2008

Alien Invaders! On-Site Programming -- Support Materials (Grade 6)

Discover Mojave: Forever Earth

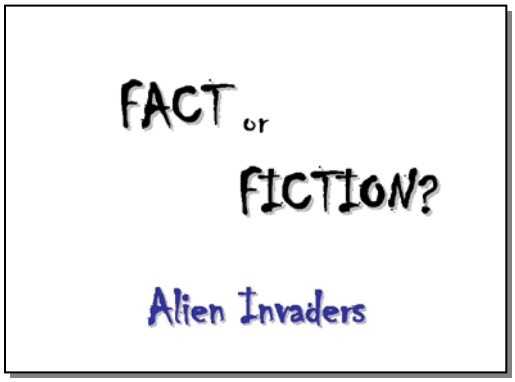
GRADE 6

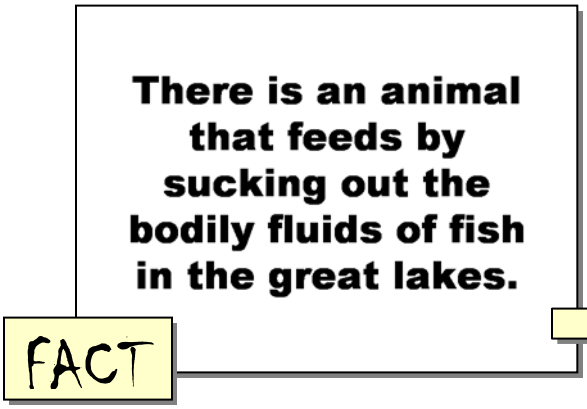
ALIEN INVADERS!

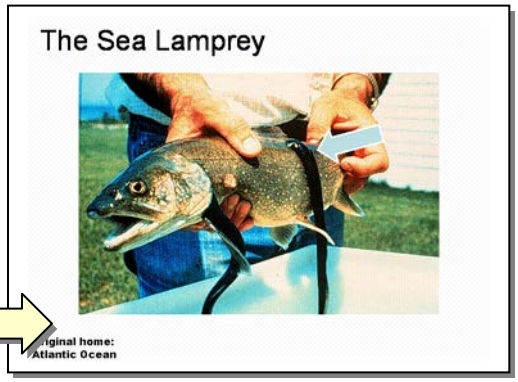
ON-SITE PROGRAMMING • SUPPORT MATERIALS

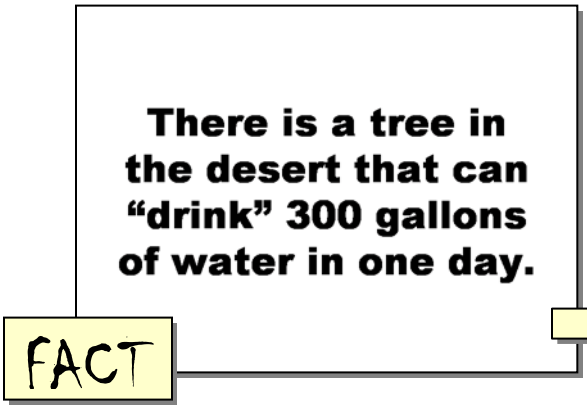
Demonstration:
INVASIVE SPECIES FACT OR FICTION POWERPOINT

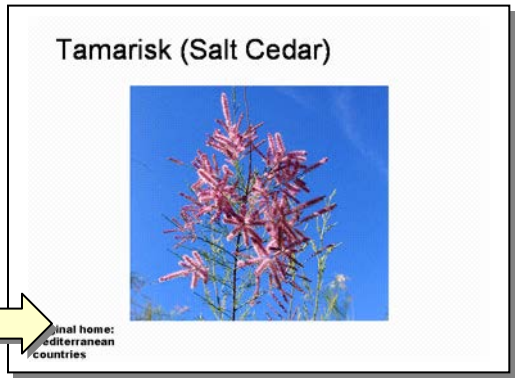
Alien Invaders Fact or Fiction is a PowerPoint presentation that is delivered with a lot of energy. It functions to reinforce the definition of "invasive species" and to underscore the tremendous amount of impact that invasive species have on the environments they invade. The presentation sets the tone for the rest of the program. Note that the actual PowerPoint contains additional animated images for each slide.

