Sculpin Family—Cottidae

Four species of sculpins in two genera are known from Wisconsin. In the United States and Canada, 111 named species occur, three-fourths of which refer to the Pacific Ocean, including the western Arctic. In addition to the named species, some 30 little-known cottids have been recorded in the North American waters of Alaska alone (Robins et al. 1980). Although primarily marine fishes of arctic and temperate seas, one genus in particular, *Cottus*, is widely distributed in the fresh waters of the northern hemisphere. Twenty-one strictly freshwater species have evolved in North American waters, and, within that genus, several species are confined to only a spring or two. The family contains at least 300 species. The cottids are known from the Oligocene to Recent. They are among the most advanced of fishes.

Sculpins are characterized by enlarged, flattened heads and by expansive pectoral fins. The body tapers from the broad head to a relatively narrow caudal peduncle. The preopercle is variously armed with spines. The eyes are dorsal in position and occasionally are close set. The first dorsal fin is spiny, but the spines are soft. The pelvic fins possess a single spine which is bound by a membrane to the first pelvic ray, creating a single element. Scales are lacking, or are represented by dermal prickles.

Although freshwater sculpins are small fishes of 18 cm or less, some marine species may attain lengths of 61 cm or more. In Wisconsin, the sculpins are typical inhabitants of rocky, cool headwater streams; here they retreat under stones during daylight hours.

Sculpins are primarily carnivorous, feeding largely on microcrustaceans and aquatic insects. In trout streams they have long been accused of eating trout eggs and young. Probably most of the trout eggs consumed by sculpins are loose eggs that have not been buried in the nests. Little evidence is available to show that sculpins limit trout numbers. In fact, in large, deep lakes sculpins are an important forage fish for large trout and other predator species.

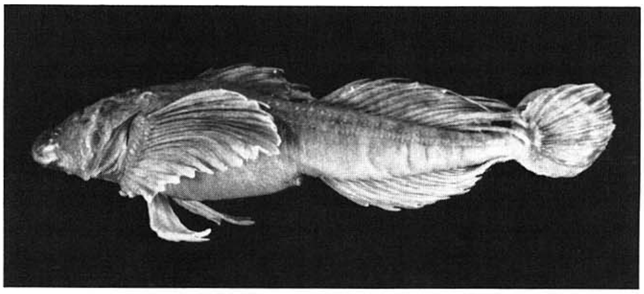
Sometimes a sculpin is used as bait by anglers.

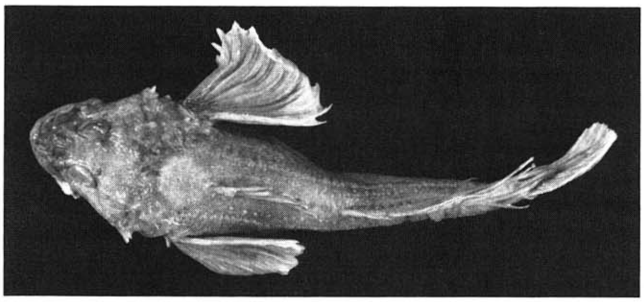
From the accounts of sculpin species which follow, it is evident that life history information for some species is sketchy. W. Van Vliet, while working in deep water with scuba gear, lost his life in October 1968 as he attempted to unlock the mysteries of spoonhead and deepwater sculpin ecology and behavior in Heney Lake, Quebec (Delisle and Van Vliet 1968). The sculpins yield their secrets grudgingly—particularly those species in deep, coldwater habitats.

Deepwater Sculpin

Myoxocephalus thompsoni (Girard). *Myoxocephalus*—head like a dormouse; *thompsoni*—named for Rev. Zadock Thompson, the author of *History of Vermont*.

Other common names: Great Lakes fourhorn sculpin, sculpin, lake sculpin, deepwater blob.





Adult 173 mm, L. Michigan, near Sheboygan (Sheboygan Co.), 28 Oct. 1966. Lateral view above and dorsal view below.

DESCRIPTION

Head and anterior body flattened dorsoventrally; posterior body and caudal peduncle compressed laterally. Average length 137 mm (5.4 in). TL = 1.21 SL. Body depth into TL 4.4–6.0. Head length into TL 3.3–3.9. Snout blunt in lateral view. Mouth terminal, large. Upper jaw extending to below middle of eye or beyond; minute teeth in narrow bands on upper and lower jaws; palatine teeth present. Gill membranes meeting at an acute angle, free from isthmus. Four preopercular spines per side; uppermost spine directed upward, others downward. Dorsal fins 2, separated from each other about diam of eye; first or spiny dorsal fin with 7–8 soft spines; second dorsal fin with 12–14 rays. Anal fin rays 13–15; pelvic fins thoracic, small, of 1 spine and 3 rays but appearing as only 3 elements (the spine and first ray encased in a single fleshy membrane); pectoral fins large, fanlike, rays 16–17. Typical scales absent, and spines or prickles present only above lateral line, few in number and often arranged parallel to lateral line. Lateral line complete or nearly so.

Back and sides grayish brown to light brown; back occasionally with 4–7 saddle marks of varying size; belly and caudal peduncle lighter. Pelvic and anal fins generally unpigmented; first dorsal fin pigmented along edge; remaining fins variously speckled or barred.

Sexual dimorphism: In male, rays of second dorsal fin much elongated and reaching to base of caudal fin and beyond; in female, these rays not reaching to caudal fin. Pelvic fins notably longer in male than in female. Male with small tubercles on rays of second dorsal and pectoral fins; tubercles absent or weak in female (McPhail and Lindsey 1970). Vladykov (1933) noted that the upper caudal rays of the male tend to be more elongated than those of the female.

SYSTEMATIC NOTES

Until recently, the circumpolar form as well as the inland freshwater form were treated as a single species, the fourhorn sculpin *M. quadricornis* (see Bailey et al. 1970). Discriminate function analysis by McAllister et al. (1978) permits separation of the coastal brackish or saltwater form and the inland freshwater form into *M. quadricornis* and *M. thompsoni* respectively.

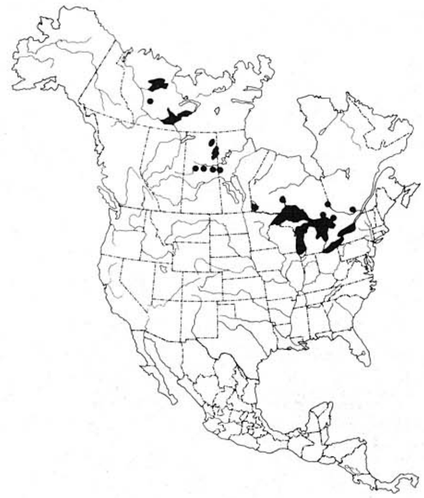
DISTRIBUTION, STATUS, AND HABITAT

In Wisconsin, the deepwater sculpin occurs in Lakes Michigan and Superior. In the Great Lakes system, the only inland water from which it has been reported is Torch Lake (Antrim County), Michigan (Hubbs and Lagler 1964). The first published record of the occurrence of this species in Lake Michigan was based on a specimen captured 26–32 km (16–20 mi) from Racine, Wisconsin, in 91–110 m of water (Hoy 1872a). In Lake Michigan, it has not been reported from southern Green Bay. Wisconsin records for Lake Superior cluster about the Apostle Islands. Eddy and Underhill (1974) reported it from Minnesota waters of Lake Superior off Grand Marais, Beaver Bay, and Isle Royale.

The deepwater sculpin is found in the Great Lakes and in deep, freshwater lakes of Canada. Scott and Crossman (1973) have discussed the effects of glaciation on its North American distribution (pp. 843–844):

> The deepwater sculpin is usually referred to as a glacial relict in both Europe and North America because, theoretically, it, together with the relict crustaceans *Mysis relicta* and *Pontoporeia affinis*, all originally occupying arctic, marine, or brackish waters, was pushed southward, along with the salt water, in front of the advancing ice sheets.

Myoxocephalus thompsoni



Range of the deepwater sculpin
● Specimens examined
○ Literature and reports
◯ Greene (1935)

Eventually the ice retreated, forming proglacial lakes as it did so, and leaving behind the deepwater sculpin and its ever-present invertebrate associates that form its food supply. Other theories proposed to explain this sculpin's freshwater distribution, which even now must be considered incompletely known, involve the voluntary migrations of marine sculpins into fresh water, and finally, dispersal by invasions of sea water up the St. Lawrence and inland from Hudson Bay.

Champagne et al. (1979) reported a 10,000-year-old fossil from Ottawa, Canada.

The future status of the deepwater sculpin is a matter of concern, especially in the light of what has occurred in Lake Ontario. At one time it was so abundant in Lake Ontario that it was considered to be a nuisance when caught in gill nets set for lake trout. It now appears to have been extirpated, for not a single specimen has been seen in 10 years, and even extensive experimental trawling has failed to capture a specimen (Scott and Crossman 1973). Scott and Crossman ascribed its extirpation to DDT pollution; S. H. Smith (1970) implied that the alewife was primarily responsible.

