

THE SMELT, AN OCEAN FISH THAT LIVES IN THE GREAT LAKES

By LOREN P. WOODS
CURATOR OF FISHES

THE STORY of the smelt, its introduction and phenomenal spread through the Great Lakes, and its decline and recent recovery has been told many times but always in parts and fragments. Therefore, unless a scrapbook has been kept, it is difficult to fit the various facets of this remarkable story together into a continuous whole.

The introduction of the smelt into Great Lakes waters has been alternately condemned and praised—condemned entirely



CHICAGO LAKE FRONT SCENE

Booms with ring nets in close array along seawall at 49th Street. The nets are lowered into the water for the taking of smelt as the fish move along the shore during their spawning run. The fish are removed with small dip nets.

without evidence as a menace to lake trout and whitefish; condemned with some cause when commercial fishermen, while fishing for other species, find smelt tangled by their teeth in the gill-nets in such numbers that in some places this kind of fishing has to cease at depths known to be inhabited by smelt during the summer months. The lake-trout fishermen on Lake Superior have recently been blaming poor fishing on the smelt. They claim that the trout leave the banks where they formerly fed and where a successful gill-net fishery was operated and that they now are found only on the grounds where there are smelt. This explanation is based on the observation that those trout that are caught are always crammed with smelt.

On the other hand, during the late 1930's and for the past four or five years the catch of smelt has been quite large, in some places the most abundant fish caught, thus adding to the income and sport of many individuals. Smelt, rather than being predators upon the more valuable species, are instead preyed upon by lake trout and walleyes and are a principal source of food for these fishes. Recently the smelt have been reported by fishermen to be feeding extensively upon small sea lampreys and if this habit is widespread the smelt may play a part in helping to keep this pest under control.

The smelt in the Great Lakes except Lake Ontario are all believed to be descended from a successful planting, in 1912, of 16,400,000 eggs in Crystal Lake, Benzi County, Michigan. However, it was not until 1918 that the first fish were noticed, and the first large spawning run occurred in 1922. In 1923 they were first collected in Lake Michigan, having escaped from Crystal Lake by an outlet. A year later they had crossed Lake Michigan to Big Bay de Noc at the north end of Green Bay. In 1925 they were in Lake Huron and by 1930 had reached Lake Erie. They seem not to have invaded Lake Superior until 1933 or 1934. Their spread down the west shore of Lake Michigan and to the southern parts of the eastern shore was delayed until 1930-31 but by 1936 all suitable waters of Lake Michigan were occupied. From 1936 through 1941 large runs occurred every spring. It was noticed while keeping records on the dispersal that generally about five years after the smelt were first reported in an area the

first spawning occurred there. The annual yield of smelt in the Great Lakes is not known, but the production in Lake Michigan alone in 1942 has been estimated to have reached nearly 14,000,000 pounds. This was about two-thirds of the entire catch reported for Lake Michigan that year and about one-seventh of the reported total catch for all species in all the Great Lakes.

DECLINE OF THE TRIBE

Although the smelt became the dominant commercial species in Lake Michigan the other fisheries did not appear to suffer but flourished instead. Then in early October, 1942, dead smelt were noticed in Lake Huron off Saginaw Bay. By the end of the month the smelt were dying at Mackinac and by mid-November the "kill" had reached Grand Traverse. Smelt fishing in January and February, 1943, flourished in Green Bay but by mid-March the fishery had collapsed completely. By the spring spawning season in 1943 only a few survivors were left. Whatever was killing the smelt was progressive over a period of four and one-half months, and only smelt, of all ages and in all waters freely connected with Lakes Michigan and Huron, were affected. Smelt in Lake Superior and Lake Erie were not killed. The total loss of smelt in the period between 1943 and 1946 was estimated to be

50,000,000 pounds. Dr. John Van Oosten of the Fish and Wildlife Service, after a careful survey of the situation, concluded that a virus or bacterial disease was responsible for the mortality. Smelt "kills" have been recorded in many New England lakes where smelt were indigenous or introduced, as in Lake Champlain during the summer of 1882 when for about a week the lake was covered with dead floating smelt and the fishery suddenly declined, indicating that the stock had been greatly reduced. Occasionally during the spawning season a storm hits the exhausted fish tossing them onto the shore and causing great local mortality. But aside from Van Oosten's supposition that the widespread deaths may have been caused by an infectious disease the only explanation previously offered was "death due to obscure causes, as among higher animals."