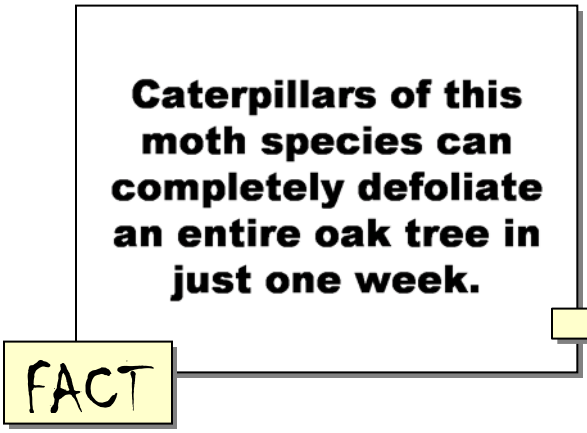


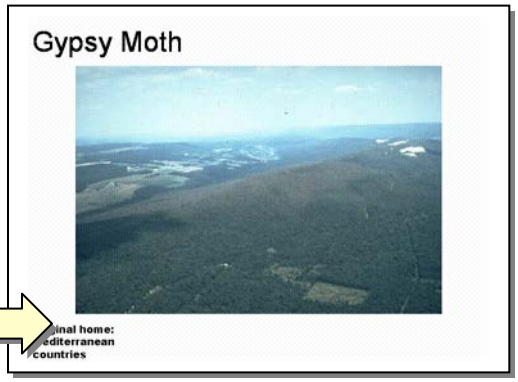












Voracious meat-eating piranhas living in Lake Mead have eaten all the native fish.

FICTION

A power plant executive will spend hundreds of millions of dollars to remove a small clam from a water pipe.

FACT

Facilitator Reference:
BACKGROUND INFORMATION FOR FACT OR FICTION ACTIVITY

Sea lamprey (*Petromyzon marinua*) are predaceous, eel-like fish native to the coastal regions of both sides of the Atlantic Ocean. They entered the Great Lakes through the Welland Canal about 1921. Having no natural predators, the lamprey proceeded to devastate whitefish and lake trout populations. To feed, the lamprey latches onto its prey with a sucking disk and sharp teeth and then carves a hole into the flesh. Anti-coagulent chemicals in its saliva ensure that the wound remains open for days while the lamprey feeds.

Since 1956, the governments of the United States and Canada, working jointly through the Great Lakes Fishery Commission, have implemented a successful sea lamprey control program. In 1958, scientists found TFM – a chemical that selectively kills sea lamprey larvae in their spawning streams – and brought the lamprey invasion under control. Lamprey numbers in Lake Michigan are currently only about 10 percent of their peak numbers in the 1950s. However, some biologists are concerned that these surviving populations might develop a resistance to the lampricide or, just as worrisome, an ability to spawn on the deltas of stream mouths where the deeper waters are not suitable for lampricide treatment.

Photo by Great Lakes Sea Grant Network

Tamarisk, or salt cedar, disrupts natural food chains and interferes with the water table by replacing native plants. Starting in the 1850s, several species of tamarisk were imported to the United States as ornamentals and for use in erosion control. Since its introduction, tamarisk has spread quickly along waterways, where it tends to form dense thickets along streams and springs, displacing native trees such as cottonwood, willow, and mesquite. Tamarisk can spread both vegetatively, by adventitious (developing on stems, leaves, and even old roots) roots or submerged stems, and sexually, by seeds. It has taken over more than one million acres of area along waterways.

Sahara Mustard

© Michael Charters

Sahara mustard

Numerous Old World mustards have invaded North America. Of these Sahara mustard (aka several other names) is the newest and by far the worst. It is a robust, fast-growing, drought-tolerant winter annual that prefers sandy soils. The basal rosette of divided hairy leaves can span three feet in wet years. The nearly leafless flowering stems branch profusely and grow to a height of about two feet, creating the appearance of a shrub from a distance. The small light yellow flowers are self-pollinating, so each of the thousands of them sets a seed pod. Large plants produce up to 16,000 seeds. Dried plants break off at the base and tumble like Russian thistle (tumbleweed, Salsola tragus), spreading seeds rapidly across the landscape. When wet, the seeds are sticky with mucilage and can be transported long distances by animals and perhaps vehicles.

