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GREAT LAKES FISHERY COMMISSION

Research Completion Report *

DISTRIBUTION AND POPULATION STATUS OF THE RUFFE
(GYMNOCEPHALUS CERNUA) IN THE ST. LOUIS ESTUARY AND
LAKE SUPERIOR

by

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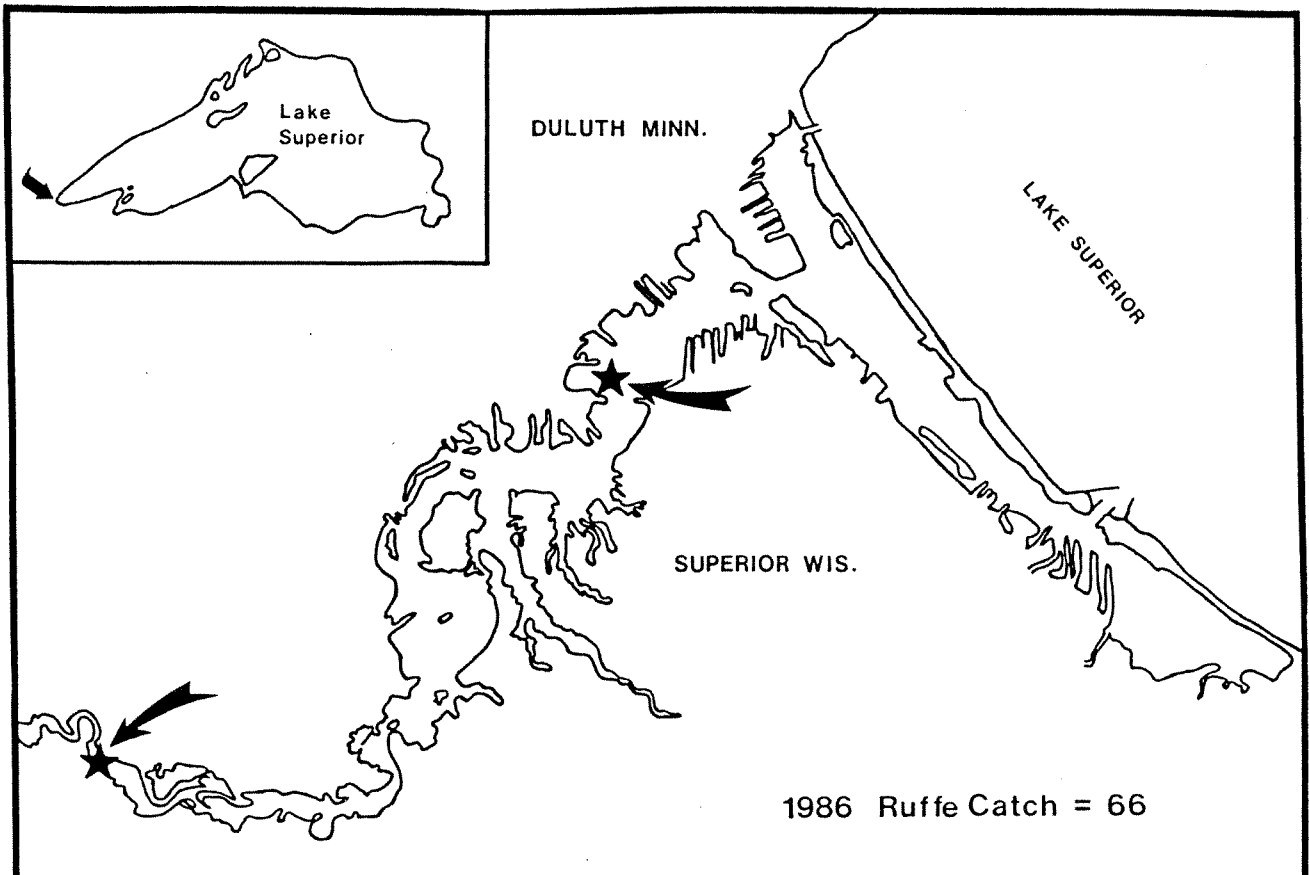
REPORT TO THE GREAT LAKES FISHERY COMMISSION
1988 SPRING RUFFE PROJECT

