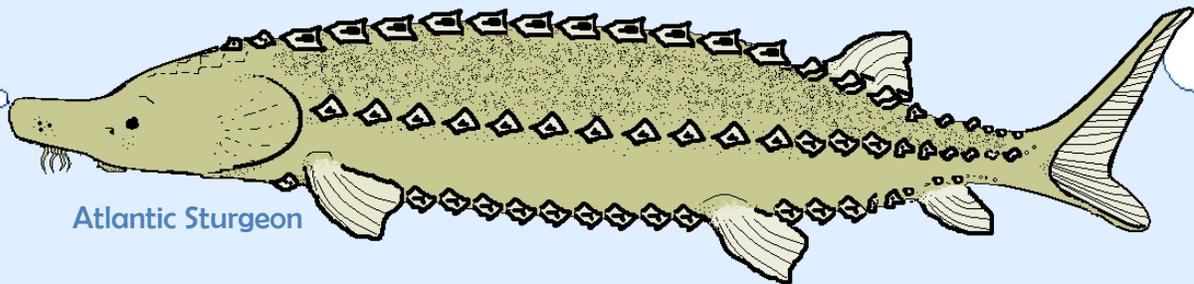
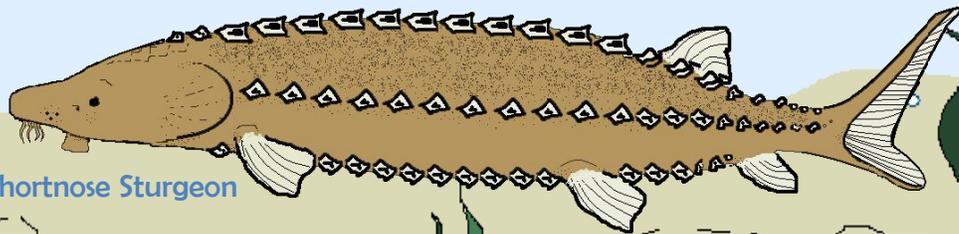


# Atlantic & Shortnose Sturgeon

## Coloring, Activities, and Education Booklet



Atlantic Sturgeon



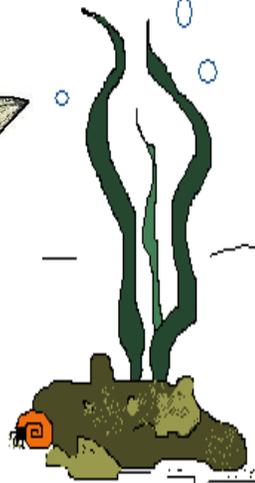
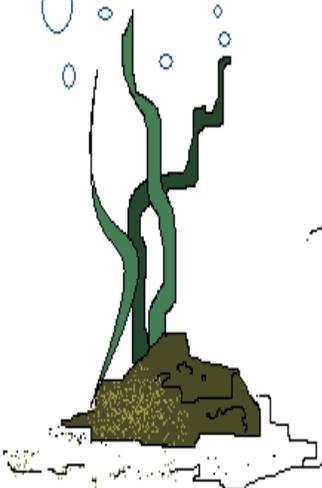
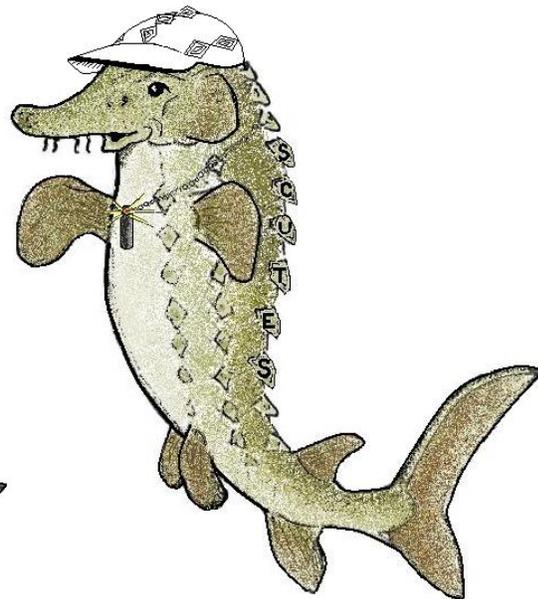
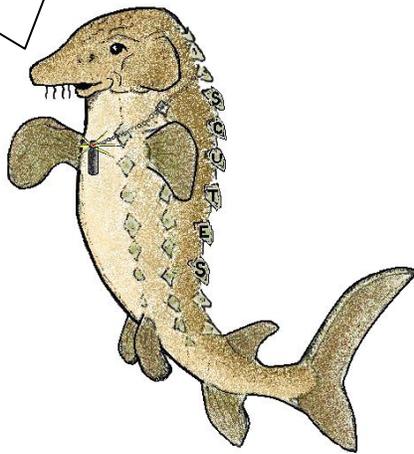
Shortnose Sturgeon



Hey Kids!

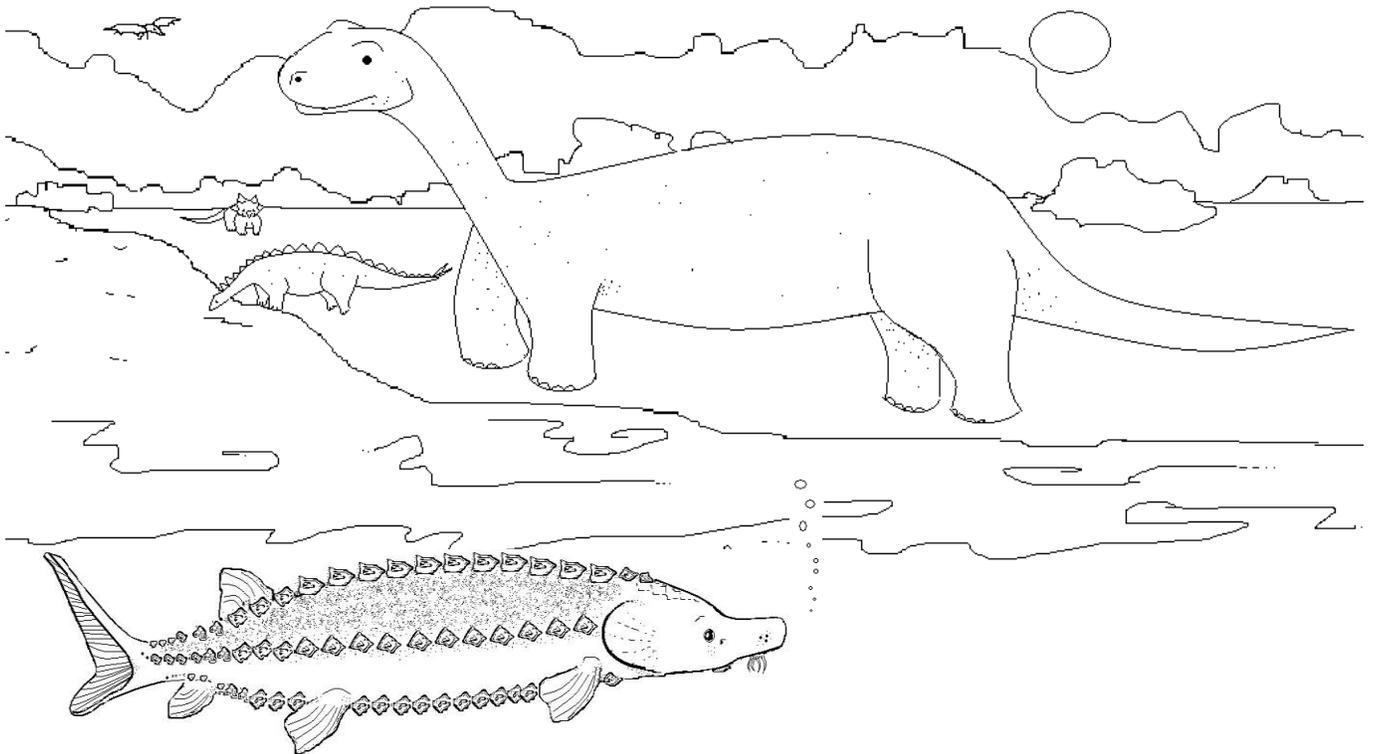
My name is Scooter, and I'm an Atlantic sturgeon. I'm hanging out with my cousin, Barb. She is a shortnose sturgeon. She's shorter than me and has a short, broad snout. I got my name from these cool scales that we have called **SCUTES**. Barb is named after the neat whiskers we have called **barbels**. I will tell you all about those later. Would you like to learn about Atlantic and shortnose sturgeon? I can tell you all sorts of things about us like our life cycles, how we travel from the ocean to rivers, how even George Washington used to fish for us, and about how we were around when the dinosaurs were still alive! We are a pretty interesting fish if you ask me! I even have some games for you to play and all sorts of things for you to color too. If there is a word in **bold** that you don't understand, have no fear! The definition is in the back of this book. Come on! Let's have some fun learning about Atlantic and shortnose sturgeon!

Hi there! I'm Barb, Scooter's cousin, and I'm a shortnose sturgeon.



# ATLANTIC & SHORTNOSE STURGEON

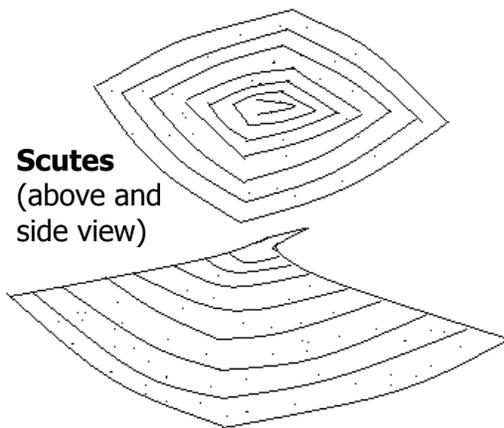
The **sturgeon** family is the most **primitive** of all bony fishes, dating back to the Cretaceous period more than 120 million years ago. It is believed that the ancestors of **sturgeon** lived with the dinosaurs. This makes the **sturgeon** that you see today almost like living fossils!



There are seventeen **species** with many more subspecies of **sturgeon** worldwide from the **genus** *Acipenser*, and they are found only in the northern hemisphere. Two **species** can be found on the East **coast** of the United States in the **Atlantic Ocean**. They are normally found in **coastal** waters, **bays**, **estuaries** and rivers. The two **species** on the East **coast** are the Atlantic **sturgeon** (*Acipenser oxyrinchus oxyrinchus*) and the smaller shortnose **sturgeon** (*Acipenser brevirostrum*).

Atlantic and shortnose **sturgeon** are **anadromous** fish, which means that they spend part of their life cycle in salt water and part in freshwater. They are able to do this by **osmoregulating**, or leveling their body salts. They spend most of their time in **coastal** ocean waters, but **migrate** and travel through **estuaries** to rivers and freshwater for **spawning**, but shortnose sturgeon spend more time in rivers and farther upstream than Atlantic sturgeon. They are slow growing and late maturing fish. While shortnose sturgeon have been known to reach no more than 5 feet and weigh up to 50 pounds, Atlantic **sturgeon** have been recorded to reach lengths over 14 feet long, weighing almost 800 pounds! The oldest **sturgeon** recorded was estimated to be around 60 years old. Some shortnose sturgeon do not reach reproductive maturity until

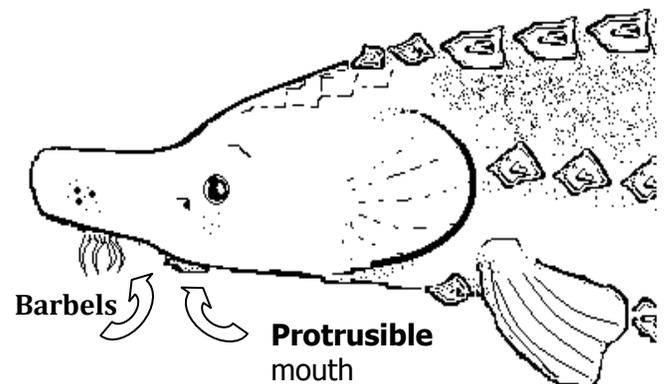
they are 13 years old while some Atlantic **sturgeon** do not reach maturity until they are 20 years old.



**Sturgeon** have five rows of bony **scutes** along the length of their body. **Scutes** are a modified **ganoid scale**. **Ganoid scales** are diamond shaped and found on **primitive** bony fishes like **sturgeon**. They can help serve as protection for the fish like armor, and also make **sturgeon** distinct from other fish.

Atlantic and shortnose **sturgeon** are benthic or **bottom feeders** which means that they feed and **forage** on creatures on the bottom of the rivers, **estuaries** and **coastal** waters.

They feed primarily on **polychaetes** (worms), **mollusks** (clams), **crustaceans** (crabs), and insect **larvae**. Their mouths are located on the underside of their body making them ideal bottom feeders. Between the mouth and tip of their snout, **sturgeon** have four **barbels** that are similar to whiskers. These **barbels** are sensors which they use to locate food. **Sturgeon** mouths are **protrusible** which means that it can be pushed out toward food on the ocean floor. They suck up food off the floor like a vacuum, and after swallowing it whole, they spit out most of the pebbles, sand, and gravel that were also vacuumed up.

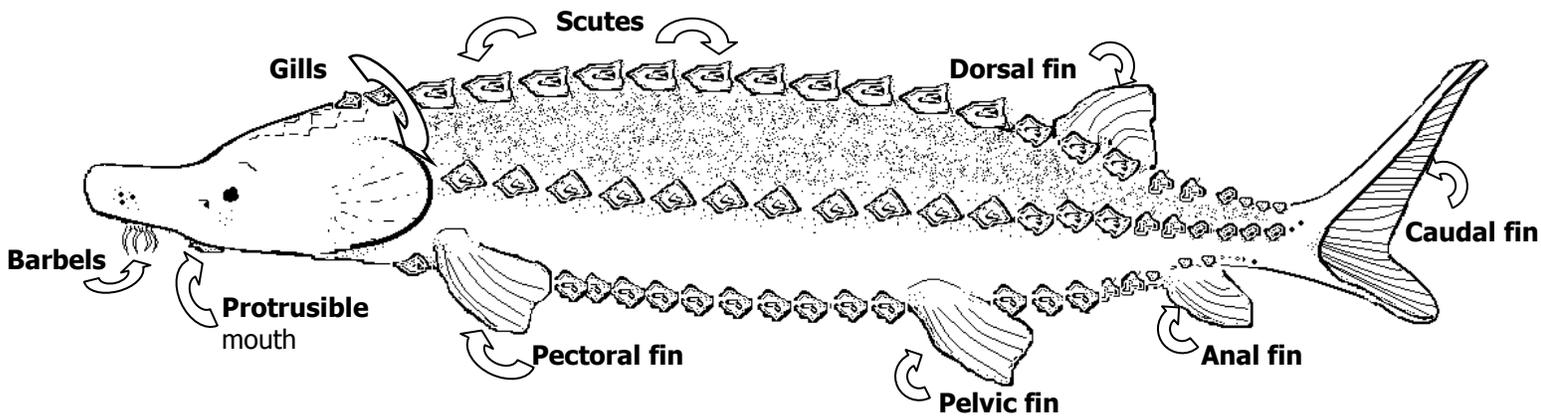


**Sturgeon** do not have teeth! When they swallow their food whole, it goes into their muscular stomach which is strong enough to crush and break up food for digestion.

## Summary of Atlantic & Shortnose Sturgeon

- The **sturgeon** family is the most **primitive** of all bony fishes, dating back 120 million years. They lived with the dinosaurs!
- Atlantic and shortnose **sturgeon** are **anadromous**, migrating between the ocean in saltwater, **estuaries** in **brackish waters**, and rivers in fresh-water, though shortnose sturgeon spend more time in freshwater than Atlantic sturgeon.
- They have 5 rows of bony **scutes** which are modified **ganoid scales**.
- Shortnose sturgeon grow up to 5 feet and weigh 50 pounds. Atlantic sturgeon can grow over 14 feet long, weigh up to 800 pounds. They can live to be over 60 years old!
- They are **bottom feeders**, use **barbels** to sense and locate food, and use their **protrusible** mouths to vacuum up food.

# Sturgeon



## Fins

**Sturgeons**, like most fish, use their fins for swimming, steering, and for balance. The **dorsal** and **anal fins** are used to stabilize the fish. **Pectoral** and **pelvic fins** are on the sides of the body, and are used for turning, stopping and also balancing. The **caudal** or tail **fin** is like a boat propeller; it pushes them through the water by moving back and forth. The **caudal fin** on **sturgeon** is bigger on the top than the bottom which is called **heterocercal**, just like a shark's tail!

## Scutes

**Sturgeon** have five rows of bony **scutes** along the length of their body. **Scutes** are a modified scale. They can help serve as protection for the fish like armor and make **sturgeon** distinct from other fish.

