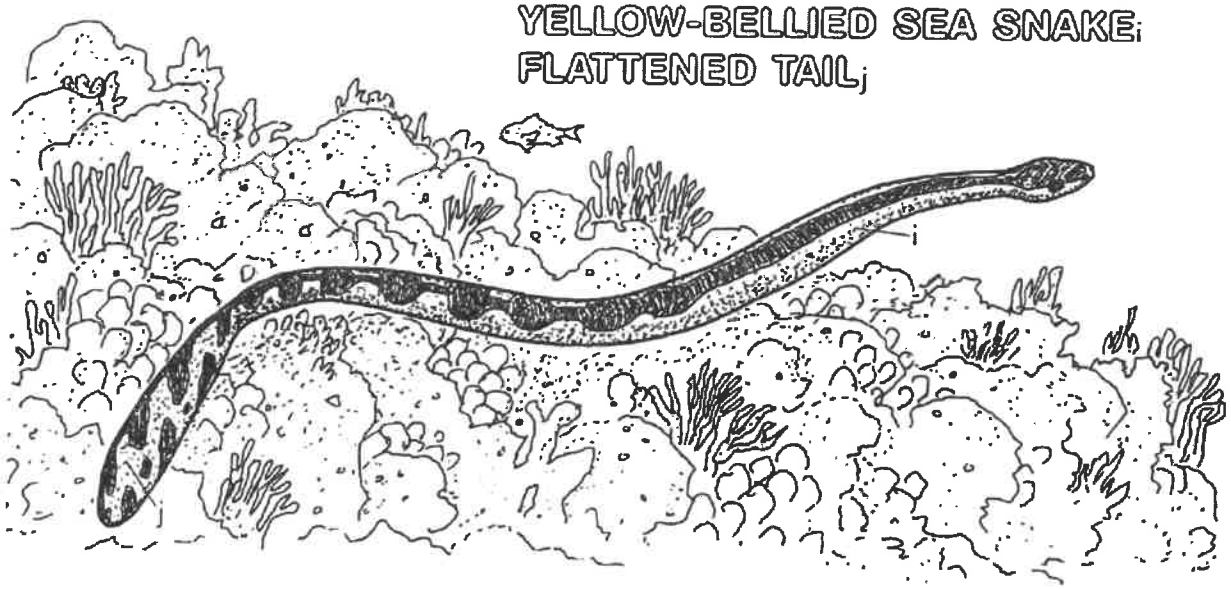
# TURTLES AND SEA SNAKES

GREEN SEA TURTLE☆
HEAD$_a$
FORELIMB$_b$
TRACK$_{b'}$
HIND LIMB$_c$
CARAPACE$_d$
TAIL$_e$
EGG$_f$
BURROW$_g$
JUVENILE$_h$




YELLOW-BELLIED SEA SNAKE$_i$
FLATTENED TAIL$_j$



# Turtles and Sea Snakes Questions

1. Name four different species of sea turtle.

2. What is a TED?

3. Where do sea turtles nest?

4. How many eggs does a sea turtle lay?

5. How many times will a female sea turtle lay eggs before leaving the breeding grounds?

6. How long do the eggs incubate?

7. What family of snakes are sea snakes related to?

8. How long can a sea snake hold its breath?

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Taken from: https://www.nationalgeographic.com/animals/2020/04/how-is-wildlife-doing-now--ten-years-after-the-deepwater-horizon/#close

# Ten years later, BP oil spill continues to harm wildlife—especially dolphins

## Some species, such as brown pelicans, have rebounded, while long-lived species have been hindered for generations. Still, data is scarce.

8 MINUTE READ

BY JOAN MEINERS

PUBLISHED APRIL 17, 2020

NEW ORLEANS, LOUISIANA

On April 20, 2010, an explosion at the BP *Deepwater Horizon* oil rig released over 130 million gallons of crude oil into the Gulf of Mexico. It was the biggest oil spill ever in U.S. waters and remains one of the worst environmental disasters in world history.

Eleven rig workers lost their lives. So did untold millions of marine mammals, sea turtles, birds, and fish. While the world watched, helpless, oil gushed into one of the planet's most biodiverse marine habitats for 87 long days.

A decade later, many species, such as deep-sea coral, common loons, and spotted sea trout, are still struggling, their populations lower than before. By contrast, a few Gulf inhabitants have shown a robust recovery—among them, menhaden fish and the brown pelican, Louisiana's state bird. (Read how the Gulf oil spill has harmed dolphins and turtles.)