RECOVERY IN RECENT YEARS

In 1945 Green Bay had a small run, and several light runs were reported elsewhere in Lakes Michigan and Huron. There was further improvement in subsequent years, and in 1949 the population was nearly recovered with Michigan alone producing over a million pounds. In 1951 there was an extremely heavy run and it is believed that now their numbers equal the pre-mortality years.

The smelt is so well known as to require little description other than that it is a small (7 to 14 inches) transparent olive-green fish of slender form with a long pointed head, large eyes, and deeply forked tail. This description is a little too general and to it must be added that between the soft-rayed fin of the back and the tail there is a small fin without rays (adipose fin) such as whitefish, trout, and salmon possess. These fishes are near relatives of the smelt and, except for a few minor anatomical peculiarities, smelt and salmon would be in the same family.

Smelt are best known as marine fish, the species (*Osmerus mordax* Mitchell) ranging in the western North Atlantic from Labrador to New York. In the sea as in fresh water, smelt gather inshore in winter and with the onset of warmer water in the spring run a short distance up streams to spawn. They have naturally become landlocked in fresh water, as in Lake Champlain and other New England lakes where they are considered to be indigenous, and they have been widely introduced into lakes large enough and deep enough to offer a cool retreat into deep water in summer. The smelt eggs introduced into Crystal Lake were from a landlocked population from a hatchery at Green Lake, Maine. In Lake Champlain there appear to be two races, a normal-sized and a dwarf race. The dwarf race appears

to be chiefly important as food for the "large" race.

HABITAT OF THE SMELT

In the ocean, smelt are never found more than a mile or two off shore or in more than a few fathoms depth. In the fall they move to the harbor mouths and are present in inshore waters all winter, even entering brackish water. They enter fresh water and begin the upstream migration when sufficiently high temperature has been reached. The spawning run begins at 40 to 42 degrees Fahrenheit and reaches its height at 50 to 57 degrees.

In fresh water after spawning, smelt do not immediately seek the deeper waters of the lake but gradually as the summer progresses go into deeper and deeper water. They appear to avoid water with a temperature higher than 59 degrees. This simple explanation for their retreat into deeper water is complicated by the fact that smelt avoid bright light. In the spring the waters are generally murky when they make their spawning runs, and as the waters become more transparent in summer so that the light penetrates more freely the smelt may be influenced to move into deeper water. This latter supposition is supported by their occasional appearance at the surface in summer late in the evening when the direct rays of the sun are no longer on the water. Generally during the summer the smelt in Lake Michigan live at depths of fifteen to nineteen fathoms where they are active enough to get tangled in gill-nets and where they may also be taken on hook and line.

PREDACEOUS AND CANNIBALISTIC

Smelt are predaceous fish living on crustaceans, insect larvae, and fishes—cannibalistic, they prey on other smelt. During the spawning season apparently most smelt do not feed at all since nearly all stomachs examined at that time have been found to be empty. Young smelt, one to three inches, as would be expected, eat plankton, chiefly crustaceans such as waterfleas and copepods, but they occasionally also eat one of their own species and fill out their diet with rotifers, algae, insect larvae, and pupae. Studies made of more than 3,000 smelt from Green Bay collected throughout the year showed that only 6.5 per cent had fed on fish, mostly other smelt but also the lake sculpins (*Cottus*) and burbot (*Lota*). All the rest were subsisting on invertebrates, especially on prawns (*Mysis*), scuds (Amphipoda), mollusca, and worms. No lake trout were found in any stomachs apparently for the reason that lake trout small enough to be preyed upon by smelt live in water so shallow that the smelt do not find them. Rarely whitefish and lake chubs are eaten but none were recorded in the above-mentioned study.

Separate studies made in Green Bay, at Manitoulin Island, and in Lake Champlain have generally agreed in indicating a largely

invertebrate diet, but in Crystal Lake a study made of 147 smelt showed a predominant minnow diet, 97 per cent lake shiner, with only a few invertebrates eaten. This sample was taken September 1, a season when both smelt and lake shiners begin to gather in shoal waters and this factor combined with the small number of stomachs examined probably does not give a representative picture of their diet.

THEY SPAWN IN STREAMS

In the sea, smelt move inshore in the fall and in the spring they enter streams, going just above tidewater to deposit their eggs. Apparently they never go far, not more than a few hundred yards, but the eggs must be laid in fresh water. Flooding with salt water kills them. The eggs are extruded in clusters and sink, adhering to pebbles, weeds, sticks, and to each other. The incubation period is about 13 days and the young are believed to go immediately to salt water.