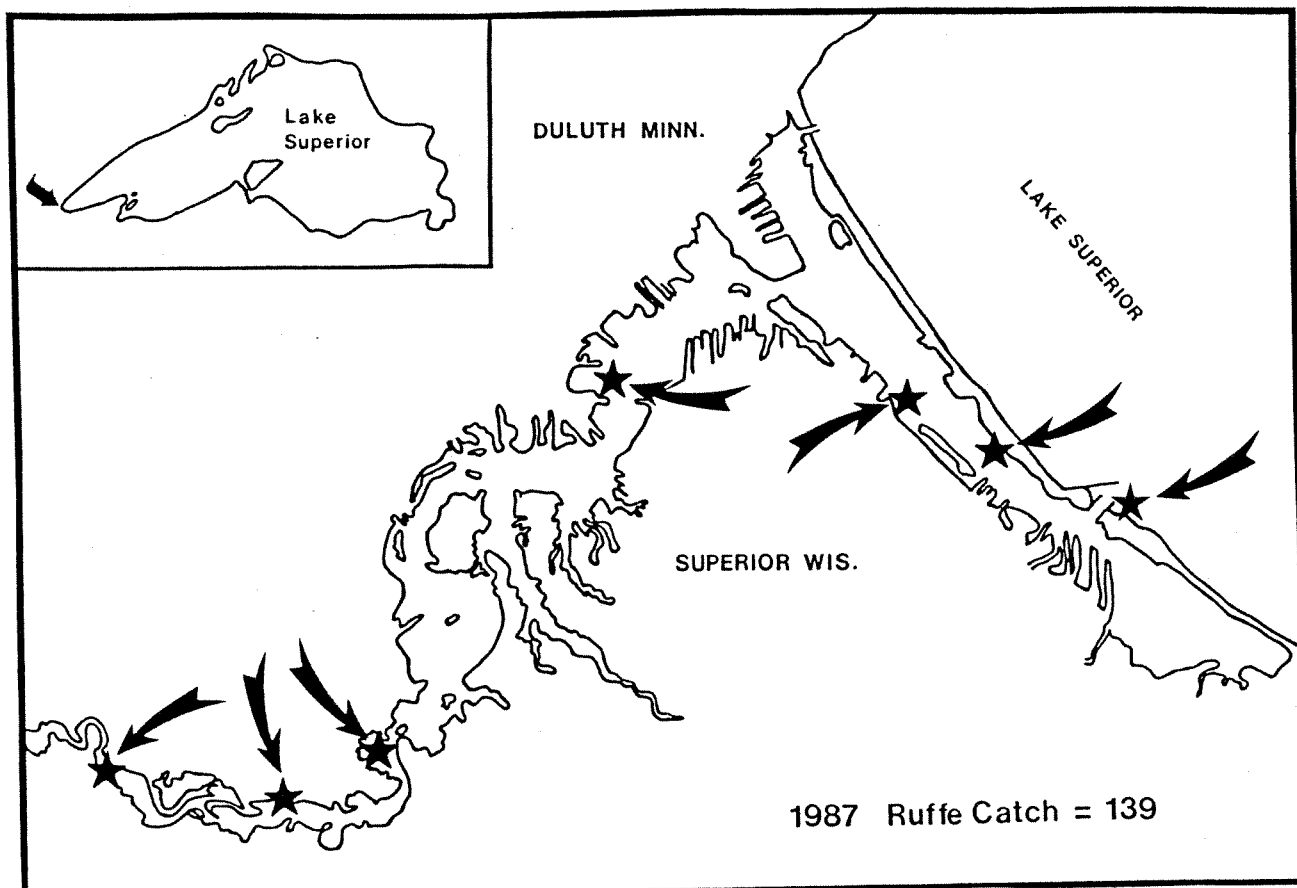
BACKGROUND:

