Fishery Leaflet 526

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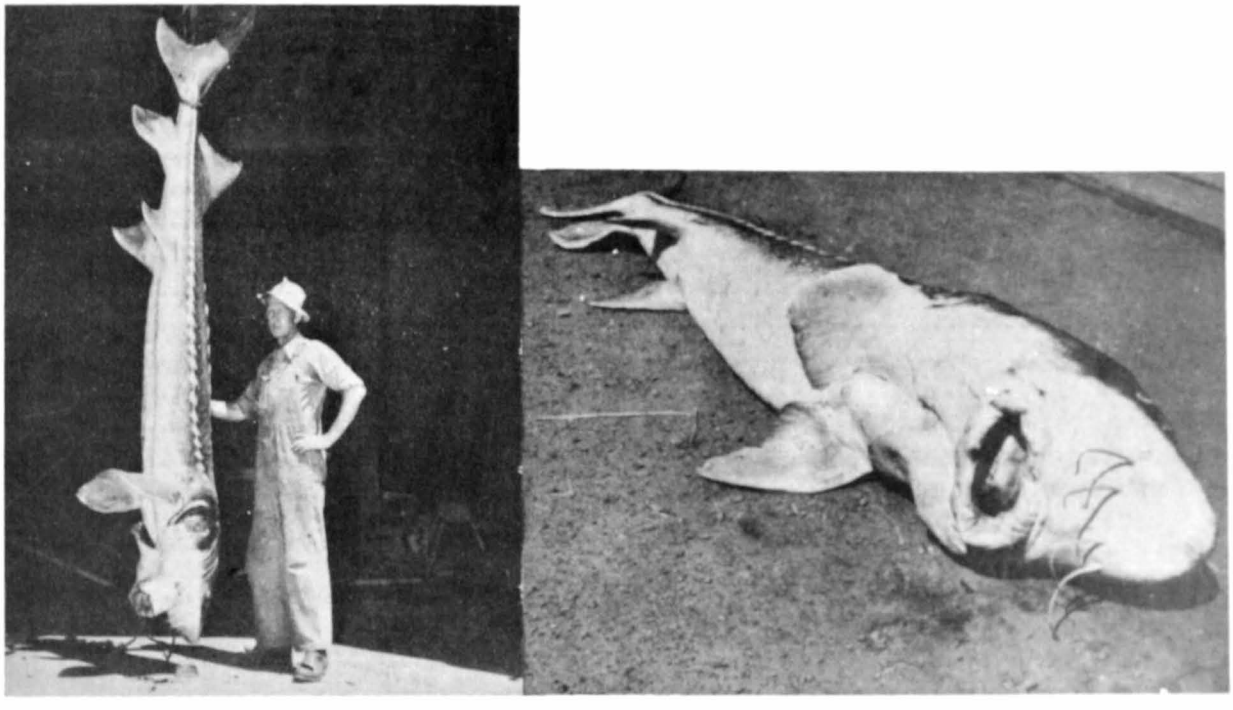
-sturgeon

# STURGEONS



Female white sturgeon *(Acipenser transmontanus)* captured by Cecil Powe in the Snake River, Lewiston, Idaho, June 11, 1949. This fish, which had already spawned, was 9 feet 10 inches long and weighed 310 pounds. *Courtesy of the Al Munson Laboratory.*

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
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CONTENTS

# STURGEONS

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## INTRODUCTION

Sturgeons are strange appearing fish. All are armored like the knights of old. Some individuals are gigantic; one species may reach a length of 16 feet and a weight of more than a ton. The mouth can be protruded to a remarkable extent, and the upper lobe of the uneven tail is much larger and longer than the lower one.

Sturgeons occur in the seas, estuaries, and rivers of northern Europe, Asia, and North America, but not in the tropics or in the southern hemisphere. They are of commercial value wherever found. The commercial catch of sturgeon in the United States during the 10-year period 1949-58 varied from a low of 453,000 pounds in 1951, worth $110,000, to 819,000 pounds in 1956, worth $144,000. The average landings and value during that period were 657,700 pounds and $127,200.

