Threespine Stickleback to Antlered Sculpin

Threespine Stickleback (*Gasterosteus aculeatus*)

Linnaeus, 1758

Family Gasterosteidae

Note: *Exhibits highly variable life history patterns with marine, anadromous, riverine, and lacustrine populations* [1, 2]. *Data in this account are from marine and anadromous populations.*

Colloquial Name: Iñuit—Kakalisaura*q* [3].

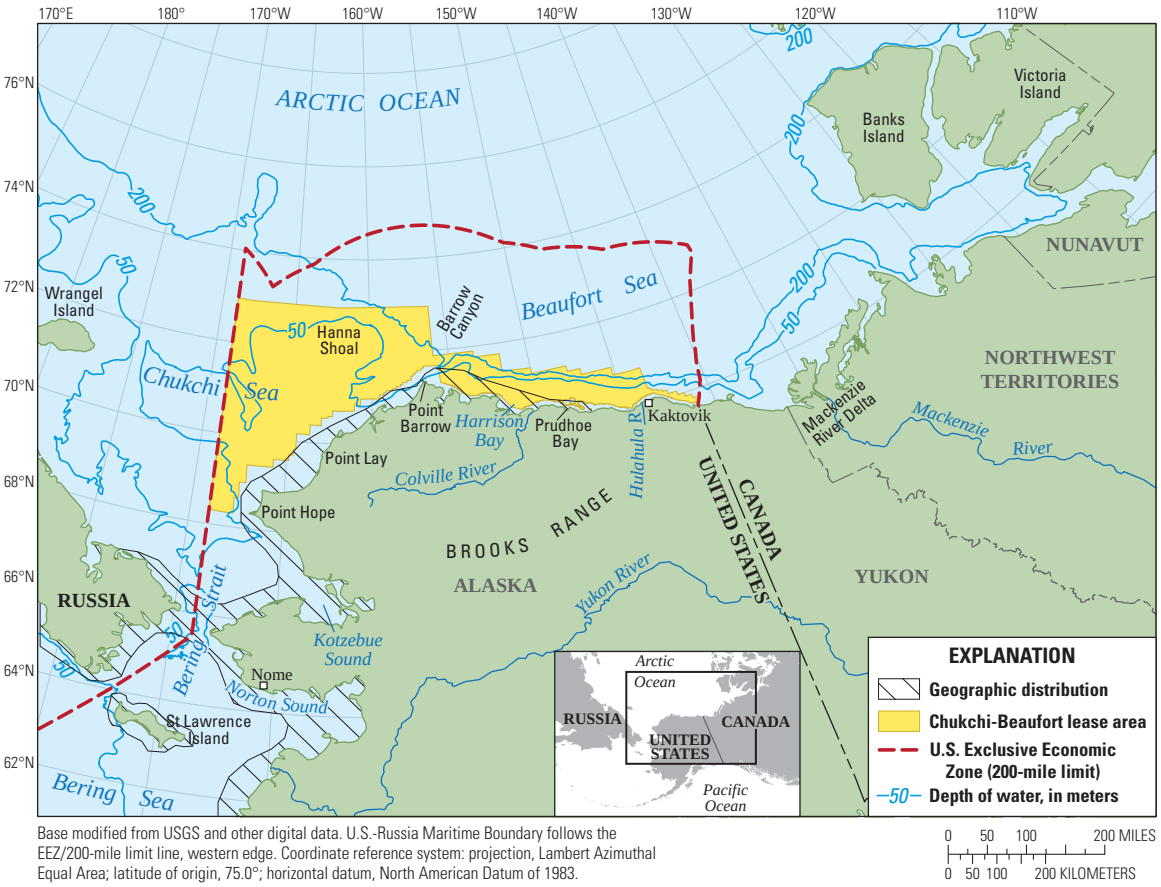
Ecological Role: In locations where common, for instance in Kotzebue Sound, this species may be of ecological importance in local food webs.

Threespine Stickleback (*Gasterosteus aculeatus*), 42 mm TL, northeastern Chukchi Sea, 2007. Photograph by C.W. Mecklenburg, Point Stephens Research.

Physical Description/Attributes: Moderately elongate body. Anadromous type is blue-black to silvery or greenish with yellow, silvery, or white bellies. Breeding males become bright blue or green with red or orange throats and bellies. For specific diagnostic characteristics, see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 333) [4]. Swim bladder: Present, without pneumatic duct [5]. Antifreeze glycoproteins in blood serum: Unknown.