On September 16, 1987, the Wisconsin Department of Natural Resources (WDNR) captured and identified the European Percid, the ruffe, Gymnocephalus cernua, in the St. Louis River, Lake Superior's western-most tributary. The identification was confirmed when a 2.4" male ruffe was sent to and verified by Ted M. Cavender, Curator of Fishes, Ohio State University Museum of Zoology, 1813 North High Street, Columbus, Ohio 43210-1394

Upon identification, other agencies actively engaged in fishery investigations were notified of the find. An engineering firm had collected a half-dozen fish in August and September of 1987 that fit the ruffe's description and were between 35 and 135 mm in length. Upon notification, they reexamined their ichthyoplankton samples collected in both the 1986 and 1987 field seasons and indeed found ruffe misidentified as larval johnny darters, Etheostoma nigrum, in both year's samples.

A total of 66 ruffe (all larvae) are accounted for in 1986 sampling and 139 ruffe were captured in total by all agencies (at least three year classes represented) in 1987 sampling (see maps below).





There is little doubt as to how this fish species reached the St. Louis River as the estuary also serves as the Duluth, Minnesota/Superior, Wisconsin harbor (an international port which ships grain worldwide). The fish was transported here in a ship's ballast tank from an unknown European port and then flushed into the harbor while loading.

Information on the find was presented to the Great Lakes Fishery Commission at the Lake Superior committee's meeting on March 16, 1988. Shortly thereafter, the commission provided a special grant of \$5,000 to the Wisconsin DNR to support a special spring fishery investigation of ruffe in the St. Louis River.

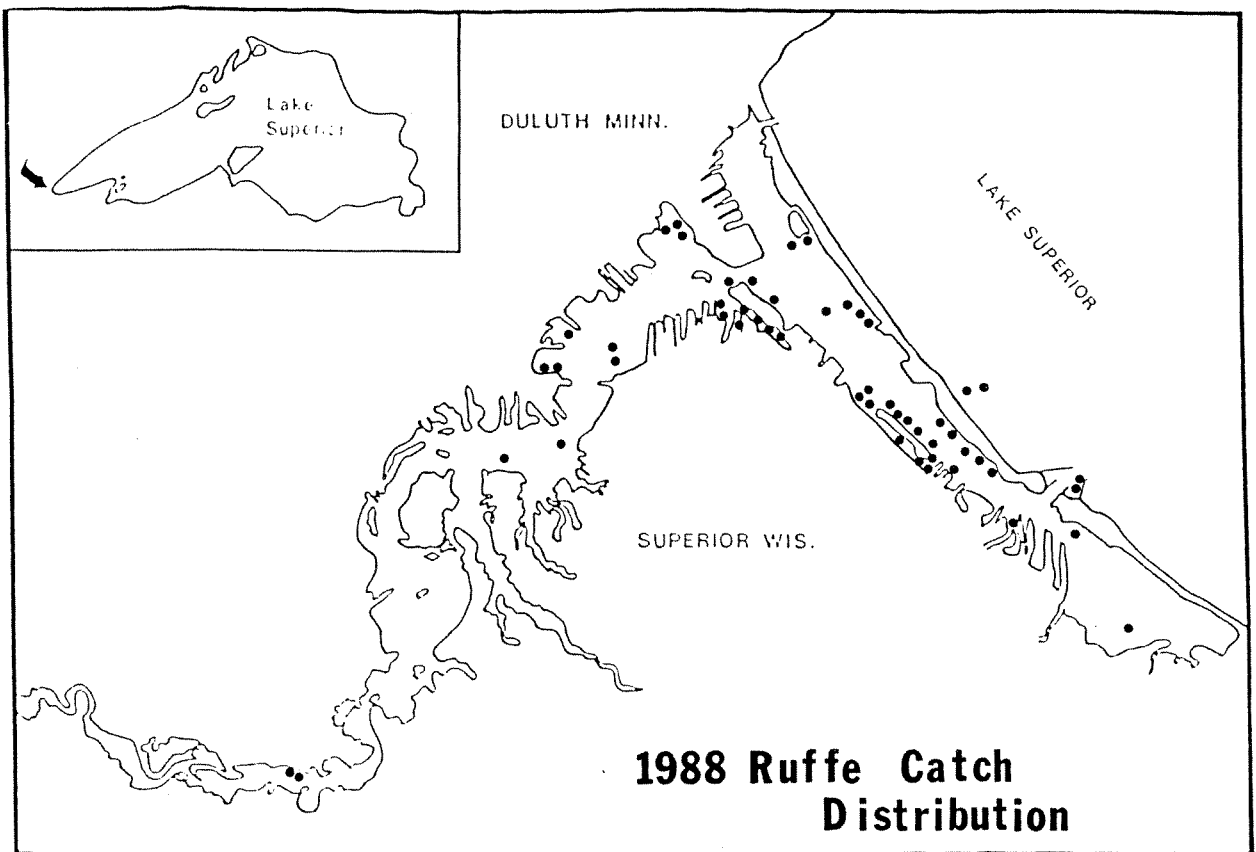
COOPERATIVE RUFFE PROJECT:

The Commission grant was used to hire an extra field crew for two months (mid-April through Mid-June) with the objective of quickly investigating the status and distribution of the ruffe in the St. Louis River. The Wisconsin and Minnesota DNR's, along with the U.S. Fish and Wildlife Service's Ashland Field Station, the Great Lakes Indian Fish and Wildlife Commission, and Minnesota's Fond du Lac Band provided both equipment and personnel whenever possible to increase the investigative effort. The projects objectives would not likely have been met without the cooperative efforts of all groups involved. Commercial fisherman, Stanley Sivertson, provided valuable information on ruffe caught in his commercial gear.

Sampling began in mid-March. Trawls, fyke nets, trap nets, gill nets, electrofishing, and shore seining were all employed at various stages of the investigation.

SUMMARY OF FINDINGS:

Over 1,500 ruffe were captured by early June with the great majority of ruffe being sampled from the lower harbor (see map below). Five ruffe have been captured to date from Lake Superior. Four of these were captured from water depths of 10-15 fathoms just outside the harbor, and the other was captured approximately 50 miles to the east of the harbor near the western Apostle Islands area.



The ruffe population is a well-established species in the St. Louis estuary with at least five year classes represented to date. The size range captured thus far is from about 2.5" to 7.5". Growth appears to resemble that of the yellow perch--spring yearlings average 3.0" to 3.2". Spring age II ruffe were about 4.7" to 5.1" with growth slowing considerably after age two. Females grow slightly faster than males.

The first ruffe captured in spawning condition were found on April 30 at a water temperature of 52° F. It appears that ruffe spawn after walleyes, yellow perch, and smelt. Ruffe can indeed be considered intermittent spawners as they were found spawning from the end of April through early June. Although not verified, some June-caught spent females appeared to be carrying a second batch of eggs. This means they not only spawn over an extended period of time, but they may spawn twice in a season (has been reported in literature from at least one European population). Nearly all ruffe captured this spring were spawning adults with males (100%) and females (>98%) mature at age I. In our efforts this spring we could not verify the actual preferred spawning sites, although we did catch two aggregations of ruffe that appeared to be spawning very near the net location. Sampling bottom material at both locations revealed no ruffe eggs. From our work this spring, it appears that ruffe may spawn in small groups at locations here and there throughout the approximately 13,000 acre lower river and estuary.

