



GUIDE FOR EDUCATORS

Consortium for Advanced Research on Marine Mammal Health
Assessment
Education & Outreach
Updated 2018

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CARMMHA Education & Outreach Overview

The Consortium for Advanced Research on Marine Mammal Health Assessment (CARMMHA) is a team of marine mammal health scientists conducting cross-discipline research that includes veterinary assessments of managed animals, field assessments with wild populations, and integrative statistical modeling to understand how the *Deepwater Horizon* oil spill affected Gulf of Mexico (GoM) marine mammal health.

Previous research by CARMMHA researchers has shown that dolphins in regions affected by the *Deepwater Horizon* oil spill have poor body condition, reproductive failure, lung disease, and adrenal system injury. We plan to build on this body of work to address important scientific questions that have emerged but remain unanswered. These questions include whether changes in diet could be contributing to poor body condition, how their immune system is impacted, and whether dolphins show signs of cardiac abnormalities similar to fish and birds affected by oil.

The CARMMHA outreach plan was shaped by the Gulf of Mexico Research Initiative's (GoMRI) mission to improve society's ability to understand, respond, and mitigate impacts of petroleum pollution and related stressors on the marine and coastal ecosystems, with an emphasis on conditions found in the GoM. The scientific knowledge gained through CARMMHA research objectives will be informative to ongoing restoration efforts, resource management, and mitigation efforts aimed at reducing the effects of stressors on marine mammal populations and improving the long-term environmental health of the GoM.

The CARMMHA outreach effort aims to:

- 1) Leverage the GoMRI-supported Sea Grant network and resources to widely disseminate significant findings from the research consortium, focusing specifically on the restoration community to ensure that CARMMHA findings inform mitigation, management, and restoration actions.
- 2) Disseminate study results and findings widely to the broader scientific community, targeting peer reviewed publications and conference presentations, and to coordinate an exchange of information through scientific conferences such as a Gordon Research Conference to enhance our understanding of adverse health effects across taxa.
- 3) Engage the general public through web-based resources, specifically CARMMHA informational webpages housed on the NMMF website and YouTube videos.
- 4) Reach the youth of Gulf communities by expanding current efforts of the NMMF through an existing collaboration with Girl Scouts of America to foster interest in STEM careers among young girls.

Resources and Materials Summary

We've developed a variety of educational tools to accommodate various age groups and instructional styles, which have been made available on the CARMMHA website www.carmmha.org.

These materials are designed to be presented together as a two-hour educational workshop; however they can each be used independently as well.

Slideshow

A PowerPoint slideshow has been developed to introduce students to the *Deepwater Horizon* oil spill and to the CARMMHA research consortium.

Activities

Four engaging, hands-on activities have been developed to highlight the focal areas of research for the consortium. They are designed to be scientifically accurate and incorporate real information from CARMMHA field projects.

They include an oil spill demonstration and clean-up, a fin ID card matching game, a mock dolphin health assessment, and a bioaccumulation relay game. A detailed description of each activity and instructions are included in this guide.

Worksheets

Coloring Worksheet: Target audience: Kindergarten - 6th grade. This worksheet is designed to be a fun way to engage young students and get them to think a little bit about how dolphins may be exposed to oil in their environment.

Graph analysis worksheet: Target Audience: 7th-12th grades. This worksheet highlights the population modeling component of the CARMMHA consortium and challenges the students to understand the parts of the graph as well as the interpretation and biological implications.

Additional Resources:

CARMMHA Website and Facebook Page - General information and project updates

CARMMHA YouTube Series - Educational videos designed for all ages



Workshop Outline

This workshop was designed in partnership with the Girl Scouts of America and follows the Girl Scout patch model of DISCOVER, CONNECT, TAKE ACTION.

DISCOVER: Printed reading materials and take-home activities will be provided to the students, which are available online at www.carmmha.org.

