Caviar DNA identification guide

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Scenario

Federal and International wildlife agents Friday busted up what they described as an international ring of caviar poachers who stole sturgeon out of waterways for at least two years and sold the fish roe for big profits. By late Friday, authorities had arrested five people in what they dubbed Operation Caviar.

Investigators say the alleged poachers were trying to capitalize on the rising price and scarcity of Beluga caviar from the Caspian Sea, where sturgeon have been fished close to extinction since the collapse of the Soviet Union.

As a science lab technician working for the US Fish and Wildlife, you have been asked to verify the fish roe to determine what species of sturgeon the caviar is from. Wildlife agents suspect that the caviar are from endangered and threaten sturgeon species.

They are requesting a genetic analysis to be done to confirm or reject their suspicion. Technicians in your lab have already extracted the DNA from each of the caviar samples. The have also performed the PCR reaction. You are now ready to subject the DNA PCR product to gel electrophoresis in order to determine if the caviar originated from endangered, domestic or threaten sturgeon species.

Good luck!

Step 1. Caviar from unknown species of sturgeon are confiscated by wildlife agents.

Step 2. Scientists extract DNA from the nucleus of the eggs.

Step 3. PCR is used to amplify the DNA, or make enough copies, to test if the DNA.

Step 4. Restriction Enzymes are added. These enzymes recognize and bind to specific DNA sites and cuts the DNA into many smaller fragments.

Step 5. Gel electrophoresis is used to visualize the results from the RFLP reaction.

Step 6. A written report detailing the results of the genetic analysis of caviar is submitted to the Wildlife agents.
“The Rivermen” by Joseph Mitchell

I often feel drawn to the Hudson River, and I have spent a lot of time through the years poking around the part of it that flows past the city. I never get tired of looking at it: it hypnotizes me.

I like to look at it in midsummer, when it is warm and dirty and drowsy, and I like to look at it in January, when it is carrying ice. I like to look at it when it is stirred up, when a northeast wind is blowing and a strong tide is running—a new-moon tide or a full-moon tide—and I like to look at it when it is slack. It is exciting to me on weekdays, when it is crowded with ocean craft, harbor craft, and river craft, but it is the river itself that draws me, and not the shipping, and I guess I like it best on Sundays, when there are lulls that sometimes last as long as half an hour, during which, all the way from the Battery to the George Washington Bridge, nothing moves upon it, not even a ferry, not even a tug, and it becomes as hushed and dark and secret and remote and unreal as a river in a dream.

Once, in the curse of such a lull, on a Sunday morning in April, 1950, I saw a sea sturgeon rise out of the water. I was on the New Jersey side of the river that morning, sitting in the sun on an Erie Railroad coal dock. I knew that every spring a few sturgeon still come in from the sea and go up the river to spawn, as hundreds of thousands of them once did, and I had heard a tugboat men talk about them, but this was the first one I had ever seen. It was six or seven feet long, a big full-grown sturgeon. It rose twice, and cleared the water both times, and I plainly saw its bristly snout and its shiny little eyes and its white belly and its glistening, greenish-yellow, bony-plated, crocodilian back and sides, and it was a spooky sight.

The shovelnose sturgeon, Scaphirhynchus platorynchus, is the smallest species of freshwater sturgeon native to the United States of America. Shovelnose sturgeon are the most abundant sturgeon, found in the Missouri River and Mississippi River systems, and the only commercially fished sturgeon in the United States of America. The behavior of S. platorynchus is highly adapted for life in the current.

Habitat: They spend most of their lives, except during spawning, on the river bottom in deep, cool channels. The current makes it easier to find food, and their specialized siphon-like mouths act like vacuums, sucking up organisms buried in the benthic substrates. They have a wide home range, and can travel large distances in one day searching for food.

The roe of the shovelnose sturgeon is marketed as "hackleback" caviar. As old world sources of Caspian and Black Sea sturgeon caviar have become endangered, roe from shovelnose sturgeon and paddlefish have recently become commercially important. Poaching of the shovelnose sturgeon is becoming a problem, as they must be 8–10 years old before spawning can occur, and females are only gravid once every 3 years.
American Paddlefish: *Polyodon spathula*

The **American paddlefish**, *Polyodon spathula*, also called the **Mississippi paddlefish** or **spoonbill**, lives in slow-flowing waters of the Mississippi River drainage system. They are closely related to the sturgeons. This large Chondrostian freshwater fish may grow to 220 cm (7 feet) and weigh up to 100 kg (220 pounds).