Scientists say it's still too early to tell definitively what the impact has been for longer-lived species such as dolphins, whales, and sea turtles.

Even so, "based on our science to date, if you were a marine mammal alive in the Gulf at the time of the spill, it doesn't look good for you," says Cynthia Smith, a veterinarian at the National Marine Mammal Foundation. "Animals that weren't born yet, those are the hope," says Smith, a marine mammal expert who traveled to the spill.

Smith is one of many scientists whose careers pivoted after this event. Funds from the Gulf of Mexico Energy Security Act, the Gulf of Mexico Research Initiative—and more recently, the $16 billion settlement between BP and the U.S. federal and state governments—have enabled a legion of researchers to undertake long-term projects investigating how the spill affected Gulf wildlife.

Many species have been difficult to study. But after a decade of close monitoring, Smith feels that she and colleagues have a clear picture of what is going on with that most gregarious of cetaceans, the bottlenose dolphin—and it's grim.

About a thousand dolphins died in the months following the spill, after they ingested toxins from the oil. Many others apparently have been sick ever since. (Read about a die-off of baby dolphins in the Gulf.)

Recent research, not yet published in a peer-reviewed journal, has revealed that only about 20 percent of pregnancies among the dolphins in Louisiana's heavily oiled Barataria Bay are successful, compared with 83 percent in unoiled regions. This number remains unchanged from 2015 findings.

Ten years out, Smith is also seeing higher rates of reproductive failure, lung disease, heart issues, impaired stress response, and death in bottlenose dolphins.

Interestingly, says Smith, these symptoms mirror the most common health issues faced by another large mammal exposed to the oil spill: humans. Two recent studies, both published in 2018, found impaired lung and heart function and strained breathing, respectively, among cleanup workers and U.S. Coast Guard personnel who had been in contact with the oil.

"You don't necessarily think of a dolphin as being representative of yourself or a human being representative of a dolphin, but our lives overlap," Smith says. "We're in this space together, and there's a lot to learn from that."

## Listening for life

Kaitlin Frasier remembers the day in 2010 that her Ph.D. adviser told her he thought she should focus her career on the recent *Deepwater Horizon* spill.

At the time, Frasier, couldn't have imagined where that journey would take her. Today, she's an assistant project scientist at the Scripps Institution of Oceanography at the University of California, San Diego, and has spent the past decade listening for signs of life in the Gulf—namely, the clicks and clacks of echolocating marine mammals.

"We can't really see the seafloor, so we don't really know how [the oil] has affected whales," Frasier says. It's hard to tell, she says, whether or not oil from sediments is getting resuspended into the water and affecting cetaceans' food. (Here's why "shocking" amounts of oil fell to the seafloor.)

The Gulf of Mexico is home to 21 species of marine mammal, most of which humans rarely see—so scientists have to listen. The sounds these animals emit can reveal which species are still active many years after the spill, and which have declined.

One species Frasier hears less and less these days is the pantropical spotted dolphin.

"It is a surprise in some ways," Frasier says, "because they used to be so commonplace. The visual observers called them rats because they were crawling all over the Gulf. And now, we just get way fewer encounters on our acoustic data."

For many species, results are not this clear. In part, that's because scientists knew little about the habits of many deepwater marine mammals before the spill, so have trouble detecting changes from current data.

Take the little-studied dwarf sperm whale: It's unclear how to interpret the short, high-pitched clicking sounds Frasier can associate with them now. Likewise, sperm whales, which emit longer, lower-frequency clicks, haven't been detected recently near the spill site, but this may just mean they have moved.

Marine mammals are important indicators of the overall health of the ocean, so studying them can tell scientists a great deal about their environment.

"We have all these different pieces of the puzzle, but it's hard to know how they fit together," Frasier says.

## The silent behemoths

Some of the longest-lived animals of all sit silent and sessile at the bottom of the sea.

Peter Etnoyer, a marine biologist at the National Oceanic and Atmospheric Administration's (NOAA) Hollings Lab, studies deep-sea corals. Some were thriving very near *Deepwater Horizon's* wellhead before the spill, according to seafloor surveys. After the spill, scientists found that half of those coral colonies—colorful, fan-shaped creatures called gorgonian octocoral—surveyed had been injured to some extent.