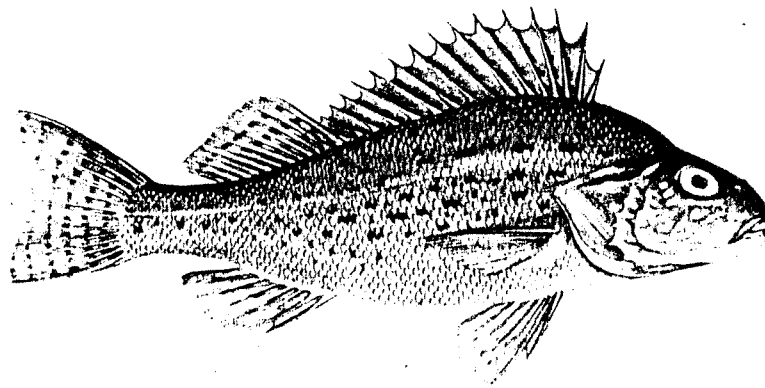
Ruffe were found to be a very bottom-hugging species as was clearly seen with gill nets, where the great majority of Ruffe were gilled within inches of the nets' lead line. During the very early spring, ruffe were located in the 20 to 30-foot deep dredged shipping channels. As waters warmed to near 50 degrees males were captured in the shallower nearby areas (suspected spawning areas). Prespawn females appeared to be holding in groups in the deeper areas, and as they ripened they moved into the shallows to spawn with waiting males. Postspawn ruffe of both sexes moved into the shallows 0-12' in early June when water temperatures approached the mid to upper 60°'s F. Anglers caught five ruffe at about this time from shore.

LITERATURE REVIEW:

NOMENCLATURE

Gymnocephalus cernua (linnaeus) - gymno = naked, cephalo = head, cernuus = with the face turned earthward; also reported as G. cernuus or G. cernus or Acerina cernua

Other common names include: England - Ruffe (e is silent) and Pope; Germany - Kaulbarsch; France - Perche Goujonniere, Brenilie; Denmark - Horke; Norway - Hork, Steinpurke; Netherlands - Kulbaars; Sweden - Gers; Finland - Kueski, Kiiski; Poland - Jazgar, Jazgarz; Russia - Jorsch; Romania - Ghibort; Czechoslovakia - Jezdik.



DESCRIPTION

Body more elongated than that of the perch. Head is blunt and scales on head are absent. There are deep mucous canals under the surface of the skin of the head. There are 5 to 10 spines on the posterior edge of the preopercle (bone just ahead of gill cover) and 3 spines on its lower edge. One sharp spine on back of gill cover. Eyes are large (popeyed look), distinct, and positioned high on head, almost squashed together at the base. Two dorsal fins connected into one containing 11 to 16 hard and 11 to 15 soft rays. Large, distinct black spots aligned in a row between dorsal fins hard rays. Distinct dark specks on soft dorsal. Anal fin has two hard and 5 or 6 soft rays. Pelvic fin has one hard ray. Tail only slightly forked with distinct dark specks throughout. Lateral line passes very high on the body is considered incomplete and consists of 35 to 40 scales.

The color of the back and flanks vary from a gray-green to a brown-green to an olive-green with irregular dark specks. Those less than four inches are much lighter in color, and speckles are much more distinct than larger specimens. The belly is yellowish to light grey, and the chest has been reported to often have a red tint. Lower fins are nearly clear. The mouth is very small. The eye of the ruffe has a tapetum lucidum in the upper two-thirds of the retina.

DISTRIBUTION

Its native range covers northern and central Europe west to north eastern France; England (absent from Ireland, newly introduced to Scotland), all of eastern Europe; the Baltic Sea Basin (abundant in the Gulf of Finland, the Neva, Kopor'e, and Luga Bays); White Sea Basin; Kolguev I.; Pechora; all of Siberia (Arctic Ocean Basin; absent in the Amur Basin) as far as the Kolyma. Rivers falling into the northern parts of the Black and the Caspian Seas; present in the Kamchiya River, near Varna. Present in the Ural River reported from the Kuban' and the Kuma, but not from the Terek. Absent from Transcaucasia. Present in the Syr-Darya from Kzyi-orda to the lower reaches, and in the delta of the Amu-Darya. It is occasionally encountered in the Aral Sea at Aral'sk.

