

SYNONYMY

Esox lucius or Northern pike is in the family Esocidae. *Esox* is an old European name for the pike and *lucius* is the Latin name for the species (Becker 398). It was at one time thought that the pike of Europe and North America were separate, however it has been determined that the differences were a cause of the history of its distribution. There are two morphological forms in North America because the pike migrated from both the Mississippi and Yukon glacial refuges (Scott & Crossman 357).

There also seems to be a mutant form that has broken off from the *Esox lucius* called the silver pike. It is sexually isolated from pike as well as the muskellunge so is a separate species (Eddy & Underhill 202).

SYSTEMATICS

Systematically it falls just after the Euteleostei and before the more advanced Acanthopterygii and Neoteloestei.

DISTRIBUTION

The Northern pike is primarily a freshwater species however, it may be found in brackish water such as the Baltic Sea which has a salinity of 10%. In North America the pike is located from Alaska south to Mississippi and Nebraska east of the Rocky Mountains and west of the Appalachian mountains. It occurs in Lake Champlain and the Hudson river then extends south, east of

the Appalachian Mountains in Vermont, New Hampshire, and central Massachusetts. The pike is also found in the United Kingdom, Ireland, Europe south to Northern Italy, around the Dead and Caspian seas, and into Siberia. The Northern Pike has also been introduced to areas outside its native limit as a game fish and as a control predator (Scott & Crossman 357).

DESCRIPTION

Esox lucius is an elongated fish with a flattened head and duckbill snout (Becker 398). The average total length of the two adult and two young pike I measured was 303.5 millimeters. The average maximum body depth was 41.38 millimeters. The body is relatively the same depth all along its length, widening at the paired fins and narrowing at the caudal peduncle. The average change in depth at the caudal peduncle is 23.13 millimeters so the caudal peduncle is only slightly narrower than the body. This relatively deep caudal peduncle helps increase the thrust so the pike can accelerate quickly.

The coloring of a Northern pike consists of light spots on a dark background. The dorsal and half of the lateral regions are a green or olive green color, while the ventral area is a lighter almost whitish color. The body seems to be flecked with gold because of the gold tips on some of the body scales (Scott & Crossman 356). The eyes are located laterally.

Since the pike is a carnivore its intestines are relatively

long but with no pyloric caeca to increase the surface area. It has a complete lateral line although I found it difficult to see on the larger fish I looked at. Its scales are cycloid.

Pike have a lower jaw which extends beyond the upper jaw and holds large, sharp canine teeth. There are cardiform teeth covering the premaxillary, basibranchials, last two pharygobranchials, vomer, palatines, and part of the tongue. Pike have large, strong canines along the edge of the vomer, inner edge of palatine, and on the dentaries. The canines pointing posteriorly prevent the prey from escaping while the pike maneuvers it to swallow. The gill rakers have been diminished and appear similar to the cardiform teeth on the roof of mouth and tongue (Scott & Crossman 356). The teeth on the gill rakers were so small they were impossible to count. Northern pike catch their prey by seizing it sideways using the canines, then using vigorous head shakes to turn the fish around and swallow it head first (Keenleyside 32). The gill rakers are then used to help manipulate the prey for better swallowing and to push the prey into the gullet through a series of contractions (Gerking 216).

The pectoral, pelvic, dorsal, and anal fins of a Northern pike are rounded and the caudal fin is rounded and moderately forked (Scott & Crossman 356). The pike does not have a need for a greatly scooped out tail because it does not need the aerodynamic design of a cruiser. It does not use lift but rather

thrust for quick starts. The average aspect ratio of all fins on the pike I measured was 1.69 so they are relatively high. The Northern pike is an accelerator so the posterior location of the dorsal and anal fins and the high aspect ratio of the caudal fin (average aspect ratio was 1.35) enables it to put on great bursts of speed for short distances. The rear insertion of the fins cause large masses of water to be pushed along the body when the pike begins its acceleration. This maximizes the thrust and the pike can get an even faster start (Webb ??). Thrust is also optimized by the contraction of the gill chambers to propel water through to back of the fish to push it forward (Becker 402). The pike needs this acceleration because it uses the "sit and wait strategy" when hunting and often begins from rest to attack prey (Eklov 316).