## SPECIES

The 20 or more species and subspecies of modern sturgeons belong to the order Acipenseriformes, constitute the family Acipenseridae, and are mostly of the genus *Acipenser*. Seven species occur in North America. Four of these are anadromous (spawn in fresh water but spend a good part of their life in the sea); the others occur only in fresh water. The six commercially important Asiatic and European species, except the "viza," are all anadromous.

## LIFE HISTORY

### Description

The body is long with a gently humped back, the tail end narrowing like a slender sculling oar. Rows of bony shields partially cover the body. Sometimes there are seven rows; usually there are only five--two rows running along each side and one row down the back.

Bony plates cover the head. The eyes are small, with a small spiracle (a small circular opening) above each eye in some species. There is only one gill opening on each side; the gills are enclosed by bony gill covers. The form of the long, wide, pointed snout varies with age, being much more blunt and abbreviated in old than in young specimens. The snouts of different species of sturgeons have various shapes and lengths. The mouth, situated on the under side of the head, is small, toothless (except in larval stages), with protractile lobed lips. There are four pointed barbels in a row across the lower side of the snout in front of the mouth.

The single, rather small, triangular dorsal fin is far back on the body, slightly ahead of the anal fin, and a little behind the pelvic fins, which also are well back. The pectoral fins are low on the sides. The caudal fin forks into a long upper lobe and a short, smaller, lower lobe; the vertebral column extends out along the upper lobe. All these fins have thick fleshy bases where they join the body.

The air or swim bladder (sound) is large and well developed. It regulates the specific gravity of the sturgeon, enabling the fish to maintain its level in the water at varying depths.

There is no external way of distinguishing the sex of a sturgeon unless the fish is near spawning time, when the bellies of the females are swollen with ripe eggs.

Sturgeons are usually olive green, grayish, or brownish purple on the back, with white occurring below the side shields. Occasionally the young have some small dark spots.

Sturgeons grow slowly and live for many years, some being more than 100 years of age. Their growth has been determined by two methods--first, by recaptures of tagged individuals, and, second, by microscopic examinations of pectoral fin rays, which have annual growth rings.

## Feeding

The diet of the adults consists mainly of worms, insect larvae, crustaceans, mollusks, and fishes. Occasionally sturgeons swoop up large numbers of minnows as the minnows lay eggs. The white sturgeon is fond of the eulachon, or the candlefish, which live in the Columbia and Fraser Rivers. In the Columbia River full-sized blueback salmon have been found in stomachs of 8-foot white sturgeons; one sturgeon contained three large 14-inch suckers and four 14- to 15-inch squawfish; another contained a tom cat. Lampreys in the Columbia River are also a prime sturgeon food.

To satisfy their enormous appetites, sturgeons also root with their snouts, feeling for prey with the long, trailing, sensitive barbels. When a sturgeon locates food on the bottom, it protrudes its mouth and sucks up the food.

If given the opportunity, however, sturgeons often vary their diet. A white sturgeon in the Snake River ate half a bushel of big white onions, which had probably floated down the Snake River from south Idaho. Lake sturgeon in the vicinity of grain elevators eat corn and wheat.

Because of their small mouths young sturgeons feed on microscopic organisms.

## Reproduction

Spawning of all species occurs in fresh water in spring or early summer when the water temperature reaches 55° to 70° F.

Females are said to spawn for the first time when about 13 to 14 years old and the males about 9 to 10 years. They may not spawn every year.

The males and the females, almost ceasing to feed when they enter the rivers, make their way slowly upstream to deposit their spawn beyond the reach of the tides. Several males may accompany one female.

