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Since the first description of the Atlantic smelt from American waters by S. L. Mitchill in 1814 ichthyologists of this continent have recognized that it represents a separate species, Osmerus mordax Mitchill (Osmerus viridescens Le Sueur (1818)).

All the fresh water forms of this fish have also usually been called Osmerus mordax. Jordan and Evermann (1896) pointed out that the western Atlantic smelt differs from the eastern Atlantic Osmerus eperlanus (Linne) by smaller scales, longer gill rakers and stronger teeth. According to the same authors mordax differs from the Northern Pacific smelt, Osmerus dentex, by shorter maxillary, which does not reach the posterior margin of eye, a narrower body and a plain colouration. Hubb (1925) found that Osmerus mordax is most like the Pacific form. The only difference he could discover was in the backward extension of the upper jaw and even this difference, as he said, was not entirely constant: "in the adult of dentax the end of maxillary lies about on the vertical from the posterior margin of orbit, while it falls more or less short of this vertical in all specimens of mordax examined." We examined several hundred of mordax fromsthe Canadian coast and come to the conclusion that the length of maxillary varies in this form to the same extent as in dentex and eperlanus. As a matter of fact, none of these characters are constant. Length of maxillary varies with the size and sex of fish, depth of body also varies in different habitats and in the same habitat during the

different seasons. Colouration depends on locality, temperature of the water, season, food, etc. Usually during the spawning time the colour of the smelt is very much darker.

After a comparison of this fish with the European smelt we conclude that these two forms cannot be separated as different species. Smitt (1895) and Berg (1932), also do not distinguish American smelt as a separate species from the European one. So it is suggested that the American form should be called Osmerus eperlanus mordax (Mitchill).

This fish possesses some intermediate characters between the European Osmerus eperlanus and the Pacific Osmerus eperlanus dentex. It is quite evident from the following comparison between four anadromous smelts of the Holarctic realm, that the variations of characters are overlapping within this group. Hence/since the European form was described by Linne (1758) first it might be considered as main species and all the rest as its geographical forms or subspecies. There are, of course, in many places some local variation of smelt which slightly differs from typical forms in number of gill rakers, vertebrae and other characters (Scandinavian, French, Siberian, Canadian and American forms) but all of them are well connected by intermediate gradations and cannot be sharply differentiated.

	Size in mm. (full length)	Scales (Squ.)	Scales in lateral line	D	A	P	V	Gill rakers	Branchiostegal rays	Vertebrae	Height A in body	Interorbital width of head length	Diam. eye in head
Osmerus eperlanus (Linne) 1758. Eastern coast of Atlantic ocean from bay of Biscay to Scandinavia	150-250 (300)	58-69	4-16	II-III 7-8	II-III 11-14	I 10-12	I 7	30-37	7	57-61	7.5-11	19-28	16.5-225
Osmerus eperlanus mordax (Mitchill) 1814. Western coast of Atlantic ocean from Virginia to Newfoundland.	150-250 (300)	58-66	11-21	II-III 8-9	II-III 12-14	I 10-11	I 7	26-34	7	60-67	7.4-9.7	24-30	16-22.6
Osmerus eperlanus dentex (Steindachner) 1870. Both sides N.Pacific. Arctic coast of Asia and America from Obi to McKenzie river. (not between Lena river and Tschukotski penn.)	150-260 (325)	55-69	14-28	II-III 8-10	II-III 11-14	I 10	I 7	26-32	7	63-68	5.5-10.5	20-29	20-29
Osmerus eperlanus dentex natio dvinensis (Smitt) White sea. Pechora river.	150-250 (350)		15-30	II-III 8-10	II-III 11-15	I 11	I 7	26-37	7	63-68	5.5-10.5	15-25	15-25

Leng. of maxillary

In adult males reach posterior margin of eye

The anadromous Osmerus eperlanus, as well as all his geographical subspecies, if landlocked (or adapted) into fresh water represent lacustrine forms which often differ from the parent form by smaller size, shorter maxillary and weaker teeth. While the anadromous forms are almost always of the same size fresh water ones are represented by different sized groups. L.S. Berg named the European fresh water forms as "morphae" ("races" of other authors) and we are using the same nomenclature for distinction of the American lanklocked smelts.