## Gills

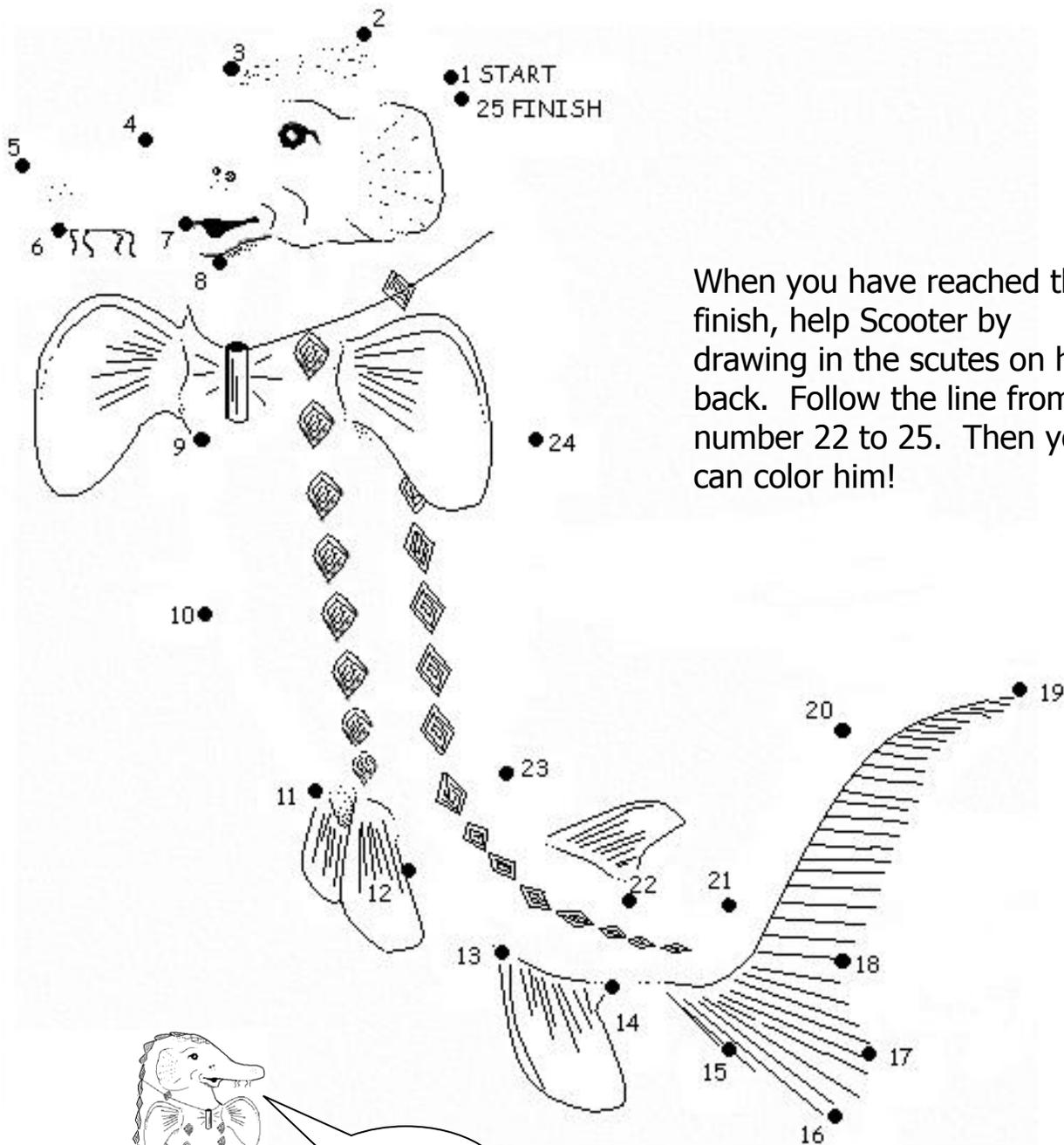
Like humans, fish need oxygen to live, but fish do not have lungs inside their body and do not breathe like humans do. Instead, fish have **gills**, which are found just behind the head and under a **gill** flap. As water flows into their mouth, it flows over their **gills** which absorb oxygen from water.

## Eating

**Sturgeon** do not have teeth! They suck up food like a vacuum with their **protrusible** mouth. After swallowing food whole, their muscular stomach crushes it into smaller pieces for digestion. Some **prey** that **sturgeon** eat are **polychaetes** (worms), **mollusks**, and **crustaceans**. There are four **barbels** between the tip of their snout and their mouth which they use as sensors to locate food.

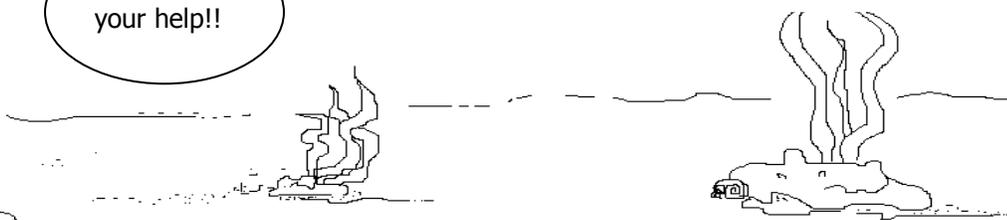
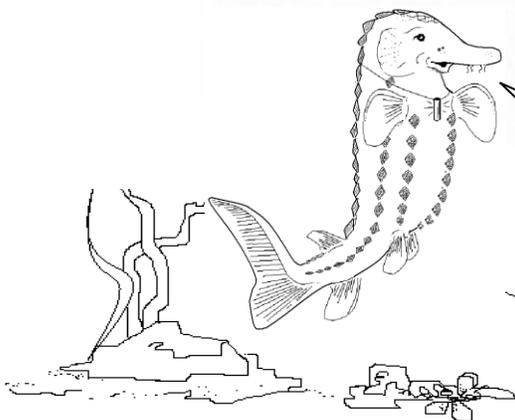
# Connect the Dots

Connect the dots from 1 all the way up to 25 to reveal a new friend!



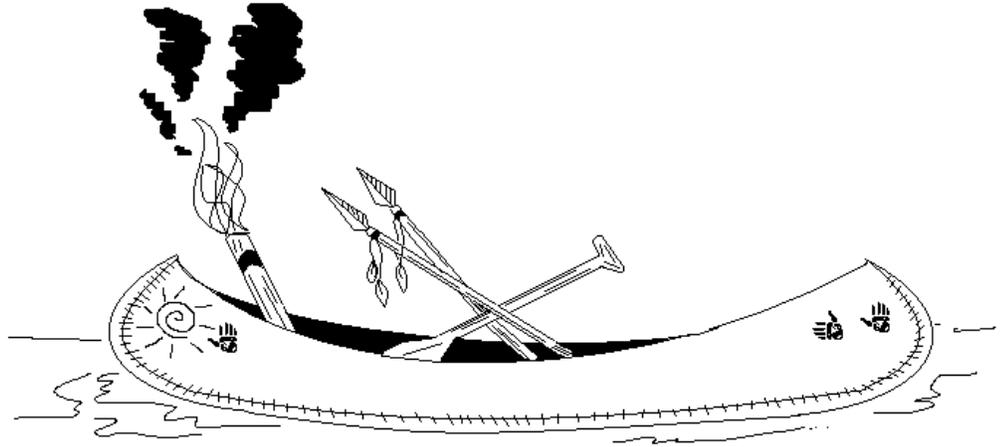
When you have reached the finish, help Scooter by drawing in the scutes on his back. Follow the line from number 22 to 25. Then you can color him!

Thanks for your help!!



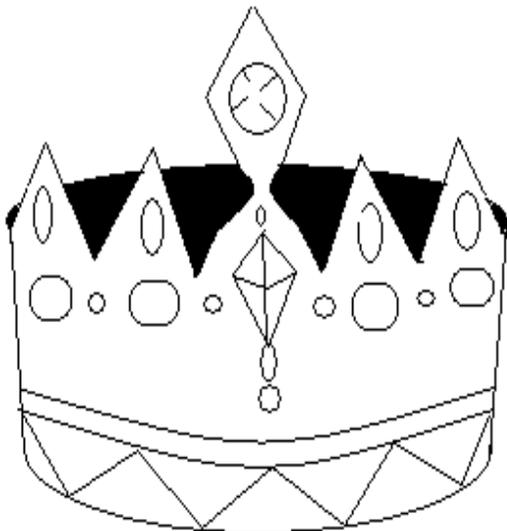
# STURGEON THROUGH HISTORY

The Native Americans of North America fished for **sturgeon** using spears, lassos, clubs and **weirs**. **Sturgeon** are known to leap out of the water on occasion and would even sometimes jump right into their boats! They were known to be curious fish, so one fishing method used by the Housatonic Native Americans to catch **sturgeon** was fishing at night while holding a torch above the water. The **sturgeon** were so curious and attracted to the light that they would come right up to the surface of the water to check out the strange sight. When they came close enough, they would get hit on the head with a club or an axe by the fisherman who would then drag the stunned fish into the boat. In addition, North American Native tribes named the full moon in August "**Sturgeon** Moon" because the fish were plentiful at that time.



**Sturgeon** were found in great numbers when European settlers first arrived in North America. Some accounts noted that there were so many **sturgeon** in the James River that you could walk across the river on their backs. In the late 1700's, George Washington started a **recreational** fishery for **sturgeon** on the Potomac River. They were very strong, large fish, so when fishermen would catch a **sturgeon** with a lasso, they would brace themselves in the boat for the

**sturgeon** equivalent to a "**Nantucket sleigh ride.**" However, it was not always fun and games with **sturgeon** on the Potomac. A **sturgeon** actually killed a Continental Army officer when he was crossing the Potomac as it jumped into his boat, landing on him and breaking his legs.

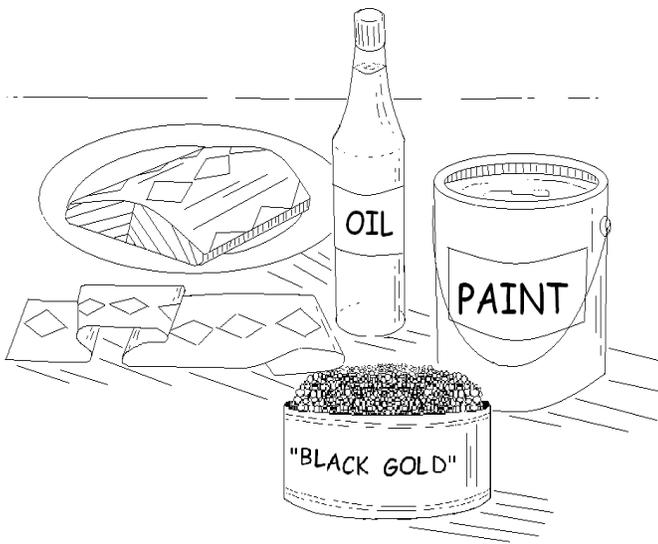


**Sturgeon** were considered to be a delicacy and a "royal" fish back in England. To be a "royal" fish meant that the king had first rights to any **sturgeon**

that were caught. The colonists were suspicious of the Native Americans who consumed these scute armored fish, and regardless of their "royal" status in Europe, continued to refuse to eat the **sturgeon**. However, after harsh winters with little food, and so many of these large fish in great abundance, Captain John Smith convinced them to make good use of **sturgeon**.

**Sturgeon** were used for many different purposes, not just food. The meat was high in protein and was prepared by a **smoking** or **pickling** process. This

process allowed for the meat to be shipped and travel great distances without spoiling. The oil of the **sturgeon** was used as a substitute for sperm whale oil as it was less smoky flavored and did not spoil as quickly. **Isinglass**, made from the **swim bladder** of the **sturgeon**, was used as a binding agent for paint as well as an adhesive. The thick skin of the **sturgeon** was made into leather by a **tanning** process, and the **roe** or **eggs** of the **sturgeon** were prepared through a **salting** process to become **caviar**.

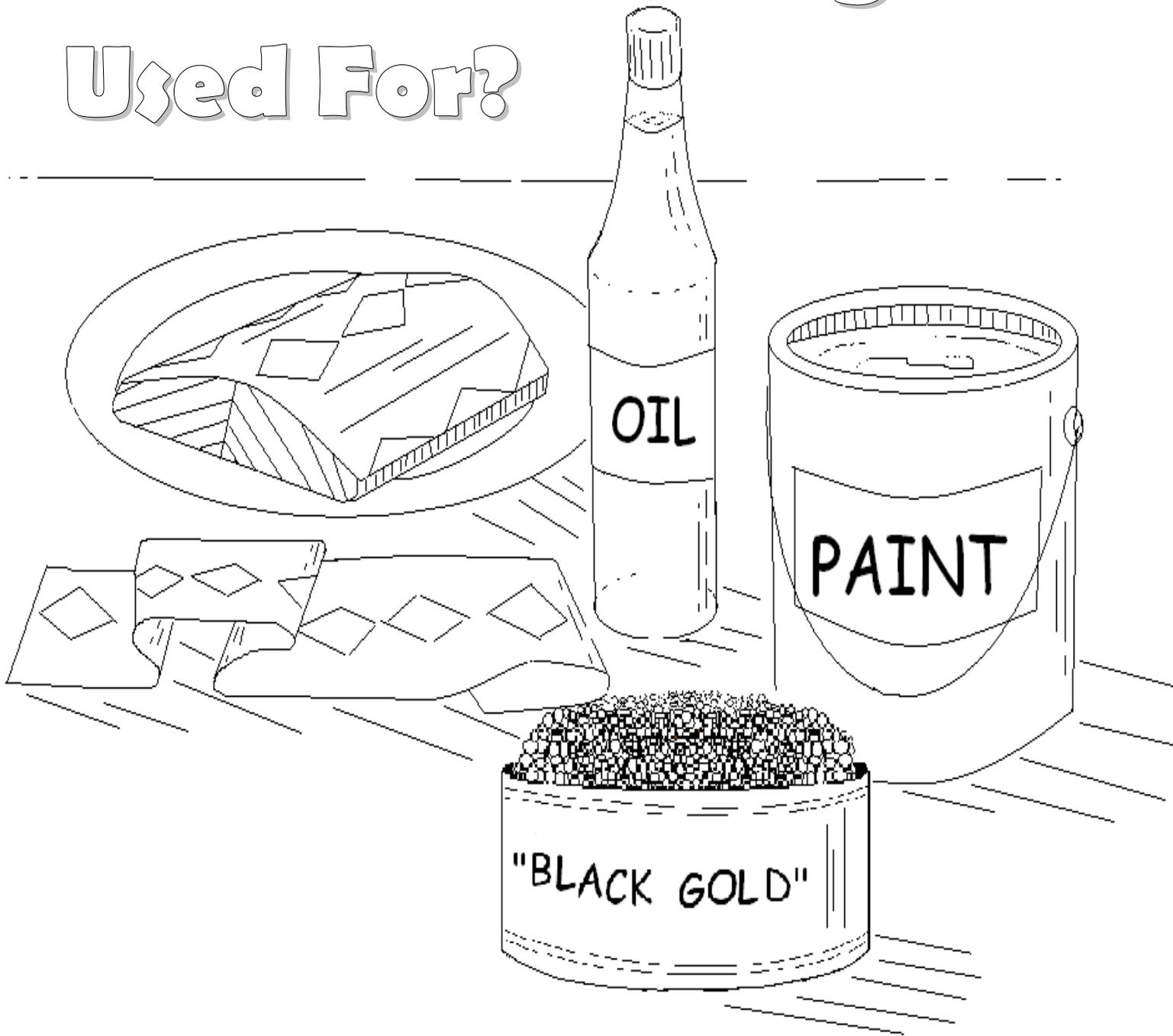


During the late 1800's, the great "**Caviar** Rush" began. News of the abundance of **sturgeon** with **caviar** or "black gold" on the East **Coast** spread quickly. Many flocked to the **coast** in search of riches, and this became known as the great "**Caviar** or Black Gold Rush." By the end of the 1800's and beginning of the 1900's, **sturgeon** stocks had declined drastically. Close to seven million pounds of **sturgeon** were reportedly caught in 1887, but due to **overfishing**, it had dropped to only 20,000 by 1905, and by 1989, a mere 400 pounds of **sturgeon** were recorded. In a time span of only 100 years, catches of **sturgeon** went from tens of thousands of fish down to only a handful.

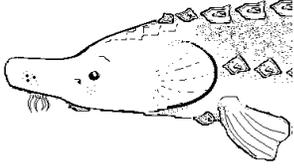
### Summary of Sturgeon in History

- **Sturgeon** used to be greatly abundant in rivers and **coastal** waters along the eastern seaboard of the United States.
- The Native Americans used spears, lassos, **weirs**, clubs, and even fire to catch **sturgeon**.
- **Sturgeon** are known to jump clear out of the water and even sometimes land in boats. People have been injured by jumping **sturgeon**.
- **Sturgeon** were used for meat, oil, leather, **isinglass**, and **caviar**.
- Stocks of **sturgeon** became greatly depleted after the great "**Caviar**" or "Black Gold Rush" when fishermen flocked to the **coast** in search of riches from **caviar**.

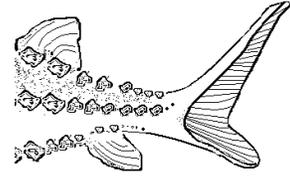
# What Were Sturgeon Used For?



Sturgeon were used for many purposes: The meat was eaten after it was smoked or pickled; the skin was tanned and turned into leather; sturgeon oil was used instead of sperm whale oil; isinglass from the swim bladder was used as a binding agent in paint as well as an adhesive, and a clarification agent for wine; and the eggs or roe were salted and prepared into caviar. Caviar became known as the other "black gold."