The female helps force the grayish or blackish eggs from her ovaries by rubbing her belly on rocks or other hard objects. The eggs may account for one-third of her weight; the quantity varies with the species, size, and locality. The size of the egg varies, even within the same species. A female of some species may spawn 2 or 3 million eggs during the breeding season. As the female deposits a few eggs the male beside her fertilizes them by discharging milt containing millions of microscopic sperm cells. Each of the eggs is enclosed in a sticky jellylike envelope. The eggs stick to each other, on vegetation, and stones on the river bed, where they lie in large masses.

After spawning, the females and the males quickly leave the area and return to their feeding grounds.

## The Young

In 3 to 7 days fertilized eggs hatch into larvae, which are less than one-half inch long. Growing rapidly, they are from 4 to 5 1/2 inches long when a month old, and bear teeth and sharp spine-tipped shields, which protect them well. As the young sturgeons grow, the shields separate, the spines disappear, and the teeth drop out.

The young sturgeon lives on its large yolk mass until it is about three-fourths of an inch long. Then it begins to feed on minute crustaceans that float in the water. At a length of about 9 inches it becomes a bottom feeder.

Before migrating to the sea young sturgeons spend from 1 to 3 years in the rivers in which they were born. By the time they reach a length of 3 feet all marine species are either in the sea or in the estuaries.

# BEHAVIOR

The sluggish sturgeons usually cruise slowly and quietly on the bottom of sandy or muddy stretches; however, they occasionally leap from the water. The splash of a 6-foot white sturgeon is often visible a mile away; 10- to 11-foot white sturgeons in the Columbia River have been seen to leap out of the water. During spawning sturgeons roll, splash, and leap out of the water. They will jump from the water also when hooked. When attempting to move up a river, they will jump over a shallow bar or riffle area. When attacked by the parasitic sea lamprey, the Atlantic sturgeon and the lake sturgeon often leap 5 to 7 feet from the water and fall back occasionally into the fishermen's boats. These leaps are frequently seen in the St. Lawrence River.

Their curiosity is enormous. When feeding, they will stop to look at any unusual object. Discovering this characteristic, the Indians and the early settlers dangled bright red or green wooden decoys through the spearing holes in the frozen lakes.

The response of sturgeons to capture varies. If an ice fisherman spears a sturgeon through the ice and yanks it into his shanty, after a nip-and-tuck struggle, he will find the roughest part of the battle is about to begin. The powerful tail lashes of the flopping sturgeon may injure the fisherman and destroy his equipment. The sharp and hard shields along the body also enable the sturgeon to inflict serious wounds. However, when captured in the rivers with nets, even the large sturgeons seldom offer resistance.

## DECLINE

Many factors contributed to the decline of the once plentiful sturgeon population in the United States. An early factor was the deliberate efforts of commercial fishermen to wipe them out because the sturgeons ripped and tore the nets every time they got into them. Overfishing was more destructive. When transportation became available, and many people had acquired a taste for caviar and smoked sturgeon, a large market developed for these delicacies. To satisfy the demand, the fishermen constructed special gear to take greater quantities of these fish. As a result, immature individuals, needed for replenishing the population, were taken along with mature fish. Other contributing factors were pollution and the dredging and damming of those rivers used for spawning.

## PROTECTION

In some areas, sturgeons are making a sizeable comeback, because some States realize that the sturgeon's slow growth and relatively great age at maturity require special regulatory measures. These States are restricting the methods of fishing, the fishing seasons, and the size and the numbers of sturgeons that can be taken each year.

These regulations vary from State to State. A few examples will point up these differences. Anglers in California may take sturgeon at any time of the year provided they catch no more than one a day and release those taken under 50 inches long. Washington protects sturgeon less than 30 inches and over 72 inches in length. Sturgeons over 72 inches long are protected because they mature at about that size; a female of that length produces vastly more eggs than a smaller one. The limit for speared sturgeon in Wisconsin is one fish per season; the minimum size is 40 inches. In South Carolina there is an open season from March 1 to October 1 for catching and shipping sturgeon and caviar. The balance of each year is a closed season.