- What is oil? Why do oil spills happen? If oil is naturally occurring why are oil spills bad? Who are the people that respond to oil spills? What types of animals are affected? What are the impacts of health on marine mammals (reproductive, respiratory, heart murmurs, immunology)?

CONNECT: WORKSHOP (1.5 - 2 hours)

Opening: Coloring worksheets for young kids and graph worksheet for older kids

06:30-06:45: Slideshow (Available for download at www.carmmha.org)

TAKE ACTION Discussion: What can you do?

- Who do I call if I find a stranded marine mammal?
- Where can I volunteer?
- Minimize pollution, do not dump down storm drains!
- What if there was an oil spill at my local beach?

6:45-7:35 Activities/ demonstrations (15 minutes each):

1. EnviroScape®! Oiled animals/ dawn dish soap demonstration
2. Mock Dolphin Medical Examination
3. Fin matching card game

07:35-07:50 Bioaccumulation Relay game

07:50-08:00 Closing

HANDOUTS: CARMMHA fliers, stickers, and patches available upon request!

Activity #1 - Oil spill simulation and clean-up

Adapted from EnviroScape® Oil Spill Activities

What you will need for this demonstration:

- EnviroScape® model (can be used with any EnviroScape® model®)
- Cooking oil (any kind - soy, vegetable, canola, etc.)
- Cocoa or cocoa mix
- Two to three feathers (from a craft store).
- Absorbent materials (at least three of these) which can include: bits of rags, sponge & sponge pieces, pieces of string, paper towel, pipe cleaners, cotton balls.
- Small cup
- Syringe, eyedropper or baster
- Dishwashing detergent
- Handheld fan (optional)
- Oil/water mixture jar
- Towels
- Tablecloth
- Sea Creatures

Before you begin, set up your EnviroScape® model and make sure you have added water to the waterbody.

► Discuss the importance of oil in our everyday lives...

People like you and I use oil in our everyday lives. Think of ways we use oil... (ask your audience to participate in this!)

- Fuel for transportation (cars, trucks, buses, airplanes)
- Fuel for heating homes and offices, for energy to provide electricity
- To make things we use every day: roads, plastics, even some medicines

Activity 1 - Clean Water

▶ Show the audience a bird feather and dip the feather in the clean waterbody and show how the feather will repel water (not absorb the water)

▶ Drop the feather in the waterbody and let the audience see it float.

Discuss: A bird's feather helps protect the bird by repelling water and allowing it to float and not be weighted down in flight.

Activity 2 - What Happens to Oil in Water?

▶ Show student clear jar with oil and water. Ask: Does oil sink or float? Do they mix?

▶ In a cup mix 1/2 cup vegetable oil and 1 Tablespoon cocoa (this will simulate crude oil)

▶ Pour a little of your oil mixture in the waterbody.

Discuss. This show what happens when oil hits water. This could be an oil spill. Large oil spills are caused by accidents that may involve tankers, barges, pipelines, refineries, and storage facilities -- usually while the oil is being transported to us, its users. But small oil-spills occur when people illegally dump their used oil, or spill it, or if they have a leak in the engine of their car or boat.

▶ Point to the oil in the water - our simulated "oil spill". Discuss. Oil and water don't mix. The oil will stay at the top and water at the bottom.

The oil is on top of the water: what do you think will happen when the wind blows, or waves come through?

▶ Make the wind blow over the water by blowing on the water, or using a hand-held fan or fanning the water with paper.

Discuss. The oil moves, spreading out and breaking up into blobs on the surface of the water. When oil is spilled in the ocean, it will be pushed and spread by currents and tides, but because it is sitting on top of the water, wind will also carry the oil to different locations.

Activity 3: How Oil Spills Affect Marine Life

▶ Dip the feather in the oil floating on the top of the water and hold it up for the audience to see.

Discuss. See how the oil clings to the feather? The feather is heavier now; it looks matted. When the water was clean, we saw the feather repel the water and float.