The Northern pike has no need for cruising gaits because when it is waiting for prey to swim by, it holds position in the water column by undulating its pectoral fins (Moyle & Chech 139). The young pike in the aquarium could remain perfectly still at a diagonal angle and then accelerate so quickly that the movement was almost imperceptible until it had moved already. The pike may slowly forage for food and attack prey on the edge of a school (Eklov 316) but never attains high speeds while swimming until it attacks. The Northern Pike is able to hold its place in the water because it has a large swim bladder that extends the length of the body to help it remain buoyant without using up

much energy. The pike uses only fast glycolytic or white muscle because it only needs the muscle to sprint. It has no use for slow oxidative or red muscle because it never cruises for long periods of time. When I cut a cross section of a pike only the white muscle was visible. There is no room in the pike's body for anything else but white muscle and a thin skin because any extra weight will cause too much drag. (Becker 402).

PHYSICAL HABITAT

The *Esox lucius* generally inhabits warm or reasonably cool areas of lakes, ponds, and slow rivers (Scott & Crossman 357). Because the pike ambushes its prey it should logically inhabit highly vegetated areas or areas with rocks and logs to provide cover in which to hide and wait for unsuspecting prey. Pike probably patrol the periphery areas of habitats waiting for prey to come into view and then attack when its victim comes into range. The young would inhabit the weedy areas and shallow sections of lakes and streams for protection from predators including other pike.

During class field trips young pike have in fact been encountered in shallow vegetated areas of lakes, streams, river margins in macrophytes, and backwater pools of streams. In the streams the young pike do not live in the most rapid running parts but in areas with little or no current so that do not expend energy station holding. There are also minnows and other

crustaceans for food in the pools. Young pike have been found in all types of vegetation such as submerged macrophytes, emergent bulrushes, and partially floating vegetation like lily pads. Adult pike were discovered in the deeper part of the gill net set off Grapevine Point. They were probably monitoring the drop off to catch any shallower fish unaware; or possibly traveling because there is not much vegetation where the gill net was set. The pike probably chooses its habitat by the food and cover that is available.

FOOD HABITS

A Northern pike will eat almost anything that moves or attracts its attention. When it is young it begins feeding on the larger zooplankton and immature aquatic insects for seven to ten days. Then it starts to eat small fish until all it consumes are fish and vertebrates. 90% of the food pike consume consists of other fish, primarily perch, suckers, and sunfish. Adult pike will eat any vertebrate that is not too big for it to handle including other pike. This diet may include mice, muskrats, crayfish, and ducklings. Northern Pike are also known to feed on their own young. The best size of prey is one-third to one-half the size of the pike (Scott & Crossman 360). Although, sometimes pike have been found to have choked on a victim that was too big for them to swallow (). *Esox lucius* is not discriminating and will make food of whatever it can find in the habitat in which it

dwells.

Northern pike forage for prey alone and only during the day because they need to hide and be able to see the prey. Keenleyside (32) describes the typical sequence of events for a pike capturing its prey as "axial tracking." First the pike will fix the prey with its eyes, turn and slowly move towards the prey, leap forward, seize the prey, and finally swallow it. For the approaching stages only the pectoral and dorsal fins are used because it moves slowly. Before the pike strikes it bends its tail to one side and forms an "S" shape; then forcefully thrashes its tail once, jumps forward, and grabs the prey.

Pike eat infrequently so when they are captured the stomach is likely to be empty. When I examined the stomachs of the pike that had been in the gill net; I found no traces of fresh food, only digested slime or an empty stomach. I examined the intestines as well but the ooze was unidentifiable. When the large pike were retrieved from the gill net it is probable that all of the contents of the stomachs had been digested, regurgitated (Eddy & Underhill 203) or the fish were traveling and had not eaten in awhile. It is also possible that the formalin did not completely stop the digestion processes of the stomach and the contents continued to be digested until the formalin fully penetrated.

BEHAVIOR

Pike hunt alone therefore they are probably solitary most of the time unless spawning. They do not school like minnows or perch. No more than one or two Northern Pike have been caught at one time in the areas where we have encountered them. The three pike found in the gill net were probably not traveling together but alone along the same route at different times. Pike are usually in the shallower water in the fall and spring but move to deeper water in the summer because it is cooler. They have a vague territory and generally remain in the same area as long food and shelter are abundant. According to a study by Eklov larger pike seem to hold more territory than smaller pike. The bigger pike also will be closer to prey in a hunting situation than the smaller pike (Eklov 323). Pike do, however, move long distances in the spring to spawn (Becker 402).