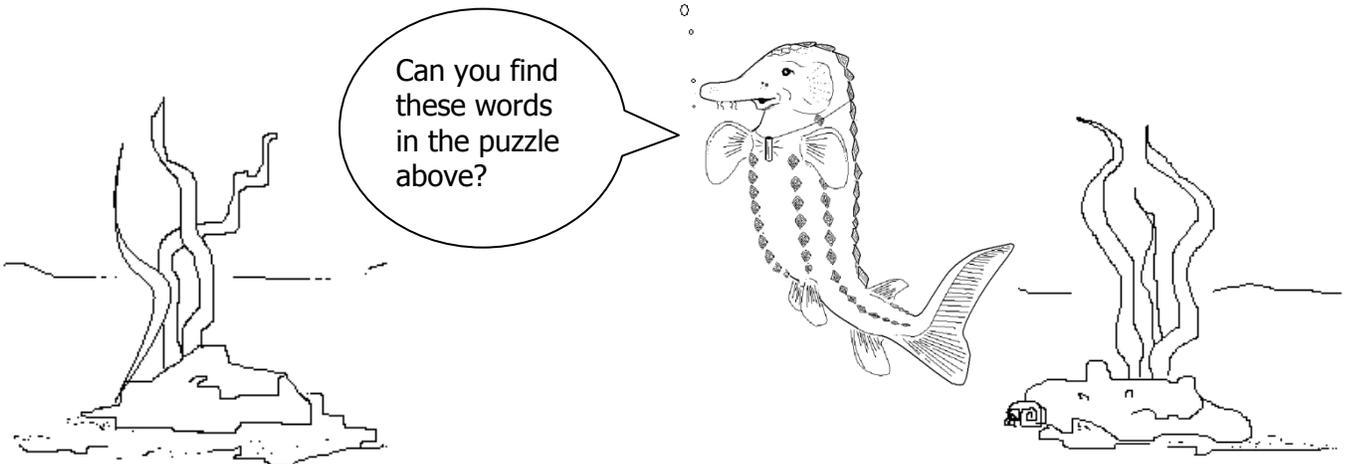
# Historic Sturgeon



P	P	R	L	E	A	T	H	E	R	C
B	R	O	S	M	O	K	E	D	I	R
I	I	E	C	U	R	I	O	U	S	E
S	M	L	H	D	T	L	I	G	H	T
I	I	T	F	I	S	H	E	R	Y	A
N	T	F	R	N	S	F	I	R	E	C
G	I	O	S	O	S	T	D	T	T	E
L	V	S	B	S	Y	M	O	I	L	O
A	E	S	C	A	V	I	A	R	G	U
S	M	I	J	U	M	P	I	N	I	S
S	I	L	R	R	S	W	I	M	Y	C
P	N	S	D	S	A	L	T	I	N	G

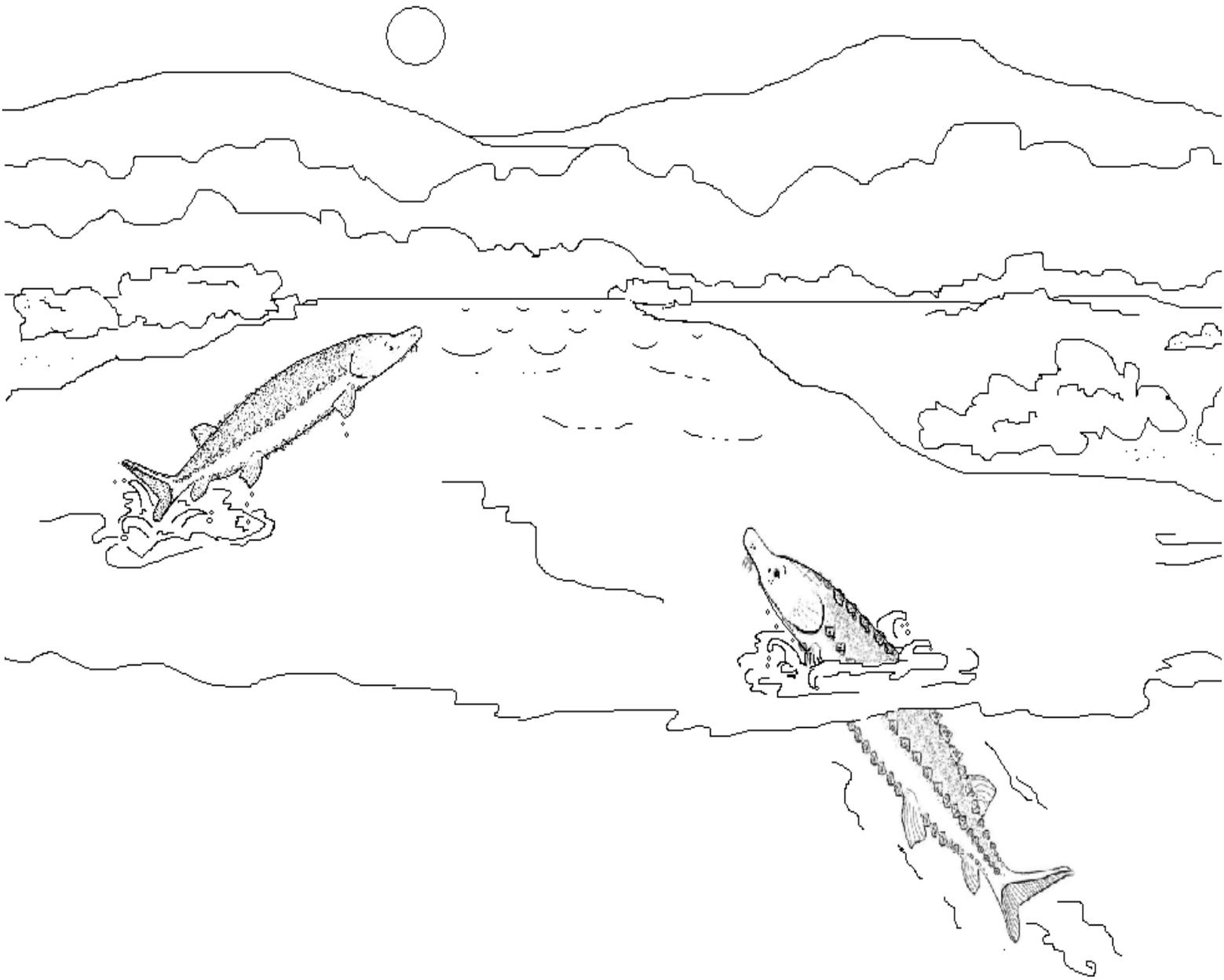
- **PREHISTORIC**
- DINOSAURS
- **FISHERY**
- **ROE**
- **CAVIAR**
- **ISINGLASS**
- SWIM
- LEATHER
- **PRIMITIVE**

- CRETACEOUS
- FOSSILS
- OIL
- **SMOKED**
- **SALTING**
- CURIOUS
- LIGHT
- FIRE
- JUMP



Words may be horizontal, vertical, or diagonal.

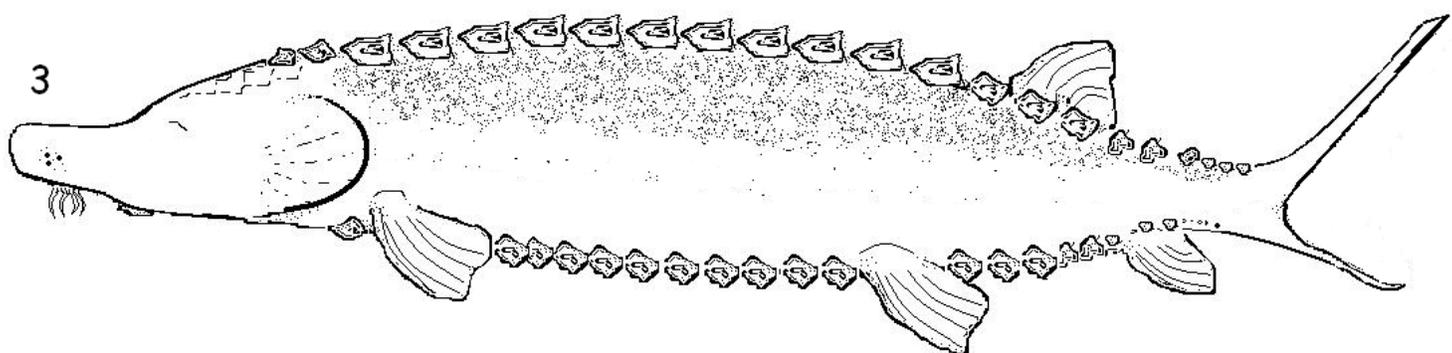
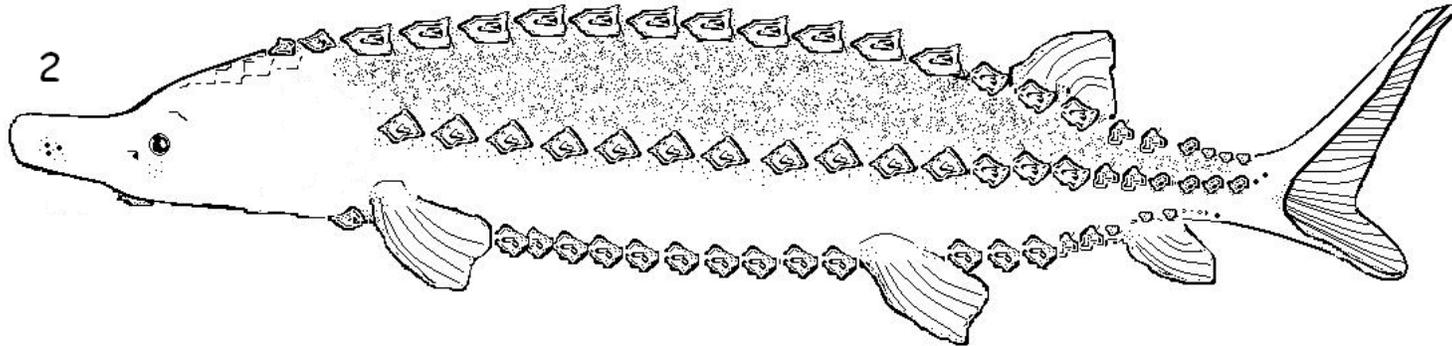
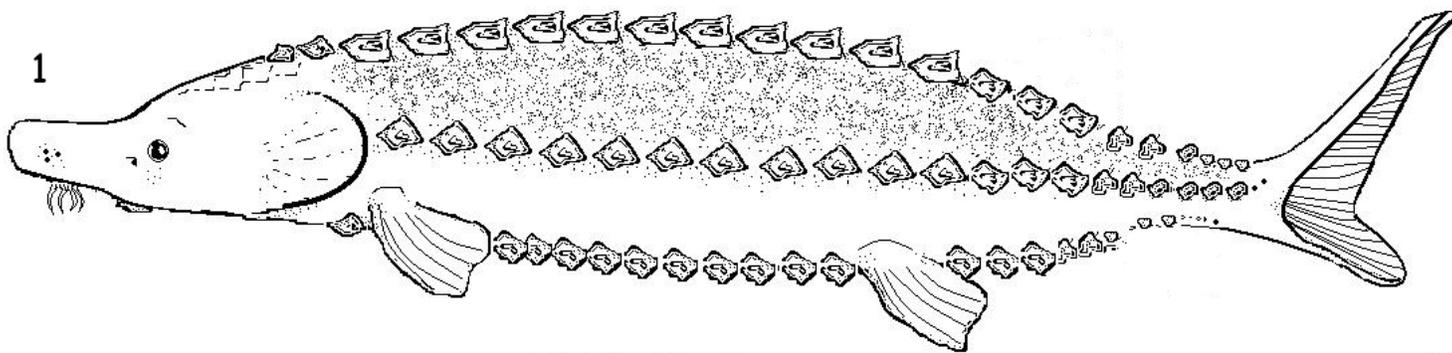
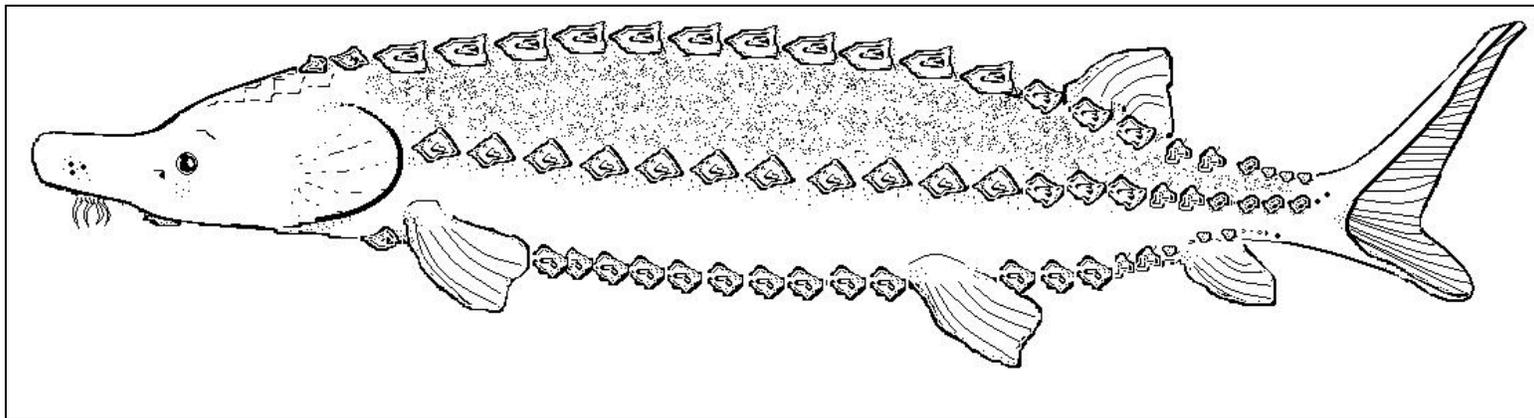
# Jumping Sturgeon



**Sturgeon** sometimes jump right out of the water! No one knows for sure why they do it. Some think that it is a form of communication or that they may be trying to get rid of parasites, and some even think that it may be just for fun.

What do you think?

# What's Missing From These Sturgeon?



Can you find what parts are missing from **sturgeon** 1, 2, and 3?

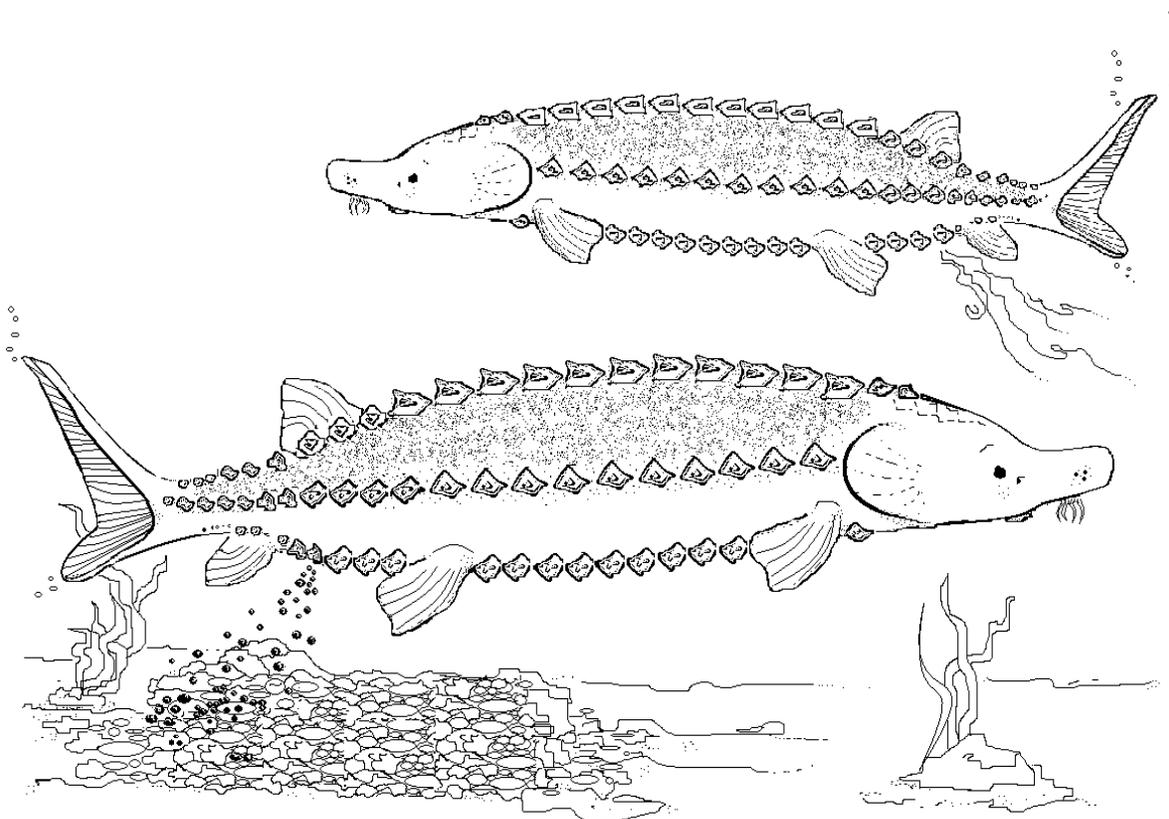
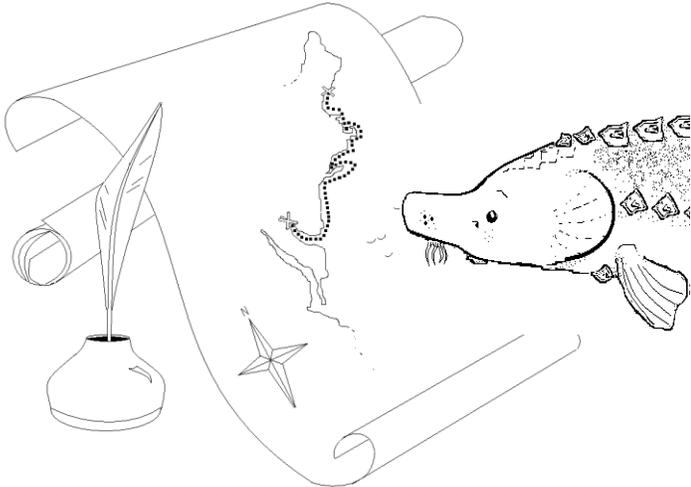
Use the **sturgeon** on the top of the page as a guide. (Hint: Fish #1 and #2 are missing 2 parts each, and fish #3 is missing 3 parts.) After you find the missing parts, you can draw them back into the picture.