Oil spills can be very harmful to marine birds and mammals. Marine life, including fish, could accidentally ingest the oil while in the water. Mammals and birds might also eat the oil while trying to clean themselves. Mammals with fur and birds with feathers might get soaked with the oil, making it hard for them to keep themselves warm. Birds also need their feathers to repel the water and help them float and to remain light enough to fly.

▶ Put the feather back in the waterbody and observe it sinking

Discuss. What would happen to a bird whose feathers are soaked in oil? Birds need their feathers to keep warm, and to be waterproof, and so they can fly and not be weighted down.

Now the feather is soggy and heavier. It might be hard to stay warm, and the bird could also try to clean himself and eat the toxic oil. Birds won't be able to fly. They might drown.

During a large spill, organizations usually set up areas where they can clean and rehabilitate wildlife. You may have seen commercials that show volunteers washing the birds and aquatic animals to try and remove the oil.

Activity 4: Cleaning up an Oil Spill

Let's try to clean up our oil spill.

► Get your audience to experiment with different absorbent materials and Observe & Record what effect these different materials have on cleaning up the spill. (for example, does the paper towel absorb the oil or does it make it spread out and move away from the paper towel?)

String - audience can try to contain the oil with the string (like a boom would) Does the boom (string) keep the oil confined to one area? Why or why not? Which materials worked the best?

Cup - audience can try to collect the oil. Does the oil spread out more? Why would this be a problem?

Sponge & Other Materials - audience can try to absorb the oil Does the oil cling to some materials? which ones?

Syringe, eye dropper or baster - audience can try to siphon oil from the water's surface - what all does it pick up? What will you do with this?

Dishwashing detergent (our chemical dispersant)- audience places a drop of dishwashing detergent on the oil in the water.

Discuss. We've tried capturing the oil, keeping it in one spot, and absorbing the oil. This dishwashing detergent simulates a chemical dispersant. A "dispersant" is a chemical used to try to break up the oil. What happens? What effect did detergent (dispersant) have on the oil? Did the detergent break up the oil but also make the oil spread out?

► Use a spoon - or your finger - to stir the water as the ocean would mix because of currents, waves and wind

What is happening? Is the ocean clean now? Where does this dispersed oil go? Does the dispersant also move? What problems might occur because of using a dispersant? Will it affect wildlife and aquatic life the same as the oil?

Discuss the use of fire to clean up an oil spill. For a small surface spill, fire may at times be used to clean it up. The oil is ignited and burns off; this is an effective method of cleaning up a spill but...

Where did the oil that was burned go? It turned to smoke and went into the air. Is fire a good solution to an oil spill?

When oil reaches the shore, what problems might occur? When oil spills reach the shoreline, there are environmental and economic impacts. The oil will cling to sand and a rocky shoreline; this is unsightly and may cause tourists to stay away. Tar balls also appear in the sand, as well as floating oil near the shore, making swimming and wading unsafe. Marshes and estuaries near the shore are greatly impacted by oil spill contamination as these areas are teeming with life and a delicate balance exists there.

What could be done to clean up the shoreline? The shoreline is cleaned up using manpower, but the majority of the floating oil must be cleaned up first or the shoreline will become re-contaminated. After the oil in the water is cleaned up or contained workers and volunteers can begin to remove contaminated sand (proper disposal methods are needed for sand contaminated with oil); the sand can be shoveled out and replaced with clean sand. Rocky coasts can be power washed and scrubbed; absorbent materials between the rocks on the shore may help absorb the oil. Marshes and estuaries are the most severely impacted regions; the slow moving waters typical to the regions don't have the wave action to draw the oil out. Oil is absorbed into the plant life and soil and can greatly harm this valuable ecosystem. Gentle oil skimming from the early stages of the spill may be very important for these marshlands. The oil that accumulates in these wetland areas is broken down by the naturally

occurring microbes but this takes decades. Aggressive cleaning efforts in marshes may do more harm than good as this is a delicate area.