In Lake Huron, the deepwater sculpin continues to be abundant despite the large numbers of alewives present (Smith 1970). In Lake Michigan, its future is uncertain. Wells and McLain (1972 and 1973) noted that it had declined markedly in abundance in Lake Michigan after 1960, because of a deficiency in recruitment. The increase in reproduction of deepwater sculpins in Lake Michigan since the late 1960s, which has probably been related to the 1967–1968 decline in the number of alewives, may be reversed if the recovery begun by the alewife in 1969–1970 continues.

The common name, deepwater sculpin, is descriptive of its lake habitat. It does not occur in Green Bay at depths of 25–35 m (Deason 1939). In Lake Michigan, its preferred optimum depth range is between 73 and 128 m (Wells 1968). It is taken in the deepest part of the southern basin of Lake Michigan, at depths to 165 m, and at depths at least as great as 256 m in northern Lake Michigan. In Lake Superior, this species appears at depths from 73 m to at least 366 m (Dryer 1966).

BIOLOGY

In Lake Michigan, the deepwater sculpin spawns in deep water in the winter, and the eggs hatch in the spring (Wells and McLain 1973). In Canada, the available evidence indicates that this species spawns in the summer or early fall (Scott and Crossman 1973). Delisle and Van Vliet (1968) suggested that spawning in Heney Lake (Gatineau County), Quebec, occurred during June and July at water temperatures of 6.0–7.2°C (42.8–45°F), at depths of 15–27 m.

A 129-mm, 30.2-g deepwater sculpin, taken in mid-June 1968 from upper Green Bay had ovaries 5.9% of the body weight. These ovaries held fewer than 10 mature, clear orange eggs 1.8–2.1 mm diam, and several hundred immature, opaque eggs 1.0–1.3 mm diam. In Lake Superior, Eddy and Underhill (1974) found females with ripe eggs from late June through July. It is probable that year-round spawning occurs in the Great Lakes. In Great Bear Lake, Northwest Territories, ovaries contained well-developed eggs in late July.

Larval deepwater sculpins are found in the hypolimnion in deep areas of Lake Michigan (Wells 1968). In Lake Huron, young-of-year were taken in 5-minute tows from 20 April to 20 May along the inner basin of South Bay (Faber 1970). The presence of older larvae without yolk-sacs during the sampling period suggests that they either had hatched before the ice break-up within South Bay, or that they had moved into South Bay after hatching in Lake Huron. Other tow net data (unpublished) showed that deepwater sculpin larvae were numerous in certain years immediately outside the entrance into South Bay.

Deason (1939) reported 2 specimens, 102 and 109 mm SL (with calculated total lengths of 123 and 132 mm respectively), from near Two Rivers in Lake Michigan, which he believed were the largest individuals reported from the Great Lakes, but which, by comparison with more recent samples, are small fish. In 1966 and 1968, the average size of 18 individuals from upper Green Bay and off Sheboygan averaged 139 (125–173) mm TL. Wells and McLain (1973) have suggested that fluctuations in size reflect increasing and decreasing reproduction levels. For instance, in eastern Lake Michigan the average weight of deepwater sculpins in the catches climbed from 21 g in 1960 to 24–25 g in 1964 to 1968. The increase in average size from 1960 to 1968 was a result of a decreasing level of reproduction; few small individuals were taken in the catches of 1964–1968. In 1970 and 1971, the average weights of deepwater sculpins in the catch were 11 and 12 g respectively; these collections contained larger numbers of younger, smaller fish.

The largest deepwater sculpin in the UWSP collections is a male taken from Lake Michigan on 28 October 1966. It is 173 mm (6.8 in) TL, and weighs 60.29 g (preserved weight). A 199-mm (7.8-in) fish was taken from Lake Ontario (McPhail and Lindsey 1970).

The deepwater sculpin is strictly predacious, feeding on small crustaceans and the few species of aquatic insects found on the bottoms. The stomachs of 124 specimens from western Lake Superior disclosed that *Mysis* and *Pontoporeia* were eaten almost exclusively, with each equally important in the diet in most months (Anderson and Smith 1971b). Copepods and cladocerans were eaten occasionally. Unidentified insect remains and small numbers of coregonid eggs were taken in April, and plant material was consumed in September.

In southeastern Lake Michigan, the deepwater sculpin was always abundant at depths of 82 and 91 m, but was never abundant at other depths (Wells 1968). It extended its range slightly shoreward in the spring. No specimens were found in water shallower than 82 m on 13 February, but a few were found in water as shallow as 64 m on 11 March and 31 m on 15 April. The shallowest waters in which deepwater sculpins were caught off Saugatuck, Michigan, were 13 m on 26 May and 7 m in August.

Although deepwater sculpins are mostly restricted to water colder than 4.5°C (40°F), factors other than temperature probably exert a strong influence on the depth distribution of the species. In one study, it was found that they did not move into shallow water in numbers even where water temperatures were less than 4.5°C (Wells 1968).

McPhail and Lindsey (1970) have suggested that, at great depths, courtship and other social interactions among fishes must occur with little benefit of vision. Twice deepwater sculpins were kept captive in aquariums for 2 weeks before they died; during this time they were timid and passive, refusing even live food. How this little fish lives, how abundant it is, and what role it plays in the ecosystem of deep northern lakes are literally deep and dark secrets.

IMPORTANCE AND MANAGEMENT

The historical importance of the sculpin species has been their place in the diet of the lake trout. Deason (1939) recorded a total of 1,215 sculpins (species not designated) taken from 65 lake trout and burbot stomachs; as many as 139 specimens were secured from a single stomach. In southern and northern Lake Michigan, 15% of the lake trout stomachs examined which contained food held fourhorn sculpins; 26% of the burbot stomachs held deepwater sculpins (Van Oosten and Deason 1938). In Lake Superior, sculpins, including the deepwater sculpin, and their eggs are a significant part of the diet of lake trout and siscowets (Eddy and Underhill 1974).

A common associate of the deepwater sculpin in Lake Michigan is the alewife. Alewives are concentrated in deep water in winter when the sculpin spawns. Alewives are known to feed on fish eggs, and may well include the eggs of fourhorn sculpins in their diet (Wells and McLain 1973). Alewives may also compete with larval sculpins for plankton food, or prey upon the larvae. Alewives had so decimated the populations of large species of zooplankton in Lake Michigan by the mid-1960s that the actual presence of alewives among deepwater sculpin fry may not have been necessary to exert a negative effect on them.

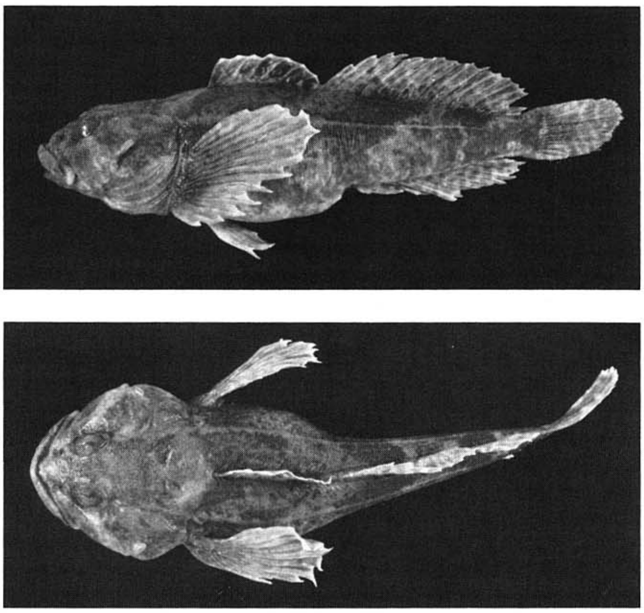
The deepwater sculpin was taken commercially from Lake Michigan in trawls in the early 1960s for the animal food market, but only small quantities were harvested (Wells and McLain 1973).

To the biologist concerned with fish distribution, the deepwater sculpin presents a number of challenging problems. These include the postglacial dispersal of the species and its zoogeography.

Mottled Sculpin

Cottus bairdi Girard. *Cottus*—the bull's head, an old name of the European sculpin called miller's thumb; *bairdi*—for Spencer F. Baird, first U.S. Fish Commissioner.

Other common names: sculpin, common sculpin, Great Lakes mottled sculpin, northern muddler, muddler, blob, gudgeon, muffle-jaw, bullhead, springfish, lake sculpin, spoonhead, miller's thumb (called miller's thumb because its broad, flat head resembles the flattened thumb of the miller who had the misfortune to have his thumb crushed between millstones).



Adult 112 mm, Tomorrow R. (Portage Co.), 21 Mar. 1959. Lateral view above and dorsal view below.