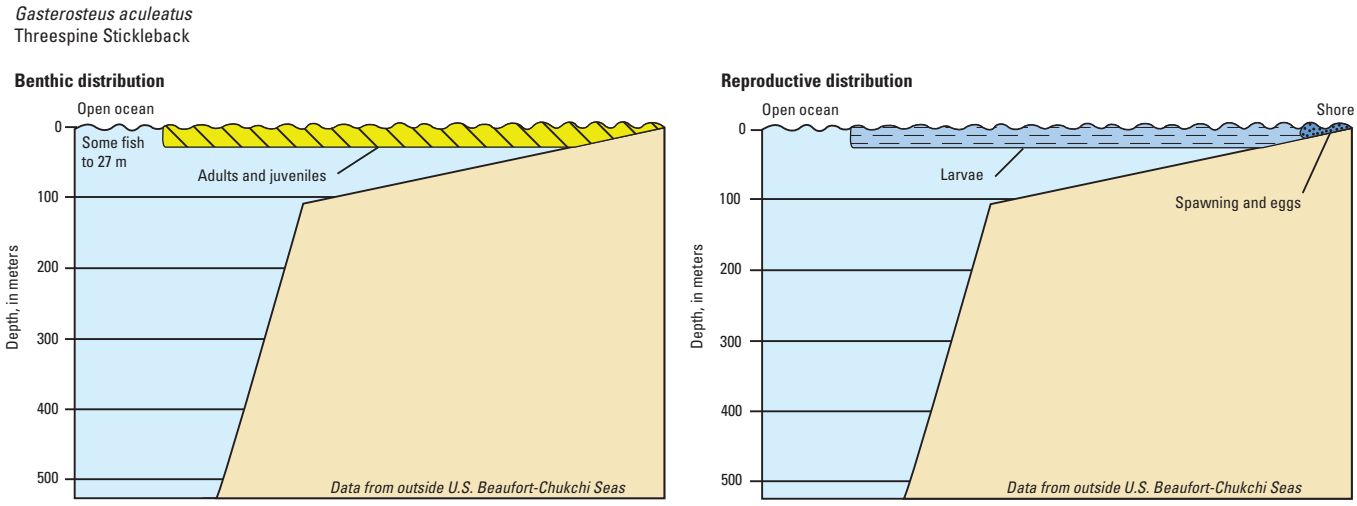
Range: *U.S. Chukchi and Beaufort Seas* [6]. Elsewhere in Alaska, in all coastal waters. Worldwide, from Bering Sea south to Monterey Bay, central California, and to Seas of Okhotsk and Japan; in Atlantic Ocean from Hudson Bay to southern Greenland, Iceland, and southern Barents Sea to Novaya Zemlya, Russia [6].

Relative Abundance: *Common in brackish water at least as far north as Kotzebue Sound, U.S. Chukchi Sea, and occasional or rare east in U.S. Beaufort Sea* [1, 9–11]. Rare in Northwest Territories, Canada [1]. Common in southwestern Barents Sea and Sea of Japan [6, 12].

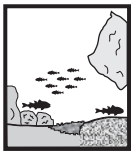


Geographic distribution of Threespine Stickleback (*Gasterosteus aculeatus*), within Arctic Outer Continental Shelf Planning Areas [7] based on review of published literature and specimens from historical and recent collections [6, 8].

Depth Range: Intertidal to 27 m, as far as 805 km offshore for juveniles and adults [4, 13]. Larvae are abundant in surface waters [14]. Marine type spawns in shallow waters, such as tidepools [15].



Benthic and reproductive distribution of Threespine Stickleback (*Gasterosteus aculeatus*).



Habitats and Life History

Anadromous and marine [1, 2].

Eggs—Size: 0.11–0.16 cm [16]. Time to hatching: 5–20 days [12]. Habitat: Benthic, in tidepools for marine type [2].

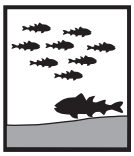
Larvae—Size at hatching: 2.0–5.5 mm [17, 18]. Size at juvenile transformation: About 10.0 mm [19]. Days to juvenile transformation: About 30 days [19, 20]. Habitat: Benthic to pelagic [14].

Juveniles—Age and size: 1–12 months [19], and 11–30 mm TL [19]. Habitat: Benthic to pelagic, staying close to nests for 4–6 days [4], around eelgrass, filamentous algae, and other plants, as well as over sand and rocks [21, 22].

Adults—Age and size at first maturity: Some mature after 1 year (fish spawn once and die), others take 2 years [16]. Growth rates vary with area [16, 23]. Maximum age: 5 years [18], typically 1–3.5 years. Varies with area [16, 23]. Maximum size: 11 cm TL [18]. Habitat: Benthic to pelagic [4], around eelgrass, filamentous algae, and other plants, as well as over sand and rocks, and in offshore waters [21, 22, 24, 25].

Substrate—Over rocks, silt, and sand for spawning [15].

Physical/chemical—Temperature: Marine type has been shown to tolerate temperatures as low as 4 °C and as high as 28 °C in laboratory experiments [26]. Salinity: Fresh to marine waters. *More common in brackish than marine waters in Kotzebue* and Norton sounds [9].



Behavior

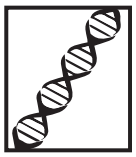
Diel—In Puget Sound, both juveniles and adults inhabit surface waters at night [27, 28].

Seasonal—Some fish migrate into coastal water in autumn to over winter [15]. Other fish winter in deep water [16].

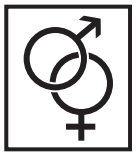
Reproductive—Off Alaska, anadromous fish enter freshwaters to spawn in late spring [1]. Anadromous fish may spawn in brackish or fresh waters [15]. Marine fish spawn in quiet areas such as tide pools [2]. Spawning occurs over rocks, eelgrass, silt, and sand [15]. Males construct nests composed of bits of plants and other debris held together by secretions formed in the kidneys. Through a series of courting behaviors, a male leads a female into the nest where she lays her eggs. Many nests contain eggs from more than one female and males guard the eggs until they hatch. Neighboring males not guarding eggs often “sneak” into a nearby nest and fertilize some of the eggs [16, 29]. Some individuals may spawn once and die [16, 30].