## CAPTURE

The sturgeon are caught commercially in the United States in large-mesh, drift gill nets, similar to salmon gill nets in construction and operation, and, especially in the Columbia and Mississippi river area, on setline or trotlines. Several fishermen have caught them in the Columbia River on a "flatfish lure" in swift water where the lure was well above the bottom. A few sturgeon are taken in haul seines and traps. Gill net fishing is most effective at night and in localities where the water is not clear. As these fish are bottom feeders, many of the sturgeon gill nets are operated as "sunken" nets, just scraping the bottom.

In the Union of Soviet Socialist Republics, there are two general types of sturgeon fisheries, salt and fresh water. In the shallower waters of the Caspian Sea a variety of setline or trotline is the most important type of fishing gear (Jarvis, 1950). These lines are often more than five-eighths of a mile in length. The ground line is fastened to stakes driven into the bottom at each end. Hooks hang at the end of short lines fixed to the ground line at intervals. The hooks usually hang about 3.3 feet below the surface, and are supported by cork floats. Gill nets are also used in the salt-water sturgeon fisheries and in some instances handlines. In the fresh-water sturgeon fisheries the haul seine is the most important type of gear, followed by setline.

Sportsmen spear them and also catch them with rod and tackle.

## VALUE

The sturgeon is valuable. The firm, hard, and rather coarse meat makes good eating, whether baked, barbecued, boiled, dried, fried, pickled, or smoked. The eggs, which look like buckshot, are made into caviar, which is served as an appetizer or used in dips, salads, dressings, and soups.

Equally useful is the sound or swim bladder from which isinglass is prepared. The principal use of isinglass today is for clarifying wines, beers, and other liquids. It is used to a limited extent in the manufacture of court plaster, special cement, and waterproofing compound.

Sports fishermen, as well as commercial fishermen, regard the sturgeons highly. These fish, often heavier and longer than the anglers, test their skill, determination, and courage.

Sturgeons interest fishery scientists also because they are survivors of a primitive group of fishes. Modern sturgeons retain the primitive, almost entirely cartilaginous, skeleton and have bony and ridged plates rather than the smooth and enameled plates of their ancestors. They acquired also a greatly reduced suctorial, toothless mouth, and barbels on the snout.

## COMMODITY PREPARATION

Besides the meat, the two most valuable commodities derived from sturgeons are caviar and isinglass.

### Caviar

Preparing caviar from the eggs is an important industry (Jarvis, 1950; Tressler and Lemon, 1951). In the United States the eggs are sieved to separate them from membranes and tissues. Luneberg salt or American dairy salt is sifted over the eggs to flavor and preserve them, and the sticky mass is well mixed by hand for 5 to 8 minutes. The salt and eggs form a brine. Only after the salt has been added to the roe does it become caviar, a Turkish word (khavyah). The eggs are poured into sieves and allowed to drain for about an hour. Then the caviar is next poured into kegs and shipped to the cannery, where it is repacked in cans or jars, sealed, and pasteurized. (The Food and Drug Administration of the United States holds that only preserved sturgeon eggs may be called caviar.)

Caviar is prepared in a similar way in the Union of Soviet Socialist Republics, where the sturgeon fisheries are much greater than in the United States. However, little caviar in the USSR is canned; much is prepared especially for export by pressing into a cake form.

The U.S. Food and Drug Administration forbids the entry into the United States of borax-preserved food. Therefore, for the United States market only salt is added to the roe. For European countries salt and borax are added, and caviar thus prepared is sweeter than that preserved with salt only (Romanoff Caviar Company, 1960). In the United States only foreign embassies and United States vessels outside the 3-mile limit may and do serve caviar containing borax.

Iran, another caviar exporter to the United States, probably prepares caviar very much as does the USSR. Since 1953 when the Irano-Soviet Fisheries Company, which controlled Iran's caviar fisheries in the Caspian Sea for 25 years, was dissolved, the Iranian Government, through the Iran Fisheries Company, has had charge of the caviar processing. The withdrawal of Soviet fishing technicians at the time the Irano-Soviet Company was dissolved created a problem, because there were few trained Iranians. As a result, the quality of Iranian caviar declined; however, the Iranians are gaining experience, and their caviar quality is now high. During 1956-57 the Company produced 126.4 tons of caviar (Iran Review, 1958).