"We don't know how long it's going to take these coral colonies to recover," Etnoyer says. "They grow very, *very* slowly. The ones we found to be injured are on the order of decades to hundreds of years old." (Learn how the Gulf oil spill was even bigger than thought.)

Corals are important habitat for species such as shrimp, crabs, grouper, and snapper. And because they exhibit growth rings like those of trees, corals act as "little environmental monitors, recording conditions over time," Etnoyer says.

Now, his team is preparing for future disasters, mapping deep-sea corals and developing a coral database with more than 750,000 records so far. The team also has a seven-year plan to help coral rebound, which includes traveling to the seafloor using divers or a remotely operated vehicle and cloning or transplanting a few hundred coral from one spot to another.

"It'll be the first time it has ever been attempted to transplant these specific corals at an industrial scale," he says.

## A setback for endangered turtles

The Gulf of Mexico is home to five species of sea turtle, all of which are protected under the Endangered Species Act.

Leatherbacks and Atlantic hawksbills roam offshore waters, while loggerhead, green, and Kemp's ridley sea turtles frequent near-shore habitats. A 2017 study estimated that of at least 402,000 sea turtles exposed to oil during the spill, 51 percent were Kemp's ridleys, the smallest and most critically endangered species.

Before the spill, the Kemp's ridley population had been projected to grow at a rate of 19 percent per year. Instead, the number of nests on Gulf beaches—the species' main nesting location—dropped 35 percent between 2009 and 2010, and plummeted again in 2013, according to a 2016 study. That research also suggested that Kemp's ridley females have struggled to maintain the weight and health necessary to reproduce.

A new version of a federal recovery plan for the Kemp's ridley was signed in 2014 in response to the spill. The move resulted in new protections for nesting beaches in Texas and Mexico, and requirements that shrimp fisheries in the Gulf use excluder devices to prevent the reptiles from being captured in trawls.

## A bright spot for birds

Birds were among the hardest-hit animals immediately after the spill, says Erik Johnson, director of bird conservation for Audubon Louisiana.

"We know the number of birds affected was somewhere between 100,000 and one million. Unfortunately, we'll never know the true number," he says. (See photos of birds and other wildlife coated with oil.)

That statistic includes common loons, northern gannets, double-crested cormorants, royal terns, Wilson's plovers, black skimmers, and seaside sparrows, to name a few. Also affected: Up to 32 percent of laughing gulls and up to a quarter of all brown pelicans. (Learn how nature can bounce back from an oil spill.)

Many birds that weren't killed outright by the oil coating their feathers have since shown higher rates of oil-related cancers, reproductive issues, and a reduced ability to regulate their body temperatures due to feather damage, according to a 2020 study.

But just as birds overall were most devastated, in some cases they seem to be showing some of the strongest recovery. Settlement money was put to use restoring Louisiana's Queen Bess Island as bird habitat. The project was completed this past February and is being hailed as a success for brown pelicans, with up to 20 percent of the state's population already nesting there, along with great egrets, roseate spoonbills, royal terns, and tri-colored herons.

## Oily fish

What was a bust for birds turned into a temporary boon for some fish: Scientists think that the lack of birds in the skies over the Gulf of Mexico is one reason some populations of fish exploded after the spill.

There were twice as many Gulf menhaden, for example, in the years following the spill as in four decades before, likely because so many fish-eating birds were absent.

Other fish species have shown evidence of having been harmed by oil, including nearly two thirds of all Gulf sturgeon, a threatened species. Studies of the economically valuable spotted seatrout and red drum found that fish in oiled areas showed reduced reproduction, and that even years after the spill, oil remaining in the environment is still toxic to fish larvae. (Read how some fish deformities have been linked to the spill.)

Recent research that tested 2,500 different fish across the Gulf found evidence of oil exposure in all 91 species sampled, suggesting that the impacts of the spill are widespread and ongoing.

## Looking ahead

It could take decades to understand how oil affects the next generation of whales, coral, sea turtles, birds, fish, and more.

For Smith, Frasier, Etnoyer, and others involved in spill research, this event has become career-encompassing. Their research will be devoted to monitoring and understanding the Gulf for many years to come—particularly if these ecosystems remain vulnerable.