Schooling—Forms schools except in spawning season [12].

Feeding—Feeds throughout water column [12].

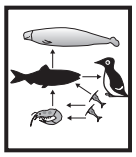


Populations or Stocks
There have been no studies.

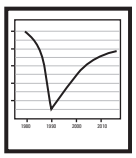


Reproduction
Mode—Oviparous, separate sexes [20].
Spawning season—May–August in Alaska [1, 16].
Fecundity—Batch spawners, laying 50–200 eggs at a time with overall fecundity ranging from 65 to 1,300 [16, 31].

Food and Feeding
Food items—Benthic and midwater prey. Small crustaceans (for example, copepods, euphausiids, mysids, and gammarid and caprellid amphipods) often are quite important, and crustacean larvae, insects, worms, mollusks, fish eggs, and small fishes are also frequently consumed [18, 32–35].
Trophic level—3.51 (standard error 0.49) [36].



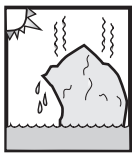
Biological Interactions
Predators—Off Alaskan and British Columbia coasts, are a large number of fishes, sea birds, and marine mammals [12].
Competitors—Likely Polar and Saffron cods, whitefishes, and flatfishes.



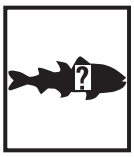
Resilience
High, minimum population doubling time less than 15 months (K=0.6–1.8; t_m=1; t_{max}=4; Fecundity=80) [36].

Traditional and Cultural Importance
None reported.

Commercial Fisheries
Currently, Threespine Stickleback are not commercially harvested.



Potential Effects of Climate Change
Uncertain; however, this is a species with a very plastic life history pattern, with an ability to adapt to a wide range of environmental conditions. Increasing abundance is possible.



Areas for Future Research [B]
Little studied species in the U.S. Chukchi and Beaufort Seas. Research needs include: (1) depth and location of pelagic larvae; (2) depth, location, and timing of young-of-the-year benthic recruitment; (3) preferred depth ranges for juveniles and adults; (4) spawning season; (5) seasonal and ontogenetic movements; (6) population studies; (7) prey; and (8) predators.

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Ninespine Stickleback (*Pungitius pungitius*)
(Linnaeus, 1758)

Family Gasterosteidae

Note on taxonomy: *Some authors recognize more species in this complex than others. North American Arctic populations have been considered a separate species* P. occidentalis *or to comprise two subspecies:* P. p. pungitius, *and* P. p. occidentalis [1].

Colloquial Name: Iñupiat—*Kakaliqauraq* [2].

Ecological Role: Likely of considerable seasonal importance as a prey of fishes, sea birds, and marine mammals; occurs in brackish and marine waters near the coast.

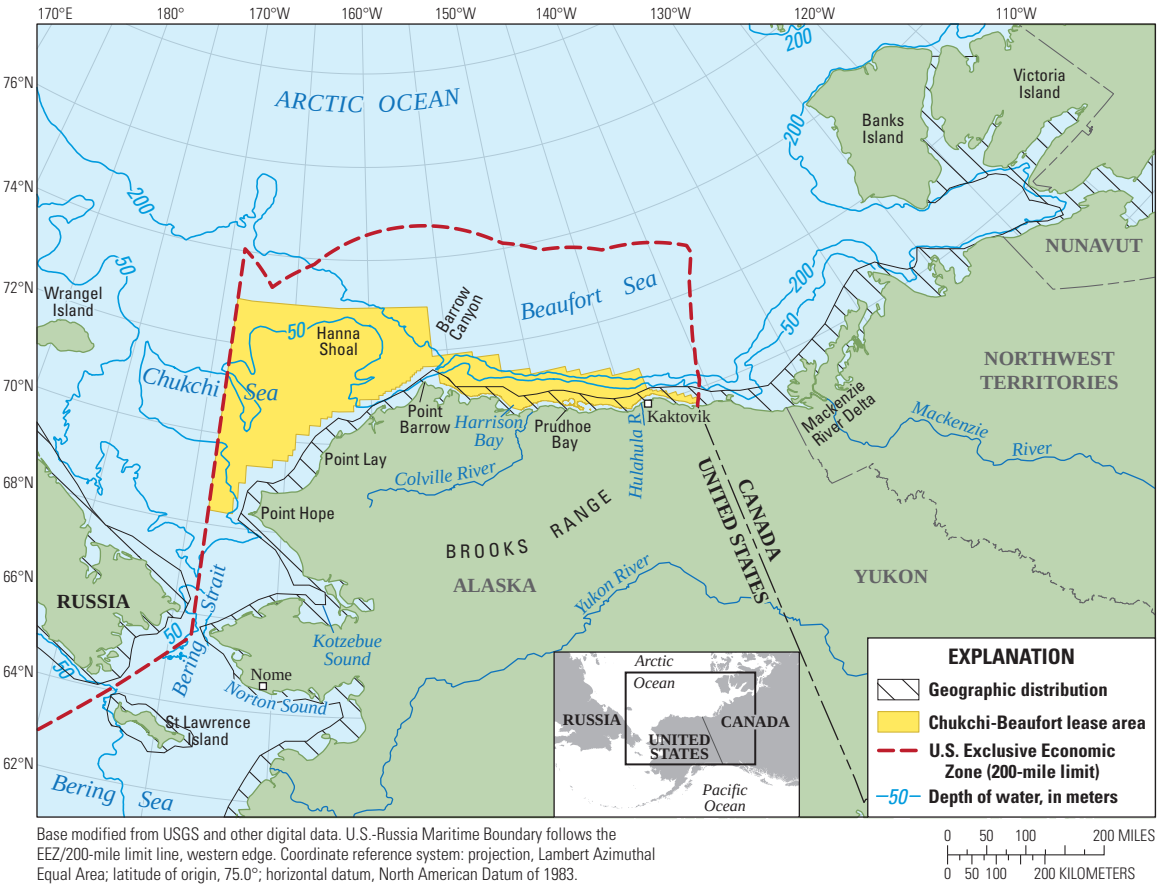
Ninespine Stickleback (*Pungitius pungitius*) 62 mm, northeastern Bering Sea (2007). Photograph by C.W. Mecklenburg, Point Stephens Research.