### Isinglass

Preparing isinglass is another important industry (Tressler and Lemon, 1951). The air bladder of a sturgeon is split open--carefully washed to remove blood, membranes, and other matter--and spread out to dry in the air with the silvery-white inner membrane up. This lining is then stripped off and, after special treatment, dried to form the commercial product.

## CULTURE

In both the United States and Europe sturgeon culture has been almost a complete failure. Among the chief difficulties is that sexually mature females and males are not always available at the same time. Other drawbacks are that the eggs are often attacked by fungi, and the fry seldom have a suitable supply of microscopic organisms for food.

## NORTH AMERICAN SPECIES

### Atlantic sturgeon *(Acipenser oxyrhynchus)*

The Atlantic sturgeon occurs on the Atlantic coast and in coastal rivers from north of the St. Lawrence River, Canada, to the Gulf of Mexico.

A close relative of the European sturgeon *(A. sturio)*, it has olive or sometimes reddish color above, fading to white below. It reaches a length up to 12 feet and a weight up to 500 pounds; however, specimens weighing more than 200 pounds are rare. A 6-foot sturgeon weighs about 90 pounds. An 18-foot specimen has been recorded from New England, but a length of over 8 feet is unusual.

In the spring or early summer this species runs into brackish or fresh water to spawn but may not spawn until late summer. The spawning grounds are in running water as much as 10 feet deep over small rubble or gravel. Females may lay as many as 2 million eggs in a season. Young sturgeon spend the first few years of their life in the lower tidal reaches of the river.

The results of tagging in Canada revealed that the Atlantic sturgeon can travel great distances (Vladykov, 1955). An individual tagged at Kamouraska, Quebec, in 1945 was recaptured 8 years later on the south coast of Newfoundland (Hermitage Bay); it had traveled a minimum distance of over 700 miles. Three other fish released in 1947, one near Isle aux Coudres in the St. Lawrence River and the other two near Kamouraska, were recaptured a year later near Halifax, Novia Scotia, after traveling about 900 miles.

The Atlantic sturgeon is an important commercial fish, both for its flesh and for the caviar made from its roe. Commercial fishermen capture it with gill nets.

## Shortnose sturgeon *(A. brevirostrum)*

Ranging from Cape Cod to Florida and perhaps along the Gulf of Mexico coast, the shortnose sturgeon is more abundant in the southern part of its range than in the northern part.

The brown color, small size, and comparatively smooth skin distinguish it. It reaches a maximum length of 2 1/2 feet, but is usually about 1 1/2 feet long. Its habits are quite similar to those of the Atlantic sturgeon.

This sturgeon is of slight commercial importance. Most of those captured commercially are taken by shad gill nets, both stationary and drifting types.

## White sturgeon *(A. transmontanus)*

The white sturgeon, the largest freshwater fish in North America, ranges from northern California to northwestern Alaska. Small populations exist in Grays and Willapa Harbors. This dark gray fish, known also as the Columbia River, Sacramento, Oregon, and Pacific sturgeon, reaches a length of 20 feet and a weight of over 1,000 pounds. One specimen weighed 1,900 pounds.

The short broad snout, the 4 barbels nearer the tip of the snout than the mouth, the 38 to 48 bony shields in the lateral series on each side of the body, and the uniform gray coloration distinguish this fish.

The males are smaller and mature earlier than the females which reach maturity between 13 and 16 years of age and at 70 to 80 pounds in weight. However, females have been found ripe at 45 pounds and males at 9 years of age. A female, 8 or 9 feet long and about 50 years old, may contain 3 million eggs.

They ascend the Sacramento, Columbia, and Fraser Rivers in the spring or early summer to spawn.