# MIGRATION AND LIFE STAGES

Most Atlantic **sturgeon** spend their winters in deep **coastal** waters. When winter ends, they begin migrating up and down the **coast** to **foraging** and **spawning** grounds in the **coastal estuaries** and rivers. Shortnose **sturgeon** migrate down to the **estuaries** and sometimes to nearby rivers, but mostly stay

within the river, not making big migrations down the coast like Atlantic sturgeon. Atlantic and shortnose **sturgeon** use **estuaries** for **foraging** grounds and also **rearing** grounds for **juveniles**. When **spawning**, they usually travel to their **natal** river which is a process called **natal** homing. A **natal** river is the river where they were originally hatched. **Spawning** grounds are found above the **salt**

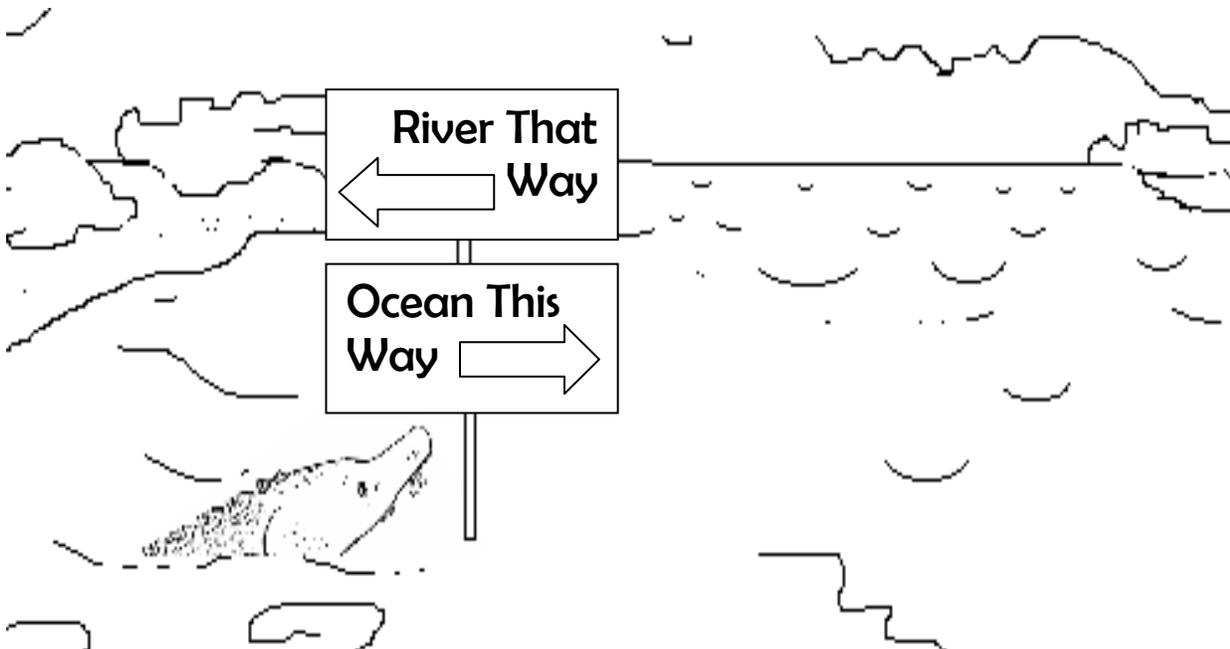
**wedge** in rivers, and are usually places with flowing water and a bottom consisting of gravel, pebbles, and cobble. When they arrive at the **spawning** grounds, females release **eggs** which are very sticky and attach to the pebbles and gravel. Males then swim over the **eggs** spreading **milt** which fertilizes the **eggs** and creates **embryos**.



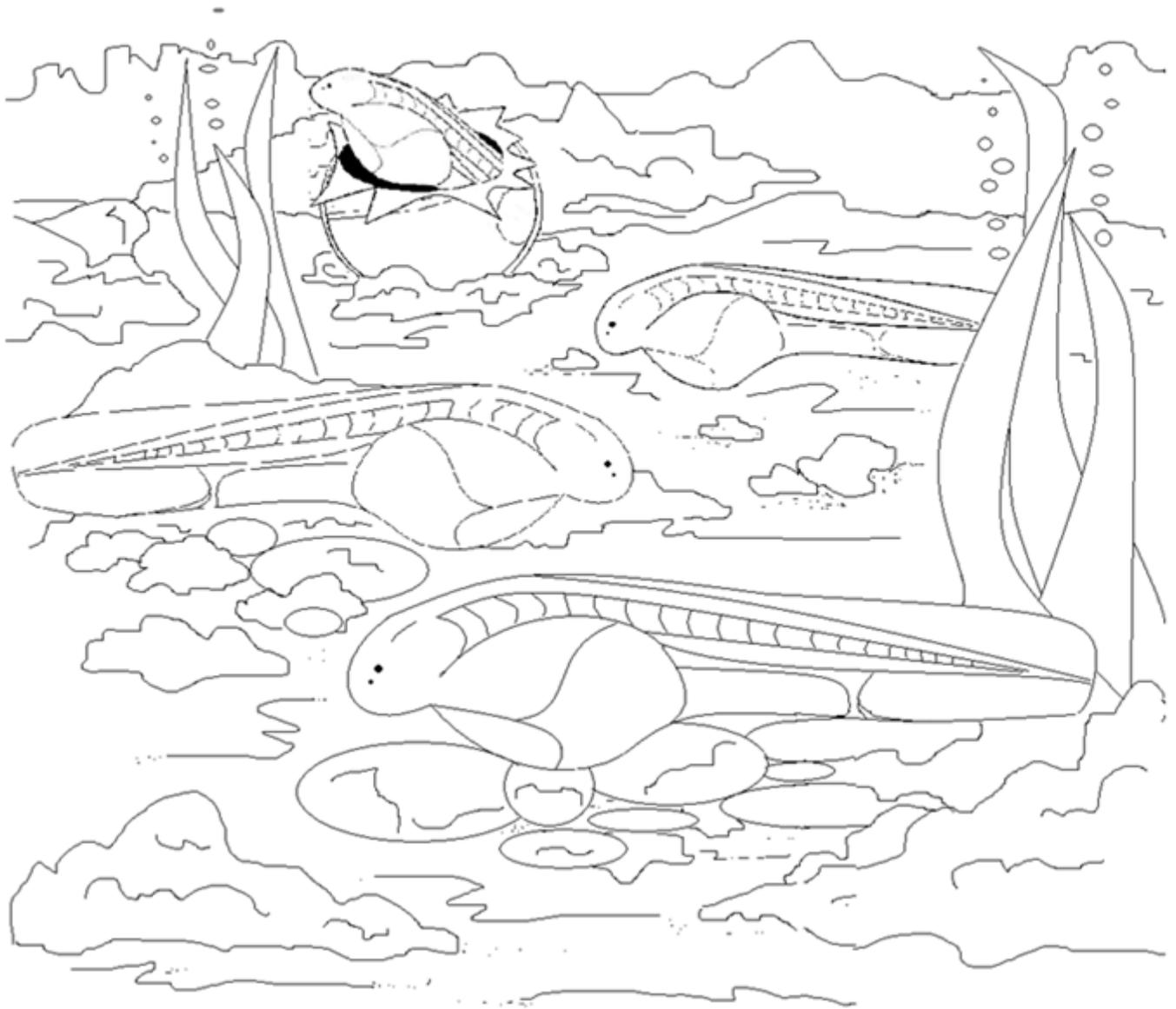
The **embryos** will hatch into **larvae** within 3-6 days. At first, **larvae** have the **yolk sac** from the **egg** still attached to them that provides food and nourishment. This stage is called the **yolk sac** larval stage and lasts about 8-12 days. When the **larvae** or **fry** are finished with the **yolk sac** and are more mobile, they begin migrating downstream to the rearing grounds, or **nursery**, in the **estuary**, and use rocks and aquatic plants for hiding. As the **fry** continue to grow, they are called **fingerlings** and continue to become better swimmers. They feed on **zooplankton** (tiny animals), aquatic plants, and insect **larvae**. When they become **juveniles**, they move further downstream to the **estuaries** and **brackish waters** which are a mixture of salt and fresh water. **Juveniles** then stay in the **estuaries** for months or even years. They are considered to be **sub-adults** by the time they leave the **estuary** and begin migrations. **Sub-adults** look the same as adults, but are not yet able to reproduce. Adults and sub-adults **migrate** along the **coast** to their wintering **habitats** and then begin the whole migration all over again in the spring.

### Summary of Migration

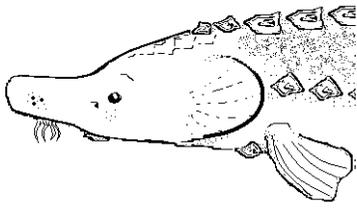
- Atlantic and shortnose **sturgeon migrate** from the ocean and brackish water to freshwater rivers for **spawning**, and to brackish **estuaries** for **foraging** and **rearing habitat**.
- They exhibit **natal** homing which means they spawn in the river in which they were hatched.
- **Spawning** occurs in freshwater. As the **embryo** grows up to be a **juvenile** and finally a **sub-adult** and adult, they move farther downstream to **brackish waters** and eventually out to the ocean.



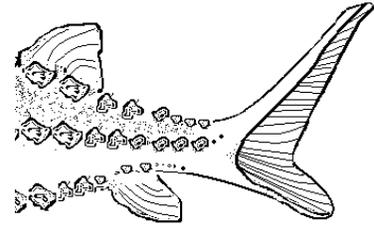
# Yolk Sac Larvae



When larvae first emerge from the eggs, they still have the yolk sac attached. This provides food and nourishment while they are growing. They hide out in the spaces between rocks and under aquatic plants for protection.



# Migratory Sturgeon

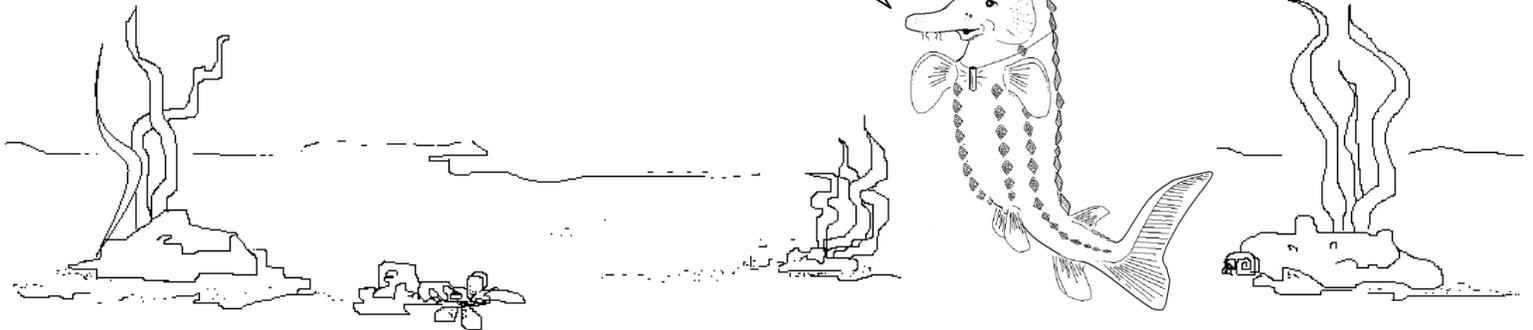


B	L	E	S	T	U	A	R	Y	C	T
S	A	P	E	B	B	L	E	S	M	E
Y	P	H	F	L	O	W	B	T	T	M
A	N	A	D	R	O	M	O	U	S	P
T	R	B	W	T	T	Y	C	R	U	E
L	P	I	V	N	M	G	E	G	B	R
A	R	T	V	U	I	R	A	E	S	A
N	T	A	Y	E	G	N	N	O	T	T
T	S	T	M	G	R	I	G	N	R	U
I	L	E	G	R	A	V	E	L	A	R
C	C	O	A	S	T	A	L	S	T	E
S	A	L	T	W	E	D	G	E	E	V

- ATLANTIC
- **STURGEON**
- **ANADROMOUS**
- **SPAWNING**
- **MIGRATE**
- **HABITAT**
- OCEAN
- RIVER

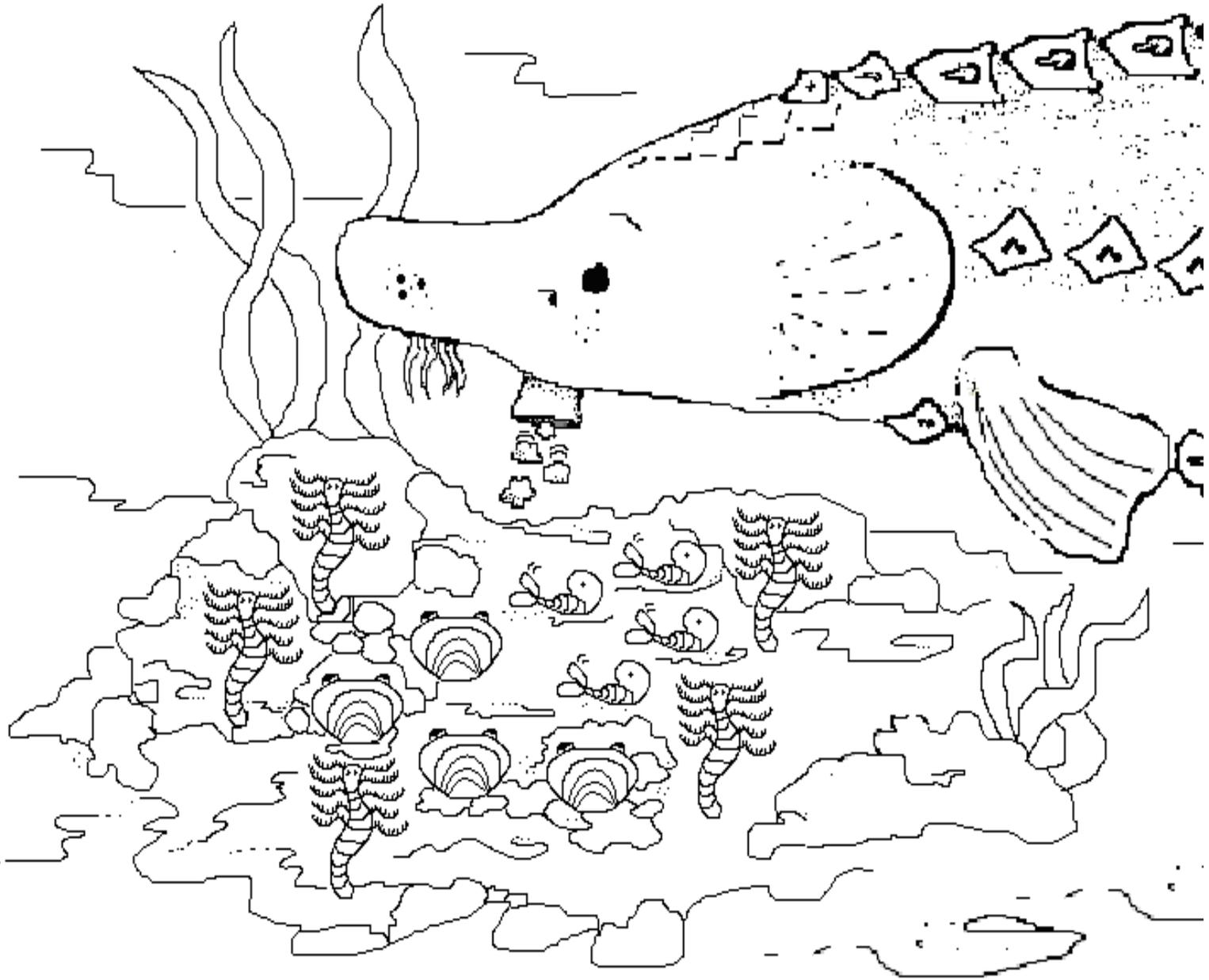
- **ESTUARY**
- PEBBLES
- GRAVEL
- **SUBSTRATE**
- **SALT WEDGE**
- **COASTAL**
- TEMPERATURE
- FLOW

Can you find these words in the puzzle above?