In the Great Lakes the run usually occurs when the ice is going out in the spring. As in the ocean the smelt go just inside the mouths of creeks. The ascent into the creeks is nocturnal; none return until daylight and a few remain in the creeks during the day. On entering the creeks they swim close to the bottom and avoid lights flashed into the water. The run generally lasts two or three weeks and is made up of fresh arrivals each night. After spawning, the fish, heads still pointing upstream, drift tail first down into the mouth of the stream. The males at spawning time

the males before they reach the sand. The clusters adhere to whatever they touch. Some of the males collected at this time had eaten some eggs. Average-size females produce as many as 25,000 eggs, larger females up to 43,000 eggs.

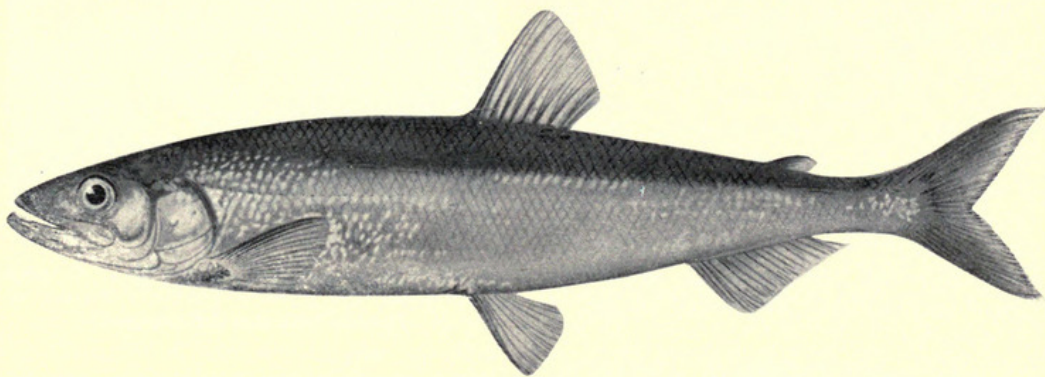
It is during the spawning migration that the sportsmen take most of their smelt by dipping. Frequently the interference is so great that the fish cannot spawn and many are injured at this time by nets, by being stepped on, or even washed onto the banks by splashing. But in spite of such hazards this prolific fish by its very numbers overcomes man's interference and enough are produced to maintain and even increase their numbers in the face of great adversity.

GROWTH AND LONGEVITY

"Landlocked" smelts in Crystal Lake have grown to a length of 4½ inches by the end of their first year. By the end of their second year, when they participate in their first spawning run, they are 7 inches in length. In the ocean and in the Great Lakes they grow a little more rapidly. By the third year they average 10 inches and most individuals are a foot long by the end of their fourth year. The maximum size recorded was a five-year-old female, 14 inches total length. The oldest individuals on record were six years of age.

GENERAL ECOLOGY

As smelt are predatory and fish eaters, so are they in turn eaten by other kinds of fishes. They are, in Lake Michigan, eaten both as young and adults by lake trout,



THE SMELT: BOTH EULOGIZED AND DENOUNCED

can be distinguished from the females by their smaller size and by the arrangement of their pearl organs. These pearl organs are horny growths on the head and on the dorsal and pectoral fins of the male. The females develop pearl organs on the head but not on the fins.

Smelt spawn over a sand and gravel bottom, one female attended by several males. All have their heads pointed upstream. The female occupies a position slightly in advance of the males and slowly sways her body through an arc of five or six inches; the eggs are extruded and pass under

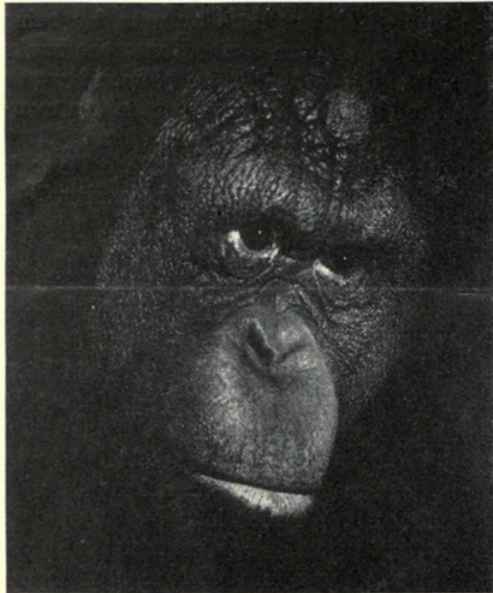
perch, walleyes, and burbot. In Lake Champlain smelt are part of the diet of these species and also of the landlocked salmon, pickerel, pike, eels, and rock bass. In Lake Michigan, trout formerly fed largely on lake chubs and sculpins, but with the increased abundance of smelt the trout's food habits shifted and the smelt became an important forage fish.