In May 2019, the U.S. Department of the Interior rolled back safety regulations to offshore drilling that were put in place to prevent a repeat of the *Deepwater Horizon* spill. At the same time, there have been expansions of Gulf protected areas, like the Flower Garden Banks National Marine Sanctuary. (Is another deepwater disaster inevitable? Read our story from October 2010.)

Meanwhile, Kaitlin Frasier will remain at her desk, listening for the chirping sounds of Risso's dolphins and the long, low vocalizations of sperm whales.

"If there was one thing I could do, it would be to take people out to the deep Gulf and show them all the wildlife that is out there," Frasier says. "Most people never get the chance, but it's the most amazing thing."

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# Killer Whale Research and Conservation Program

**This text is provided courtesy of the National Fish and Wildlife Foundation.**

The Southern Resident killer whale has been listed as endangered since 2005, and today only about 75 of these animals remain in the Pacific Northwest. Human activity and a sharp decrease in populations of Chinook salmon, the whale's main food source, continue to hinder its recovery.

In response, the National Fish and Wildlife Foundation, SeaWorld, Shell, the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration partnered to create the Killer Whale Research and Conservation Program, a public-private partnership to aid in the recovery of this iconic species. By funding projects that address salmon research, and the monitoring of killer whale health and habitat restoration, the partnership seeks to increase the killer whale population off the coast of Washington state.

## Salmon Research

Over 80 percent of a Southern Resident killer whale's summertime diet consists of Chinook salmon. However, the population of salmon has drastically diminished in the Salish Sea, and killer whales are suffering as a result.

The Killer Whale Research and Conservation Program is investing in organizations such as Long Live the Kings, which researches the correlation between salmon and zooplankton.

"Understanding zooplankton is important to getting a handle on what is driving the survival of the salmon," said Michael Schmidt, deputy director of Long Live the Kings. "We're working toward a

future with more salmon and thus more prey for killer whales."

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## Health Monitoring

Another key management concern is that killer whales may not be getting enough food during certain times of year. The Vancouver Aquarium, with support from the Killer Whale Research and Conservation Program, is using unmanned aerial vehicles to take high-resolution images of the endangered whales. This innovative photogrammetry project allows researchers to closely monitor killer whales' health by comparing impacts of different salmon runs.

"Before we started the photogrammetry work, the only way we could tell how killer whales were responding to choices in food was by counting the mortalities," said Dr. Lance Barrett-Lennard, head of Vancouver Aquarium's Cetacean Research Program. "Looking at them from above gives us an entirely different perspective. We can see how wide they are. We can see their entire shape. We can see whether they are pregnant or not. And we can detect very fine-scale differences in body condition, much more reliably than we ever could looking at them from the side."

Knowing when whales are too thin will help identify salmon runs that overlap with that space and time. "That enables our conservation managers to really focus their efforts where it will be most effective in helping the killer whales," said Dr. Barrett-Lennard.

## Habitat Restoration

The Killer Whale Research and Conservation Program also funds projects that address the decrease in Chinook salmon at its source. This holistic approach led to a project hundreds of miles inland from the Salish Sea.