Physical Description/Attributes: Slender, elongate body. Olive to pale brown on back, silvery or brassy yellow on sides and belly. Breeding colors vary with population; spawning males often have a great deal of black on sides, belly, and chins [3, 4]. Pure black males have been noted [3]. For specific diagnostic characteristics, see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 334) [4]. Swim bladder: Present, without pneumatic duct [5]. Antifreeze glycoproteins in blood serum: Unknown.

Range: *Along shores of U.S. Chukchi and Beaufort Seas* [1]. Elsewhere in Alaska, along Bering Sea and western and northern Gulf of Alaska coasts inland to northeastern British Columbia. Worldwide, western Pacific Ocean in Seas of Japan and Okhotsk, and along Arctic shores except absent from Canadian high Arctic Archipelago, Greenland, and Iceland [1].

Relative Abundance: *Common, although overall abundance is poorly described. Occasionally taken in large numbers along coasts in U.S. Chukchi and Beaufort Seas* and in Canadian Beaufort Sea [8–12].

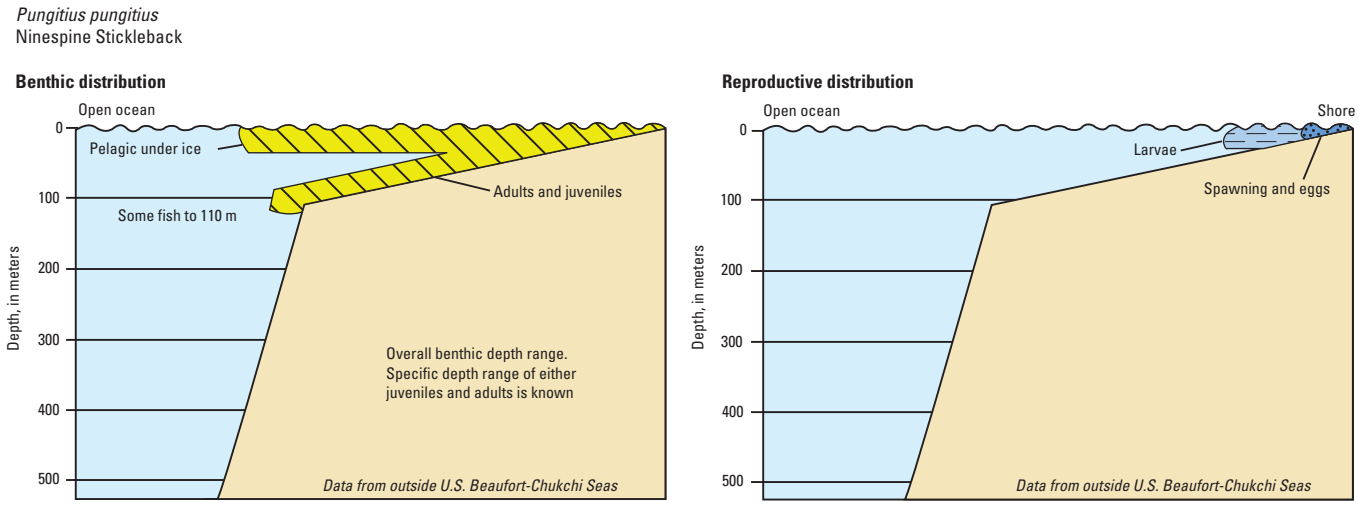
Ninespine Stickleback
Pungitius pungitius



Base modified from USGS and other digital data. U.S.-Russia Maritime Boundary follows the EEZ/200-mile limit line, western edge. Coordinate reference system: projection, Lambert Azimuthal Equal Area; latitude of origin, 75.0°; horizontal datum, North American Datum of 1983.