Retrieved May 30, 2008 from http://www.desertmuseum.org/invaders/invaders_saharamustard.htm

Gypsy Moth

Originally brought to the United States in 1869 to create silk, the **gypsy moth** escaped captivity and can now be found throughout the eastern U.S., feeding on more than 300 species of trees. The gypsy moth, *Lymantria dispar*, is one of North America's most devastating forest pests. The species originally evolved in Europe and Asia and has existed there for thousands of years. In the late 1860s, the gypsy moth was accidentally introduced near Boston, Massachusetts by E. Leopold Trouvelot. About 10 years after this introduction, the first outbreaks began in Trouvelot's neighborhood, and in 1890, the state and federal governments began their attempts to eradicate the gypsy moth. These attempts ultimately failed and since that time, the range of the gypsy moth has continued to spread. Every year, isolated populations are discovered beyond the contiguous range of the gypsy moth. However, these populations are eradicated or they disappear without intervention. It is inevitable that the gypsy moth will continue to expand its range in the future.

Nuisance Mussels

Although only as big as your thumbnail, these zebra and quagga mussels cause $5 billion worth of damages each year. They are believed to have been transported to the Great Lakes via ballast water from a transoceanic vessel. By removing most of the phytoplankton or food for microscopic zooplankton and filter feeders, which in turn support larval and juvenile fishes and other animals, these mussels can effectively starve the native populations of infested lakes and rivers.

The **quagga mussel** (*Dreissena rostriformis bugensis*) is one of seven species. This species is indigenous to the Dneiper River drainage of Ukraine. The quagga mussel was first observed in North America in September 1989 when it was discovered in Lake Erie. It was not identified as a distinct species until1991. The species was called the quagga Mussel after the quagga, an extinct subspecies of African zebra, possibly because, like the quagga, its stripes fade.

Within two to three weeks, quagga veligers (larvae) “settle” and attach by strong byssus threads to hard or soft surfaces. They grow best in areas of free-flowing water where they can filter out large quantities of plankton.

Facilitator Reference:
QUAGGA MUSSEL FAST FACTS

ORIGIN and SPREAD

- Quagga mussels, *Dreissena bugensis*, are indigenous to the Dneiper River drainage of Ukraine.
- Quagga mussels were introduced into the Great Lakes in 1986 in ship ballast water. Until their discovery in Lake Mead, they had been limited to the upper Mississippi River and the Great Lakes.
- The primary way quagga mussels can spread westward is on boats trailered by the public or commercial haulers.
- Since the Lake Mead discovery, quagga mussels have also been verified in Lake Powell, Lake Mojave and Lake Havasu.

LIFE HISTORY and HABITAT REQUIREMENTS

- A single spawning female potentially releases tens of thousands to millions of eggs.
- Quagga mussel larvae are known as “veligers.”
- Life stages of the zebra mussel are: egg → larva (veliger) → juvenile → adult.
- Quagga mussel eggs and larvae are microscopic; adults can grow to 1 inch in size.
- The life span of the quagga mussel is two to five years.
- Unlike the zebra mussel which requires hard surfaces, quagga mussel larvae can settle and attach to hard or soft surfaces.
- Water flowing faster than 1.5-2.0 m/sec affects larval settlement and fertilization.
- Adult quagga mussels do not survive in water where the pH is lower than 6.5.
- Quagga mussels are uncommon in water with Secchi disk depths under 1 meter. It is thought that high turbidity may interfere with feeding.
- Adult mussels colonize all types of living and non-living surfaces including boats, water-intake pipes, buoys, docks, piers, plants, and slow-moving animals such as native clams, crayfish, and turtles.

IMPACT

The greatest direct ecological impact of quagga mussels relates to their feeding behavior. Quagga mussels are filter feeders and can process up to 1 gallon of water per day per mussel. This feeding ability combined with high numbers rapidly clears the water of even the largest lakes.

Also, quagga mussels can:

- Ruin a boat engine by blocking the cooling system, causing overheating.
- Increase drag on the bottom of a boat, reducing speed and wasting fuel.
- Overwhelm local waters and cover beaches with broken shells with sharp edges, making these areas unpleasant and smelly.

Student Worksheet:
DATA COLLECTION SHEET (SIDE 1)

Alien Invaders

Investigation:

Why are quagga mussels taking over Lake Mead?