DESCRIPTION

Head and anterior body flattened dorsoventrally; posterior body and caudal peduncle compressed laterally. Length 76–102 mm (3–4 in). TL = 1.23 SL. Depth into TL 4.4–5.6. Head length into TL 3.5–4.5. Snout rounded in lateral view. Mouth terminal, upper lip often protruding slightly beyond lower. Numerous short, blunt teeth in narrow bands on upper and lower jaws; palatine teeth usually present. Gill membranes broadly joined to isthmus. Upper preopercular spine large, directed upward, and curving slightly inward; lower 2 preopercular spines small, directed downward, and covered by skin. Dorsal fins 2, narrowly connected; first dorsal fin with 6–9 soft spines; second dorsal fin usually with 17–19 rays (last ray double; i.e., forked from base). Anal fin rays usually 13–15 (last ray double; i.e., forked from base). Pelvic fin thoracic, of 1 spine and 4 rays but appearing as only 4 elements (the spine and first ray encased in a single fleshy membrane); pectoral rays usually 14–15. Typical scales absent, but small prickles present on sides below lateral line at level of first dorsal fin. Lateral line incomplete, terminating under second dorsal fin. Chromosomes 2n = 48 (W. LeGrande, pers. comm.).

Upper region of head, back, and sides brown to tan, with dark brown to blackish mottling; lower region of head and belly whitish. First dorsal fin with small black spot anteriorly, and a larger black spot posteriorly; all fins speckled randomly, or banded; pelvic fin least pigmented.

Breeding male with a dark basal band on first dorsal fin, and a broad orange band on edge of fin; overall body color dark. Female lightly mottled.

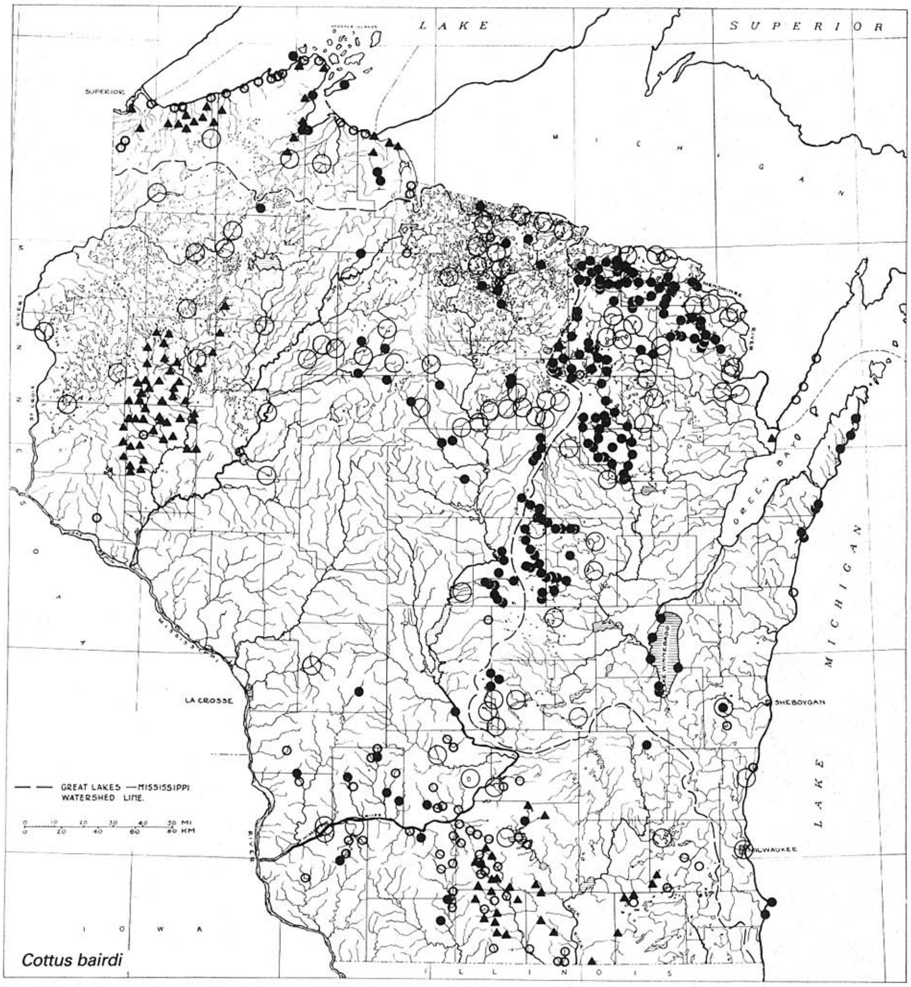
Sexual dimorphism: In male a thin, elongated (like tip of leaf) genital papilla; in female genital papilla rudimentary or absent (Ludwig and Norden 1969). Male averages larger than females. Female with distended abdomen from approximately 2 months before spawning.

SYSTEMATIC NOTES

In the Great Lakes region, two subspecies have been recognized (Hubbs and Lagler 1964): the northern mottled sculpin, *Cottus bairdi bairdi* Girard, and the Great Lakes mottled sculpin *Cottus bairdi kumlieni* (Hoy). The northern mottled sculpin has distance between tip of snout and anus when measured backward from anus extending to a point nearer base than end of caudal fin; in the Greal Lakes mottled sculpin this distance extends to a point nearer end of the caudal fin. In the latter, the body is generally more slender and the dark bars are less distinctly developed. Greene (1935) recognized the Great Lakes mottled sculpin from the shores of Lake Michigan near Milwaukee and Port Washington, and near Bayfield on Lake Superior; however, he also reported records of the northern mottled sculpin in those vicinities. More work is needed to give such subspecific separation validity.

DISTRIBUTION, STATUS, AND HABITAT

In Wisconsin, the mottled sculpin occurs in the Mississippi River, Lake Michigan, and Lake Superior drainage basins. It is distributed in headwater streams and large lakes. Typically a stream species, it nevertheless avoids large sectors of the driftless area. This species inhabits the shoal waters of Lakes Michigan



Range of the mottled sculpin
● Specimens examined
▲ Wisconsin Fish Distribution Study (1974–75)
○ Literature and reports
◯ Greene (1935)

and Superior. Greene (1935) found it in 2.4% of the total river collections, 19.2% of the collections from smaller streams, and 4.9% of the lake collections.

The mottled sculpin is common in cold headwater streams throughout the state, where it is frequently the most common fish in the sample. It is common at barriers in the mouths of tributaries to Lake Superior (McLain et al. 1965). In Lake Winnebago, it is common along the shoreline (Priegel 1967b). It is rare along the shoals of southern Lake Michigan, but becomes more common northward.

In Wisconsin the mottled sculpin was encountered most frequently in clear or slightly turbid water at depths of 0.1–0.5 m, over substrates of sand (23% frequency), gravel (22%), silt (16%), rubble (12%), mud (12%), boulders (8%), detritus (4%), bedrock (1%), and clay (1%). It occurred in streams of the following widths: 1.0–3.0 m (41%), 3.1–6.0 m (20%), 6.1–12.0 m (16%), 12.1–24.0 m (17%), and 24.1–50.0 m (8%). It is found in pools and in medium to fast riffles in the vicinity of cover, which may be in the form of vegetation or of bottom materials such as gravel and rubble. The distribution of the mottled sculpin is more dependent on available shelter than on bottom type.

BIOLOGY

In Wisconsin, the mottled sculpin spawns in April and May. Ludwig and Norden (1969) observed spawning in Mt. Vernon Creek (Dane County), and unless otherwise designated the following account is derived from that source.

In Mt. Vernon Creek, spawning occurred from 1 April to 3 May at water temperatures of 8.9–13.9°C (48–57°F). The mottled sculpin nests consisted of cavities beneath flat rocks at depths of 22 cm, in areas of sufficient current to prevent silting. Other nests were observed in crevices among large gravel (5–8 cm diam), on Elodea, and in tunnels within loam material. The tunnels had openings of about 4 cm diam, and were more than 15 cm deep. One of the deepest tunnels contained the largest egg cluster (2,874 eggs), but it was not determined whether these holes were made by the sculpins. Entrances to the nests usually faced the middle of the stream or upstream. The bottoms of the nests were usually composed of small gravel, although rock, sand, silt, and mixtures of these were sometimes present.

Each nest was occupied by a single, mature male mottled sculpin in nuptial coloration. Ludwig and Norden occasionally observed gravid and spent females and immature sculpins in the nest with the adult male, but in no nest was more than one mature male found. The mature males were in their nests from the onset of spawning until the fry left at the end of May. Females remained in the nests only during spawning.

Each nest was guarded by the attending male. Koster (1936) reported a behavioral pattern resembling the movements of the barking dog, which he called "barking"—a characteristic warning to all other mottled sculpins from the nesting male. Koster observed an encounter in which a resident male bit an intruding male, who returned the bite.