Words may be vertical, horizontal, or diagonal

# FORAGING

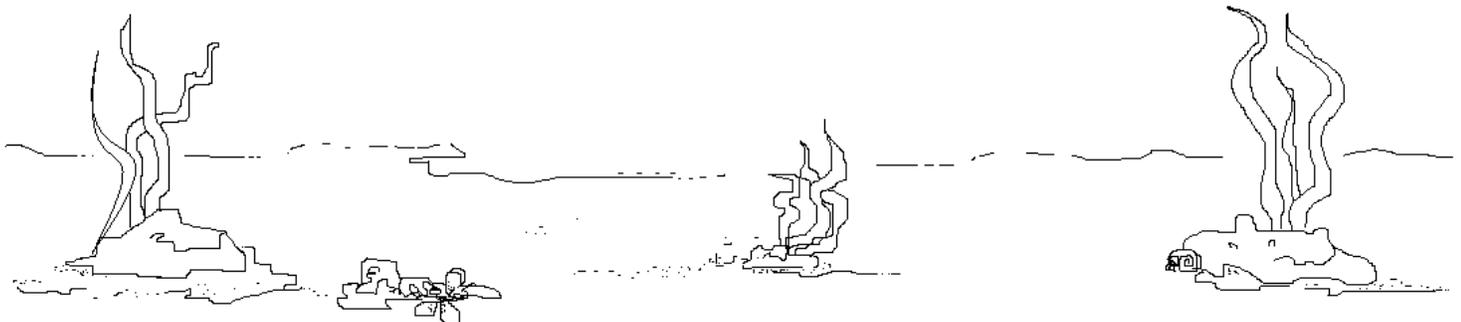
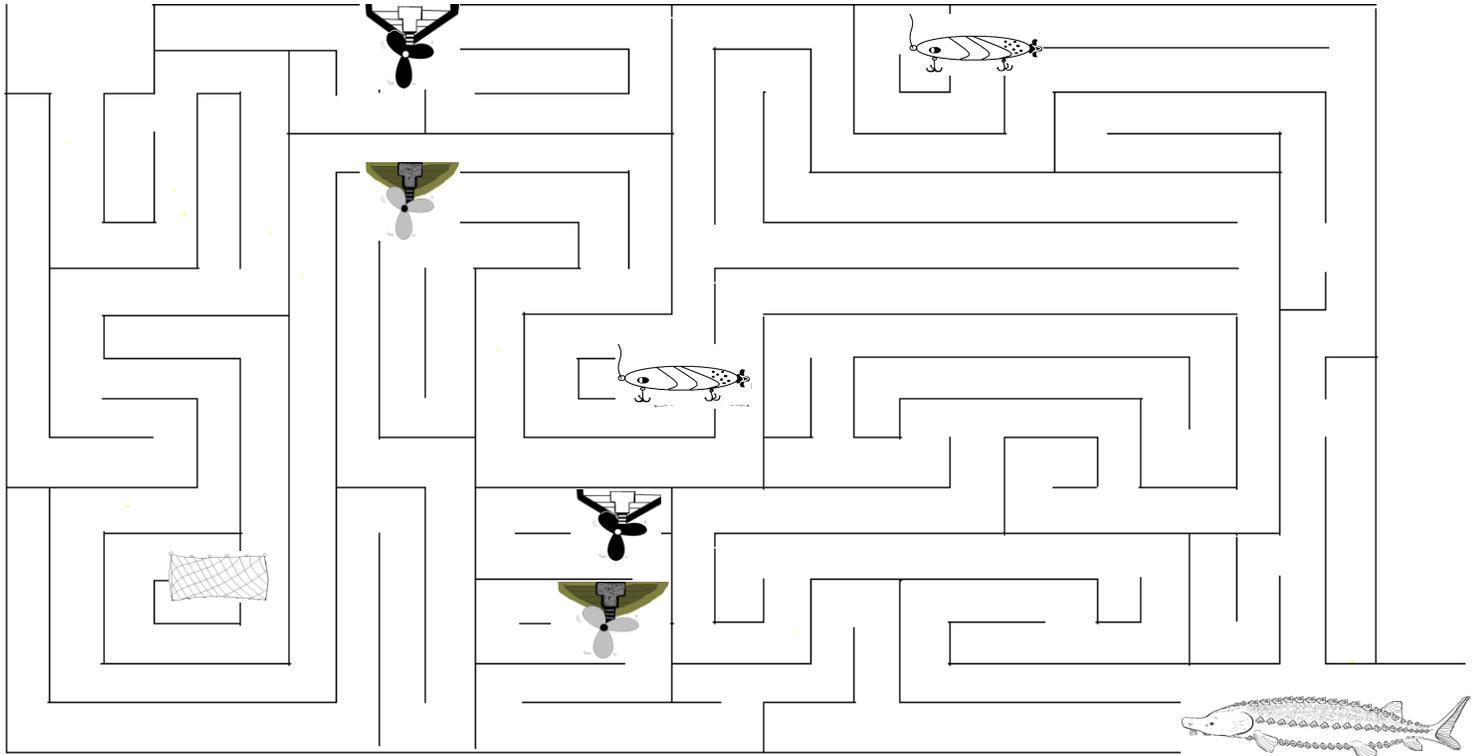
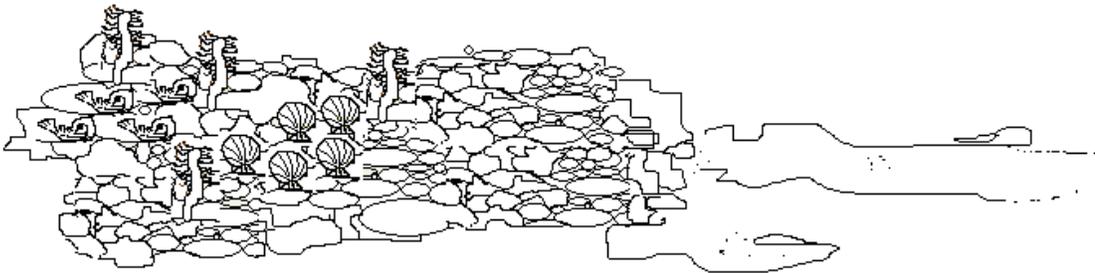


Atlantic and shortnose sturgeon use estuaries and bays as foraging/feeding grounds. They eat various **prey** including **crustaceans**, polychaetes, and **mollusks**. Their protrusible mouth sucks up food along with sand and pebbles like a vacuum. After they swallow the food whole, they spit out the pebbles and sand.

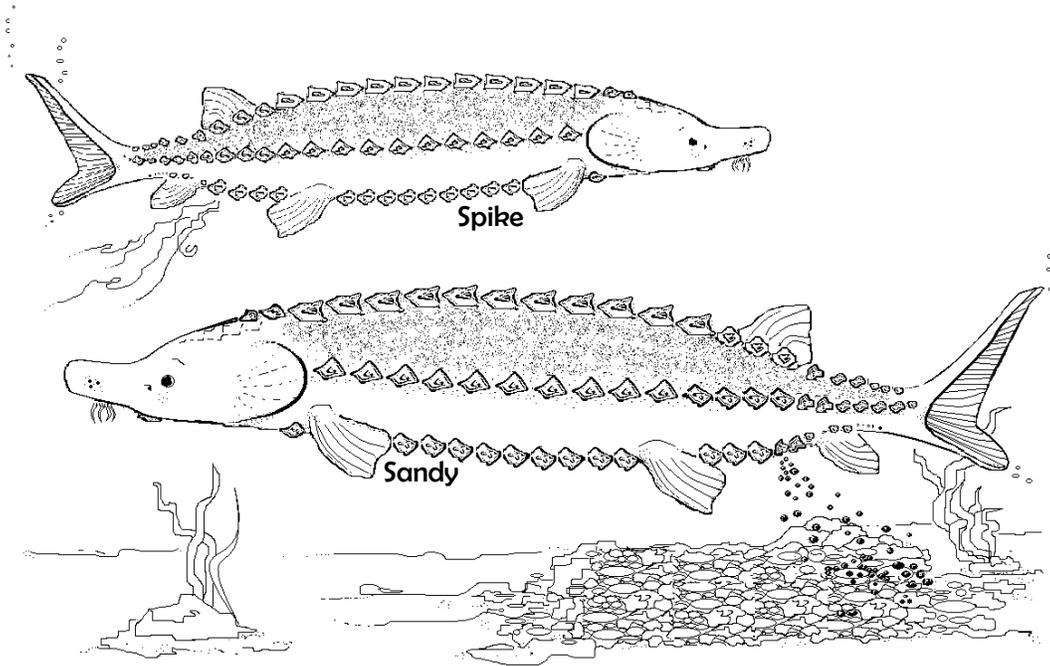
How many **prey** items can you find?

# Migration Maze: Foraging

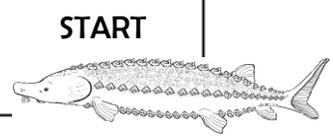
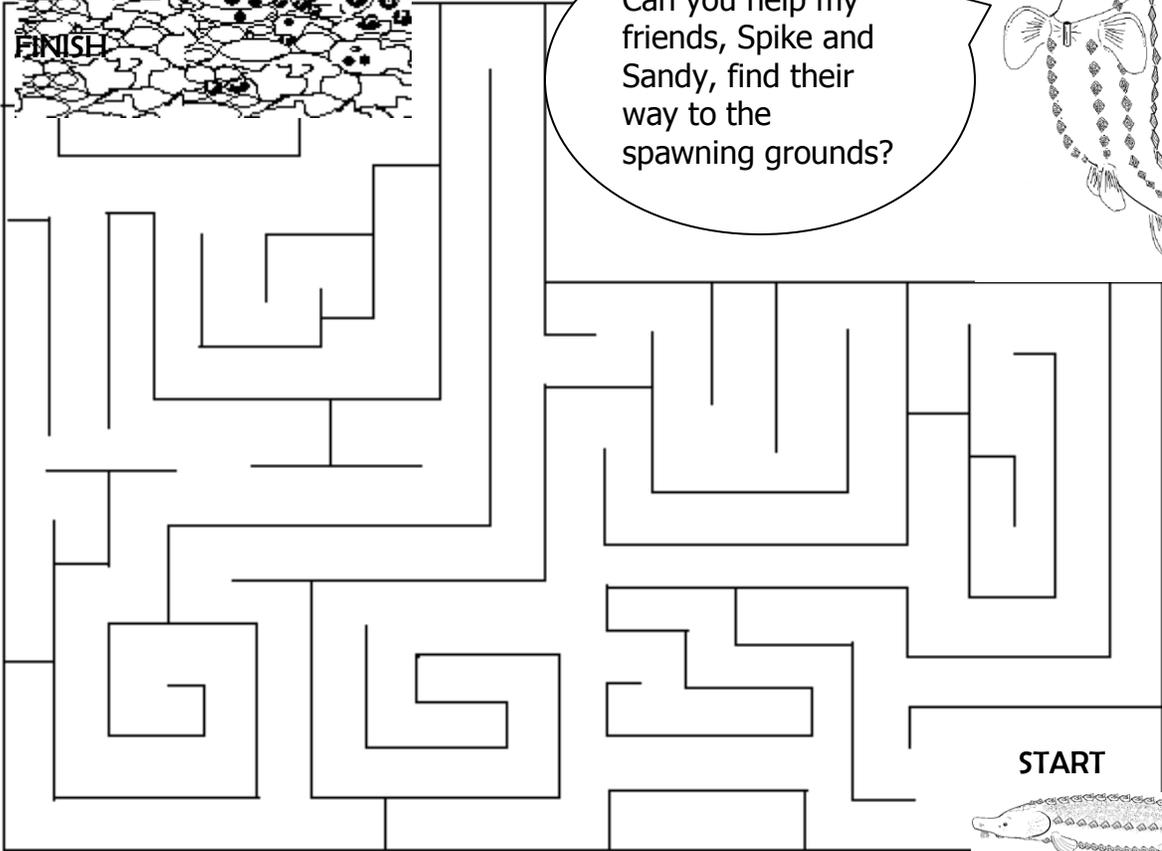
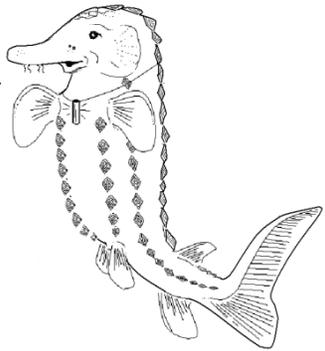
Help the **sturgeon** find his way to the foraging grounds....be careful, there are many obstacles along the way like boat propellers, fishing nets, and fishing **lures**.



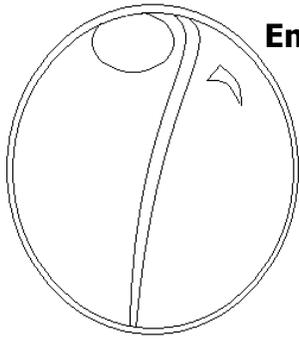
# Migration Maze: Spawning



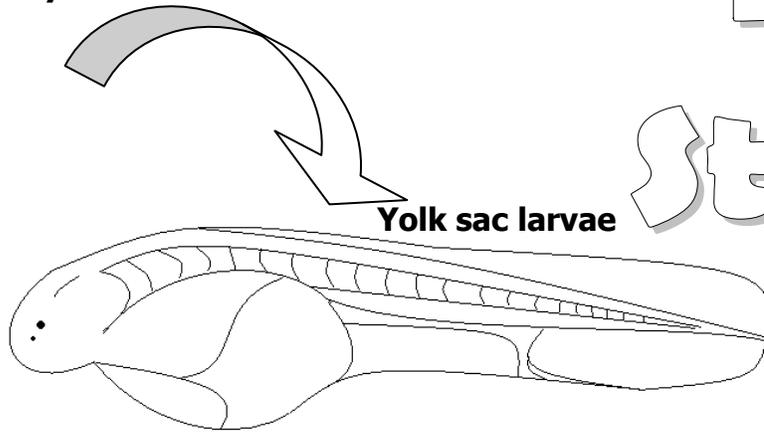
Can you help my friends, Spike and Sandy, find their way to the spawning grounds?