The paddlefish takes its common and scientific names from its distinctive snout, which is greatly elongated and flattened into a paddle shape.

### Breeding Habits

Feeds mainly on fish, mollusks, crustaceans and worms.

### Servuga Grey Caviar

- 50 grams $375.00
- 125 grams $1,500.00
- 500 grams $3,800.00

### American Paddlefish Caviar

caviar prices

- 50 grams $50.00
- 125 grams $90.00
- 500 grams $620.00

### STATUS

Paddlefish take many years before they are able to spawn. A female may take 9 to 10 years, and males 7 years old before they are able to spawn.

They are capable of producing over one-half million eggs a year, but they may not spawn every year.

### Acipenser stellatus

*Acipenser stellatus*, is a species of sturgeons, living in the Black, Azov, and Caspian sea basins. It reaches 220 cm (over 7 feet) and weighs up to 80 kg (approximately 180 lbs). The maximum reported age for this species is 27 years.

The servuga sturgeon is an endangered species and trade in products made from its body parts are restricted by CITES. There have been several attempts in Russia, Iran, Italy, and the US to adapt this species for aquaculture, with varying degrees of success.
**Beluga Sturgeon: **Huso huso

Female sturgeon of all species reach sexual maturity late in life, between the age of six and twenty-five years. The beluga (Huso huso), also called the giant sturgeon, is the most prized caviar producer.

Beluga can live for 100 years, and grow to six meters (almost 20 feet) long and as much as 1,200 kilograms (more than 2,500 pounds).

They can take 14 to 22 years to reach reproductive age, and females of many sturgeon species reproduce only once every three to four years. The fish must be killed to harvest caviar, and global demand for its eggs has prompted overfishing and rampant illegal trade. As a result, sturgeons are vulnerable to overfishing and unable to recover quickly.

The United States Fish and Wildlife Service has banned imports of Beluga Caviar and other beluga products from the Caspian Sea since October 2005.

Farmed Raised Osetra Caviar

- 50 grams $110.00
- 100 grams $230.00

Caviar Prices - Osetra Classic

- 50 grams $288.00
- 125 grams $711.00
- 500 grams $2800.00

The United States Fish and Wildlife Service has banned imports of Beluga Caviar and other beluga products from the Caspian Sea since October 6, 2005.

Illegal to purchase in the USA.

- 50 grams $800.00
- 100 grams $1500.00
- 500 grams $5,000.00

Fishermen drag a net with beluga sturgeon from the Caspian Sea in Kazakhstan.

Wildlife Forensics
Osetra: A. baeri, A. naccarii and A. persicus

Osetra caviar comes from the Osetra sturgeon (*Acipenser persicus* or *Acipenser gueldenstaedtii*), weighing 50-400 pounds and living up to 50 years. Osetra caviar ranges from warm brown to green-gray in color, to dark blue to jet black or even white. Osetra caviar is said to have a nutty flavour and so is prized as an elite caviar. The servuga takes 17 to 18 years to reach sexual maturity. The length of time it takes beluga sturgeon to reach maturity is also the reason why the beluga is closer to extinction than the sevruga or osetra. The recovery of wild sturgeon in general is dependent on farming of sturgeon species for commercial production of beluga, osetra and sevruga sturgeon caviar.

Farmed Raised Osetra Caviar
- 50 grams $110.00
- 100 grams $230.00

Caviar Prices- Osetra Classic
- 50 grams $288.00
- 125 grams $711.00
- 500 grams $2800.00
**Servuga: Acipenser stellatus**

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**Breeding Habits**

Feeds mainly on fish, mollusks, crustaceans and worms.

**Servuga Grey Caviar**

- 50 grams: $375.00
- 125 grams: $1,500.00
- 500 grams: $3,800.00
Sterlet: Acipenser ruthenus

The exceedingly rare sterlet is the smallest of the Caspian sturgeons, measuring a little under 50 inches (2 meters) long, weighing 7 pounds (16 kilograms), and living on average to the age of 22 years.

**Location:** This sturgeon inhabits rivers that flow into the following seas: Caspian, Black, Azov, Baltic, White, Barents, Kara, and inhabits both the Black and Caspian seas, and ascends rivers to a greater distance from the sea than any of the other sturgeons.