TYPICAL HABITAT

The ruffe is found in many highly varying environmental conditions which displays the species wide range of ecological tolerance. It occurs in running (streams and rivers), standing (lakes), as well as brackish water. In running waters it is mostly found in the deeper, more slowly moving parts (areas reminding one most of standing water). In standing waters it is found in all zones of lakes but on a whole is typically associated with the lakes bottom. The ruffe is found in a variety of lake sizes both small (ponds) and large and appears to show no preference for lake size. It also occurs in both shallow and deep waters of lakes with reports of ruffe captured down to depths of 240 feet in Norway. It is typically not the depth of water which determines where the ruffe will be found but the bottom type. It prefers areas with a soft mud bottom more or less devoid of vegetation as its main food item (tenipeds) are most abundant in this area. The ruffe is reported to thrive in eutrophic lakes. In brackish water it is found at least to a salinity of 5 percent. Brackish populations exhibit extraordinary rapid growth rates. During winter the species seeks deeper water. Distinct migrations of ruffe from rivers into lakes with the onset of winter is reported.

SPAWNING

The ruffe is considered an intermittent spawner. It breeds successfully in running, standing and brackish water. It typically spawns from about mid-April to the beginning of June (depending on latitude) when water temperatures reach 50° to 59° F. Ruffe wander towards shallow water to spawn and typically lay eggs at depths between 8 inches and 6 feet but literature reports spawning down to a depth of 60 feet. The ruffe reportedly selects spawning sites with firm, sandy, sandy-stoney, and clay bottoms, sometimes with vegetation. There are also reports of ruffe spawning on plant remains and moss. Larger female ruffe can carry between 100- and 200-thousand eggs. The eggs are typically 0.5 to 1.0 mm in diameter and are reported to be adhesive upon fertilization and contact with water. Eggs typically hatch in 9 to 14 days.

FOOD HABITS

The ruffe diet appears to be highly varied. Some notes of their food habits are reported below:

- . Feeds on small animals, particularly the eggs of other fishes.
- . Will only turn to predator "in need." Food consists mainly of gnat larvae (known to the angler as bloodworms) water-fleas, small crustaceans, tubifex and fish spawn. When it appears in large numbers, it is unpopular because of its habit of feeding on the spawn of other fishes and later newly-hatched fry.
- . Food mainly aquatic insects and crustaceans.
- . The ruffe is typically a prey fish in Finland.
- . The ruffe devours eggs of the local smelt. Feeds on bottom organisms.
- . The main items in the diet of the ruffe in the Nadym Basin - USSR are mollusks, the larvae of Chironomidae and caddis flies, and macrophyter.
- . Main food of ruffe consists of tendipedids. It competes for food with the more valuable fish. Often it devours the eggs of whitefishes and other fishes.
- . Estimated annual rations for the ruffe from the Courland Lagoon are shown in the table below:

Annual Rations of the Ruffe, g

Food Item	Age of ruffe, years						
	1	2	3	4	5	6	7
Chironomidae	15.6	29.3	56.5	52.6	74.1	94.3	102.7
Copepoda	2.1	0.7	0.2	0.8	0.3	0.4	0.2
Cladocera	15.6	6.0	25.8	31.2	1.8	2.4	0.7
Ostracoda	30.1	16.3	14.8	15.8	11.2	16.3	0.3
Mollusea	0.03	0.05	0.3	2.4	2.2	2.9	2.5
Trichoptera	1.5	3.8	8.4	22.0	30.4	38.7	29.6
Insecta	0.7	0.5	0.6	1.1	0.9	1.3	0.4
Malacostraca	0.8	2.1	1.3	3.4	4.2	5.5	12.9
Pisces	--	--	--	5.2	1.9	2.6	59.1
Total	66.43	58.75	107.9	134.5	127.0	161.4	208.4

- . Lake Ilmen (USSR) ruffe is a typical benthophage, however, its underyearlings feed on the most prevalent forms of zooplankton (Chyporus, Bosmina, Cyclops), which are the food of most juvenile fishes, including pike-perch and smelt. At this age the ruffe consumes Chironomidae very infrequently, and then only very small forms. Stomachs of Lake Ilmen ruffe at an age of I+ and older contained predominantly Chironomidae throughout the spring to autumn period. At the age of 3 years and above the ruffe of all ages feed on the eggs of various fishes. Smelt eggs are consumed most intensively.