The sea lamprey has been held completely responsible for the decline of the lake trout in Lake Michigan and Lake Huron. The evidence on which this assumption is based

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PRIZE WINNERS IN NATURE PHOTO SHOW LISTED

The photographs that won first-prize silver medals in each of the three sections of the Division of Prints in the Ninth Chicago International Exhibition of Nature Photography are reproduced on this page. The exhibit, which is divided into animal-life, plant-life, and general sections, is held



'PETE, THE ORANG-UTAN'

By J. M. Miller, of La Grange, Illinois. Awarded silver-medal first prize in the Animal-Life Section of Nature Photography Exhibition.

annually in February under the joint auspices of the Chicago Nature Camera Club and the Museum.

This year's photo contest and exhibit exceeded those of all previous years in attracting the interest of photographers. Entries were received from 917 persons, many living in South America, Europe, Asia, Africa, Australia, and other far places. A total of 3,721 pictures was entered, of which 3,068 were color transparencies and 653 prints. From these the judges selected 845 slides and 248 prints for exhibition. The entries showed a 10-per-cent increase in

slides and 20-per-cent increase in prints compared with the 1953 show, which had broken all previous records.

Following are lists of medal winners and awards of honorable mention for both prints and color slides:

MEDAL WINNERS

Prints:

ANIMAL-LIFE SECTION: J. M. Miller, La Grange, Ill.—*Pete, the Orang-utan*

PLANT-LIFE SECTION: Grant Haist, Rochester, N. Y.—*Fungi Family*

GENERAL SECTION: Bosworth Lemere, Santa Barbara, Calif.—*Soft Snow Blanket*

Color Slides:

ANIMAL-LIFE SECTION: Robert Potts, San Francisco—*Green Sea Anemone and Purple Sea Urchin*

PLANT-LIFE SECTION: Jack Roche, Caldwell, N.J.—*Fritillaria Imperialis*

GENERAL SECTION: John Benzel, Covina, Calif.—*Smoke Tree*

HONORABLE MENTIONS

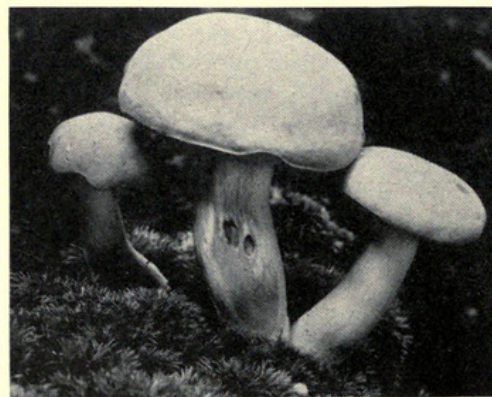
Prints and Color Slides, All Sections

CHICAGO AREA

Pearl Schwartz Rice, Willard H. Farr, M. E. Kuntz, Helen Suter, William M. Angus, Jr., Louis W. Braun, Ted Farrington, Louise Broman, Howard Miller, Erik Sorensen, John Bajgert

OUTSIDE CHICAGO AREA

Raymond G. Feagans, Bremerton, Wash.; Mary Frey, Mankato, Minn.; Lou Gibson, Rochester, N. Y.; Nan Justice, Raleigh, N. C.; J. L. Kenner, Boston; Smith MacMullin, Inglewood, Calif.; Eugenia Norgaard, Los Angeles; Floyd Norgaard, Los Angeles; Charles Norona, Los Angeles; A. W. Price, Ramsey, N. J.; R. L. Propst, Lebanon, Ore.; S. J. Rawley,



'FUNGI FAMILY'

By Grant Haist, of Rochester, New York. Awarded silver-medal first prize in Plant-Life Section of Nature Photography Exhibition.

Miami, Ariz.; Mabel Ross, Salt Lake City; Dora Sorenson, Minneapolis; Kathryn Stake, Salt Lake City; R. C. Taylor, North Hollywood, Calif.; Henry Tefft, Jr., Denver; Warren Z. Walter, Los Angeles; Roy Young, Los Angeles; William Amos, Middletown, Del.