Geographic distribution of Ninespine Stickleback (*Pungitius pungitius*), within Arctic Outer Continental Shelf Planning Areas [6] based on review of published literature and specimens from historical and recent collections [1, 4, 7].

Depth Range: Nearshore, surface waters to depths of 110 m [4]. In ocean, spawning occurs nearshore, in estuary tide pools [13]. Larvae remain near spawning nests [14].



Benthic and reproductive distribution of Ninespine Stickleback (*Pungitius pungitius*).

Habitats and Life History

Anadromous, riverine, and lacustrine forms [15].

Eggs—Size: 1.0–1.5 mm [16, 17]. Time to hatching: Unknown. Habitat: Benthic, in nests made of algae and plant material [3, 16].

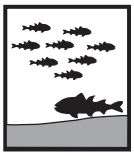
Larvae—Size at hatching: 5.7 mm on average [17]. Size at juvenile transformation: About 15 mm [14]. Days to juvenile transformation: Perhaps 3 months [14]. Habitat: Benthic, remaining near nests [14].

Juveniles—Size range: About 15–38 mm [14, 18]. Habitat: *In ocean, benthic, and midwaters, often under ice* [9, 19, 20].

Adults—Age and size at first maturity: 1–2 years [16, 21, 22] and at least 38 mm in Baltic Sea [18]. Maximum age: At least 2 years in North America [21]. Freshwater fish in Great Britain live to 3.5 years [23]. Maximum size: 9 cm TL [4]. Habitat: *In ocean, benthic, and midwaters, often under ice* [9, 19, 20].

Substrate—Rocks and sand for spawning [3].

Physical/chemical—Temperature:–1.9–20 °C [19, 21]. Salinity: Fresh to marine [15]. In Baltic Sea, prefers warmer, brackish waters for spawning [14].



Behavior

Little is known of the behaviors of these fish in Arctic waters.

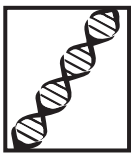
Diel—*Once at sea, makes offshore excursions, as much as 6 km off the coast in Beaufort Sea* [22, 24].

Seasonal—Toward autumn some fish migrate to marine waters. *Over wintering can occur in estuaries and river deltas* [10, 11, 25, 26].

Reproductive—Spawning occurs at shallow depths in fresh and brackish waters [3, 16]. Nesting occurs in dense vegetation or in more exposed areas, such as in the crevices of boulder fields or under rocks. Males construct tunnel-shaped nests of plant material and lure females to them through a series of courtship behaviors [3, 16]. Males often mate with more than one female [15–17]. Females are batch spawners. Males protect fertilized eggs and larvae through and somewhat after hatching, often retrieving errant young and spitting them back into the nest [3].

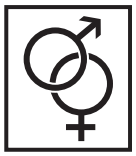
Schooling—Juveniles school, adults may form small groups [27].

Feeding—Appears to occur during daylight hours [27].



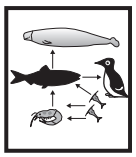
Populations or Stocks

There have been no studies.

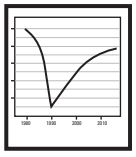


Reproduction
Mode—Oviparous, separate sexes.
Spawning season—*Spring and summer* [3, 16].
Fecundity—350–960 eggs, in batches of 20–80 eggs [28]

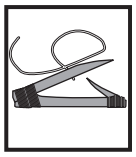
Food and Feeding
Food items—Zooplankton (for example, mysids and ostracods), adult and larval insects, mollusks, and fish eggs [8, 29, 30].
Trophic level—3.29 (standard error 0.40) [31].



Biological Interactions
Predators—*In U.S. Beaufort and Chukchi Seas, other fishes including Arctic Cisco, Least Cisco, Dolly Varden, Fourhorn Sculpin, and Humpback Whitefish* [8, 32], *as well as belugas (off Point Barrow in May)* [33], *and ringed seals (over much of the year in northeastern Chukchi Sea* [34]. Generally, Ninespine Stickleback are an important prey species for other fishes, birds, and mammals.
Competitors—Likely such zooplanktivores as whitefishes, Pacific Herring, sculpins, and gadids.

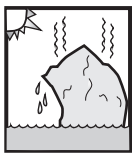


Resilience
Medium, minimum population doubling time 1.4–4.4 years (t_m=1–2; t_{max}=5; Fecundity=350) [31].

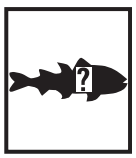


Traditional and Cultural Importance
Historically, Ninespine Stickleback were used as both human and dog food, although currently this species is not used [2, 16].

Commercial Fisheries
Currently, Ninespine Stickleback are not commercially harvested.



Potential Effects of Climate Change
Ninespine Stickleback are a predominantly boreal species with widespread presence along Arctic shores [1], which could be expected to increase in abundance and continue expanding to localities where suitable habitat can be found, as the climate warms.



Areas for Future Research [B]
Little is known about the biology and ecology of this species from the region. Research needs include:
(1) depth and location of pelagic larvae; (2) depth, location, and timing of young-of-the-year benthic recruitment; (3) preferred depth ranges for juveniles and adults; (4) spawning season; (5) seasonal and ontogenetic movements; (6) population studies; (7) prey; and (8) predators.