Summary Discussion. Oil spills threaten humans, animals, and the environment. It is important to begin cleaning up an oil spill as quickly as possible. Clean-up crews made up of various government agencies, corporations, and volunteer organizations respond to the incident, often using various tools to clean up spilled oil, including placing long floating barriers (booms) around the spill, so it cannot spread further. They may have special machines that vacuum up the oil. People may try to absorb the oil, using sponge-like pads. Or break it up using chemicals. These chemicals (called chemical dispersants) are controversial because the chemical used to break up the oil can also be toxic to marine life and the environment. Some biological cleanup using oil-eating bacteria is also being investigated; small spills have been cleaned with bacteria that break up the oil and kill the toxins. New ways of cleaning up spills are being developed, including a machine that separates oil and water.

We have learned that oil spills are a serious threat to our environment, aquatic life and even our economy. Oil spills mean that fishermen can't catch fish to sell for eating, and tourists might not visit a beach with oily water and a dirty shore.

We also learned that we use oil and things made with oil every day. We saw how oil spreads out and breaks apart on the surface of the water. How the wind and waves can spread the spill even further. We saw how marine life can be harmed by the oil, and how hard it is to clean up a spill after it happens.

You can prevent small oil spills by never dumping oil in a waterbody or storm drain: always dispose of used oil in the appropriate way. Encourage people you know to have oil leaks in their car or boat fixed right away.

When accidents happen on a larger scale society needs to be prepared with new and better ways of cleaning up oil. Maybe you will think of something!

Activity #2 - Fin ID Matching Game



In this activity, students will learn what it is like to be a wildlife biologist or veterinarian and how professionals in the field use different tools to assess and characterize each animal they are analyzing.

This activity will focus on fin identification. Begin by explaining to students how fin identification works by speaking to the following points:

1. ASK: Why is animal identification important?
 - a. To be able to look at each animal within an entire population as an individual. This allows scientists to track an individual's development over time, whether that be biological or social development, and determine how long that animal lives.
 - b. Also, by identifying specific individuals, scientists can count the number of unique individuals in the population, and from that, estimate the total size of the population.
2. ASK: What is a dorsal fin and why do we use dorsal fins to identify the animals?
 - a. Explain the dorsal fin and what's it's used for.
 - b. Dorsal fins are the easiest part of the animal to see when they are near the surface, especially during high winds, choppy waters and rainy weather.
 - c. Identify that dorsal fins (and tail flukes) are pretty unique and specific for each animal - but dorsal fins are easier to see.
3. As dolphins grow up and interact with other animals, they develop knicks and notches in their dorsal fins which helps scientists identify each dolphin individually.
4. When dolphins are born, they're dorsal fins are super smooth and essentially perfect which makes them much harder to identify. Sometimes scientists cannot tell calves apart for their first few years of life but other times, they can identify calves based on who their mothers are.
5. Some researchers, like NOAA scientists and scientists from the NMMF, maintain a library of images and databases that keep all the data collected for each animal in one compiled location so it's easy to look at the population as a whole.
6. This isn't just for dolphins! Fin identification is used on Killer Whales as well. Other animals in the wild may be identified by tag numbers, other markings on their bodies or - for large whales - photos of their body shape from above!