PREDATION

Since adult *Esox lucius* are solitary, large fish, they have no predators except lamprey and humans. Young pike, however, may be eaten by predators such as other pike, perch, minnows, water birds, and aquatic mammals while in the shallow spawning grounds. Adults that are small may become food for bears, dogs, ospreys, and eagles while they are in the shallow waters as well (Scott & Crossman 361). Quick accelerating ability may help the young escape these predators.

SYMBIOSIS

Parasites are the only other organisms that could be fatal to Northern pike. Some of the parasites common to *Esox lucius* in North America are fungi (1), Protozoa (19), Trematoda (48), Cestoda (13), Nematoda(23), Acanthocephala (18), leeches (4), Mollusca (2), and Crustacea (10). The most commonly seen parasite is a trematode that forms an external cyst called black-spot. It can be present in large numbers on a single pike. There is also a bacteria that forms a "red sore" disease. It causes red abrasions that involve the muscle tissue. There are also tapeworms that spend their final stages in the Northern pike (Scott & Crossman 361). *Diphyllbothrium latum* is a tape worm pike may swallow when it is in the earlier form of a water flea. The worm grows and occurs in the viscera and muscles of the pike (Norman 421).

REPRODUCTION

Northern pike move to streams, flooded marshes, rivers, and shallow areas in lakes to spawn in the spring from April to early May. They will begin movement before the ice completely melts. Most of the traveling is done at night and spawning during the day (Carlander 352). A female and male will either form a spawning pair or the female will be attended by two or three males. If they are in pairs, the fish are usually of equal size; if there is a group the males are smaller than the female. This

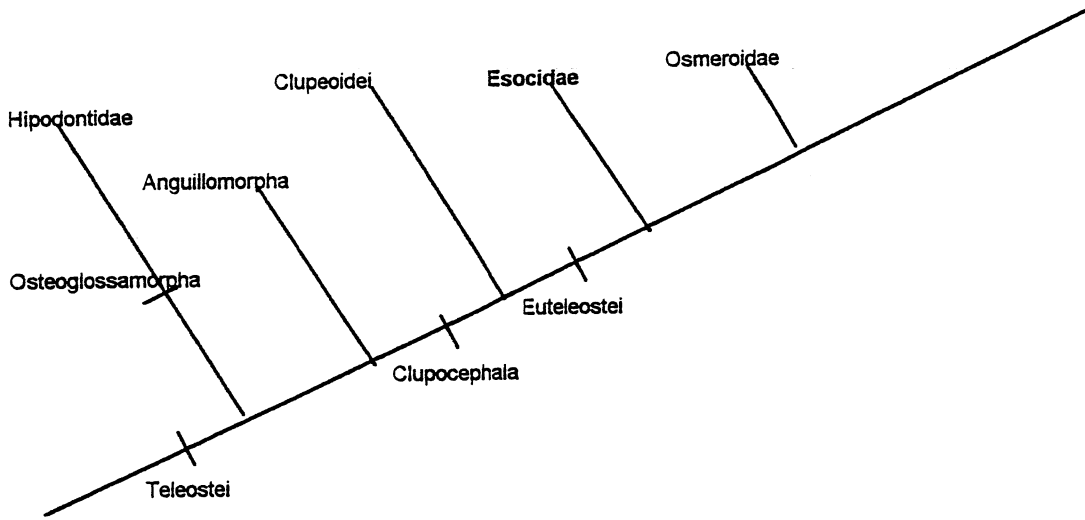
indicates that the larger, older males can keep the smaller males away from the female partner (Keenleyside 94). Pike do not make nests, but spread the eggs in shallow areas over macrophytes and debris. The eggs sink and stick to the residue and vegetation on the bottom.

DISCUSSION

The design of the pike with the posteriorly inserted dorsal and anal fins and the large aspect ratio caudal fin accommodates the quick acceleration gait it uses to hunt. This quick start ability enables it to lay in wait for its prey and the swim bladder allows it to do so with the least expenditure of energy possible. Because it must hide to hunt, it inhabits weedy areas that afford sufficient cover and provide habitats for prey as well. Since the pike has no preferential prey it can feed on anything it finds. This reduces the amount of time it must wait for food to pass by. The sharp teeth enable it to grab its food in the quickest way possible and turn it around after it has been caught. Regardless of how the pike strikes, it need not release its prey because the positioning is wrong. The Northern pike is found in the ideal environment for which it is morphologically suited and lives in a way which efficiently incorporates its design and hunting abilities.