In 1954 biologists of the California Department of Fish and Game tagged 994 white sturgeon and 25 green sturgeon *(A. medirostris)* in San Pablo Bay to obtain information for managing the sport fishery (Pycha, 1956). Only 62 of the white sturgeon and 3 of the green sturgeon tags had been returned by anglers and commercial fishermen by April 1959 (Chadwick, 1959). One white sturgeon and 3 green sturgeon returns were from Oregon waters, showing some interchange among the sturgeon populations along the Pacific coast.

From an examination of the pectoral rays of the tagged fish, these biologists found that white sturgeon were about 40 inches long when 8 years old, 50 inches when 13, and 94 inches when 30 (Pycha, 1956). Weight increased slowly with length up to 35 inches, increased rapidly between 35 and 45 inches, slackened somewhat between 50 and 60 inches, and then increased rapidly.

This is a valuable food fish, its flesh and roe commanding high market prices.

## Green sturgeon *(A. medirostris)*

Like the white sturgeon, the green sturgeon ranges from northern California to northwestern Alaska. It is rarely found in fresh water, preferring to spend much of its time near river mouths. In earlier years this fish was common in the Columbia River 140 miles from the sea. It reaches a length of 7 feet and a weight of about 350 pounds.

The green sturgeon has an olive green color, with an olive stripe on each side.

The elongate narrow snout, the 4 barbels nearer the mouth than the tip of the snout, and the 23 to 30 bony shields in the lateral series on each side of the body are further distinguishing characteristics.

Its habits and life history are thought to be similar to those of the white sturgeon.

The green sturgeon is considered to be an inferior food fish and is, therefore, of slight commercial importance.

### Lake sturgeon *(A. fulvescens)*

Called also rock, red, rubber-nose, Ohio, and stone sturgeon, the lake sturgeon occurs throughout southern Canada and the north central United States.

This fish is the giant of our inland freshwater fishes. It has been known to reach a length of 8 feet and a weight of 310 pounds. Most of those in the Great Lakes area measure less than 6 feet and weigh under 100 pounds.

The external appearance of the lake sturgeon varies greatly with age and size. In the young, the body shields are rough with the spines strongly hooked, and the snouts are sharp. The shields of the adults grow smoother, many of them disappearing with age, and the snout grows less pointed. The young are tan or buff-colored with dark blotches on the sides. The adults are darkish above and paler below, without spots.

The oldest lake sturgeon on which an age determination was made was 152 years old. It was caught in 1953 in Lake of the Woods.

Lake sturgeon spawn in swift running rivers over bottoms covered with gravel and stones, often spawning at the foot of falls, in 2 to 15 feet of water.

Spending most of the spring in fairly shallow water, lake sturgeon seek deeper water in summer. In winter, they school in the deeper holes, occasionally cruising the more productive shallow areas for food.

The movements of lake sturgeon are limited and never have involved journeys greater than 250 miles (Vladykov, 1955).

This desirable food fish is of considerable importance in the St. Lawrence River. Most commercially caught specimens are captured in gill nets.

### Shovelnose sturgeon *(Scaphirhynchus platorynchus)*

Known also as hackleback, sand, and switchtail, the shovelnose sturgeon is found from the Mississippi River system northward to the Hudson Bay drainage in Canada, with the exception of the Great Lakes.

This pygmy of the sturgeon family is an even pale yellowish olive, without blotches or spots. It seldom exceeds 3 feet in length or 6 pounds in weight and spawns in May or June in rapidly flowing waters.

Distinguishing this slender fish from the lake sturgeon is easy. The long slender tail is twice as long as that of the lake sturgeon, and the tail fin ends in a long filament almost as long as the rest of the tail. Bony plates cover the tail. The snout is broad, flat, and shovel-shaped.

### Pallid sturgeon *(S. albus)*

Known as the white shovelnose and the white sturgeon, the pallid sturgeon is found locally in Illinois and seems to be limited to the Mississippi River and its larger tributaries. It occurs usually in swifter water than the shovelnose (to which it is related) and spawns in spring and summer.