Courtship commences when the male mottled sculpin first sights a female. Savage (1963) noted a ritualistic display of the head by the male, which consisted of one or more of the following elements: shaking, nodding, or gill-cover elevation. Undulations of the body also occurred, either alone or accompanying the head display. Shaking is a movement of the head in the horizontal plane, and nodding is a movement in the vertical plane. The rate of movement of the head was too rapid for accurate recording. Gill-cover elevation is a forward movement of the gill covers, which results in the visual enlargement of the head when viewed from the front. The movements which appeared most frequently were head shaking and gill-cover elevation.

In a laboratory study, the actual contact of the male with the female outside the nest was also observed by Savage (1963:320):

> Biting by the male was observed on 10 occasions and was of two types: (1) biting of the female's cheek, side, pectoral fin, or tail and (2) taking of the female's head into the mouth. A female was never observed to bite during encounters.

A ripe female always entered the nest when bitten on the head or pectoral fin. In each instance, the female turned upside down while inside the nesting cavity. Savage recorded the mottled sculpin's courtship and spawning behavior (p. 321):

> . . . Male A, positioned at the entrance [of the nest], shook and nodded vigorously and bit at the female, who turned away at first but soon turned back toward the shelter. Then the male took the female's head into his mouth, shook her, released and bit at the female's cheek twice. Each bite was followed by shaking. The male continued to shake and undulate as the female moved past him and into the shelter, turned upside down and remained there. The male turned partly upside down and his venter came into contact with the female's dorsum. His head and all his fins, except his pelvics, became jet black and his body became very pale. The male soon righted himself and placed himself across the entrance. The female remained in the nest for several days and was often seen in the upside-down position. Frequently the male also was seen to be upside down, pressed against the female.

Savage (1963) noted that, when the region of the urogenital pore became swollen, it was only a matter of a few hours before the female spawned. If she was isolated and unable to spawn with a male, the eggs were usually released; less often, the female became eggbound and died.

At spawning the gonadal products are released against the roof of the nesting cavity while both adults are in inverted positions. The majority of the eggs of the mottled sculpin were laid in an initial burst, followed by the apparent slow release of more eggs. Within several minutes after their release, the eggs had firmly adhered to the roof of the nest and had hardened; this was indicated by the fact that the activities of the two fish no longer moved the egg mass along the surface of the roof. The female had left the nest by the next morning.

The eggs were attached to the roof of the nest in clusters, which formed a fairly round, flattened mass that had 6–10 layers of eggs in the center. A mass contained an average of 1,205 eggs. Clusters were distinguishable from one another by color variations, which indicated that more than one female had spawned in each nest. There was an average of 3.3 color clusters per egg mass in 18 nests observed (Ludwig and Norden 1969).

According to Savage, the fanning of the eggs has been incorporated into the behavior of the male mottled sculpin during encounters with females, and does not appear to be necessary for the proper development of the eggs.

Eggs in preserved mottled sculpin females from Mt. Vernon Creek averaged 1.88 (1.50–2.06) mm diam. They were uniform in size and light orange-yellow in color. The average number of eggs in 39 females, 41–71 mm SL, was 328 (111–635).

In Mt. Vernon Creek, mottled sculpin prolarvae began to appear in the nests on 17 May. In the laboratory, eggs at 11.1–12.8°C (52–55°F) developed eye spots in 9 days, and hatched in 17 days. Larvae were 5.9 mm TL at hatching. At 14 days, when they had lost their yolk-sacs and were 6.7 mm long, they left the nest. In Erickson and Little John lakes (Vilas County), larval mottled sculpins were sporadically collected during May and June. Tow net data suggested that larval mottled sculpins located in open water areas for a short time (Faber 1967). Fish (1932) illustrated and described the 6.0-, 6.6-, 7.2-, 10-, and 11-mm stages.

In Mt. Vernon Creek 6.5 months after hatching, male mottled sculpins averaged 37.5 mm SL, and females, 33.8 mm SL (Ludwig and Norden 1969). In central Wisconsin, young-of-year from Lyndon Creek were 24–28 mm TL on 26 June; in northern Wisconsin, young from the Pine River (Florence County) were 18–25 mm on 22–23 July. In Lake Winnebago (Winnebago County), the young were 31–40 mm on 18 August, and in Lake Michigan shallows (Door County), they were 27–42 mm on 19 September.

By examining the otoliths of mottled sculpins, Ludwig and Norden (1969) determined that, in collections made from Mt. Vernon Creek in May, age-I males averaged 37.5 mm SL, and females, 32.7 mm SL; age-II males, 59.2 mm, and females, 53.1 mm; and age-III males, 74.5 mm, and females, 67.9 mm. In the Wisconsin collections, only one fish of age-IV was found—a female which contained 949 eggs (Ludwig and Lange 1975).

In the lower Jordan River, Michigan, the calculated total lengths of mottled sculpins at annuli 1 through 4 were 39.5 mm, 71.4 mm, 89.9 mm, and 87.8 mm; in the Ausable River, these lengths were 48.3 mm, 82.8 mm, 102.9 mm, and 102.3 mm (Quick 1971).

Sexual maturity is reached by some mottled sculpins at age II. Bailey (1952) noted that all females over 74 mm (2.9 in) TL were sexually mature. The largest male, collected from an irrigation canal which originated in the West Gallatin River, Montana, was 140 mm (5.4 in) TL. A large Wisconsin mottled sculpin (UWSP 586) is a female, 137 mm (5.4 in) TL, taken from Elton Creek (Langlade County) on 20 July 1966.

In the Madison area, mottled sculpins fed mainly on amphipods, mayfly nymphs, and chironomid larvae, and to a lesser extent on caddisfly larvae, ostracods, copepods, cladocerans, oligochaetes, leeches, plant remains, and algae (Pearse 1918). Mottled sculpins from the Lt. Plover River (Portage County) had eaten *Gammarus* sp., Diptera, and Trichoptera larvae; one stomach contained seeds (P. Brogan, pers. comm.). In the stomachs of mottled sculpins from southeastern Wisconsin, Cahn (1927) found stonefly larvae, small dragonfly and mayfly nymphs, chironomid and *Simulium* larvae, and rarely a small mollusk. A mottled sculpin from the Pine River (Florence County), 104 mm TL, contained a 51-mm central mudminnow.

Mottled sculpins from the West Gallatin River, Montana, had ingested mollusks (*Physa* and *Pisidium*), insects (Ephemeroptera nymphs, Plecoptera nymphs, Coleoptera larvae and adults, Hemiptera, Trichoptera larvae and pupae, Diptera larvae and pupae), Hydrachnidae, fish (longnose dace, mottled sculpins), and the eggs of mottled sculpins.

A few cases have been reported of mottled sculpins eating the eggs of trout, but evidence indicates that these eggs were improperly covered with gravel by the spawning trout. Most studies indicated that the mottled sculpin feeds on invertebrates that are found between and underneath rocks, where they are not available to most other fish (Moyle 1969). Mottled sculpins are more or less continuous feeders.

In southern Ontario, mottled sculpins were taken at average water temperatures of 16.6°C (62°F) when air temperatures averaged 22.9°C (73°F) (Hallam 1959). In Lake Monona (Dane County), Neill (1971) noted that this species tended to avoid the thermal plume of the Lake Monona steam generation plant. The unheated littoral zones, where this species occurred, rarely exceeded 29°C (84°F). In Lake Huron, the behavior of mottled sculpins was affected by a drop in water temperatures from 20 to 7°C (68 to 45°F) within a few seconds; the drop was caused by a sudden underwater seiche (Emery 1970). The mottled sculpins ceased feeding, and, in the cold water, often swam erratically. A number died as a result of thermal stress. In Iowa streams, M. Johnson (1971–1972) found the mottled sculpin in waters averaging 20°C (16–22°C).

The large pectoral fins of the mottled sculpin are used in darter fashion to support the body against the current, with the head upstream. The movements of the mottled sculpin are also darterlike in their rapidity; they often resemble hopping. The mottled sculpin hides under rocks during the major part of the day; large growths of vegetation provide secondary hiding places. Bailey (1952) noted that some small mottled sculpins hide in the quiet water near shore by stirring up clouds of silt which settle and cover them.

During the nonbreeding season, spatial isolation and aggressive behavior were not observed in mottled sculpins in a laboratory experiment. McCleave (1964) captured as many as six sculpins at one time in a 0.093-m^2 (1-ft^2) area, and fish often were seen touching one another. In Lake Huron, mottled sculpins occasionally reached densities of 2–5 per m^2 during the daytime, when feeding activity was rare (Emery 1973). Emery found that at night this species was more active than during the daytime, and was found more often in open, sandy areas. Feeding activity peaked at dusk, but continued after full darkness. Night coloration was similar to daytime coloration, but was somewhat paler.

In Trout Creek, Montana, where it was the most abundant species in the stream, the home range of the mottled sculpin was estimated at less than 50 m (McCleave 1964). The estimated population of sculpins was about 1.7–2.0/m^2. Homing was not exhibited in tagging experiments. About one-third of the displaced sculpins homed, one-third did not move, and one-third moved away from home. The longest upstream movement noted was 180 m, and the longest downstream movement was 153 m.