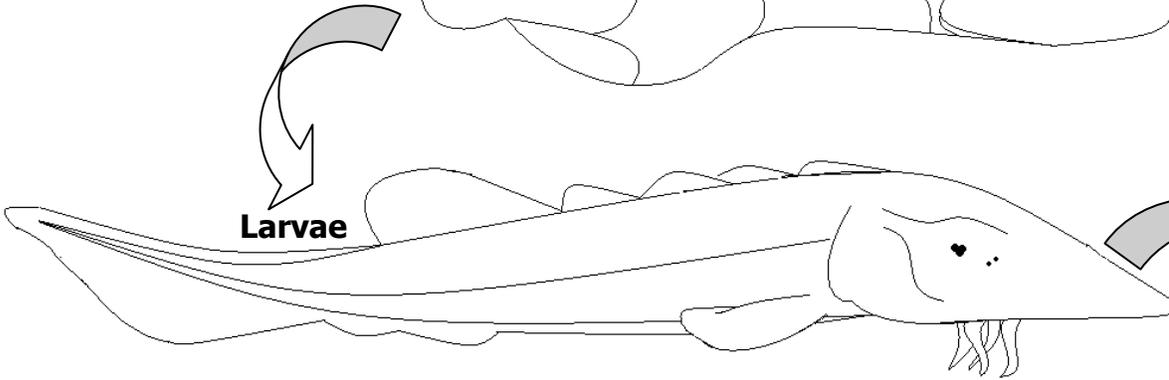
# Life Stages



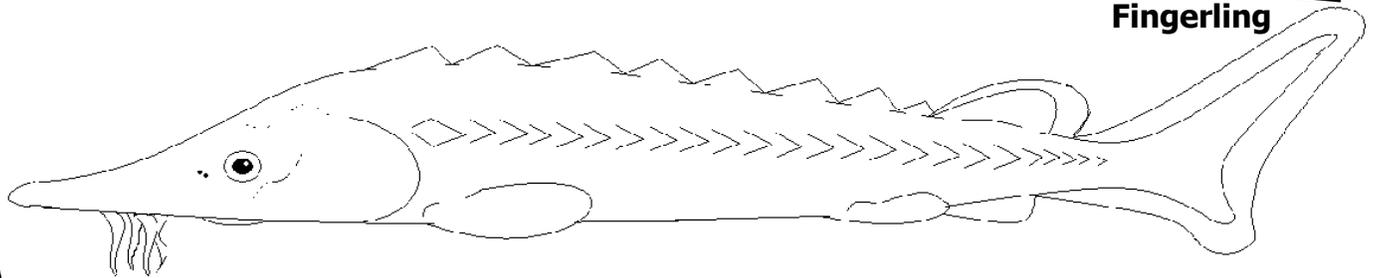
**Embryo**



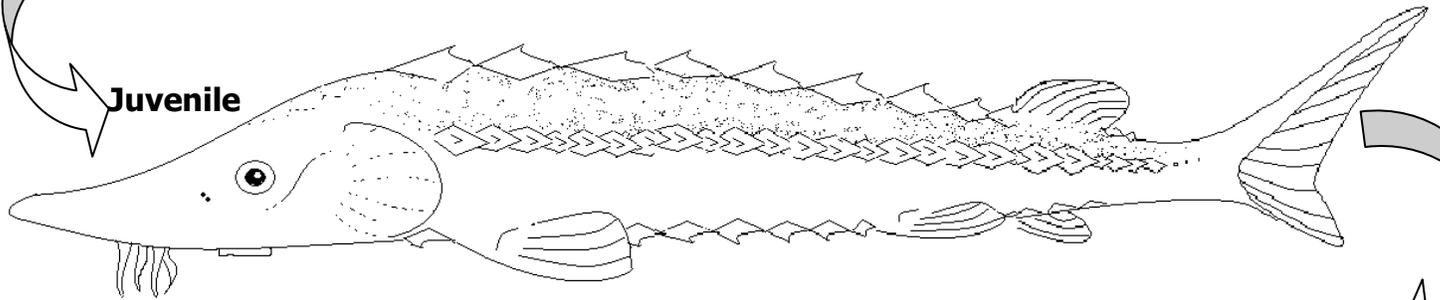
**Yolk sac larvae**



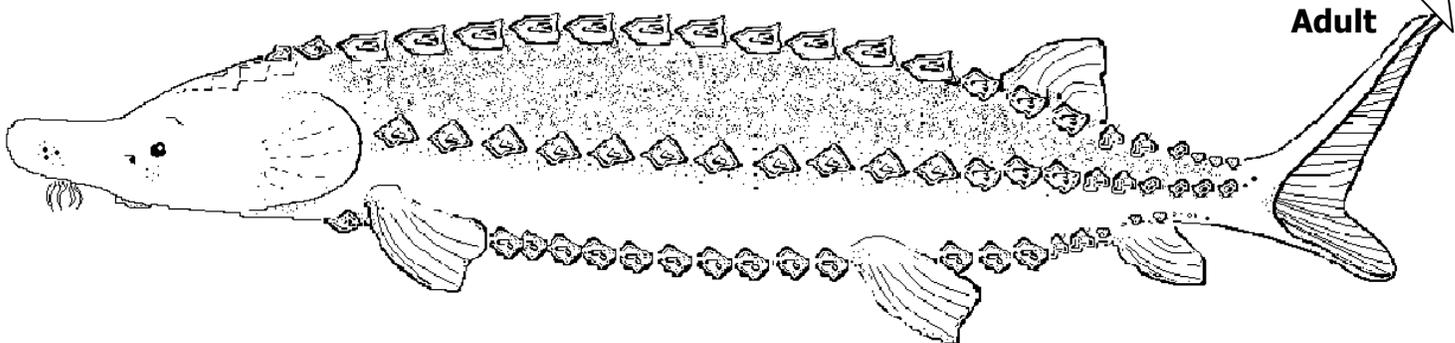
**Larvae**



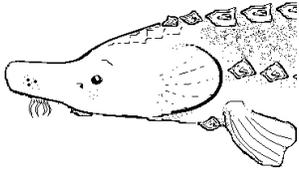
**Fingerling**



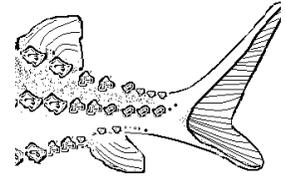
**Juvenile**



**Adult**



# Life Cycle and Physiology



P	J	U	V	E	N	I	L	E	S	N
V	R	B	A	E	L	T	S	L	M	P
F	D	O	R	S	A	L	C	A	O	E
R	T	L	T	M	C	E	U	R	P	C
Y	P	Y	B	R	A	G	T	V	Y	T
O	E	S	N	E	U	G	E	A	G	O
L	L	F	Y	N	D	S	S	E	G	R
K	V	I	F	S	A	D	I	Y	I	A
S	I	N	O	R	L	M	P	B	L	L
A	C	M	P	B	A	R	B	E	L	S
C	F	D	F	T	M	P	A	B	S	E
B	G	S	U	B	A	D	U	L	T	S

- **FIN**
- **BARBELS**
- **CAUDAL**
- **DORSAL**
- **PECTORAL**
- **PELVIC**
- **PROTRUSIBLE**
- **GILLS**
- **SCUTES**
- **EGGS**
- **YOLKSAC**
- **LARVAE**
- **FRY**
- **JUVENILES**
- **SUBADULTS**

Can you find these words in the puzzle above?



Words may be horizontal, vertical, or diagonal.

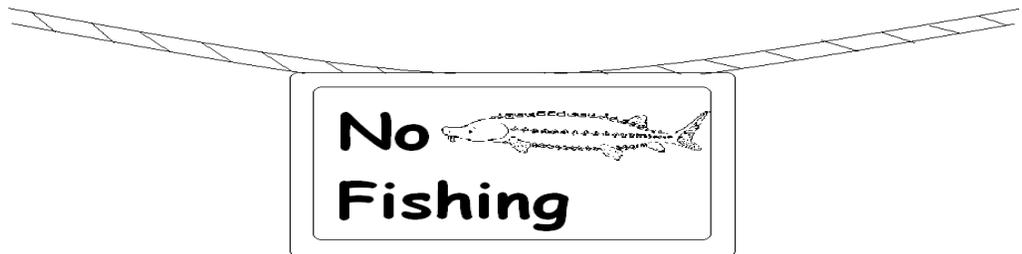
# PROTECTION

Shortnose sturgeon were listed as **endangered** throughout their range in 1967 under the **Endangered Species** Preservation Act and later under the **Endangered Species Act** (ESA) when it was started in 1973. They are still listed as **endangered** under the ESA, which means that they are protected by law from fishing and other threats.

In 1998, the Atlantic States Marine **Fisheries** Commission (ASMFC) recognized the need to put protections in place for Atlantic **sturgeon**. They started a ban which stopped fishing for Atlantic **sturgeon** for 20 to 40 years or until the populations could be restored to a level where 20 years of adult females were protected. Also, no one is allowed to keep any Atlantic **sturgeon** that are accidentally caught.

NOAA's **Fisheries** Service (NMFS) then listed Atlantic **sturgeon** as a "**Species** of Concern (SOC)" in 2004. A **Species** of Concern listing does not provide

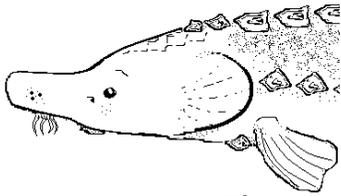
protections like a listing under the ESA. Listing a **species** as a SOC is meant to promote efforts to conserve the **species** about which NMFS is concerned. It is also meant for the **species** that have little information available to determine whether listing under the **ESA** is necessary.



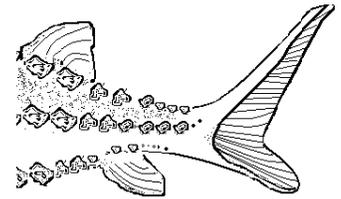
Atlantic **sturgeon** were listed as a "Candidate **Species**" as well, because NMFS was reviewing the status of the **species** to determine if listing under the ESA was necessary. In 2007, the **status review** of Atlantic **sturgeon** was completed. Based upon the best available scientific and **commercial** information, NMFS determined that listing all of the Atlantic **sturgeon** populations off the East **coast** of the United States as either **endangered** or **threatened** under the ESA is warranted. Four of the five populations (fish born in rivers which flow into southern Massachusetts to Florida) have been listed as **endangered** while Atlantic sturgeon who were born in rivers that flow into the Gulf of Maine have been listed as **threatened**.

## Summary of Protection

- Shortnose sturgeon have been listed as **endangered** throughout their range since 1967.
- There is a ban on fishing for and keeping Atlantic **sturgeon** for up to 40 years .
- Atlantic **sturgeon** were previously a NMFS **Species** of Concern and Candidate **Species**.
- NMFS just recently listed the Gulf of Maine population of Atlantic **sturgeon** as **threatened** and the other four populations as **endangered** throughout the rest of the U.S. range.



# All Stirred Up!



These words and definitions have gotten all stirred up!

Unscramble the words and then draw a line to match them to the correct definition.

LUSDAUBT

○ \_\_\_\_\_

SLGISSNIA

\_\_\_\_\_ ○ \_\_\_\_\_

LERPTUSBORI

\_\_\_\_\_ ○ \_\_\_\_\_

AVARLE

\_\_\_\_\_ ○ \_\_\_\_\_

FHGOSGVREIIN

\_\_\_\_\_ ○ \_\_\_\_\_

GERAOF

\_\_\_\_\_ ○ \_\_\_\_\_

SMOUDRAAN

\_\_\_\_\_ ○ \_\_\_\_\_

FBTOOTMDREEE

\_\_\_\_\_ ○ \_\_\_\_\_

AVICRA

\_\_\_\_\_ ○ \_\_\_\_\_

YSTEUAR

\_\_\_\_\_ ○ \_\_\_\_\_

ARBLESB

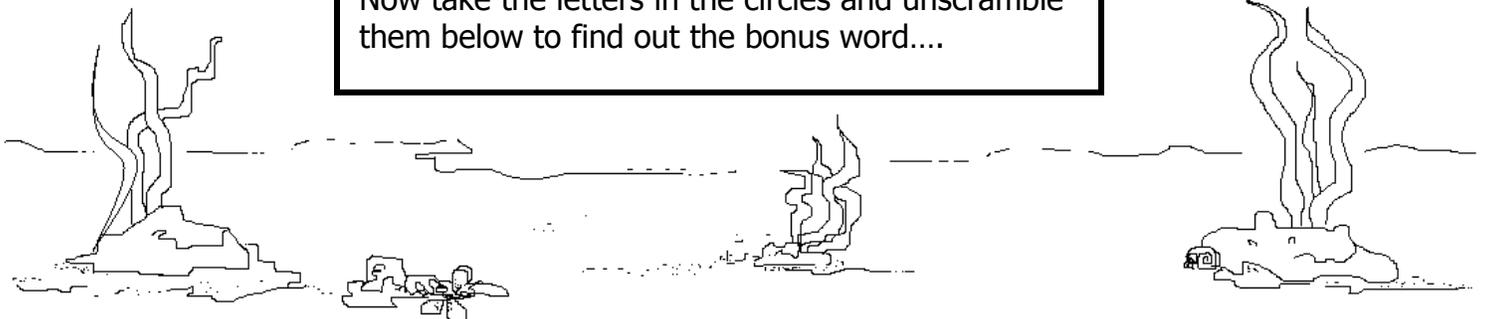
\_\_\_\_\_ ○ \_\_\_\_\_

KYOSLCA

\_\_\_\_\_ ○ \_\_\_\_\_

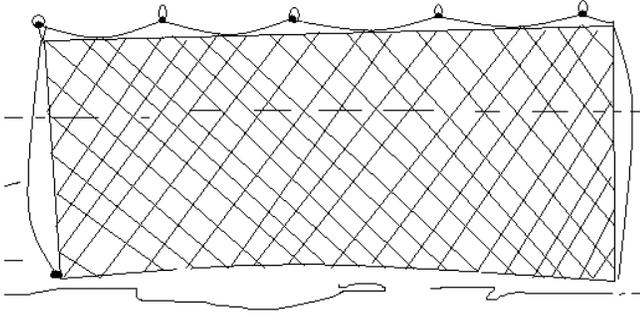
- A. The first mobile life stage of **sturgeon** after hatching from an **egg**
- B. This occurs when the number of fish taken from an ecosystem and population is greater than the population's ability to grow and reproduce
- C. Referring to a mouth/jaw which is capable of being extended outward in order to suck up **prey** items
- D. Searching for food or **prey**
- E. Made from the **swim bladder** of **sturgeon**; used as a binding agent for paint, an adhesive, and also a clarifying agent for wine
- F. Fish that spend some of their life cycle in salt water and **migrate** to fresh water rivers and streams to spawn
- G. Whisker-like sensors near the mouth used to find **prey**
- H. A fish that feeds on the benthos or bottom of the water column
- I. Processed **roe** or **eggs** of **sturgeon**
- J. Near the mouth of a river where the ocean saltwater meets and mixes with the freshwater of the river
- K. A sac attached to the **embryo** that provides nourishment
- L. An animal that has not matured to an age where it can reproduce, but exhibits ALL external traits of the adult

Now take the letters in the circles and unscramble them below to find out the bonus word....



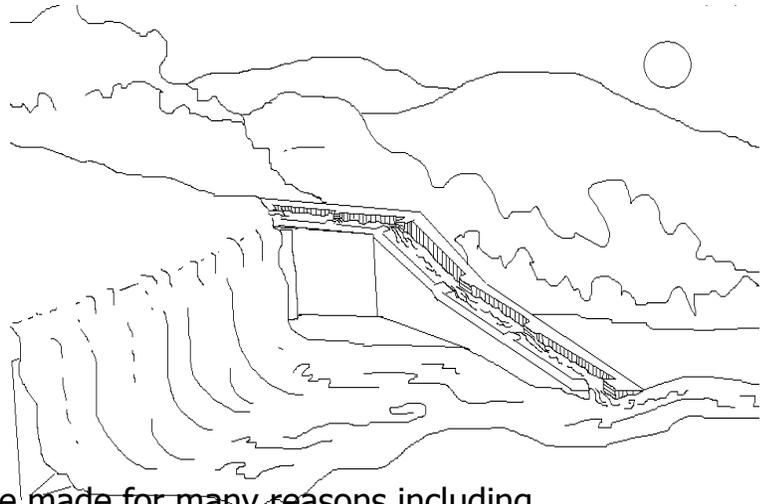
# THREATS

Although it is no longer legal to fish for or keep Atlantic and shortnose **sturgeon**, they are still caught accidentally as **incidental catch** in some **fisheries**. They are caught by **recreational** fishermen on lures and hooks, often accidentally snagging the sturgeon on the side or tail. **Sturgeon** are



vulnerable to **commercial fisheries** that fish with **gill nets**. The way fishermen fish with **gill nets** usually is by setting and leaving nets for long periods of time, anywhere from several hours to days. **Sturgeon** swim into these nets and can get stuck. If their **gills** get closed shut by the nets, they can suffocate and die.

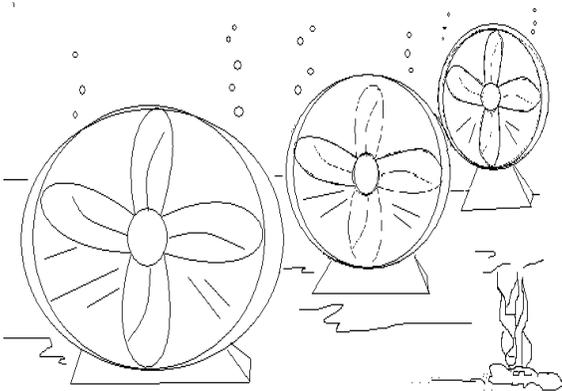
Another threat posed by nets is what happens when nets are lost. Due to weather, storms, and rough waters, nets can break free and get lost in the ocean. These are called "ghost nets" and can float around the ocean and rivers entangling **sturgeon** as well as other fish **species**, marine mammals, and sea turtles.



**Dams** on rivers pose another threat to Atlantic and shortnose **sturgeon**.

**Dams** were constructed on many rivers along the East **Coast**. They were made for many reasons including production of electricity through hydropower (using flowing water to make electricity) and for sending water where it needs to go for growing plants for food. **Dams** can be harmful to **sturgeon** by blocking the way to their

**spawning** grounds. If they are unable to reach their **spawning** grounds, they may choose to not spawn at all or end up **spawning** in an area that is not suitable for the development of **embryos**. Many **dams** have special fish ladders or fish ways that are made to allow fish to swim upstream of the **dam**. Other dams install fish lifts or elevators to move fish up and over a dam. However, **sturgeon** do not use these fish



ways to pass the **dams**, and even if they did, engineer have not yet developed ways to pass the large fish back downstream of the dam.

**Sturgeon** can also be harmed by tidal **turbines**, another form of hydropower. Some tidal **turbines** look like fans under the water. The power of the tide makes the fan spin, and this motion creates energy. If **sturgeon** swim near these **turbines**, they can be struck by the blades of the fan. Similar to the dangers that tidal **turbines** pose, boat strikes pose a threat to **sturgeon** as they can be struck by the blades of a propeller and the boat itself as the boat is passing.

**Pollution** and **dredging** can also cause problems for Atlantic and shortnose **sturgeon** survival. **Pollution** can be caused by many different actions, and can include run-off from agricultural sites, roadways, construction sites, and pesticide applications. All of these things can affect water quality. A couple of water quality factors that affect **sturgeon** are dissolved oxygen and temperature. Run-off from agricultural sites can include fertilizer which can cause harmful algal blooms. When algae blooms, it can take oxygen out of the water which can kill fish and other aquatic life. Temperature is another factor that can affect the migration **spawning** cues for **sturgeon**. The **spawning** migration begins with the rise in temperature in the spring. Hatching time and **egg** development are also dependent on temperature.



**Dredging** is another potential threat to **sturgeon** and is when the river bottom is dug up to either make the river deeper or wider. **Sturgeon** can be caught in the dredge and killed. **Dredging** can affect **spawning habitat** as well by filling the water with mud and **pollution** which can cover over the gravel and cobble **substrate** that is needed for **spawning**.