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Whitespotted Greenling (*Hexagrammos stelleri*)

Tilesius, 1810

Family Hexagrammidae

Colloquial Name: *None in U.S. Chukchi and Beaufort Seas.*

Ecological Role: Likely of limited abundance and little ecological importance in the U.S. Chukchi and Beaufort Seas.

Physical Description/Attributes: Brown to green tinged with orange and yellow. Body and head usually have small white spots and anal fin is yellow often with brown bars. For specific diagnostic characteristics, see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 392) [1]. Swim bladder: Absent [1]. Antifreeze glycoproteins in blood serum: Unknown.

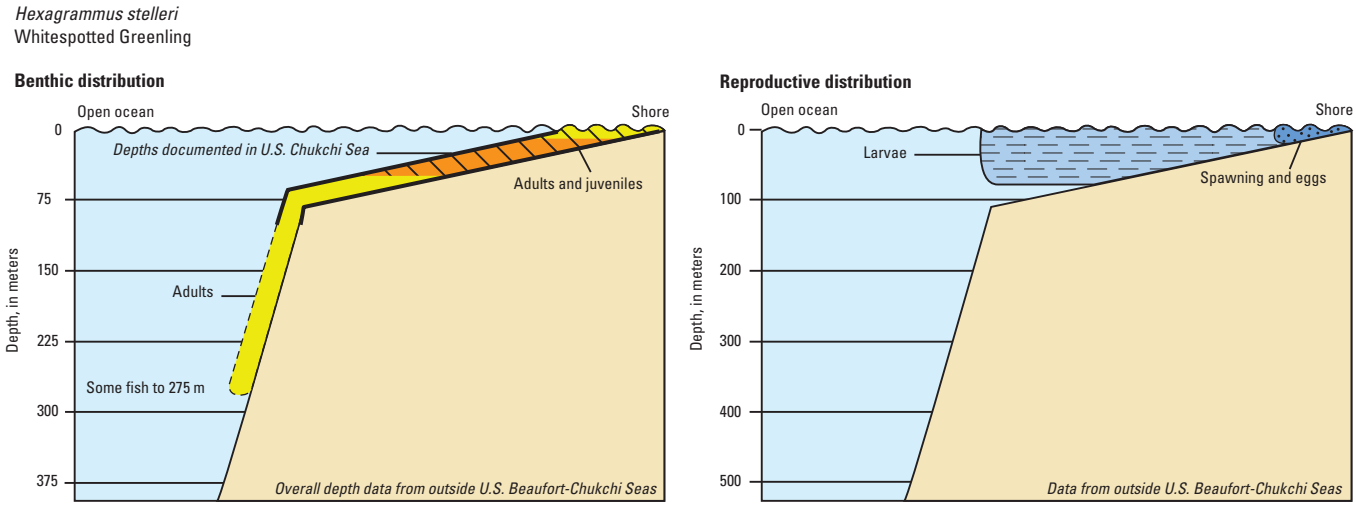
Whitespotted Greenling (*Hexagrammos stelleri*) 32 cm TL, southern Kuril Islands, 2003. Photograph by B.A. Sheiko, Russian Academy of Sciences.

Range: *U.S. Chukchi Sea and Beaufort Seas, reported eastward to Simpson Cove (about 70°N, 145°W)* [1–4]. Northern Sea of Japan, Hokkaido Island to Commander-Aleutian chain and northeast to Simpson Cove, Beaufort Sea, and Bering Sea to Puget Sound, Washington [4].

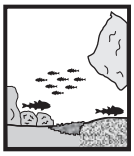
Relative Abundance: *Uncommon in U.S. Chukchi Sea and western Beaufort Sea* [1–4, 6, 7]. Abundant from Sea of Japan [8] to eastern Bering Sea [9] and the Gulf of Alaska [10, 11].

Geographic distribution of Whitespotted Greenling (*Hexagrammos stelleri*), within Arctic Outer Continental Shelf Planning Areas [5] based on review of published literature and specimens from historical and recent collections [2, 4].

Depth Range: In northern waters, intertidal to 175 m, usually less than 100 m [1]; down to 275 m in Sea of Japan [2]. Juveniles, very shallow waters to 50 m [12–14]. *Documented from 14–50 m in U.S. Chukchi Sea* [3, 6]. Spawning occurs in shallow waters to at least 8 m [15]. In Gulf of Alaska, larvae are abundant in surface waters [16].

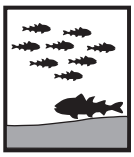


Benthic and reproductive distribution of Whitespotted Greenling (*Hexagrammos stelleri*).