In a tributary of southern Lake Superior, mottled sculpins moved downstream chiefly in winter and during floods (Manion 1977). Headrick (1976) presented evidence that the mottled sculpin avoided newly ditched areas in central Wisconsin streams, although some fish did invade such areas eventually, probably when vegetative cover had become established.

In Mt. Vernon Creek (Dane County), associates of the mottled sculpin were the white sucker, brown trout, rainbow trout, brook trout, brook stickleback, redside dace, and the American brook lamprey; the last was common only during its short spring spawning run (Ludwig and Norden 1969). In a central Wisconsin tributary to the Waupaca River, I captured 122 mottled sculpins with the white sucker (95), largescale stoneroller (1), blacknose dace (10), creek chub (46), pearl dace (19), northern redbelly dace (1), golden shiner (3), bluntnose minnow (1), fathead minnow (4), common shiner (160), central mudminnow (17), johnny darter (4), pumpkinseed (3), and brook stickleback (134).

IMPORTANCE AND MANAGEMENT

The mottled sculpin has often been called a trout indicator, and it is a fact that, where good sculpin populations exist, the water generally holds trout populations as well. Small populations of mottled sculpins may inhabit the lower reaches of streams which no longer support trout, or, as in Lake Winnebago, lakes which support a warmwater fishery.

Mottled sculpins are known to form a part of the diet of large brook and brown trout. Adams and Hankinson (1926) reported that the mottled sculpin is eaten by American mergansers and northern pike. In a selection test in which equal numbers of mottled sculpins, creek chub, and brook trout of approximately the same size were presented to four mergansers, the ducks consumed about equal numbers of creek chubs and brook trout, but fewer mottled sculpins (Latta and Sharkey 1966). Deason (1939) reported finding six mottled sculpins in the stomachs of water snakes (*Natrix sipedon*).

From time to time, both the mottled sculpin and the slimy sculpin have been regarded as serious predators on trout eggs. Moyle (1977), in reviewing the problem of sculpin predation on salmonids, concluded that the limited evidence indicated that only under exceptional artificial conditions can sculpins severely limit salmonid populations through either predation or competition. In fact, sculpins are commonly an important prey of lake-dwelling salmonids, and occasionally of salmonids in streams. In one study, the sculpin was thought to serve as a buffer prey species for brook trout, by reducing brook trout predation on their own young. It is also possible that sculpin predation on predacious stoneflies may increase the supply of drifting herbivorous insects for trout, and perhaps reduce stonefly predation on trout eggs and young.

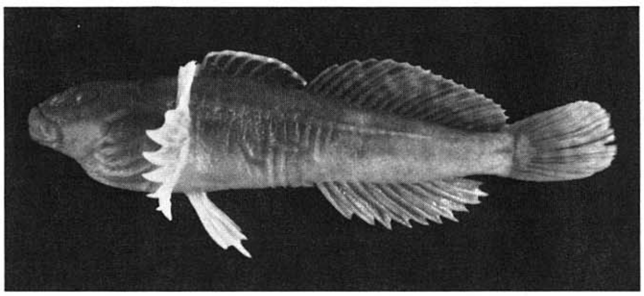
The mottled sculpin is host to the glochidial stages of the mollusks *Alasmidonta calceola* and *Anodontoides ferussicianus* (Hart and Fuller 1974), and so ensures the continued success of these clam species.

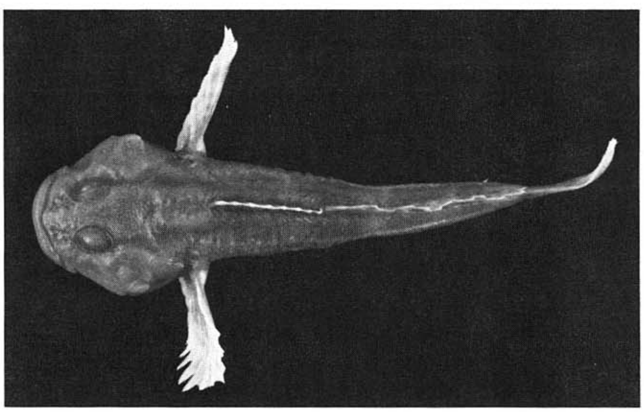
The mottled sculpin is caught incidentally by trout fishermen who use worms or nightcrawlers as bait. Some trout fishermen use the mottled sculpin as bait, particularly for large brown trout.

Slimy Sculpin

Cottus cognatus Richardson. *Cottus*—the bull's head, an old name of the European sculpin called miller's thumb; *cognatus*—related (to the European species *Cottus gobio*).

Other common names: slimy muddler, common slimy muddler, northern sculpin, sculpin, stargazer, Bear Lake bullhead, cockatouch, cottus, big fin, northern miller's thumb (called miller's thumb because its broad, flat head resembles the flattened thumb of the miller who had the misfortune to have his thumb crushed between millstones).





Adult 80 mm, L. Michigan, Kewaunee Harbor (Kewaunee Co.), 7 Apr. 1962. Lateral view above and dorsal view below.

DESCRIPTION

Head and anterior body flattened dorsoventrally; posterior body and caudal peduncle compressed laterally. Average length 76 mm (3 in). TL = 1.24 SL (in Citron Creek, Crawford County); TL = 1.19 SL (in Lake Michigan) (Foltz 1976). Depth into TL 5.0–5.9. Head length into TL 3.6–4.5. Snout rounded in lateral view. Mouth terminal, upper lip often protruding slightly beyond lower. Numerous teeth in narrow bands on upper and lower jaws; palatine teeth usually absent. Two midline mandibular pores. Gill membranes broadly joined to isthmus. Upper preopercular spine large, directed upward, and curving slightly inward; lower 2 preopercular spines small, directed downward, and covered by skin. Dorsal fins 2, narrowly connected; first dorsal fin with 7–9 soft spines; second dorsal fin usually with 16–18 rays (last ray usually single). Anal fin rays usually 11–13 (last ray usually single). Pelvic fins thoracic, with 1 spine and 3 pelvic rays but appearing as only 3 elements (the spine and first ray encased in a single fleshy membrane); pectoral rays usually 13–14. Typical scales absent, but small patch of prickles present on sides below lateral line at level of first dorsal fin. Lateral line incomplete, terminating under second dorsal fin. Chromosomes 2n = 48 (W. LeGrande, pers. comm.).

Upper region of head, back, and sides dark olive to dark brown, with dark mottling; often with 2 dark, oblique saddle marks under anterior and posterior parts of the second dorsal fin (especially evident in young); lower region of head and belly lighter to whitish. First dorsal fin darkly pigmented at base, with almost clear edge; remaining fins variously speckled, or banded as in the pectorals.

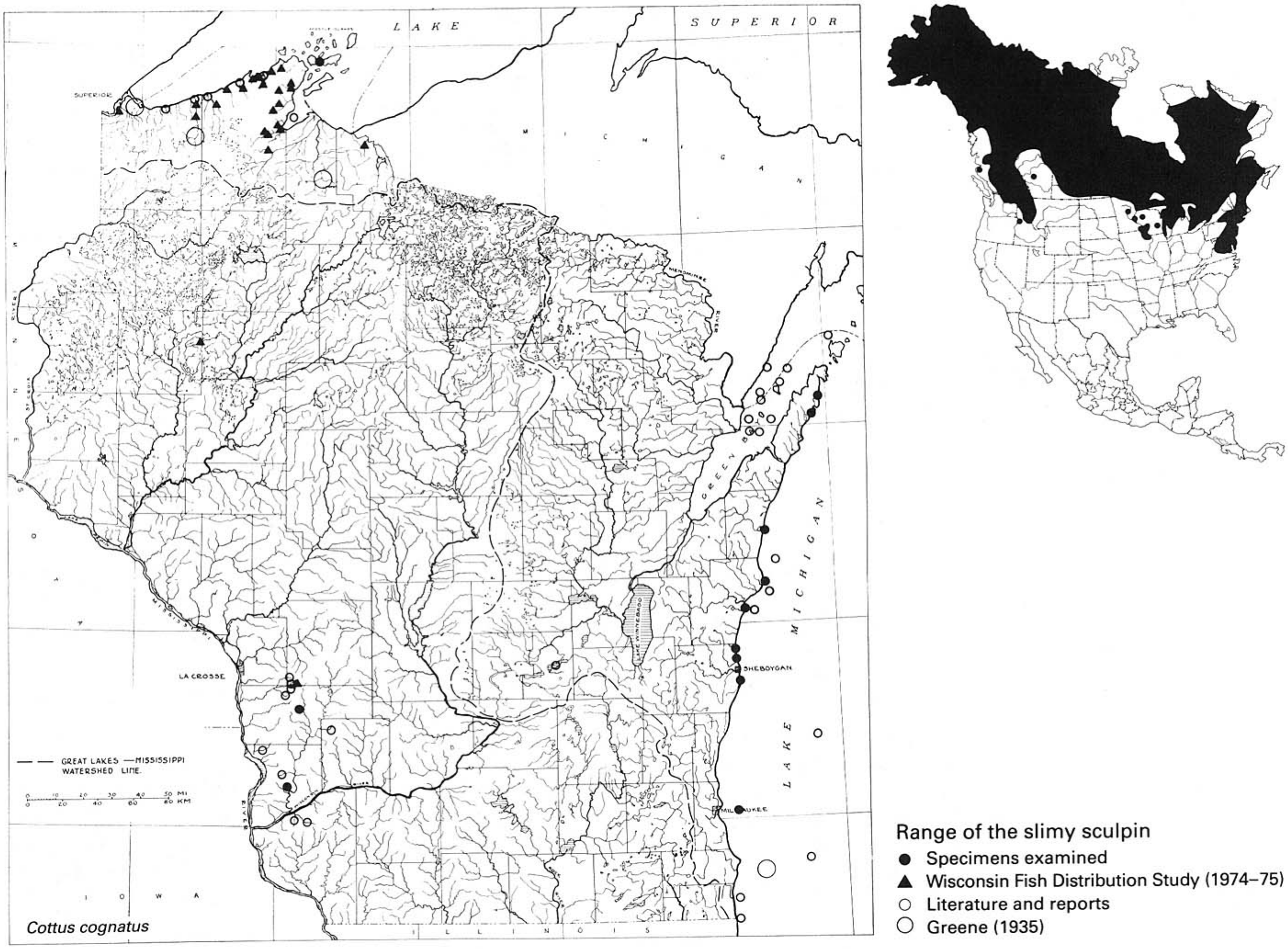
Breeding male dark overall, with a broad, reddish-orange edge on spinous dorsal fin; breeding female lighter overall, with distended abdomen.