- . The ruffe has a crepuscular activity pattern (increased locomotor activities at dawn and dusk).
- . The foraging abilities of ruffe may be less dependent on temperature than those of perch.
- . The diet of ruffe consists mostly of chironomids and zooplankton/benthos, and to a lesser extent includes Gammarus, gastropods, and bivalves. The diets of ruffe and small perch are similar, whereas larger perch are more picivorous.
- . Perch and ruffe have similar optimal growth temperatures.
- . Ruffe's visual activity was less than perch as they had a shorter reaction distance and a lower capture probability.
- . Ruffe may not rely on vision to the same extent as perch, and hence can exploit the deeper parts of lakes where light levels are low.
- . Fry of 7 to 10 mm will take a high percentage of rotifera and nauplius-stage of copepoda.
- . Fry measuring 10-14.5 mm had mainly eaten copepod-larvae, copepodit-larvae, but also on a smaller scale adult cladocera and copepoda, rarely larvae and pupae of tendipedidae.
- . With increasing size, from 15 mm and larger, the larvae of tendipedidae become more and more important in the diet.
- . Eating during the winter is a necessity for the ruffe.

AGE AND GROWTH

Newly hatched larvae measure approximately 3.7 mm. A short period after hatching the young lead a pelagic life but soon they seek to the water layers above or just over the bottom. Young measuring 13 mm (1/2") will be found mainly at the bottom. Literature reports maximum length of about 12 inches. Maximum life-span is estimated to be between 10 and 12 years. Following are summaries of age and growth from various areas of their native range.

Unknown Source

Age 1 - 6 to 7 cm
 Age 2 - 9 to 11 cm
 Age 3 - 11 cm
 Age 4 - 12 cm
 Age 6 - 14 cm (5.5")
 maximum length - 25 cm (9.8")
 maximum weight - 400 gms

Finland

Ruffe usually less than 20 cm (7.9")
 mean age 3-5 yrs.
 mean max. age 7 yrs.
 age of maturity 2 or 3 yrs.

Lake Ubimskoe - USSR

450 specimens 102 mm (4.0") to base of caudal
maximum length 140 mm (5.5") base of caudal
average weight 21 gms (<1 ounce)
maximum weight 60 grms (2.1 ounces)
dominant age both sexes 3 yrs.
sexual maturity end of 2nd year of life

Lake Ilmen - USSR

Body length (Sept.)

Age	(Inches)	Age of maturity - age 1+
1+	1.8-2.3	
2+	2.6-3.2	
3+	3.1-3.6	
4+	3.5-5.3	
5+	3.9-4.2	
6+	4.1-4.3	

Nadym Basin

Ruffe becomes sexually mature at an age of 2+, but principally 3+ to 4+, on reaching a weight of 20 to 30 gms and a length of 110-120 mm (4.3"-4.7"). The spawning stock usually consists of fish between the ages of 3+ and 7+. Females spawn twice in the Nadym Basin. First generation eggs are yellow and 1.03 mm in diameter, and second generation eggs are whitish and 0.40 mm in diameter. The ruffe grows most intensively in the first years of life before reaching sexual maturity, growth rate of females higher than males.

Below is a length-weight table for ruffe from the Nadym Basin.

LENGTH AND WEIGHT INCREASE OF THE RUFFE

Age, years

Sex	2+	3+	4+	5+	6+	7+	8+	9+	11+
Males	$\frac{77}{8}$	$\frac{113}{25}$	$\frac{121}{37}$	$\frac{125}{39}$	$\frac{131}{44}$	$\frac{141}{50}$	-	-	-
Females	$\frac{91}{14}$	$\frac{115}{26}$	$\frac{122}{35}$	$\frac{133}{42}$	$\frac{137}{52}$	$\frac{155}{71}$	$\frac{163}{93}$	$\frac{163}{112}$	$\frac{192}{160}$
Both Sexes	$\frac{84}{11}$	$\frac{114}{25}$	$\frac{121}{36}$	$\frac{129}{40}$	$\frac{134}{48}$	$\frac{148}{60}$	$\frac{163}{93}$	$\frac{163}{112}$	$\frac{192}{160}$
N	15	47	88	56	34	15	4	1	1

Note: Body length, mm in numerator; weight gms in denominator

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