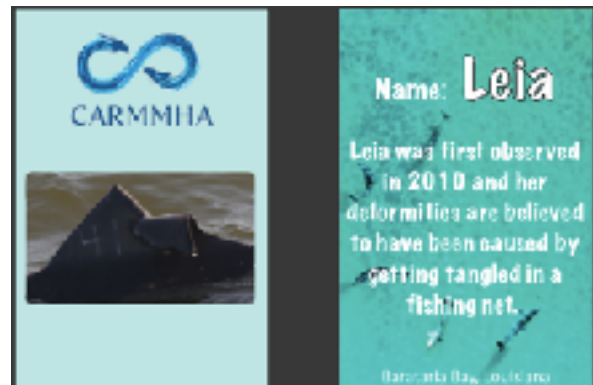
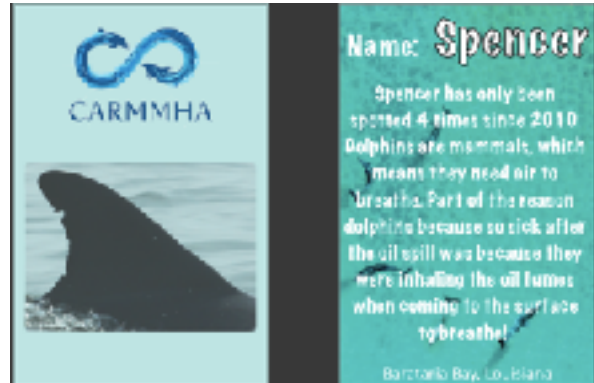
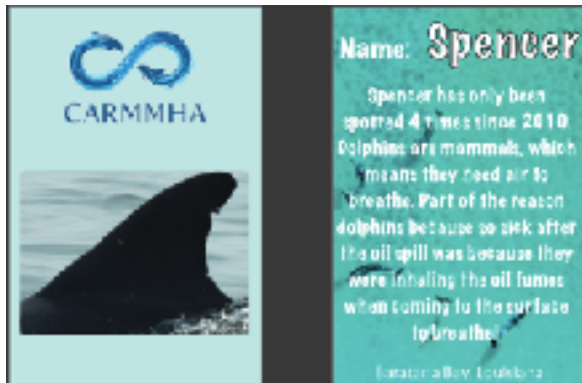
Now it's your turn to practice your fin identification!

INSTRUCTIONS:

1. You will have a deck (or 2) of cards. Lay the cards spread out on a table, **Fin Photo Up, Name/Info Side Down.**

2. Depending on the number of students, split them into two teams if you feel it is necessary.
3. Instruct the students that the goal is to match all the fins on the table.
 - a. Go through and match two fins together that they think look similar.
 - b. To confirm they have a match, flip the card over and read the names.
4. Once the teams have all cards matched (or if time is coming to an end), go through and have one team read one of the dolphins that they were able to match (their name and their fun fact(s)). Then have the other team read one and go back and forth learning about the different animals in Sarasota and Barataria Bay!

****You don't have to announce it as a race, the goal is for the kids to thoroughly look and try to identify the fins that match BEFORE flipping the cards over to confirm they have a match, it's not like a game of "memory" ****



Activity #3 - Mock Dolphin Health Assessment

Description: In this mock dolphin health assessment activity, you will rescue a pretend dolphin and then proceed through a complete medical checkup, just like would be done in the field! This includes an ultrasound, body measurements, x-rays, and satellite tagging. You can use any kind of pretend dolphin and real or pretend veterinary supplies for this activity. Follow along on the worksheet and the slideshow to learn the steps of a real dolphin health assessment!





Mock Health Assessment Supply Checklist:

- Dolphin Medical Check-up worksheet
- Dolphin Health Assessment Slideshow (available at www.carmmha.org)
- Towels to keep dolphin wet and cool
- Pens
- Gelatin Mold to practice ultrasound
- Ultrasound machine (if available)
- Medical kits (pretend syringes, stethoscopes, lab coats, etc.)
- Blow -up or stuffed dolphins
- Stretcher and PVC pipe

- Dolphin models (anatomical models available online)
- GPS tags
- Measuring tapes
- GPS tagging map



DOLPHIN MEDICAL CHECK-UP!