Sexual dimorphism: Mature male with a subtriangular genital papilla, not present in female.

DISTRIBUTION, STATUS, AND HABITAT

In Wisconsin the slimy sculpin occurs in the Mississippi River, Lake Michigan, and Lake Superior drainage basins. In recent years this species has been discovered in isolated relict populations in the Mississippi drainage in and near the driftless area. These populations, except for a few in Iowa and Minnesota tributaries to the Mississippi, appear to be widely removed from the rest of the species' range in the Great Lakes drainage and throughout Canada.

In 1964, slimy sculpins were collected from Citron Creek (Crawford County) by M. Johnson and were sent to the University of Michigan Museum of Zoology for verification (Becker 1966). During July and August 1969, M. Johnson collected this species from 11 sites in southwestern Wisconsin—at 4 locales in the upper Coon Creek system (Vernon and Monroe counties); 1 locale on Rush Creek (Crawford County), a tributary to the Mississippi River; 4 tributaries to the Kickapoo River (Crawford, Vernon, and Richland counties); and 2 locales in the Green River system (Grant County). In 1975, this species was taken with the mottled sculpin in Rock Creek (Barron



Range of the slimy sculpin
● Specimens examined
▲ Wisconsin Fish Distribution Study (1974–75)
○ Literature and reports
◯ Greene (1935)

County) by the Wisconsin Fish Distribution Study (1974–1975). R. M. Bailey (1956) postulated that the slimy sculpin and the lake chub (*Couesius plumbeus*) are glacial relicts that survived in the driftless area during the Wisconsin glaciation.

In the Lake Michigan system, the slimy sculpin occurs in Lake Michigan and in Green Bay. In 1957, it was collected from Big Green Lake (Green Lake County) (V. Hacker, pers. comm.). Its presence in this deep lake suggests that other deep, inland lakes in Wisconsin may have populations of slimy sculpins. In addition to its occurrence in Lake Superior, it is found in numerous tributaries to the lake.

The slimy sculpin is uncommon to common in tributaries to Lake Superior. It is uncommon in streams of southwestern Wisconsin, where it is generally confined to springs and to short, spring-fed runs of only a few meters to several hundred meters in length. Such areas are vulnerable to any number of man-induced changes, including siltation. This species is not known in tributaries to Lake Michigan, but it does occur in the lake itself. In eastern Lake Michigan off Grand Haven, Michigan, slimy sculpins were almost four times as abundant in 1970 as in 1960. A large population of slimy sculpins was observed off Saugatuck, Michigan, in 1970 (Wells and McLain 1973).

Typical habitats of the slimy sculpin are deep, oligotrophic lakes, or swift, rocky-bottomed streams. Coldwater temperatures are obviously preferred, and the species is commonly found in association with trout or salmon. In streams it appears over substrates of rubble, boulders, silt, gravel, bedrock, and sand, where these are associated with dense growths of aquatic plants in moderate to fast currents.

In streams of southwestern Wisconsin, the slimy sculpin occurs in small springs and in headwater pools and riffles. It is found where the stream is 0.5–3.0 m wide and averages 13 cm deep, over substrates of sand, gravel, and rubble associated with abundant *Nasturtium* sp., *Ranunculus* sp., and filamentous algae (M. Johnson, pers. comm.).

BIOLOGY

Spawning by slimy sculpins in Wisconsin inland streams is probably similar to that of the same species in Valley Creek, a small Minnesota tributary to the St. Croix boundary water (Petrosky and Waters 1975). There spawning occurred in late April; the larger females appeared to have spawned first.

The spawning behavior of both slimy sculpins and mottled sculpins in streams is basically the same. Koster (Breder and Rosen 1966:548) made the following general observations:

> . . . The nest consists of a cavity usually beneath some flat object. It is constructed by the male who carries the larger objects out in the mouth and washes the lighter materials out by means of fanning and wriggling motions. The males sometimes fight over nests. The fight commences with a characteristic 'barking' action of the defending male and ends with the loss of the nuptial color by the conquered fish. The 'barking' actions are best likened to the barking of a dog. The courtship commences when the male first sights a female. The male flanks and drives the female into the nest after a few seconds or more of 'barking.' The eggs are deposited on the ceiling of the nest. Both sexes lie on their backs, the female often being pressed between the belly of the male and the nest cover. The female leaves after spawning. The males stay with the nest. Females mate but once a season. About a month after deposition the eggs hatch and the fry fall to the bottom of the nest. The yolk sac is absorbed in three to six days depending upon the water temperature, and the young begin to leave the nest. Males of *Cottus bairdii bairdii* and *Cottus cognatus* have been found guarding nests containing young that had already begun to feed.

The spawning behavior of lake populations of slimy sculpins is unknown, and may be different from that of stream populations. In southern Lake Michigan the slimy sculpin began to spawn some time before 5 May, at which time 66.4% of the sculpins were spent (Rottiers 1965). By 23 May, all but one eggbound female were spent. Fish in a deepwater sample (82 m), however, were totally unspent as late as 26 May. Collections of ripe females from Lake Michigan suggested that most spawning occurred at depths of 31–82 m. The bottom types where collections were made ranged from fine sand to mud. During the 1964 season, spawning peaked at 31 m early in the season, and at 46 m somewhat later in the season. The bulk of the specimens were captured in bottom water with a temperature of 6°C (42.8°F) or less.

According to Rottiers, in Lake Michigan the slimy sculpin is a bottom dweller and probably deposits its eggs in clumps on the bottom. In areas inhabited by the slimy sculpin, trawl tows indicate that the bottom is flat and quite free of debris, providing practically no material for nests and egg attachments.

The egg counts for 143 slimy sculpins from Lake Michigan (50–105 mm TL) averaged 291 (98–660). The eggs of 55 fish averaged 1.81 (1.41–2.07) mm diam (Rottiers 1965). Off Two Rivers (Kewaunee County), the number of eggs averaged 270 (84–653) per female (Foltz 1976). In Valley Creek, Minnesota, the egg counts for 34 females ranged from 59 eggs in an age-I fish which was 43 mm long to 645 eggs in an age-V fish which was 111-mm long (Petrosky and Waters 1975). The number of eggs produced increases with the size of the female.

Fish (1932) illustrated the 18-mm stage and described the 18- and 21.5-mm stages. Wells (1968) noted that, in Lake Michigan, larval slimy sculpins are found at midlevels, mostly in the hypolimnion. Little else is known about the young-of-year of this species, except that some apparently appear on the bottom in the fall. On 4 November, catches at 46 m and 55 m contained 72 and 5 individuals, respectively, which were between 25 and 38 mm long.

The calculated lengths at the annuli for slimy sculpins in the upper Jordan River, Michigan, were: 1—33.2 mm; 2—58.0 mm; 3—76.9 mm; and 4—91.9 mm; in the lower Jordan River, the calculated lengths were: 1—45.1 mm; 2—70.3 mm; 3—90.0 mm; and 4—105.0 mm (Quick 1971). The average lengths of slimy sculpins of ages I–VII from southern Lake Michigan were: I—39.4 mm; II—49.1 mm; III—71.8 mm; IV—83.4 mm; V—92.6 mm; VI—98.3 mm; and VII—108.0 mm (Rottiers 1965). The largest range in length within age groups was 45–89 mm in age-group III, and 65–109 mm in age-group IV.