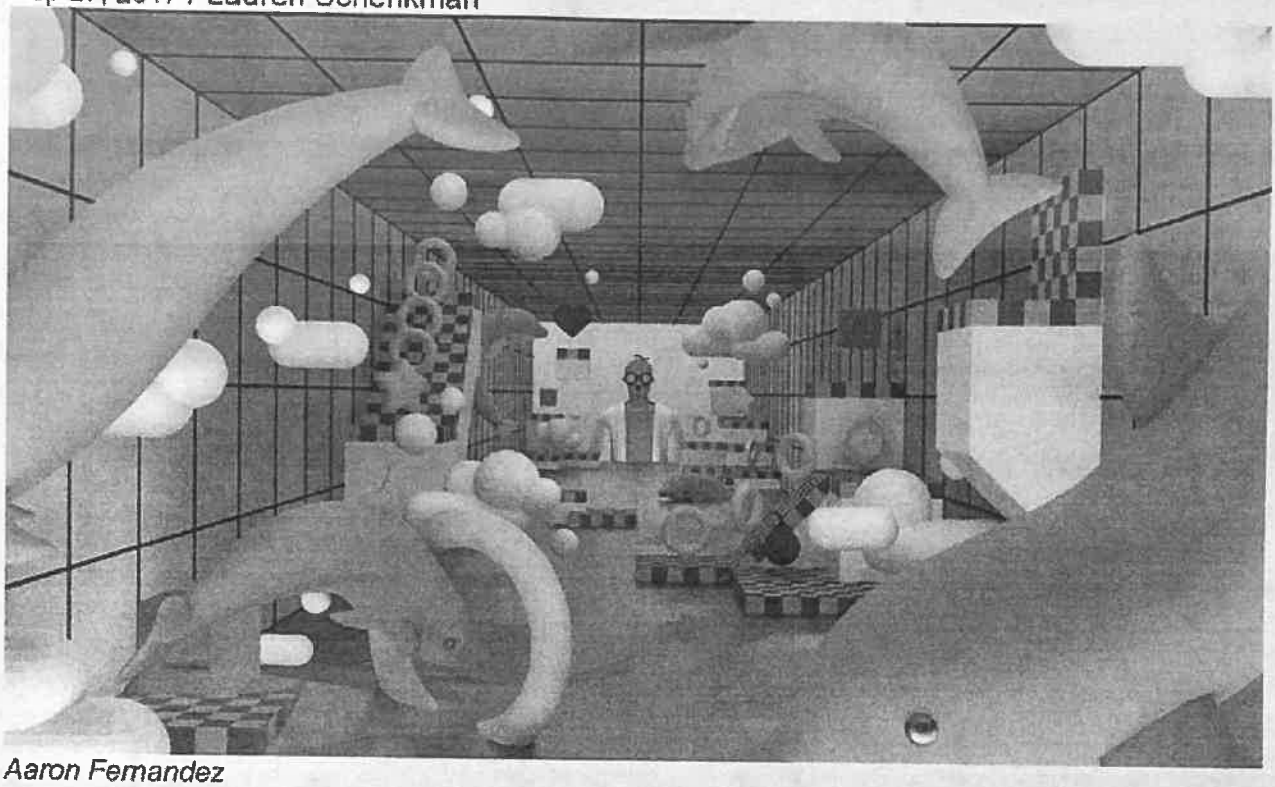
There, in the Puget Sound's mountain streams and rivers, the Skagit Fisheries Enhancement Group is restoring habitats for juvenile salmon.

"Chinook salmon are a species of salmon that stay in their freshwater environment for a full year before they migrate out to the estuary and the ocean," said Alison Studley, Skagit Fisheries Enhancement Group's executive director. "In order to have healthy habitats for Chinook to survive, we have to have places or them to spend that year."

Maintaining a freshwater habitat for Chinook salmon to mature helps sustain the killer whale population in the Salish Sea.

# What can scientists learn from dolphins playing whack-a-mole?

Sep 27, 2017 / Lauren Schenkman



*Aaron Fernandez*

## By creating tech that lets dolphins play computer games and request belly rubs, we can understand their intelligence and perhaps even get a preview of life on other planets, says marine mammal researcher Diana Reiss.

In some ways, dolphins and humans aren't so different. We're both intelligent, social animals, and we both rely on complex vocal signals to convey information. However, while we have recognized for decades that dolphins possess their own distinct language, we still don't understand what they are saying. Now Hunter College cognitive psychologist and marine mammal scientist Diana Reiss (TED Talk: The interspecies Internet?) is collaborating with Marcelo Magnasco at Rockefeller University and other researchers to develop a giant touchscreen that could start to decode their communication.

**Dolphins communicate with sounds — a vast array of them.** Besides producing clicks for echolocation, dolphins also make pulsing sounds, squawks, brays, pops and low grunts (called "thunks" by scientists), as well as a range of complicated whistles. Each dolphin has a contact call, a unique whistle that each dolphin uses to identify itself, and "there are a rich variety of other calls," says Reiss, which remain undecoded by humans. But here's one problem in studying the aquatic animals: When recording them, it's extremely difficult to track

which dolphins are making which sounds — which makes it difficult to match a call to an activity and understand what it means. As of now, according to Reiss, scientists are only able to identify the general kinds of sounds that dolphins make when engaged in a certain activity, like foraging or play. "It would be like saying, 'these are the kinds of sounds humans make when they're socializing,'" she says. "It hasn't advanced us that much."