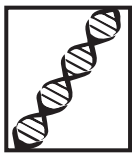
Habitats and Life History

Eggs—Size: 1.6–1.9 mm [17]; colored green, blue, violet, or grey [15]. Time to hatching: 30 days [14, 18]. Habitat: Demersal, nearshore [15].
Larvae—Size at hatching: 7.0–9.0 mm SL [11, 19]. Size at juvenile transformation: 30–40 mm FL [14, 19]. Days to juvenile transformation: About 1 year [14]. Habitat: Pelagic, near surface [16, 20].
Juveniles—Age and size: 3–15 cm FL [9, 19]. Habitat: Demersal, nearshore, among rocks, often in heavy algae and eelgrass cover [1, 14, 20–22].
Adults—Age and size at first maturity: A few mature at age–1 (15.0 cm FL) and most at age–2 (17.0–20.0 cm FL) [9, 12, 17]. Maximum age: At least 6 years, probably more [17]. Maximum size: About 48 cm TL [1], and 1.6 kg [23]. Habitat: Demersal, on continental shelf among complex substrates and, occasionally, soft bottoms, often in heavy algae and eelgrass cover [1, 14, 20–22, 24, 25].
Substrate—Sand, silt, gravel, cobble, shell hash [3, 26, 27].
Physical/chemical—Temperature: –1.5–11.7 °C in southeastern Bering Sea, (mainly 4–7.2 °C) [28]. Salinity: Marine and estuarine [14, 24].

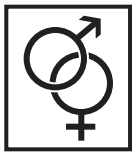


Behavior

Diel—Substrate-oriented; remains within 1.5 m of sea floor, occasionally rising to 5–6 m in midwaters [29]. Strictly diurnal (Sea of Okhotsk) [29] and active, moving into shallow waters to feed at night (eastern Bering Sea) [9]. More agonistic toward each other than toward other species [29].
Seasonal—From late spring to autumn, pelagic larvae transform to juveniles and recruit to sea floor [12–14]. Mature fish winter in deeper waters of continental shelf and return to nearshore in the summer, whereas juveniles remain nearshore year-round [12, 14].
Reproductive—Spawning occurs in shallow waters [15]. Females lay adhesive eggs on algae and highly territorial males guard them until they hatch. Males may guard as many as 7 egg masses (1,200–5,200 eggs each) from multiples females [14, 15].
Schooling—Usually solitary though small schools of as much as 1 dozen individuals have been observed [29].
Feeding—Both juveniles and adults move into shallow, often intertidal waters, to feed [9]. Often roots around in substrate for prey [29].

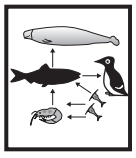


Populations or Stocks
There have been no studies.

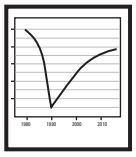


Reproduction
Mode—Partial (heterochronal) spawners.
Spawning season—Spawning occurs from autumn through spring in Puget Sound [15, 30] and from June to October in the Gulf of Alaska, Bering Sea, and off Asia [17, 31–33].
Fecundity—1,070–12,397, in batches [15, 17, 19].

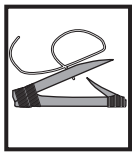
Food and Feeding
Food items—A very diverse array of benthic and midwater prey in Bering Sea and Gulf of Alaska. Pelagic larvae: Such zooplankters as copepods, amphipods, ostracods, crab larvae, and euphausiids. Benthic juveniles and adults: Crustaceans (for example, gammarid and caprillid amphipods, calanoid and harpacticoid copepods, shrimps, crabs, and barnacles), snails, bivalves and bivalve siphons, polychaetes, fish eggs, and fishes [20, 26, 34–36].
Trophic level—3.33 (standard error 0.41) [37].



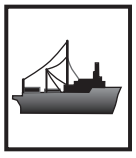
Biological Interactions
Predators—Arctic Terns, horned and tufted puffins, and river and sea otters in Gulf of Alaska and eastern Bering Sea [38–41]. Predation by seals is likely in the Chukchi Sea.
Competitors—Likely other benthic feeders such as flounders, sculpins, and eelpouts.



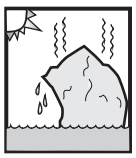
Resilience
Medium, minimum population doubling time 1.4–4.4 years (Fecundity=6,679–38,408) [37].



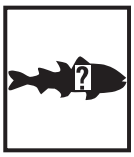
Traditional and Cultural Importance
None reported. Elsewhere, Whitespotted Greenling was an important food fish for Alaska Natives living in the Gulf of Alaska, Aleutian Islands, and eastern Bering Sea [42, 43].



Commercial Fisheries
Currently, Whitespotted Greenlings are not commercially harvested. There is a commercial fishery for this species in the northern Sea of Okhotsk [44].



Potential Effects of Climate Change
As with other predominantly boreal Pacific fish species, Whitespotted Greenling are expected to expand their range in Arctic waters as the climate warms.



Areas for Future Research [B]

Little is known about the ecology and life history of this species. Research needs for this species in the study area include: (1) depth and location of pelagic larvae; (2) depth, location, and timing of young-of-the-year benthic recruitment; (3) preferred depth ranges for juveniles and adults; (4) spawning season; (5) seasonal and ontogenetic movements; (6) population studies; (7) prey; (and 8) predators. The vulnerability of Whitespotted Greenling to climate change should be assessed. It is a suitable indicator of changes in the nearshore marine and, if incorporated into a regional monitoring design, key population parameters should be studied.