- Collect blood for analysis
- Listen to the heart and lungs
- Is this dolphin a male or female?
 - MALE or 
 - FEMALE 
 - If female, is she pregnant?
 - YES
 - NO



- Gather a breath sample for analysis
- Take photos and measurements:




Rostrum to tail:  cm

Height of dorsal fin:  cm

Width of tail flukes:  cm

- Attach a satellite tag for monitoring
 - Tag Number: _____

Get X-Rays of the teeth 

Track future movements on the computer!

Activity #4 - Bioaccumulation Relay

Background

Although it might seem that toxins that enter the ocean would be diluted in the water, some actually build up in the food chain as they pass from prey to predator. For example, phytoplankton (small, microscopic plants that float in an ocean's currents) get their food or energy from the sun by means of photosynthesis. However, phytoplankton may also absorb toxic chemicals or heavy metals that are dissolved in the water. Fish may then eat these plankton, which means they also are eating those toxins. Those toxins then become a part of the fish's body. The more the fish eat, the more toxins they absorb and accumulate. Fish are then eaten by dolphins, and a dolphin may eat many fish. With each step along the food chain, consumers consume larger amounts of concentrated toxins.

Scientists call this effect **bioaccumulation**—the buildup over time of harmful substances in animal and plant tissues. These substances are then passed on to animals higher in the food chain. Persistent organic pollutants (POPs) are chemicals that are resistant to environmental degradation and can persist for long periods of time in the environment. Because of their persistence, POPs are particularly prone to bioaccumulation. Some examples of POPs are industrial chemicals such as PCBs, and pesticides such as DDT. Many of these chemicals are no longer used, but they still persist in the environment and can cause harmful health effects in wildlife.

Instructions

- 1) Explain the concept of ecosystems and food chains. Do not define bioaccumulation, but prompt students to think about the delicate balance of ecosystems and how humans can affect them.
 - a) Explain that they will be learning how a food chain works within an ecosystem by participating in this activity.
- 2) Assign each student as a specific animal (either fish or dolphin) and that each animal can only eat a set number of prey items. Fish can only have up to 5 phytoplankton (poker chips). Dolphins can only eat up to 3 fish (students).
- 3) Dolphins get a neon safety vest (or something to indicate they're a predator). This is so it is easy to identify who is representing fish and who is representing dolphins.

Suggested Animal Ratios									
# of students	22	23	24	25	26	27	28	29	30
# of dolphins	9	10	11	12	12	13	14	14	15
# of fish	13	13	13	13	14	14	14	15	15


- 4) Be sure to mark the perimeter of the playing field or "ocean" (if applicable).
- 5) Clarify the rules to encourage good sportsmanship (No forceful tagging or pushing, May only tag on back, arms and hands)
- 4) Describe the steps of the first hunt activity. Each fish will have 15 seconds to start collecting food (chips). After 15 seconds, the fish will stop eating and the dolphins will join the ocean. Dolphins will try to eat the fish by tagging them. If fish get tagged, they must place a hand on the dolphin's shoulder and remain with them while they continue to

hunt. After a minute, the students re-group - dolphins and their fish sit together and fish hold onto their chips.