**In the 1980s, Reiss got a tantalizing glimpse into how technology could bridge the communication gap.** Just as the PC was becoming more available, she and her colleagues built a dolphin-friendly version of sorts: a 9-by-9-foot electronic keyboard that could be lowered into a pool. Each key bore a unique symbol. When dolphins pressed a given key with their beaks, the signal traveled via fiber-optic cable to an Apple II computer, which was programmed to generate a dolphinesque whistle. These sounds were in the same frequency range as dolphin whistles but were unique, so that the dolphins could use the keyboard to make requests from their human handlers: for toys, such as a ball or ring, or for hands-on attention, like a belly rub. When Reiss listened to recordings of the pool made via underwater microphones, she heard the dolphins mimicking the Apple II's whistles on their own, and sometimes even combining them with their own contact calls. Reiss was thrilled and curious — could the keyboard serve as a Rosetta Stone for understanding how dolphins learn new sounds and use them? However, the keyboard's functionality was limited, and the camera and microphone technology that could match recorded sounds to individual dolphins didn't exist.

**Now, Reiss and a group of biophysicists have brought this idea into the 21st century with a dolphin touchscreen.** The team has built a 4-by-8-foot window into the wall of a pool at the National Aquarium in Baltimore. Because immersing an actual touchscreen in water would be dangerous, Rockefeller postdoctoral researcher Ana Hočevar Brezavšček developed a smart solution: A projector on the researchers' side casts interactive programs onto a screen that dolphins can see, and optical sensing technology detects when a dolphin touches the screen.

**Could dolphins use it, too?** To find out, the team created a dolphin-friendly version of whack-a-mole, in which virtual fish swim across the screen and vanish when they're touched. They tried it out with an adolescent, 10-year-old dolphin named Foster. Within seconds of the screen turning on, Foster "came up to it, stopped on a dime and started touching the fish," Reiss reports. When the fish disappeared at touches from his melon, or forehead, the game was "self-reinforcing," she says. "He just got it." In another session, he began tapping the virtual fish with his beak. His behavior was surprising, given that Foster — born and raised at the aquarium where he is fed dead, defrosted fish — has never seen a live fish before. Reiss says it's too early to speculate why he grasped the game so immediately.

**Now Reiss is reviving her 1980s experiment.** Heartened by these successful sessions with Foster, the team has paused their experiments so they can develop an app, similar to the keyboard that Reiss used decades earlier, in which whistles will be associated with symbols and objects. But this time, the team also has a complex array of microphones and cameras to deploy. Installing this system with such intelligent creatures has had its challenges. "Dolphins are curious, and they will try to break things," says Rockefeller biophysics PhD student Sean Woodward. He designed a system of four acrylic panels, each with four microphones embedded in it, to be placed along the walls of the dolphin pool to track sound in different locations. So far, he says, the dolphins have been rubbing themselves on the panels to scratch their itches, but the equipment is still intact. He is also installing 11 cameras to track the locations of the dolphins (multiple cameras are needed to correct for refraction in the water). By combining the audio and visual data, the team will be able to trace each sound back to a particular point in the pool and to a specific dolphin, creating a running transcript of exactly who is saying what and when. Data-mining algorithms will help sift through this information and look for patterns. It's possible we'll soon start to understand how the dolphins learn symbols and sounds and how their sounds correspond to particular behaviors. With such fine-grained data, Reiss is hopeful they'll make significant progress in understanding dolphin communication.

**The key, Reiss says, is not to train the dolphins, but rather to give them "choice and control" in how they learn.** "Dolphins are really our partners on this," she says. Observing their reactions, on their own terms, to new stimuli via the touchscreen's apps should illuminate the nature of their intelligence. And because dolphins are both highly intelligent and extremely different from us, figuring out how their minds work could provide us important insights into how intelligence evolves and manifests given different environments, inputs and biologies. We'll be able to see more clearly, Reiss says, "what's unique in us and what we share with other animals."

**Understanding their communication could even help us as we explore other planets.** Like potential extraterrestrial life forms, dolphins are intelligent non-humans who evolved to thrive in a vastly different environment from us. "Decoding dolphin language could be a practice ground for aliens," says Reiss.

## ABOUT THE AUTHOR

***Lauren Schenkman*** *is a journalist and fiction writer. Her writing has appeared in the New York Times Magazine, Granta, and the Hudson Review, and she was formerly a reporter and editor at Science magazine.*

- animals
- communication
- diana reiss
- dolphins
- language
- research

Taken from:

https://ideas.ted.com/what-can-scientists-learn-from-dolphins-playing-whack-a-mole/