### Summary of Threats

- **Incidental catch** of **sturgeon** in some **fisheries** still happens.
- **Dams** can block **sturgeon** from reaching their **spawning** grounds.
- **Sturgeon** do not use fish ladders to get upstream of a dam. Even if they did, there is still no good way to get them back downstream of the dam.
- Tidal **turbines** can harm **sturgeon** if they get struck by the blades.
- Ship strikes and boat propellers are also a threat to **sturgeon**.
- **Dredging, dam** construction, and **pollution** are all factors that can cause a **loss of habitat** for **sturgeon** and can affect **spawning**, rearing, and foraging.

# Threats to Atlantic and Shortnose Sturgeon

## DOWN

(2) This occurs when run-off with fertilizer causes tiny aquatic plants to reproduce quickly, removing oxygen from the water, which can be deadly to fish.

(3) This is used as a form of alternative energy, but **sturgeon** can be killed if they swim into it and get caught in the blades.

(6) A net is called this when it is lost by a fisherman and floats around in the water. Sturgeon and marine animals can become entangled in these nets.

(7) This is what it is called when human actions are causing harm to the environment through chemicals in exhaust and runoff, as well as litter and trash in rivers, oceans and on land.

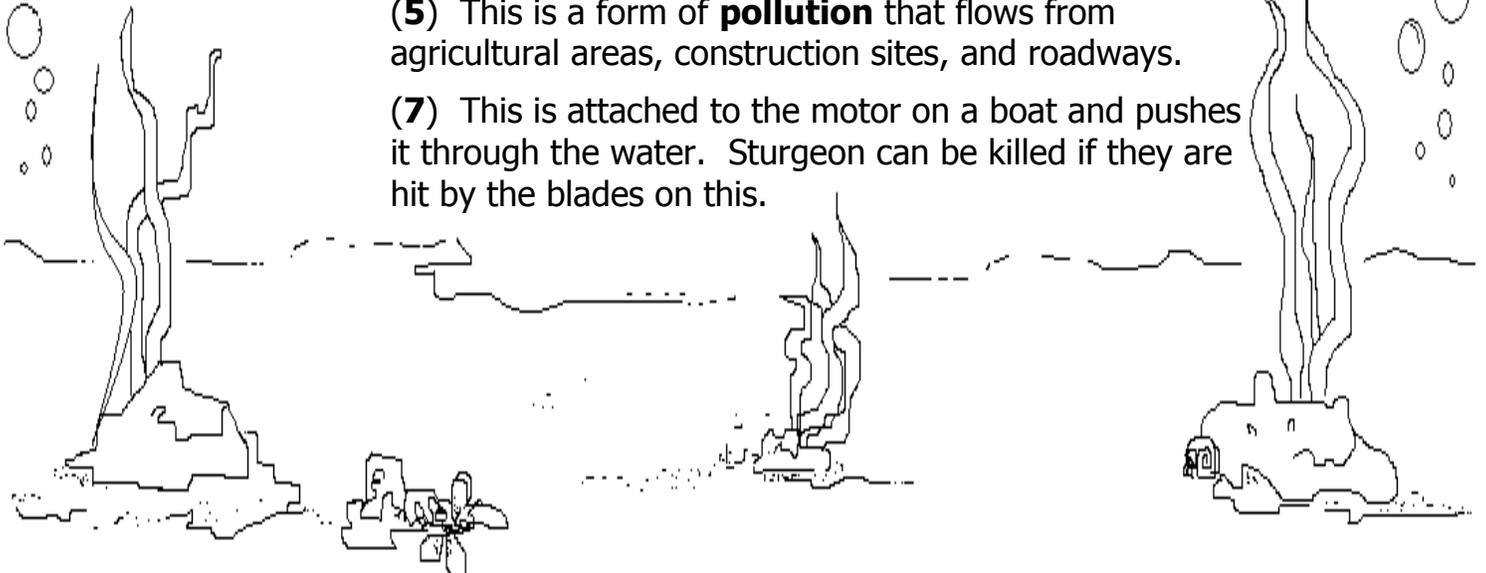
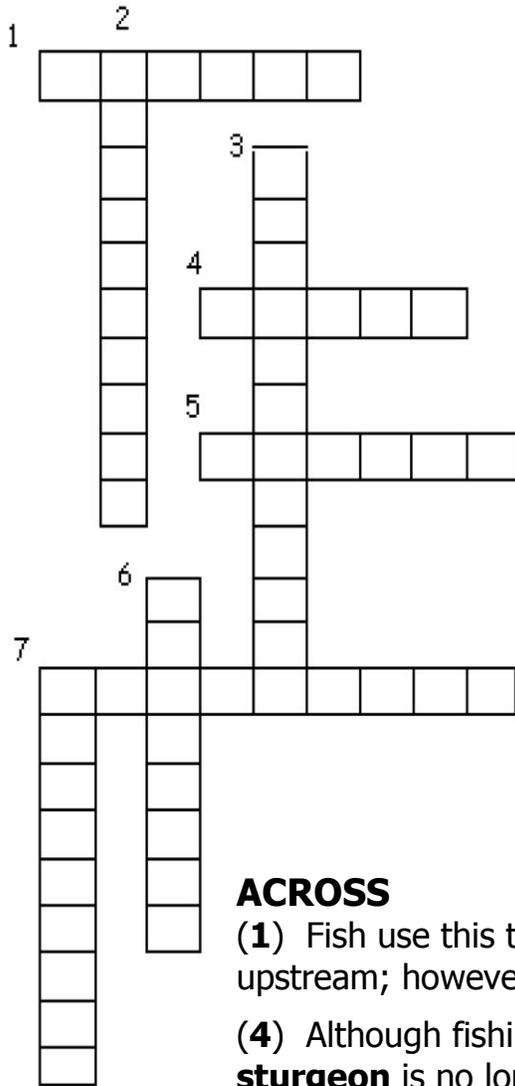
## ACROSS

(1) Fish use this to climb over and pass a **dam** upstream; however, **sturgeon** do not use this.

(4) Although fishing for Atlantic and shortnose **sturgeon** is no longer legal, they are still caught as incidental \_\_\_\_\_.

(5) This is a form of **pollution** that flows from agricultural areas, construction sites, and roadways.

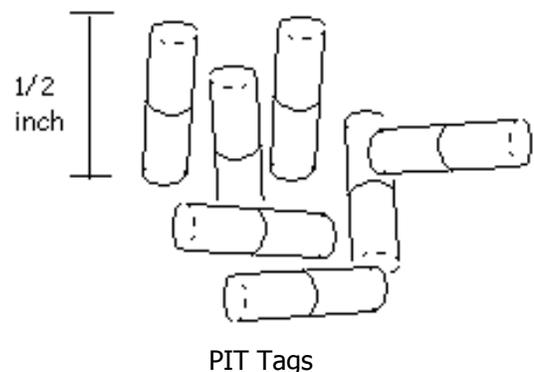
(7) This is attached to the motor on a boat and pushes it through the water. Sturgeon can be killed if they are hit by the blades on this.



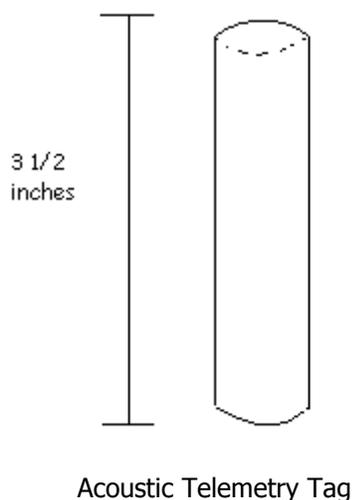
# RESEARCH

Scientists and researchers have been studying **sturgeon** for many years. Even though much research has been conducted, there is still a lot of information that we do not know. Where exactly are the **spawning** grounds? Where do they go in the winter? Why do they jump? ... and much more. In an attempt to try to answer some of these questions, researchers have been using **tagging** as a way to track and follow **sturgeon** throughout their migrations and **coastal** movements. A few types of tags that researchers have been using are **satellite tags**, **acoustic telemetry tags**, and **PIT** (passive integrated transponder) **tags**. Each tag aids researchers in getting different information that they are searching for.

**PIT tags** are tiny little microchips that are placed under the skin of the **sturgeon**. The tag is inserted with a small needle which pierces the skin and allows the tag to be placed just under the skin. When researchers catch **sturgeon** through their sampling efforts, they scan it with a **PIT tag** reader. **PIT tag** readers are small, handheld devices that activate the tag when being scanned and record the unique and individual tag number. They can then take that tag number and find out in what river or where on the **coast** that fish was originally tagged.



**Acoustic telemetry tags** serve to give a broader picture of the migrations of **sturgeon**. Acoustic tags are inserted by researchers through a more surgical approach. Using a scalpel, the researcher will make an incision (cut) into the body cavity large enough to fit the tag just under the fatty skin layer. This incision is then closed with stitches. These tags are larger than the typical **PIT tag**, and are programmed to "ping" or send out signals at specific intervals. Each of these tags has a unique number. When a tagged fish swims near one of the acoustic telemetry receivers, the receiver records the number, date, and time. These acoustic receivers, which are about the size of a 1 liter bottle of soda, are deployed up and down the **coast** in **coastal** waters as well as in rivers and **estuaries**. Researchers go to their

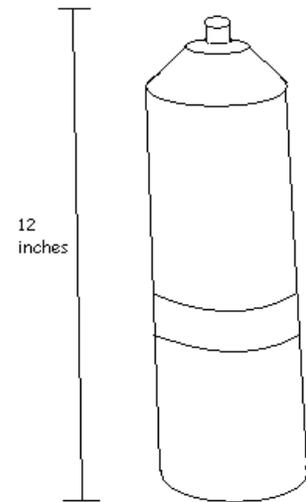


receivers periodically and download all of the data that was collected. Each time a tag is identified by the receiver, it is called a "hit." The researcher can then see where and when certain fish "hit" the receiver. With this information, and through cooperation with other researchers, they can begin to see exactly where the fish has been traveling.

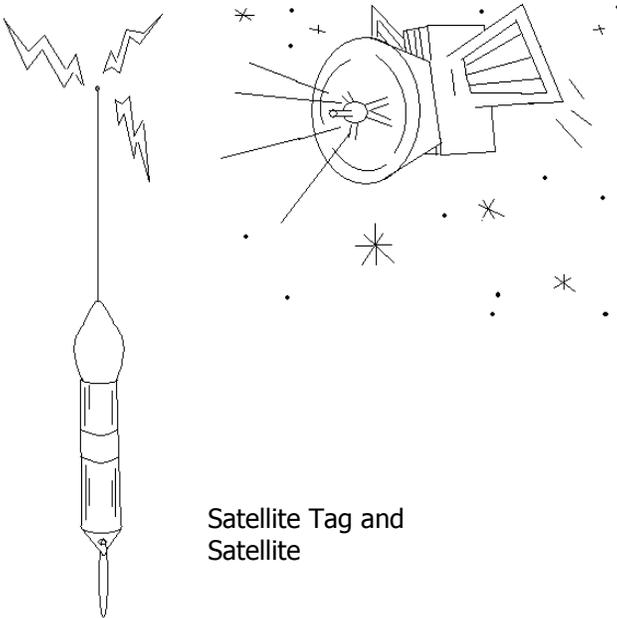
**Satellite tags** are a more in-depth and comprehensive collection system. Once the **satellite tag** is attached through a **dorsal** scute on the sturgeon's back, they begin collecting information immediately. This information is either stored in the tag or sent directly

up to the satellites. If the data is being stored, there is usually a designated date where the tag will release from the fish. When the tag releases, it floats up to the surface and begins downloading to satellites all the data that it had collected in its time on the fish. This information is then given to the researcher. More expensive and larger **satellite tags** are capable of providing "**real time**" data where the information is constantly being uploaded and updated to the satellites and researchers. This information can show direct paths and near exact locations of everywhere the fish went while it was

tagged. With all of the data that can be collected from various kinds of tags, they are able to create maps that will show where the sturgeon traveled.



Acoustic Receiver



Satellite Tag and Satellite

### Summary of Research

- Research has been focused on studying Atlantic and shortnose **sturgeon** for many years, but there is still much about these **sturgeon** that we do not know.
- Researchers use various tags to track **sturgeon**. These include **PIT tags**, **Acoustic Telemetry tags**, and **Satellite tags**.
- **PIT tags** are small microchips inserted into the skin. **PIT tag** readers can read the unique identifier of the tag when waved over it.
- **Acoustic tags** "ping" and their signal is picked up by the receivers. Tag number, date, and time are recorded in the receiver.
- **Satellite tags** can either store location data that is recorded constantly once deployed and upload to satellites at the predetermined date, or provide "**real time**" data by uploading continuously to satellites orbiting the Earth.

# Mapping & Tracking

Help map the travels of a **sturgeon** in the river. Pick your favorite colored crayon or marker and draw a dotted line or arrow for where the sturgeon traveled in the river from Monday morning to Saturday night. Each day has a morning, afternoon, and night. Follow the receiver data through the days of the week starting with Monday morning and ending with Saturday night.

## Receiver Data:

**#1** Monday morning, Monday afternoon, and Saturday afternoon.

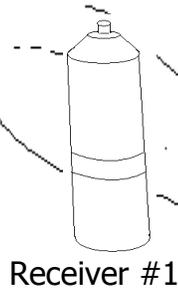
**#2** Monday evening, and Tuesday morning, Wednesday morning, Saturday morning, and Saturday night.

**#3** Tuesday afternoon, Tuesday night, Friday night

**#4** Wednesday afternoon, Wednesday night

**#5** Thursday morning, Thursday afternoon, Thursday night

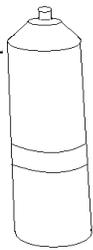
**#6** Friday morning, Friday afternoon



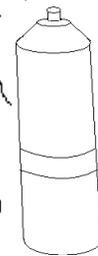
Receiver #1



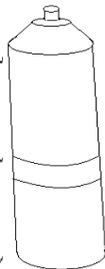
Receiver #2



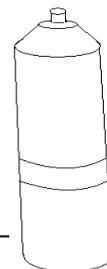
Receiver #3



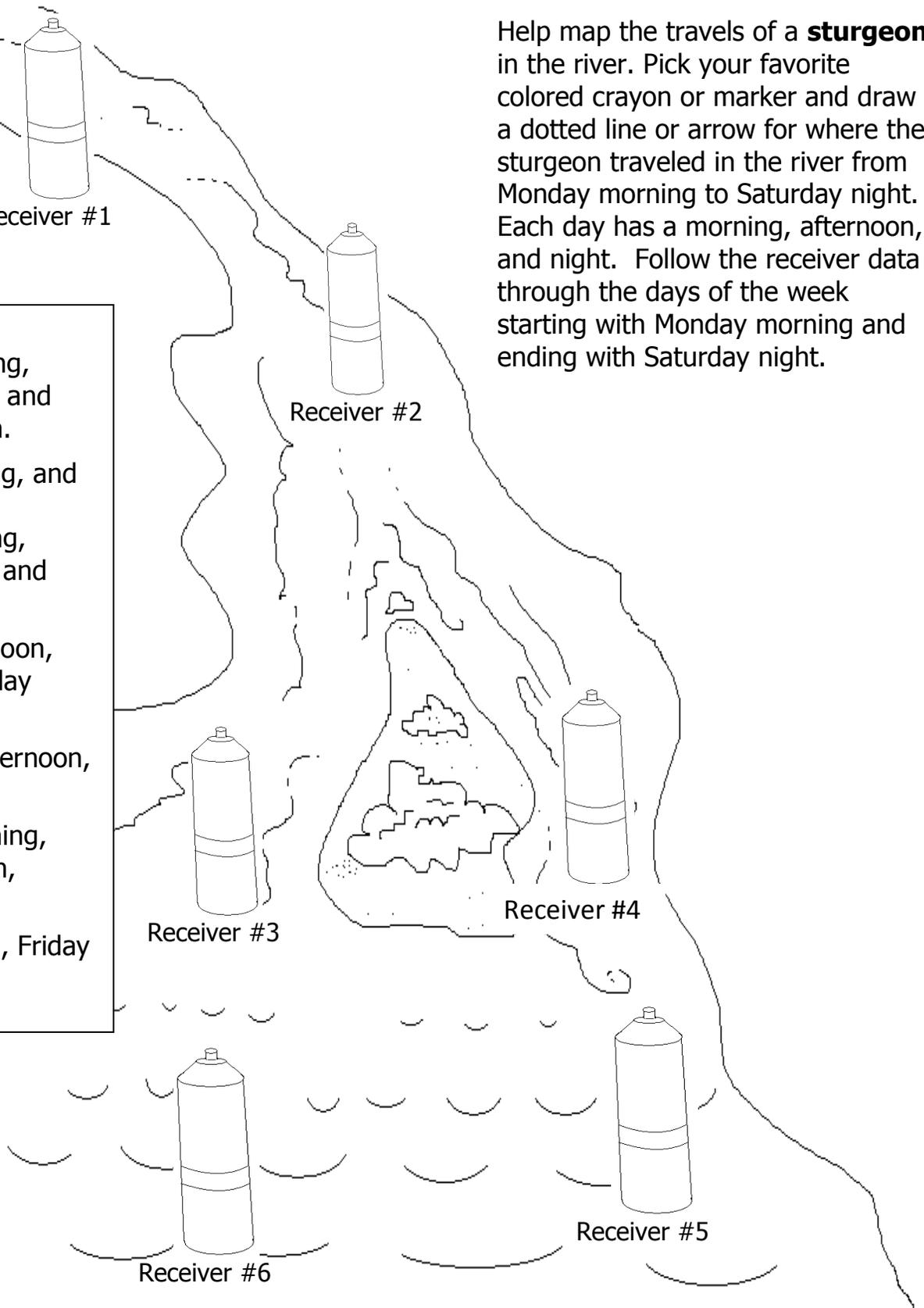
Receiver #4



Receiver #5



Receiver #6



## Glossary

**Acoustic Telemetry Tags** - tags used for **tracking**; it sends out a "ping" which is picked up and recorded by an acoustic receiver