The length-weight relationship (sexes combined) was determined from the postspawning specimens by the equation $\text{Log } W = -4.336 + 2.6354 \text{ Log } L$, where W is weight in grams and L is total length in millimeters. The annuluslike rings used in aging the otoliths are deposited between March and August in Lake Michigan slimy sculpins.

In southern Lake Michigan the average life expectancy of slimy sculpins is between 4 and 6 years. One specimen in a sample of 466 fish had reached 7 years.

In Lake Michigan, all slimy sculpins shorter than 55 mm (2.2 in) were immature, whereas all fish longer than 70 mm (2.8 in) were mature. No age-I sculpins were mature; 13.2% had reached maturity by age II, and 89% at age III; all slimy sculpins were mature by age IV (Rottiers 1965). In Valley Creek, Minnesota, one female was mature at age I, and most slimy sculpins of both sexes were mature at age II (Petrosky and Waters 1975).

In Valley Creek, an age-V female had reached a length of 111 mm (4.4 in). In Canada, the slimy sculpin has been reported to reach 120 mm (4.7 in) (McPhail and Lindsey 1970).

The food of slimy sculpins inhabiting Valley Creek was similar in most respects to that of the brook trout in the same stream. The most important food group was *Gammarus*, followed by Diptera larvae, Trichoptera larvae, and snails. Feeding on *Gammarus*, Trichoptera larvae, and snails increased with the age of the fish, whereas feeding on Diptera larvae decreased with age (Petrosky and Waters 1975). The slimy sculpin feeds by foraging on the bottom, while the brook trout feeds mostly on drift. The stomachs of slimy sculpins from the Duluth and Apostle Islands sectors of Lake Superior contained mostly crustaceans (mainly amphipods), followed in importance by chironomid larvae and other insects, coregonid and sculpin eggs, mollusks, plant material, oligochaetes, Hirudinea, and unidentifiable material (Anderson and Smith 1971b).

In the laboratory, slimy sculpins from southeastern Lake Michigan acclimated at water temperatures of 5° and 15°C (41° and 59°F) had preferred temperatures of 9° and 12°C (48° and 54°F), respectively, and an optimum temperature of about 10°C (50°F) (Otto and Rice 1977). Incipient upper lethal temperatures ranged from 18.5 to 23.5°C (65.3 to 74.3°F); the ultimate upper lethal temperature (at which 50% of the fish died) was about 26.5°C (79.7°F).

M. Johnson (1970) compared the slimy sculpin and the mottled sculpin from Wisconsin streams to determine how quickly heat narcosis (end point upon cessation of respiratory movements) would be reached at 30°C (86°F). Fish were taken directly from their natural habitats and tested immediately. Reaction times were significantly different for the two species: the slimy sculpin succumbed in 49.3 seconds, and the mottled sculpin in 60 seconds. Using a derived theoretical maximum temperature for instantaneous narcosis, the prediction was made that, with regard to temperature tolerance, the egg and larval stages were critical in the survival of both species. At these stages, the slimy sculpin would be restricted to waters of less than 10°C (50°F), while the mottled sculpin would tolerate temperatures up to 20°C (68°F.)

The summer field temperatures of slimy sculpin waters in Iowa average 14°C (57°F) [11–17°C (52–63°F)] (M. Johnson 1971–1972). Unpublished data collected from southwestern Wisconsin waters indicated an average summer water temperature of 13.8°C (56.8°F). Johnson postulated that, although winter water temperatures in the upper Midwest would allow movement of this species from one stream to another, the temperature requirements of the egg and larval stages would prohibit the establishment of the species in many streams. Johnson also suggested that the slimy sculpin may require a year-round water temperature which is fairly constant, since it is consistently found near springs; such water is of a nearly constant physical and chemical condition. Wells (1968) noted that, in southern Lake Michigan, the slimy sculpin seldom occurs in waters above 10°C (50°F), and most often is found in waters of 4–6°C (39–43°F), except during fall overturns when it is taken in waters up to 13°C (55.4°F).

In Lake Opeongo, Ontario, slimy sculpins at night were seen in water 3–5 m deep, resting on the sand with parts of their pectoral and pelvic fins covered with bottom materials (Emery 1973). During the daytime, they were observed at depths of 30–35 m; light levels at this depth approached full darkness. When disturbed, the sculpins moved in a quick circle and then dived straight down, burying themselves in the loose substrate.

In southern Lake Michigan, the depth distribution of slimy sculpins ranges from shore to 91 m, but it may occur at depths as great as 130 m (Rottiers 1965, Wells 1968, Foltz 1976). After thermal stratification, the range decreases somewhat, and the sculpins become more numerous between 46 and 64 m. Wells (1968) noted that in southern Lake Michigan they are distributed over a wide depth range in the winter, that they abandon shallow areas in the spring as soon as the waters warm significantly, and that they continue a gradual movement away from shore through the summer and fall. On 13 February, the greatest numbers of slimy sculpins were found at 18–64 m; after 15 March, and to the end of the year, they were found at all depths greater than 31 m.

In the Apostle Islands region of Lake Superior, slimy sculpins were concentrated in deeper water than in southeastern Lake Michigan (Dryer 1966). They were most common at depths greater than 73 m, and probably the greatest numbers were at 91–108 m. No evidence of seasonal changes in distribution could be detected.

In southwestern Wisconsin, M. Johnson (pers. comm.) captured 201 slimy sculpins at 11 collection sites. It was the only species collected at two of the sites, and it appeared with brown trout fingerlings at three sites, although Johnson noted that other sites also contained trout which were too elusive to catch in a seine. The number of individuals associated with the slimy sculpin at these sites were (number of collection sites given in parentheses): 38 longnose dace

(4), 29 blacknose dace (4), 15 creek chubs (4), 14 brook sticklebacks (3), 9 stonerollers (sp.?) (3), 17 fantail darters (2), 3 white suckers (2), and 1 johnny darter (1). Although the slimy sculpin and the mottled sculpin were not taken together in that collection series, equal numbers of the two species appeared in a Rock Creek (Barron County) collection (Wis. Fish Distrib. Study 1974–1975). In Valley Creek, Minnesota, the only species occurring in the study area besides the slimy sculpin were the brook trout, brown trout, rainbow trout, and the American brook lamprey (Petrosky and Waters 1975).

IMPORTANCE AND MANAGEMENT

Before the decline of the lake trout in Lake Michigan, the slimy sculpin was an important item in the diet of the large salmonids. Van Oosten and Deason (1938) noted that, in Lake Michigan and in Green Bay, 7.7% of the lake trout stomachs containing food held slimy sculpins, and that in southern and northern Lake Michigan, 1.6% of the burbot containing food held slimy sculpins.

The slimy sculpin has been accused of being a significant predator on salmonid eggs and larvae. Clary (1972) reported predation on hatching brown trout eggs and sac-fry by the slimy sculpin, but only at the time of hatching. Koster (1937) noted that there was virtually no evidence that slimy sculpins fed upon the eggs of lake trout and brook trout, and that only in rare instances did they prey upon young brook trout. Greeley (1932) suggested that sculpins probably feed only on loose trout eggs that have not been buried in the nests. In Valley Creek, Minnesota, where slimy sculpins 5 cm or longer were present in densities of about 7000/ha, no trout eggs were found in the stomachs examined (Petrosky and Waters 1975).

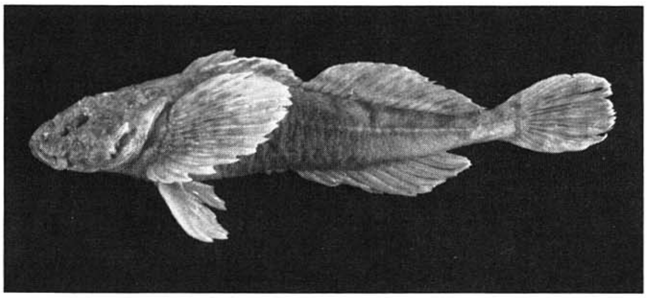
In Wisconsin, the slimy sculpin has little or no value as a bait minnow. According to Scott and Crossman (1973), in the Nipigon waters, Ontario, it is a favorite brook trout bait, and many of the trout that won the Nipigon Trophy were caught on "cockatouch."