A "morpha" is a non-geographical form. All fresh water morphae of smelt are usually deep water fishes which often cannot be seen at all except at the time of spawning. They spawn usually in creeks but can spawn also in lakes near shores, mostly at nights, and immediately after spawning they return into deeper portions of the lake. The smallest forms are entirely plankton feeders, the larger feed mostly on small smelt. All fresh water smelt have a very large economical importance as food for fresh water salmonids. Smelts of all sizes are the chief food for Cristivomer namaycush, Salmo salar m. sebago and Salvelinus fontinalis in many lakes in Canadian and American maritime provinces.

Kendal (1927) has shown that at least two types (or races) of landlocked smelt occur in the lakes of New England and we think that at least three of the above mentioned morphae can be recognized on this continent.

(a) Osmerus eperlanus mordax morpha spectrum (Cope). This form has been described by Cope (1870) from Wilton Pond,

Maine, under the name Osmerus spectrum. It differs from anadromous fish by its very small size, not exceeding 75-80 mm. (3½ inches, and an exception to 4 inches).

D II 8-9; A II 13-14; P I II-12; V 1 7; Squ. 59-63; L.L. 8-12; Gill rakers 30-34; Branchiostegal rays 7; vertebrae 60-64.

Height of anal is 8.8 % to 9.3 % of body length. Eye diameter more than interorbital width (108-110 %) and is 24 % - 25 % of head length. Head small, approximately 20 % of body length. Mouth small. Teeth very weak. Canine teeth on vomer absent. Maxillary short, hardly or not at all extending beyond the middle of eye. In relation to its small size, the eyes are very much larger than in anadromous form. Entirely a plankton feeder, the main food consisting chiefly of Diaptomus, Cyclops, Leptodora, Daphnia, Epischura and Bosmina. Distributed in many lakes of New Brunswick, Maine, etc. In larger lakes it occurs together with other forms. In smaller lakes it is often the only representative. Spawning period later than in large smelt. In Mill lake and in Lake Utopia (New Brunswick) it spawns in the middle of June. During the spawning period the body of the males only is covered by tiny white tubercles. The majority of this smelt breed at the end of the second year but among them a certain percent can breed also at the end of the first year. This is the parallel form of the European Osmerus eperlanus morpha spirinchus Pallas, which differs from anadromous Osmerus eperlanus by the same characters as American Osmerus eperlanus mordax morpha spectrum from Osmerus eperlanus mordax. As a rule this form also breed at the end of the second year but as an exception one-year-old specimens were observed with ripe gonads during the spawning time.

The European form of this fish has a wide distribution over North Western Europe and in many places has commercial importance and sold as a salted and dried product. A large quantity of them are caught in North Russian lakes by means of seines during the winter under the ice. They are a delicious little fish which are used by many Russians for fish soup and fish pie. The American form does not differ much in taste from Russian smelt.

(b) Osmerus eperlanus mordax morpha abbotti (Cope), which was described by Cope in 1870, from Cobbosseecontee lake, Maine, under the name Osmerus abbotti. This fish represent an intermediate form between two other American landlocked smelt from which it can be, however, distinguished. It differs from the anadromous smelt by smaller size; the largest specimens attain only a length of 150 mm.

Eye is relatively larger than both in anadromous and the following forms but much smaller than in the previous one. The diameter of eye usually equals the interorbital space, and is 19 % - 23 % of head length.

D II 8-10; A II 12-15; P I 10-11; V I 7; Vertebrae 60/65; Squ. 58-65; L.L. 11-21; Gill rakers 21-35; Branchiostegal rays 6-8.

Height of anal is 7,2 % to 8,8 % of body length. Mouth moderate. Teeth are much stronger than in spectrum but never as strong as in the following form. The chief difference between this fish and spectrum is that the canine teeth on vomer are always present although they are very often quite thin and weak. The maxillary reaching only to the end of the pupil but never extending

to the posterior margin of the eye.