This fish probably grows to be 4 feet or so in length and about 16 pounds in weight. Its color is light, the upper parts bluish gray, the lower part of the sides and belly shading from light gray to almost milky white.

## ASIATIC AND EUROPEAN SPECIES

### Beluga sturgeon *(Acipenser huso)*

The beluga is common in the Black Sea, the Sea of Azov, the Caspian Sea, and tributary rivers, but does not occur in Siberia.

It reaches a maximum length of 16 feet and a maximum weight of about 2,200 pounds and produces about 350 pounds of caviar. However, adult belugas usually weigh from 240 to 290 pounds and produce from 30 to 45 pounds of caviar. There are no bony scutes on the snout, and the barbels are flattened and tape-like.

Soviet scientists have crossed a beluga with a sterlet (Sunday Star, Washington, D.C., 1960). The largest grain of caviar is made from beluga eggs, and the finest caviar comes from the sterlet eggs. The goal of the scientists is to combine the flavor of the sterlet and the size of the beluga.

### Russian osetr sturgeon *(A. güldenstädti)*

One of the most valuable fish species in the rivers of the Union of Soviet Socialist Republics, the Russian osetr inhabits also the rivers of Siberia, eastward as far as Lake Baikal, and abounds in the rivers of the Black and Caspian Seas. It reaches a

length of 7 1/2 feet and a maximum weight of 176 pounds, and produces up to 26 pounds of caviar.

In the Volga River it spawns in May, and its young remain in the river for a considerable time.

In the USSR several specimens of this species were caught bearing gold rings placed on them more than 100 years previously (Bajkov, 1930).

### Sevruga sturgeon *(A. stellatus)*

The sevruga abounds in the rivers of the Black Sea, the Caspian Sea, and the Sea of Azov. It reaches a length of 7 feet, ranges from 26 to 110 pounds, and produces from 2 to 11 pounds of caviar. The egg is small but tasty. Like the sterlet, the sevruga has a long and pointed snout, but its barbels are simple and without fringes. Though growing only to about half the size of *A. güldenstädti*, it is no less valuable, the flesh being more highly esteemed, and the caviar and isinglass bringing a higher price.

### Sterlet sturgeon *(A. ruthenus)*

One of the smaller species of *Acipenser*, the yellow-bellied sterlet inhabits the Black and Caspian Seas and their rivers. It averages from 2 to 3 feet in length and 2 to 3 pounds in weight. It was rarely exported before World War I, but was reserved almost exclusively for the Russian Imperial Court and other officials of the Muscovite Empire (Gourmet, 1946).

### Viza sturgeon *(A. glaber)*

The viza has become a fresh-water fish, no longer descending to the sea.

### European sturgeon *(A. sturio)*

This gray or brown sturgeon, with a white belly, is closely related to the Atlantic sturgeon *(A. oxyrhynchus)*. It occurs on all the coasts of Europe, but not in the Black Sea, and is the only species which occurs in western Europe.

It reaches a weight of 900 pounds and a length of 9 or 10 feet, occasionally 16 feet.

It is doubtful if the European sturgeon enters British rivers to spawn (MacMahon, 1946), although it spawns in large rivers of continental Europe.

In Britain the sturgeon is a "royal fish." A decree of Edward II provides "The King shall have the wreck of the sea throughout the realm, whales and great sturgeons . . . except in certain places privileged by the King."

## RELATIVES

Sturgeons have two fresh-water relatives which belong to the family Polyodontidae. They differ from the true sturgeons in having naked bodies, very small eyes, long snouts, and rather large mouths. The paddlefish or spoonbill sturgeon *(Polyodon spathula)* is found in the lowland streams of the Mississippi Valley and rivers of the southern United States and grows to a length of about 4 or 5 feet. The swordbill sturgeon *(Psephurus gladius)* is found in the larger rivers of China and grows to a greater size.

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