1) Temperature ⇨ FACTS: quagga mussel survival: 4°C to 25°C Best: 12°C to 20°C

Temperature Measurement	Data	
At the surface	°F	°C
2 meters below surface	°F	°C
5 meters below surface	°F	°C

a. Can quagga mussels live in the **temperatures** you found? ☐ **YES** ☐ **NO**

b. Are these the BEST **temperatures** for quagga mussels to grow? ☐ **YES** ☐ **NO**

2) pH ⇨ FACTS: quagga mussel survival: pH = 6.5 to 8.7 Best: pH is HIGHER than 7.0

pH Measurement	Data
At the surface	
2 meters below surface	
5 meters below surface	

a. Can quagga mussels live at the **pH** you found? ☐ **YES** ☐ **NO**

b. Is the BEST **pH** found here? ☐ **YES** ☐ **NO**

Team Members _____

Student Worksheet:
DATA COLLECTION SHEET (SIDE 2)

3) Food ⇨ FACT: quagga mussels like to eat plankton, especially Daphnia and copepods.

a. Is there **food** for quagga mussels here? ☐ **YES** ☐ **NO**

b. What kind of **food** did you find? Sketch it in the box.

4) Big Question!

Why are quagga mussels taking over Lake Mead?

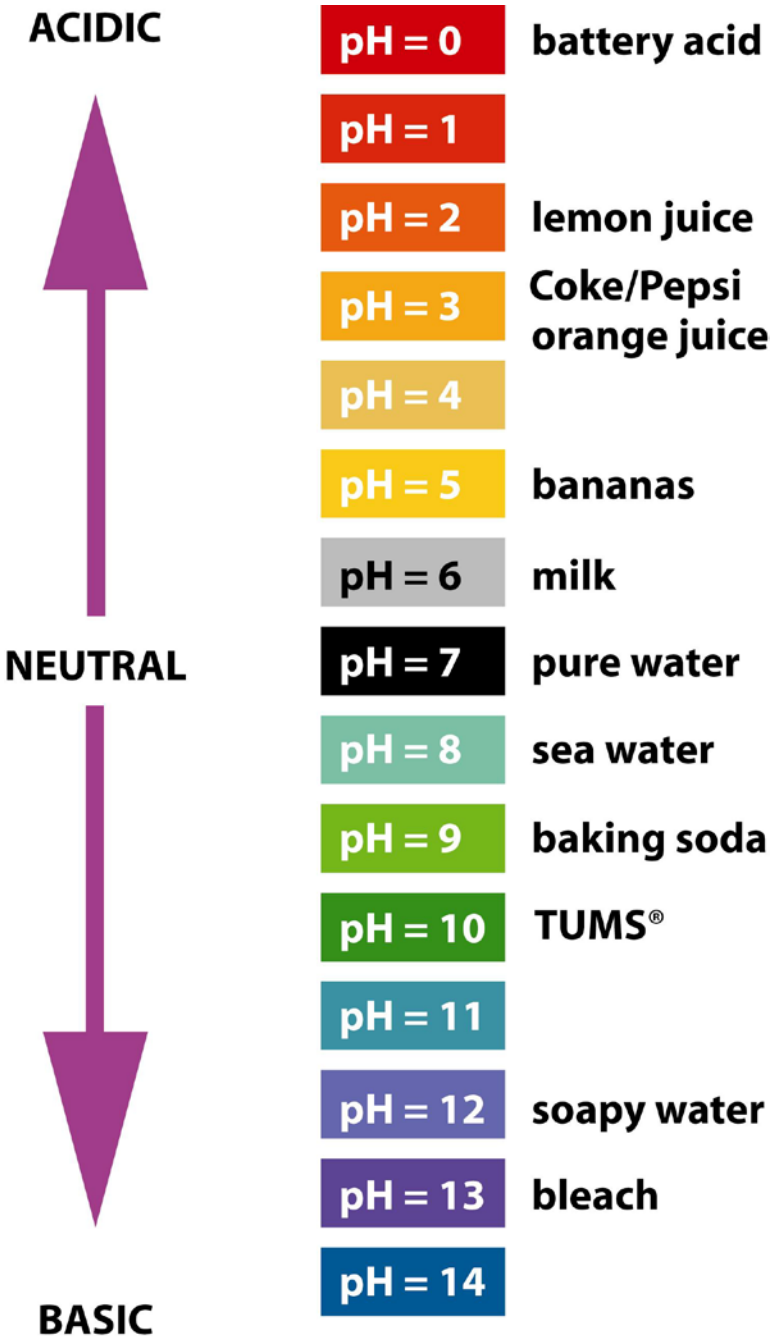
5) What will happen to water clarity?