**Anadromous** - fish that live in the salt water oceans and **migrate** to fresh water rivers and streams to spawn

**Anal Fin** - fin located on the underside of a fish just behind the anus which is used for stabilization

**Atlantic Ocean** - the second largest ocean; located between the East **Coast** of North and South America and the West **Coast** of Europe and Africa; covers approximately one-fifth of the Earth's surface

**Barbel** - whisker-like sensors found between the snout and mouth on **sturgeon** which are used to find **prey**

**Bay** - an area of water bordered by land on three sides; generally have calmer waters than the adjacent sea due to the protection of the surrounding land

**Bottom Feeder** - a fish that feeds on the bottom of the water column

**Brackish Water** - water that is more salty than fresh water, but not as salty as seawater; results from mixing of seawater with fresh water, as in **estuaries**

**Buoyancy** - the upward force that fluid exerts on things that are less dense than the water; upward force that keeps items afloat

**Caviar** - the processed **roe** or **eggs** of **sturgeon**

**Caudal Fin** - the tail fin; propels fish through the water by moving back and forth or side to side

**Coastal** - area where the land meets the sea or ocean; the seashore

**Commercial** - intended to be sold; Atlantic and shortnose sturgeon were once a **commercial** fishery for their meat and eggs (**caviar**)

**Crustacean** - a large group of arthropods, with almost 52,000 described **species**; includes various familiar marine animals such as crabs, lobsters, crayfish, shrimp, krill, and barnacles

**Dam** - a barrier constructed across a **waterway** to control the flow of water, usually for redirection of water in order to harness power of the water flow

**Diadromous** - referring to fish that make migrations between salty sea water and fresh river water

**Dorsal Fin** - the fin located on the back of the fish used for stabilization

**Dredging** - A method for deepening streams, lakes, or reservoirs by scraping and removing solids from the bottom

**Endangered Species** - a **species** that is in danger of extinction

**Estuary** - the mouth of a river where the tide or flow of marine water (salt water) meets and mixes with the freshwater of the river

**Eggs** - the reproductive body consisting of an **embryo** together with the nutritive and protective envelopes

**Embryo** - a fertilized **egg**

**Fingerling** - refers to an early life stage of a young fish when it generally measures to a size similar to a human finger

**Fishery** - industry involved in the catching, processing, and marketing of fish

**Forage** - searching for food or **prey**

**Fry** - life stage at which fish have identifiable body parts; follows the larval stage

**Ganoid Scales** - diamond shaped **scales** that are found on **primitive** bony fishes like **sturgeon**; **scutes** are a modified **ganoid scale**

**Genus** - a taxonomic rank used in classifying organisms

**Gills** - the respiratory organ of most aquatic animals that process or breathe water to obtain oxygen

**Gill Net** - specific net type used by fisherman; fish swim into the net and are caught by their **gills** or tangled up in the webbing

**Habitat** - the area or environment where where organisms like plants and animals live or occur

**Heterocercal Fin** - a tail or **caudal fin** with unequal lobes; in **sturgeon**, the top lobe is larger and points upward, like the tail of a shark

**Incidental Catch** - accidental catch of a non-target **species** while fishing for another **species**

**Isinglass** - made from the **swim bladder** of **sturgeon**; used as a binding agent for paint, adhesive, and also a clarifying agent for wine

**Juvenile** - the life stage at which fish exhibit most but not all traits of an adult fish

**Larvae** - the first mobile life stage of **sturgeon** after hatching from an **egg**

**Loss of Habitat** - when **habitat**, or areas where animals live or occur, is no longer available to them due to **dam** construction and **pollution**; **habitat** loss is thought to be a major factor in declining **sturgeon** populations

**Migrate** - to move from one area to another, usually for feeding or reproduction

**Milt** - combination of sperm cells of male fish with the fluid containing them; during **spawning**, the male releases **milt** as the female deposits her **eggs**

**Mollusk** - An invertebrate animal usually enclosed in a shell, such as an oyster, mussel, or clam

**Natal** - pertaining to birth

**Nantucket Sleigh Ride** - a phrase to describe when a whale was harpooned and would drag the whaling boat behind him; typically referring to whaling for sperm whales off of Nantucket, MA

**Nursery** - The part of a fish's or animal's **habitat** where the young grow up, also known as rearing grounds

**Overfishing** - occurs when the number of fish taken from an ecosystem and population is greater than the population's ability to reproduce and replenish the number in the population

**Pectoral Fin** - fins on the side of the body used for turning, stopping, and balancing

**Pelvic Fin** - the paired fin behind the **pectoral** fin on the sides of the body also used for turning, stopping, and balancing

**Pickling** - the process of preserving food by anaerobic fermentation in brine, a solution of salt in water

**PIT tag** - PIT (passive integrated transponder) tags are an injectable, internal microchip that allows unique identification of a marked fish; the tag is passive, meaning that it does not put forth the unique number until it is requested by a scanner

**Pollution** - the introduction of contaminants into an environment that causes instability, disorder, harm, or discomfort to the ecosystem

**Polychaete** - A large and diverse group of segmented marine worms

**Primitive** - very old; having only slightly evolved from an earlier primeval or ancestral type

**Prehistoric** - belonging to or existing in times before recorded history

**Prey** - animal hunted or caught for food

**Protrusible** - capable of being thrust outward; **sturgeon** have a **protrusible** mouth which they use to suck up **prey** items like a vacuum

**Rearing** - the action or practice of bringing a person, animal, or plant to maturity or to a certain stage of growth; juvenile sturgeon spend most of their time in their rearing grounds, or nursery

**Recreational** - engaged in a pastime; fishermen who fish for a hobby and not to sell their catch are called **recreational** fishermen

**"Realtime" data** - Data that is available to users as soon as it is received by the system

**Roe** - fish **eggs**; **sturgeon eggs** or **roe** are turned into **caviar**

**Salting** - the preservation of food with dry salt; related to **pickling** (preparing food with brine, i.e. salty water); one of the oldest methods of preserving food

**Salt Wedge** - the area in an **estuary** where there is minimal mixing of salt and fresh water; where the salt water forms a wedge thickest on the ocean side and tapered off toward the freshwater side

**Satellite Tags** - tags used for **tracking** that are capable of storing near exact location data as well as time and depth, which is then downloaded to satellites

**Scales** - small rigid plates that grow out of an animals skin for protection; **sturgeon** have **ganoid scales**

**Scutes** - modified boney **ganoid scales** on **sturgeon**; there are five rows on a **sturgeon's** body that extend from the head to the base of the tail

**Smoking (smoked)** - the process of flavoring, cooking, or preserving food by exposing it to the smoke from burning or smoldering plant materials, most often wood

**Spawning** - the action of depositing or laying eggs or sperm (milt)

**Species** - a group or class of animals or plants having certain common and permanent characteristics which clearly distinguish it from other groups

**Sturgeon** - common name used for **species** of fish in the family Acipenseridae

**Status Review** - comprehensive assessments of a **species'** biological status and its threats, and are the basis for making determinations as to whether a **species** warrants listing under the **Endangered Species Act**

**Sub-adult** - an animal that has not matured to an age where it can reproduce, but exhibits all external traits of the adult

**Substrate** - the sediment material found on the bottom of a body of water

**Swim Bladder** - an internal organ that enables fish to control **buoyancy**; this organ in **sturgeon** is used to make **isinglass**

**Tracking** - monitoring movements and activities

**Tagging** - a way to identify previously caught fish by marking them with wire or a flag; way to track fish when tagged with acoustic, PIT, or **satellite tags**

**Tanning** - the process of making leather from the skins of animals using tannin, an acidic chemical compound

**Threatened Species** - a **species** that is likely to become **endangered** in the future

**Turbine** - a machine that uses moving water to create energy by passing the water through a series of blades

**Waterway** - any navigable body of water

**Weir** - a kind of trap for fishing; fishing **weirs** were constructed out of sticks that were woven together like a basket and configured in different patterns like a maze, where water could flow through, but the fish could not leave them

**Yolk sac** - a sac attached to an **embryo** that provides early nourishment; early stages of larva retain the **yolk sac** for nourishment

**Zooplankton** - tiny free floating organisms in aquatic systems that provide food for **sturgeon** in the larval stages

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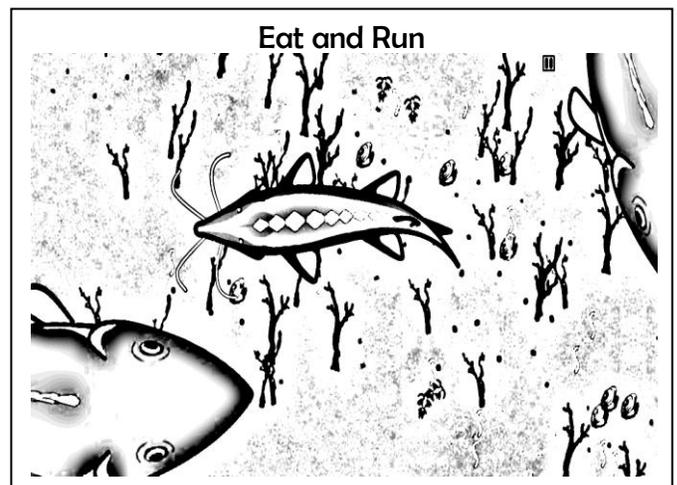
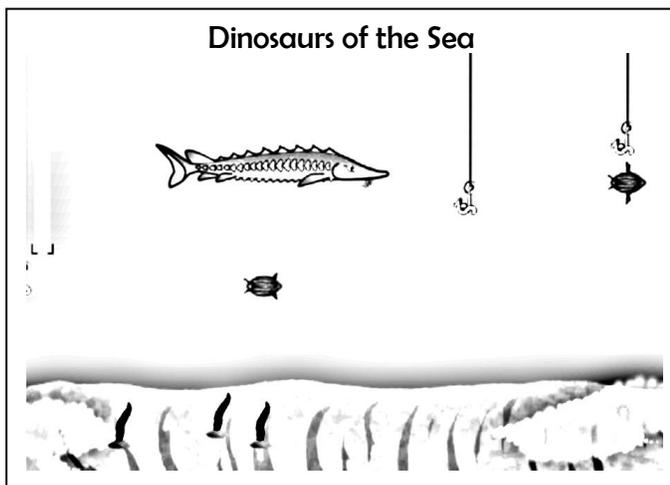
## For SCUTES Computer Games Visit:

### Dinosaurs of the Sea

[http://www.nero.noaa.gov/prot\\_res/scutes/games/SturgeonDinosaurSea.swf](http://www.nero.noaa.gov/prot_res/scutes/games/SturgeonDinosaurSea.swf)

### Eat and run

[http://www.nero.noaa.gov/prot\\_res/scutes/games/SturgeonEatNRun.swf](http://www.nero.noaa.gov/prot_res/scutes/games/SturgeonEatNRun.swf)



# Answer Key



## What's Missing From These Sturgeon?

1. Dorsal fin, Anal fin
2. Barbels, Gills
3. Eye, Middle row of scutes, Caudal fin

## Foraging

How many prey items can you find?

13

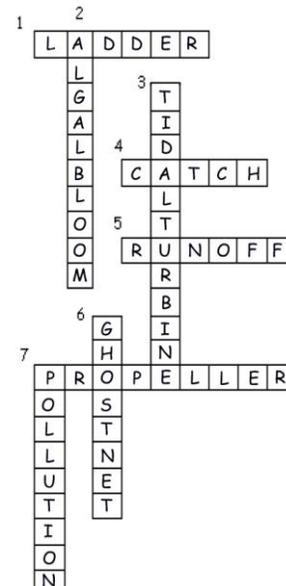
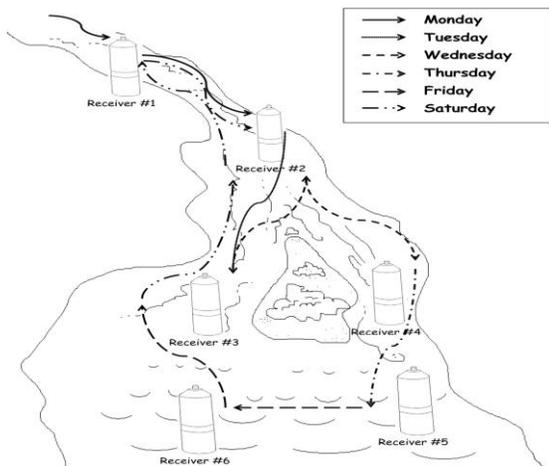


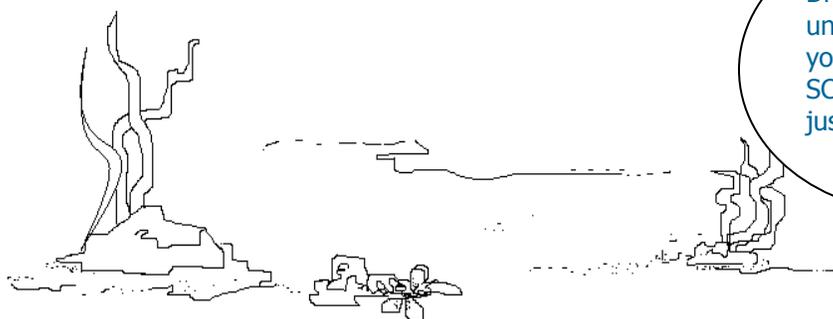
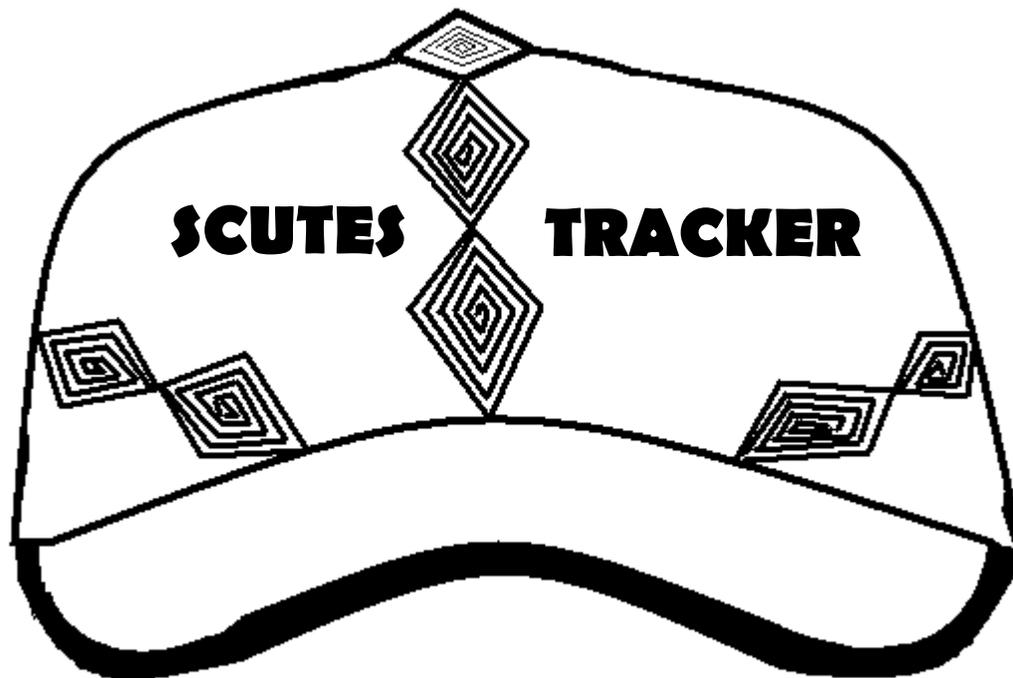
## All Stirred Up!

Subadult:	L	Anadromous:	F
Isinglass:	E	Bottom Feeder:	H
Protrusible:	C	Caviar:	I
Larvae:	A	Estuary:	J
Overfishing:	B	Barbels:	G
Forage:	D	Yolksac:	K

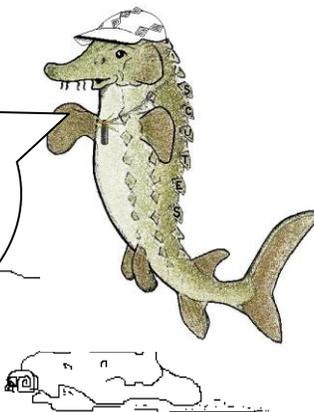
Bonus word: Sturgeon

## Threats to Atlantic and Shortnose Sturgeon





Draw yourself  
under the hat so  
you can become a  
SCUTES Tracker,  
just like me.



This Book  
Belongs To....

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