This is the most common and best known landlocked smelt in many lakes of Canadian and American maritime provinces. It feeds on plankton as well as on insect larvae (Ephemeridae, Phryganeidae, Chironomidae, etc.) and small fishes (sticklebacks, fry of other fishes). It represents the main food for certain salmonids. Spwaning time of this fish varies in different lakes from April to May. During this period the head and sides of the fish are covered by small white epithelial tubercles, especially in breeding males. The main bulk of the spawning run consists of two-year-old fish but three or even four-year-old individuals have been observed among them in Chamcook lake and Lake Utopia (New Brunswick). A certain number of sterile fish have been collected together with spawning ones and the majority of these sterile individuals were one year old. Only a few ripe yearlings, mostly males, were caught during the spawning time together with the bulk of spawning fish.

A parallel form occurs in European lakes (Ladoga, Onega and others) and has been described by L. S. Berg (1932) as Osmerus eperlanus natio ladogensis which differs from Osmerus eperlanus by similar characters as Osmerus eperlanus mordax m. abbotti from anadromous Osmerus eperlanus mordax. Forma ladogensis is important commercially in Russia.

(c) Osmerus eperlanus mordax morpha utopiensis (morpha nova). This is the largest American landlocked smelt. In Europe the parallel form is unknown and if it occurs it is probably confused with large specimens of ladogensis (smelt up to 15 inches have been recorded from Lake Wener, Sweden). However, this morpha can be easily distinguished on this continent.

D II 8; A II 12; P I 10; V I 7; Squ.61-65; L.L. 11-18; Gill rakers 31-34; Branchiostegal rays 7; Vertebrae 60-63.

Height of anal is 6.7 % of body length. Eye diameter less than interorbital width and composes 18 % of the length of head. Interorbital width is approximately 23 % of length of head. Head large, 22.5 % of body length. Mouth very large. Upper jaw about reaching vertical from the posterior margin of eye. Vomerine teeth are very strong, fang like. Teeth on tongue are very strong, the terminal one is the largest, fang like. Teeth on dentale, maxillare and palatinum. Colouration is very dark almost black above. Black pigment on head, pectoral and caudal fins.

Size large, up to 280 mm. and more (12 to 14 inches). This fish occurs in larger and deeper lakes as First Chamcook, Lake Utopia (New Brunswick). Local fishermen call in "Lath Edging". This is usually a deep water fish which feed mostly on small smelt but on certain occasions it comes to the surface and can be caught on an artificial fly. Very large smelt have been recorded from other lakes as Lower Loch Lomond in New Brunswick, Lake Champlain in New York, Lake Sebago in Maine, etc. It is very likely that all these large forms can be referred to this morpha. It Lake Utopia it spawns in early spring when the lake is still covered by ice.

Very often all these three morphae occur in the same lake, as in the case of Lake Utopia, but they spawn in different creeks and in different time and one who collects them during the breeding season can be almost sure that he has a certain morpha. It is possible, however, as in the case of many other fishes, these morphae

can interbreed if the spawning periods overlap one with another.

Landlocked smelt were successfully introduced in some inland lakes in United States where they became completely established. A large morpha of smelt has been introduced in the upper waters of the Great Lakes where it has become a true addition to the fauna. (Creaser, 1925).

KEY TO AMERICAN LANDLOCKED FORMS:

Size small. Adult fish attain a size of 67-90 mm. (2½ - 3½ inch.) in total length. Eye diameter more than interorbital width. Mouth small. Teeth very weak, canine teeth on vomer absent. Maxillary short, usually not reaching the middle of eye. Plankton feeders. . . . *Osmerus eperlanus mordax* morpha *spectrum*.

Size medium. Adult fish attain size of 120-150 mm. (4½ - 6 inch.) in total length. Eye diameter equals interorbital width. Mouth moderate. Teeth stronger than in previous. Canine teeth on vomer always present but very weak. Maxillary reaching to the end of pupil. Feeds on plankton, bottom insects and small fishes. . . . . *Osmerus eperlanus mordax* morpha *abbotti*.

Size very large. Adult fish attain a size of 200-300 mm. (10-14 inch.) Eye diameter less than interorbital width. Canine teeth on vomer are very strong. Mouth large. Maxillary extending beyond the pupil and reaching (or even extending) the posterior margin of eye. Rapacious, feeding on small smelt. . . . . *Osmerus eperlanus mordax* morpha *utopiensis*.

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