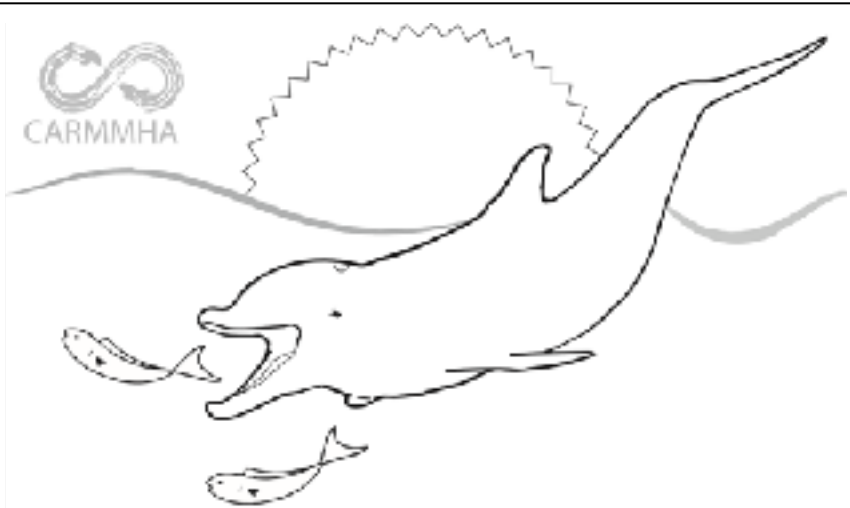
- a) Did any fish get all of their allowed food?
 - b) Did any dolphins get all of their allowed food?
 - c) Was there enough fish left uneaten to repopulate the fish population?
 - d) Was this an overall healthy ecosystem?
- 5) Describe the process of bioaccumulation. **Bioaccumulation** is the buildup of harmful substances - such as pesticides or other persistent pollutants - into an organism's tissues and organs. These contaminants increase in concentration in the tissue of an organism at higher levels of the food chain - also known as **biomagnification**. So, what may not directly affect the fish may result in sickness or even death to the dolphins. Have students examine the plankton (chips) they collected and indicate that red chips are actually fish that were contaminated with toxins.
- a) How many dolphins ate fish with toxins?
 - b) How many dolphins were safe from toxins?
 - c) How can this further impact the ecosystem (including humans)?

Supply Checklist:

- Instructions
- Coins/ Poker Chips
- Vests or shirt to indicate "dolphins"



CARMMHA



List two ways dolphins could get oil inside their bodies:

1. _____

2. _____

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LEARNING TO ANALYZE GRAPHS

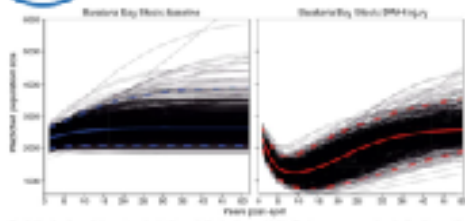


Fig. 4. Simulated population trajectories for bottlenecks. The population starts at 1000 individuals (year 0) and with Population Growth (PG) rates equal to 0.05. The population recovers from 1 bottleneck event (left) and recovers from 1000 events in a matter of 1000 years (right). Note the rapid recovery from population loss and the gradual recovery from mass mortality.

DOLPHIN POPULATION TRAJECTORY ANALYSIS

KEYWORDS

Dolphin
 r, reproductive rate
 Out of kilter
 Unpredictable
 Population
 Population recovery
 Trajectory
 Median
 95th percentile
 Population expansion
 variation
 Sustainability
 Level of expansion

1. What variable is represented by the x-axis?
2. What variable is represented by the y-axis?
3. What does each black line represent?
4. What does the solid blue line represent?
5. What do the dashed blue lines represent?
6. According to these models, if the Dorsal fin loss (DFL) rate is 100%, what would happen to the population size in 10 years?
7. For approximately how many years did the colony population size decrease after the spill?
8. How many years will it take for the colony population size to rebound to pre-spill population estimates?

THINKING OUTSIDE THE GRAPH

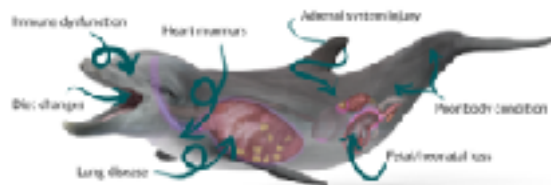
9. What do you think would have happened to the population of Bottleneck Bay bottlenose dolphins if the oil spill had never happened?

THINKING OUTSIDE THE GRAPH

10. What do you think would have happened to the population of Bottleneck Bay bottlenose dolphins if the oil spill had never happened?

11. Why is it important to have a sustainable population?

12. Why is it important to have a healthy animal population?



Center for Advanced Research
 on Marine Mammal Health & Environment