⇨ FACT: quagga mussels filter the water to collect food.

a. Secchi disc depth today:_____

b. As quagga mussels take over, how will the secchi disc depth change? _____

Student Reference:
PH SCALE AND EXAMPLES

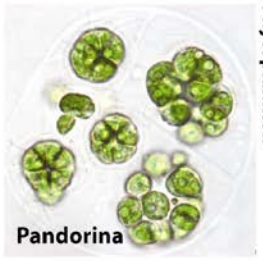


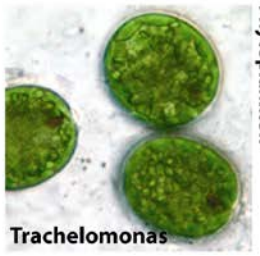
Adapted from the Acid Rain Student's Site: www.epa.gov/acidrain/site_students/phscale.html

Student Reference:
PLANKTON IDENTIFICATION SHEET

phytoplankton

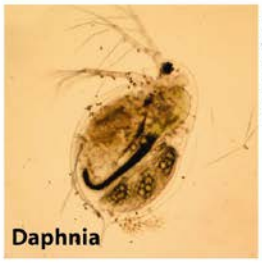
- microscopic plants that live in water
- first in the food chain
- use chlorophyll to make sugars out of energy from the sun, chemicals (like nitrogen), and dissolved carbon dioxide gas.





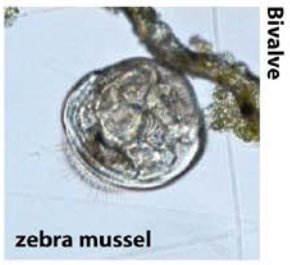
zooplankton

- microscopic animals and single-celled organisms that live in water
- eat other plankton



veliger

- the free-swimming, microscopic young (larvae) of zebra mussels and other fresh water mollusks
- eat plankton



Facilitator Reference:
POSSIBLE SOLUTIONS TO MUSSEL MANEUVERS CONSEQUENCES

A PLACE

Lucky You…You find plenty of places – like rocks and water pipes − where you can attach. Move forward But, before you go…What about the water pipes? Are quagga mussels beneficial, harmful, or neither to water pipes?

CONSEQUENCE: Quagga mussels are **harmful** to water pipes; quagga mussels clog pipes. In the case of the Monroe Plant in Michigan, cleaning zebra mussels, a species related to quagga mussels, from the water intake system cost more than $300,000 in 1989 (LePage, W. The Impact of *Dreissena polymorpha* on Waterworks Operations at Monroe, Michigan: A Case History, 1992).

A FISH

Oh, no! There are lots of striped bass here! They've already eaten many of your young − and look, here comes another one! Draw again from this row. But, before you go…What about the striped bass? Are quagga mussels beneficial, harmful, or neither to striped bass?

CONSEQUENCE: Quagga mussels are **beneficial** to striped bass; striped bass eat quagga mussel veligers.

A CHEMISTRY

Right on! You've landed in a lake with lots of calcium, which you need to grow a strong shell. Move forward. But, before you go…What about the other organisms with shells in the lake? Most do not need as much calcium as the quagga mussel. Are quagga mussels beneficial, harmful, or neither to other animals with shells?

CONSEQUENCE: Quagga mussels, in terms of calcium, have **no effect** on the other animals with shells. Students might suggest that quagga mussels could clear the water of calcium. This is a great answer, but in reality there is so much calcium in the lake that it would be impossible for quagga mussels to deplete it.

B CHEMISTRY

Yuck! There's been an accident at the dock, and lots of oil spilled into the water. You can't survive here! Draw again from this row. But, before you go…What about the other organisms in the lake? After the oil spill is cleaned up, what happens to them if there are no longer quagga mussels here?

CONSEQUENCE: If the other organisms can recover from the oil spill, they will likely benefit from the loss of quagga mussels. One really needs more information on the types of animals that lived in this area to decide whether the loss of quagga mussels is beneficial or harmful.

B **BIRD**

Well…there are several birds that eat quagga mussels, including great blue herons and cormorants. But you just laid 1,000,000 eggs! Move forward. But, before you go…What about great blue herons and cormorants? Are quagga mussels beneficial, harmful, or neither to these birds?

CONSEQUENCE: Quagga mussels are **beneficial** to these birds; they eat quagga mussels. But quagga mussels can also be **harmful** to birds. As filter feeders, quagga mussels can incorporate toxins from polluted water into their tissues; these toxins are passed on to the birds when they eat them.