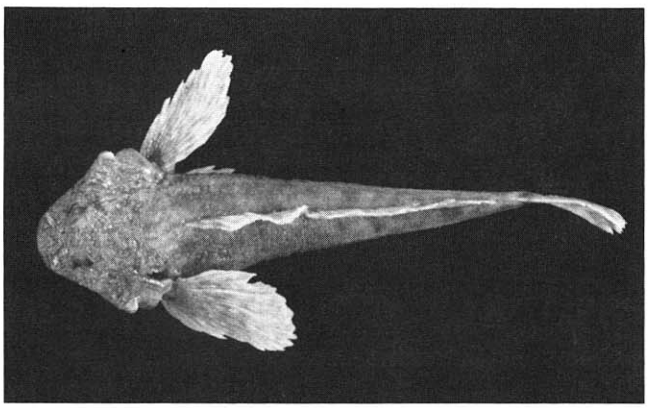
In the upper Jordan River, Michigan, Quick (1971) estimated a density of slimy sculpins at 85,045 fish/ha; in the lower Jordan River, at 589 fish/ha. In Valley Creek, Minnesota, Petrosky and Waters (1975) calculated the density of slimy sculpins during the study period at about 20,000/ha. Comparisons with annual production estimates for brook and rainbow trout made previously suggested a normal total annual production for all fishes of about 200 kg/ha, with sculpins contributing about one-third and trout about two-thirds to the production.

Spoonhead Sculpin

Cottus ricei (Nelson). *Cottus*—the bull's head, an old name of the European miller's thumb; *ricei*—after its discoverer, M. L. Rice, then a student in zoology at Northwestern University in Evanston, Illinois.

Other common names: spoonhead muddler, Rice's sculpin, cow-faced sculpin.





Adult 77 mm, L. Superior (Bayfield Co.), June or July 1968. Lateral view above and dorsal view below.

DESCRIPTION

Head and anterior body flattened dorsoventrally; posterior body and narrow caudal peduncle compressed laterally. Average length 62 mm (2.4 in). TL = 1.20 SL. Depth into TL 5.1–6.2. Head spadelike in dorsal view; head length into TL 3.3–4.3. Snout flat in lateral view. Mouth terminal, small. Single midline mandibular pore. Numerous teeth in narrow bands on upper and lower jaws; palatine teeth absent. Gill membranes broadly joined to isthmus. Upper preopercular spine well developed, and hooked or curved upward and backward. Dorsal fins 2, always narrowly connected, but sometimes fins widely separated; first dorsal fin small with 7–9 soft spines; second dorsal fin usually with 16–18 rays. Anal fin rays usually 12–14. Pelvic fins thoracic, of 1 spine and 4 pelvic rays but appearing as only 4 elements (the spine and first ray encased in a single fleshy membrane); pectoral fins very large, 14–16 rays. Typical scales absent, but top of head and upper body more or less covered with small prickles. Lateral line complete.

Upper region of head and body light brown and tan, mottled with small dark speckles; ventral region of head and belly yellowish. Young occasionally with 4 dark saddle marks, the first 3 through base of second dorsal fin, the fourth on caudal peduncle. All fins lightly speckled, except pelvics which are clear. Distinct, narrow, vertical bar at caudal fin base.

Sexual dimorphism: Adult male with short, broad triangular genital papilla; much reduced in female.

SYSTEMATIC NOTES

The spoonhead sculpin was described from a specimen found on the shore of Lake Michigan near Evanston, Illinois (Nelson 1876). It is a distinctive sculpin with an unconfused taxonomy (McPhail and Lindsey 1970). Perhaps its closest relative is one of the Old World sculpins, *Cottus sibiricus*, *C. spinulosus*, or *C. gobio*.

DISTRIBUTION, STATUS, AND HABITAT

According to McPhail and Lindsey (1970), the spoonhead sculpin probably survived glaciation in the deeper waters of turbid rivers in the upper Mississippi basin. It moved northward in the wake of the retreating ice, and apparently died out in the southern portion of its original range. Although its tolerance of brackish waters is evidenced by its occurrence around Akimiski Island in James Bay, it has not extended its range up the east side of Hudson Bay. McPhail and Lindsey wrote: "In fact the distribution of this species is unique, and the factors governing its dispersal are unknown."

In Wisconsin, the spoonhead sculpin occurs in Lakes Michigan and Superior. In Lake Michigan it reaches the southern limit of its distribution.

The spoonhead sculpin is uncommon in Lake Superior, and rare to depleted in Lake Michigan. According to Wells and McLain (1973), the spoonhead sculpin, which once was common lakewide in Lake Michigan, has continually decreased in numbers and is now rare or absent in the southern portion of the lake. Several specimens were observed in trawl catches made by the Great Lakes Fishery Laboratory in that area in 1954, but none were seen in extensive trawling in 1960 and in 1964–1971. Although an occasional spoonhead sculpin might have been overlooked among slimy sculpins, it is doubtful that many would have gone undetected. The present status of

Range of the spoonhead sculpin
● Specimens examined
○ Literature and reports
◯ Greene (1935)

the spoonhead sculpin in northern Lake Michigan is not known; one was caught by trawl off Ludington, Michigan, in 1971. No causes have been suggested for the apparent disappearance of the spoonhead sculpin from southern Lake Michigan.

Over its range, the spoonhead sculpin is not known to be strikingly abundant or successful anywhere, despite the diversity of its habitats (McPhail and Lindsey 1970). In Michigan it is rare and depleted; in Montana it is rare; and in Ohio it is depleted (Miller 1972).

In Lake Michigan, the spoonhead sculpin occurs from shallows to depths of 134 m, and in Lake Superior it is found at depths of 37–110 m (Deason 1939, Dryer 1966). In the Great Lakes basin, it has been recorded from inland lakes only on Isle Royale and from Lake Charlevoix, Michigan. In the southern part of its range, this species is not known from any of the smaller lakes and streams, but in Canada, inland and northward, it has been caught in small, swift streams, turbid rivers, and the inshore shallows and deeper waters of lakes. Most northern collections are from the shallows of large, muddy rivers; a few are taken from lakes, and a few from tide pools in James Bay (McPhail and Lindsey 1970).

BIOLOGY

It is not known when the spoonhead sculpin spawns, but recent evidence suggests that it occurs in late summer or early fall. Delisle and Van Vliet (1968) reported that milt was exuded, under slight pressure, from males caught 1 August at a depth of 42.7 m in Pemichangan Lake, Quebec. At that depth the water temperature was 4.5°C (40°F). Scott and Crossman (1973) noted that Ontario specimens contained larger eggs in August than in June or July, and that they contained exceedingly small eggs in December.

In Lake Superior (Ashland County), an 84-mm, 7.54-g female spoonhead sculpin, collected 29 April, had ovaries 13.3% of the body weight; she held 638 orange eggs, which averaged 1.4 (1.0–1.7) mm diam. A 68-mm, 3.14-g female from the same collection had ovaries 8.2% of the body weight; she held 357 yellow to orange eggs, which averaged 1.12 (1.0–1.3) mm diam.

Fish (1932) illustrated and described the 27.5-mm stage from Lake Erie. The maximum size known for a spoonhead sculpin is a 134-mm (5.3-in) TL fish which was caught in gill nets in Pemichangan Lake, Quebec (Delisle and Van Vliet 1968). Eleven spoonhead sculpins, taken at 91 m from the Apostle Islands region of Lake Superior by trawl, ranged from 43 to 84 mm (1.7 to 3.3 in) TL.

The diet of 77 spoonhead sculpins from the Duluth-Superior sector of Lake Superior and of 64 spoonheads from the Apostle Islands was dominated by crustaceans; it also included insects, fish eggs, and other material (Anderson and Smith 1971b). Amphipods were the principal food of the spoonheads in both areas during all months. *Mysis* and copepods were consumed in lesser amounts in the two areas, and isopods were eaten only at Duluth-Superior. The consumption of insects (primarily chironomids), was not as important in the Apostle Islands region as it was in the Duluth-Superior area. Coregonid eggs were eaten during April and May in both areas. Plant material, oligochaetes, Hirudinea, and unidentified material constituted the balance of the stomach contents of spoonheads in both areas.

The spoonhead sculpin tolerates fresh and brackish waters.

In Lake Superior, the spoonhead sculpin is restricted to the deeper water, and no fish have been taken in water shallower than 37 m. The abundance of the species increases with depth to 73–90 m (Dryer 1966). In Lake Michigan, Hubbs reported (unpublished) that he collected several half-grown individuals from about 0.3 m of water near the head of the east arm of Grand Traverse Bay, and one individual from near the shore at Jackson Park, Chicago (Deason 1939).

IMPORTANCE AND MANAGEMENT

Historically, the spoonhead sculpin was preyed on by lake trout and burbot in Lake Michigan. Van Oosten and Deason (1938) noted that, in Lake Michigan and in Green Bay, 3.8% of the lake trout stomachs and 6.6% of the burbot stomachs containing food held spoonhead sculpins. According to Deason, as many as 33 spoonhead sculpins were found in a single stomach. Deason (1939) reported that the spoonhead sculpin was found in the stomachs of lake trout and burbot captured in gill nets at 24–134 m. Spoonheads have also been reported from the stomach of a whitefish caught in Charlevoix Lake, Michigan. As a result of its disappearance from southern Lake Michigan and its depletion in northern Lake Michigan, the spoonhead sculpin's use as a forage fish is limited.

Scott and Crossman (1973) noted that the spoonhead sculpin is of interest zoogeographically, since its presence in a body of water provides information on the geological or glacial history of the region.