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George C. Becker
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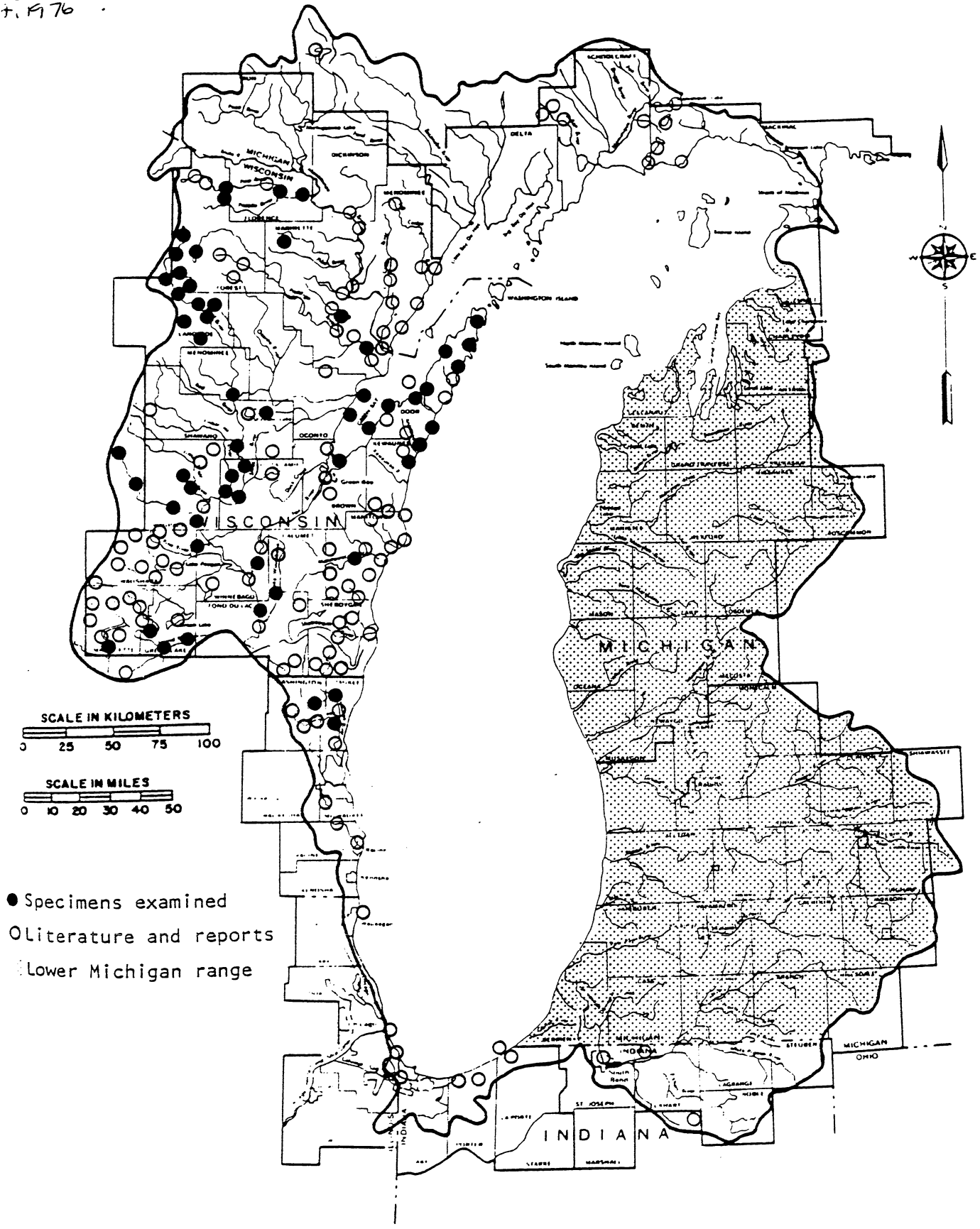
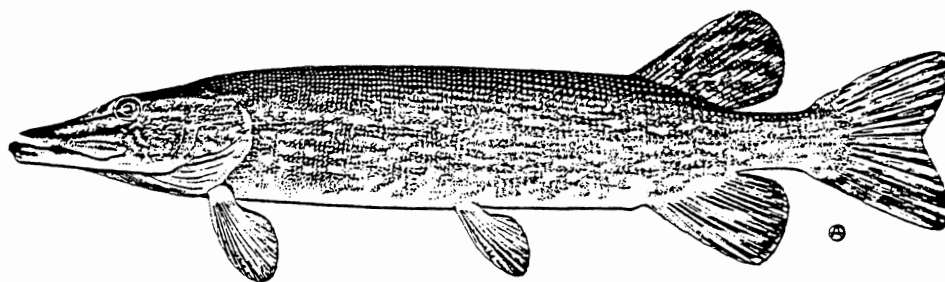


Fig. 29. Distribution of the Northern Pike (*Esox lucius*).