B **NEIGHBORS**

Yikes! The razorback sucker is a fish neighbor that, like you, eats plankton for food. But no need to worry—you can easily eat far more than this fish! Move forward. But, before you go…What about the razorback sucker? Are quagga mussels beneficial, harmful, or neither to razorback suckers?

CONSEQUENCE: Quagga mussels are **harmful** to razorback suckers because they deplete the food source (plankton) for this native fish.

C **CHEMISTRY**

Hmmm…the pH of the lake is only 6.0 —this makes it hard to make your shell. You can't live here! Draw again from this row. But, before you go…What about the other animals that can live in a lake with a pH 6.0? Are quagga mussels beneficial, harmful, or neither to these animals?

CONSEQUENCE: Quagga mussels have **no effect** on these animals, since they will never cohabit an area with them. Animals that have a broad range of pH tolerance might exist in an area that can be invaded by quagga mussels. In that case, these species would be subject to quagga mussel damage.

C **LIGHT**

Uh, oh. You ended up at the bottom of a deep lake. It's so dark here that plankton can't grow. With no food, you can't survive here! Draw again from this row. But, before you go…What about the other organisms that live here? Are quagga mussels beneficial, harmful, or neither to the organisms that can survive here?

CONSEQUENCE: Quagga mussels have **no effect** on these animals, since they will never share an area with them.

C **CRAYFISH**

Hey! Hop on for a free ride! It may seem odd, but quagga mussels can attach to crayfish, clams, and other animals. Move forward. But, before you go…What about the crayfish? Are quagga mussels beneficial, harmful, or neither to crayfish?

CONSEQUENCE: Quagga mussels are **harmful** to these animals; when many quagga mussels attach to an animal such as a crayfish, the animal's movement is limited and can even be suffocated.

D

FOOD

All gone! There are so many quagga mussels that all of the plankton has been eaten from this part of the lake. There's no more food, so you can't live here anymore! Draw again from this row. But, before you go…What about the other animals that eat plankton in this part of the lake? Were quagga mussels beneficial, harmful, or neither to the other animals that live here?

CONSEQUENCE: Quagga mussels were **harmful** to native animals that also eat plankton; without food, native species will die.

D

TEMPERATURE

Brrr…it sure got cold this winter! It wouldn't have been so bad if you weren't stuck in this shallow inlet. As it is, you are struggling to survive. Draw again from this row. But, before you go…what about the other animals in the inlet? Were quagga mussels beneficial, harmful, or neither for them?

CONSEQUENCE: Quagga mussels were probably **harmful** to native animals living in the inlet, but without more information we can't say. The types of animals living in the inlet were probably young fish that depend on plankton for food, which quagga mussels eat. If clams or mussels lived in the inlet, the quagga mussels could have attached to them, suffocating them.

D

PLACE

Wow! The marina is filled with boats! Just look at all the places where you can attach! Congratulations: you finished! But, before you go…What about the boats? Are quagga mussels beneficial, harmful, or neither for the boats?

CONSEQUENCE: Quagga mussels are **harmful** to boats. Quagga mussels will block a boat's engine cooling system and cause the boat to overheat. Also mussels attached to hulls can increase drag and increase fuel consumption.

Facilitator Reference:
TALLY SHEET

Alien Invaders

Mussel Maneuvers
Use this sheet to keep track of the number of times quagga mussels benefit, harm, and have no effect on their new environment during the card activity!

Beneficial

Total

Harmful

Total

Neither

Total

Team Members

Facilitator Reference:
BUDGET PLANNING SHEET

Alien Invaders

Management Plan
Create a Management Plan Budget. Each team has **$150,000** to spend.

Expense	*Cost*	*We will spend:*
Media Campaign		
A. Local T.V. Commercial	$30,000	
B. Newspaper Ad.	$11,000	
C. Park Posters/Park News	$4,000	
D. Park Brochure	$11,000	
E. Billboard	$30,000	
F. Super Bowl Ad.	$2,600,000	
Boat/Trailer Inspection		
A. Rangers	$454,000	
B. Rangers	$91,000	
C. Rangers	$20,000	
D. Volunteers	$15,000	
Monitoring		
A. Biologist	$25,000	
B. Biologist	$8,000	
C. Volunteers	$8,000	

Team Members