Lewis Batts, Kalamazoo; E. H. Bourne, Penfield, N. Y.; Dr. M. A. Chandler, New Toronto, Canada; R. B. Chillas, Jr., Philadelphia; Reginald V. Corlett, Toronto; Harry and Ruth Crockett, Phoenix; Frank Fernandez, Rochester, N. Y.; T. Fuller, Louisville; Robert Hermann, San Diego; Robert C. Holman, Mifflinburg, Pa.; C. Molinelli, Martinsville, Ind.; Dr. R. Moose, San Bernardino, Calif.; Louis Quitt, Buffalo; Alice Stark, Toronto; S. Stern, New York

H. A. Thornhill, Merced, Calif.; Ralph J. Zaenglein, Maryville, Tenn.; Karl Obert, Santa Barbara; Gertrude Poole, Palo Alto; Arthur Underwood, Rochester, N. Y.; H. L. Gibson, Rochester, N. Y.; Richard D. Grill, Baltimore; Ben Hill-Tout, Vancouver; Kan Hing-fook, Hong Kong; Herman Krohn, Omaha; Charles Perkins, Washington, D. C.; L. B. Perry, Manchester, Conn.; George Sollman, Cobleskill, N. Y.; Henry C. Sollman, Cobleskill, N. Y.; Cheung Yu-chiu, Hong Kong; O. G. Edwards, Bangalore, India; Howard Oberlin, Canton, Ohio; Tan Seng-Huat, Penang, Malaya; Ralph W. Armstrong, Neptune, N. J.; I. C. Barker, San Francisco; Norma Belland, Cristobal, Canal Zone

THE SMELT

(Continued from page 5)

is the coinciding spread of lamprey and decline of trout plus the greatly increased number of scarred lake trout caught in these two lakes. It is possible that the decline of the smelt (1943) was one of the factors contributing to the decline of the lake trout that began in 1946, accelerated in 1947, and dwindled to almost nothing by 1948 and 1949. Since the smelt was an important item of diet of trout, it appears likely that the almost complete disappearance of smelt must have had an adverse effect on the trout. This effect was probably only temporary as the trout shifted back into their old habits of feeding on chubs. Not enough is known of this particular situation or of the interrelationships of Great Lakes fishes generally for anyone to be able more than to guess at a cause, or causes when some catastrophe hits a particular species.

The sea lamprey was first noticed in the Great Lakes about the same time that the smelt began to flourish here and possibly the smelt were of some importance in keeping the lampreys in check by eating their young. Unfortunately no studies were made on the food of smelt in Lake Erie where sea lampreys are rare or in lower Lake Huron, the only lake areas above Niagara that had been invaded by sea lampreys before the decline of the smelt.

The final word regarding the basic good or harm accomplished by the introduction of the smelt into Great Lakes waters has not been written. Not enough is known of the over-all productivity of the lakes or of the interrelations of species of fishes, invertebrates, and plants to determine the smelt's importance as a competitor for food, especially of young fishes, as a predator on other species, or the over-all effect of the introduction and expansion of an exotic on the native species.

Spring Visiting Hours Begin

Visiting hours from 9 A.M. to 5 P.M. will go into effect at the Museum from March 1 through April 30, an extension of one hour beyond the 4 o'clock closing time observed during the winter months.

Marjorie Clagett, Bowling Green, Ky.; Lily Colvin, Los Angeles; Ellen Cubitt, Toronto; Selina Cunliffe, Methuen, Mass.; Lad Cutak, St. Louis; Mrs. J. E. Goodwin, Toronto; Herbert Kaltman, New York; Ruth J. Nichol, Butte, Mont.; George Purdy, Port Orchard, Wash.; Donald T. Ries, Normal, Ill.; Conrad Roth, Portsmouth, Ohio; J. A. Russell, Sacramento; E. H. Thomas, Tacoma; Ruth Tollefson, Milwaukee; V. E. Ward, Angels Camp, Calif.; Elvin Warrick, Urbana; Charles Webber, San Leandro, Calif.; Paul J. Wolf, Bronxville, N. Y.; Violet Wooden, Fortuna, Calif.; Alfred Blyth, Edmonton, Canada; M. M. Deaderick, Carpinteria, Calif.; Caryl Firth, Trappe, Md.; Challis Gore, Orinda, Calif.; O. F. Metz, El Paso; A. J. Mueller, Appleton, Wis.; Howard Foote, New York; Dr. C. L. Lim, Penang, Malaya

SPECIAL MEDALS FOR COLOR SLIDES

Awarded by the Photographic Society of America

Raymond G. Feagans, Bremerton, Washington—*In Paradise Cove*; B. H. Perchuk, Chicago—*Red and Green*



'SOFT SNOW BLANKET'

By Bosworth Lemere, of Santa Barbara, California. Awarded silver-medal first prize in General Section of Nature Photography Exhibition.



Woods, Loren P. 1954. "The Smelt, An Ocean Fish that Lives in the Great Lakes." *Bulletin* 25(3), 4–6.

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