**Life Span:** The sterlet commonly reaches the age of 22 to 25 years. sterlet, or imperial, caviar was once the most prized fish roe of all. The eggs are small-grained and golden in color. Valued also as a food species, the sterlet has been fished almost to extinction.

**Scientific classification**

- **Kingdom:** Animalia
- **Phylum:** Chordata
- **Class:** Actinopterygii
- **Order:** Acipenseriformes
- **Family:** Acipenseridae
- **Genus:** Acipenser
- **Species:** *A. ruthenus*

**STATUS**

Fifty years ago 700 tons were caught in an average year. Now they are very rare. Although it is no longer caught in commercial quantities,
White Sturgeon: *Acipenser transmontanus*

The **white sturgeon** (*Acipenser transmontanus*, meaning "sturgeon beyond the mountains"), also known as the **Pacific sturgeon**, which lives along the west coast of North America from the Aleutian Islands to Central California.

**Physical Appearance:** It is the largest freshwater fish in North America. A white sturgeon can weigh more than 1,500 pounds (680 kg), and grow to 15 feet and can live well over 100 years.

Canadian researcher William Sommers found that a sturgeon’s taste buds are located on the outside of its mouth. This, along with the barbels, allows it see if a possible food source is edible before sucking it up into its mouth. He also found that as adults, the white sturgeon’s diet somewhat varies. This is dependent upon the river systems it lives in.

**Reproduction**

The white sturgeon grows slowly, maturing in eight to 20 years, depending on location. White sturgeon produce 100,000 to four million eggs per spawning, but they spawn only once every two to eight years.

**White Sturgeon Farmed Caviar**

- 50 grams $75.00
- 125 grams $325.00
- 500 grams $1500.00

**STATUS**

**Size, Weight and Age**

Largest freshwater fish in North America

- Weigh 1,500 pounds
- 15 feet
- Can live over 100 years
BIO TECH TERMINOLOGY

Biotechnology: Using living organisms (or things from living organisms) to make products or create processes that improve our lives. Applications of biotechnology can be found in areas of forensics, medicine, agriculture, food industry, and conservation biology.

DNA: Deoxyribonucleic acid. The basic genetic material found in the cells of all organisms, made up of two chains of nucleotides wound together in a double helix. DNA contains information that is critical to the structure and function or your body's cells. DNA instructions preserve species' characteristics

DNA Ladder/Marker: A series of DNA fragments of known size used to determine the size of unknown DNA fragments (e.g. PCR products) by comparison.

Gel Electrophoresis: A method of separating molecules based on their size and electric charge. Molecules are forced to run through a gel (a porous matrix) by placing them in an electric field. The speed at which they move depends on their size and charge. DNA fragments separate out based on a difference in size since they are all negatively charged.

Nucleotides: The structural units or building blocks of DNA and RNA. The four nucleotides that make up DNA are adenine (A), thymine (T), cytosine (C) and guanine (G) (Note: uracil (U) replaces thymine (T) in RNA).

PCR: The Polymerase Chain Reaction. A method of making millions of copies of a specific region of an organism's genome (amplifying) through alternating cycles of specified temperatures.

PCR Cycle: Involves the three steps of the polymerase chain reaction that rely upon changes in temperature. Step 1: Denaturation at 94 degrees Celsius, Step 2: Annealing between 55-65 degrees Celsius dependent on the primers used) and Step 3: Extension at 72 degrees Celsius.

PCR Product: The result of the polymerase chain reaction (PCR). After successfully completing PCR, the millions of copies of the targeted region of the template DNA are referred to as PCR product.

Polymerase: An enzyme that catalyzes the synthesis of nucleic acids on pre-existing nucleic acid templates. The polymerase used for PCR must be able to withstand the high temperatures needed during the extension step in the PCR cycle. Hence, thermophilic (“heat–loving”) polymerases are generally used for PCR.

Primer Set: Small pieces of single stranded DNA (usually ~ 10 - 20 bp long) that anneal (stick to) to a specific region of DNA. Primer sets consist of both a forward and reverse primer that are designed and synthesized by researchers to frame the area of the genome that is of interest, essentially defining the area that will be copied millions of times.

Template DNA: A sample of DNA being tested. Template DNA usually consists of an organism's entire genome and provides the initial sequence for amplification using PCR.