NORTHERN PIKE

Esox lucius Linnaeus



FUNCTIONAL ANATOMY AND MORPHOLOGY OF ESOX LUCIUS

	increment1	2	3	4	MEAN	
Total length	mm	524	552	77	61	303.5
Fork length	mm	491	517	73	58	284.75
Standard length	mm	444	474	67	52	259.25
Mass	mg	972	1021	2.31	1.08	499.1
BODY MORPHOLOGY						
Body Shape	e/f/g/etc	e	e	e	e	
Max depth	mm	77	72	9	7.5	41.38
Fineness ratio		6.8	7.7	8.6	8.1	7.8
Max width	mm	57	61	6	5	32.25
Dist max depth from	mm	170	185	21	20	99
Depth caudal pedun	mm	31	34	4	4	18.25
FIN MORPHOLOGY						
Pectoral shape	t/f/etc	rounded	rounded	rounded	rounded	
Pectoral area	mm ²	1140	1088	18	9	563.75
Pectoral span	mm	60	64	6	3	33.25
Pectoral AR		3.16	3.8	2	1	9.96
Pectoral base leng	mm	19	17	3	3	10.5
Pelvic shape	t/f/etc	rounded	rounded	rounded	rounded	
Pelvic area	mm ²	1288	1026	15	12	595.25
Pelvic span	mm	56	57	6	4	30.75
Pelvic AR		2.43	3.2	2.4	1.3	2.33
Pelvic base length	mm	16	18	2.5	3	9.9
Dorsal shape	t/f/etc	rounded	rounded	rounded	rounded	
Dorsal area	mm ²	3363	3477	36	35	1727.75
Dorsal span	mm	59	57	6	5	31.75
Dorsal AR		1.04	0.93	1	1	99
Dorsal base length	mm	57	61	6	7	32.75
Anal area	mm ²	2475	2400	54	20	1237.25
Anal span	mm	55	50	9	5	29.75
Anal AR		1.22	1.04	1.5	1.3	1.27
Anal base length	mm	45	48	6	4	25.75
Caudal shape	t/f/etc	forked	forked	forked	forked	
Caudal area	mm ²	4118	3944	40	35	2034.25
Caudal span	mm	71	68	8	7	38.5
Caudal AR		1.22	1.17	1.6	1.4	1.35
Caudal third area	mm ²	4293	4565	54	55	2241.8
Caudal third span	mm	134	114	18	12	69.75
Caudal third AR		4.18	2.85	6	2.6	3.9
SENSORY SYSTEMS						
Eyes						
Diameter	mm	15	19	4	3.5	10.38
Distance from nose	mm	67	22	12	10	27.75
Shape	r/o/etc	round	round	round	round	
Location	d/l	lateral	lateral	lateral	lateral	
Acoustico Lateralis						
Length of lateral	mm	body	body	body	body	
FEEDING						
Head and Jaws						
Head length	mm	137	146	24	19	81.5
Mouth position	t/i/s	terminal	terminal	terminal	terminal	
Mouth gape	mm	53	55	6	7	30.25
Mouth width	mm	40	44	6	5	23.75
Ratio gape/width		1.3	1.3	1	1.4	1.25

Teeth on

c/v-l/m/s

Premaxilla		cd	cd	cd	cd
Maxilla					
Dentary		c	c	c	c
Vomer		cd/c	cd/c	cd/c	cd/c
Palatine		cd/c	cd/c	cd/c	cd/c
Pharyngobranchials		cd	cd	cd	cd
Basibranchials		cd	cd	cd	cd
Tongue		cd	cd	cd	cd
Intestine					
Length	mm	360		60	210
BUOYANCY					
Swimbladder	p/a	p	p	p	p
No. chambers		1	1	1	1
Pneumatic duct		a	a	a	a
Muscles					
% red in myotome		0	0	0	0
% red pectoral fin m.		0	0	0	0