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Okhotsk Hookear Sculpin (*Artediellus ochotensis*)

Gilbert & Burke, 1912

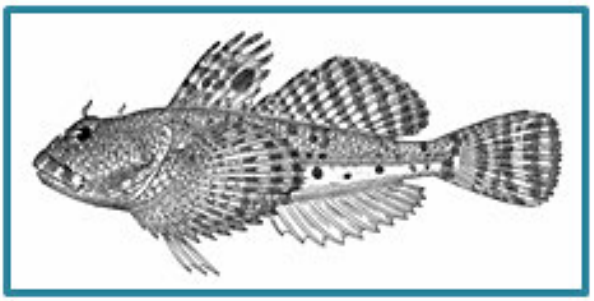
Family Cottidae

Note: *Except for geographic range data, all information is from areas outside of the study area.*

Colloquial Name: *None in U.S. Chukchi and Beaufort Seas.*

Ecological Role: Largely unknown. However, Okhotsk Hookear Sculpin are unlikely to represent a significant prey resource to higher-level organisms.

Physical Description/Attributes: Head and upper body light reddish brown, light reddish spots on body and small reddish brown blotches on first dorsal fin. For specific diagnostic characteristics, see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 494) [1]. Swim bladder: Absent [1]. Antifreeze glycoproteins in blood serum: Unknown.

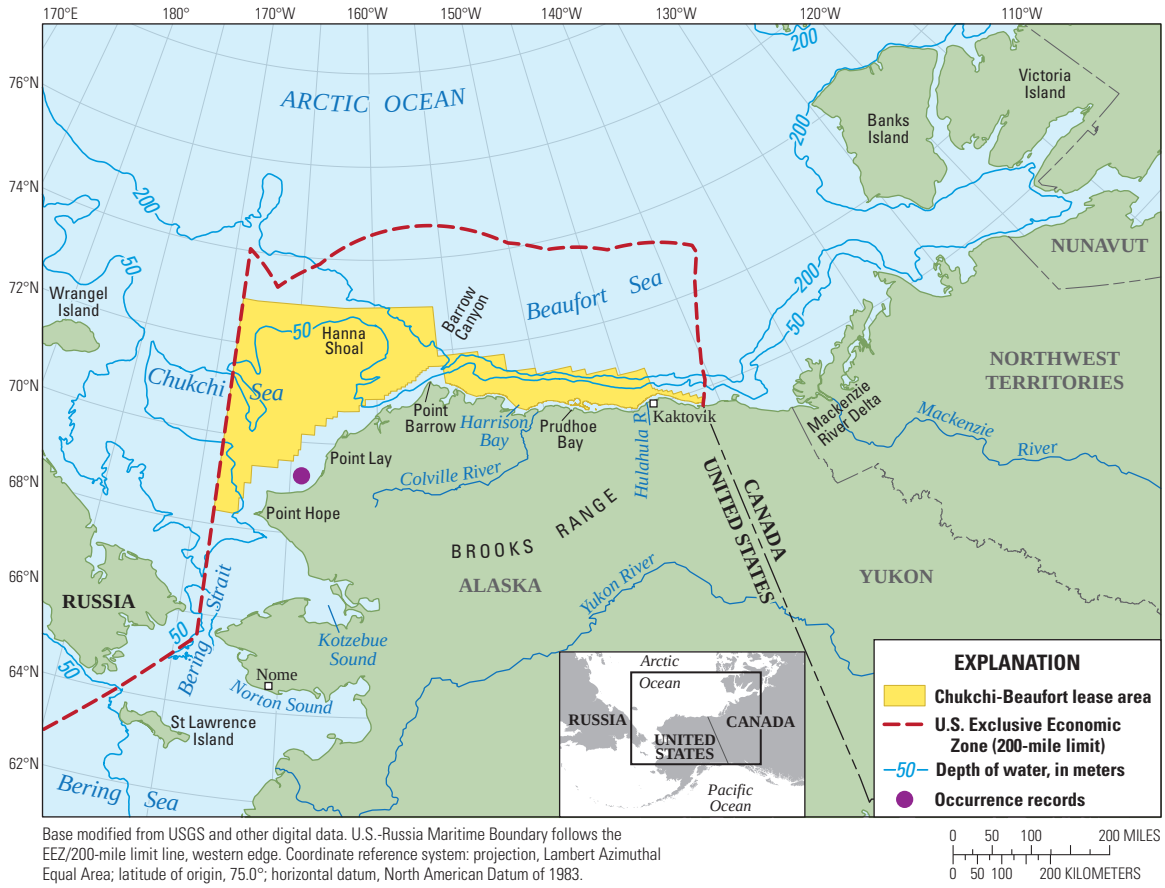


Okhotsk Hookear Sculpin (*Artediellus ochotensis*). From Mecklenburg and others (2002, p. 494) citing others; drawing of fish from off western Kamchatka Peninsula, Russia.

Range: *U.S. Chukchi Sea north of Lisburne Peninsula (one record only)* [2]. Worldwide, Japan Sea at Peter the Great Bay to Okhotsk Sea, Kuril Islands, and Commander Islands, to Gulf of Anadyr, Russia, western Bering Sea [2].

Relative Abundance: *Rare in U.S. Chukchi Sea* [2]. Elsewhere, occasional in Sea of Okhotsk. [5] and rare in Sea of Japan [6].

Okhotsk Hookear Sculpin
Artediellus ochotensis

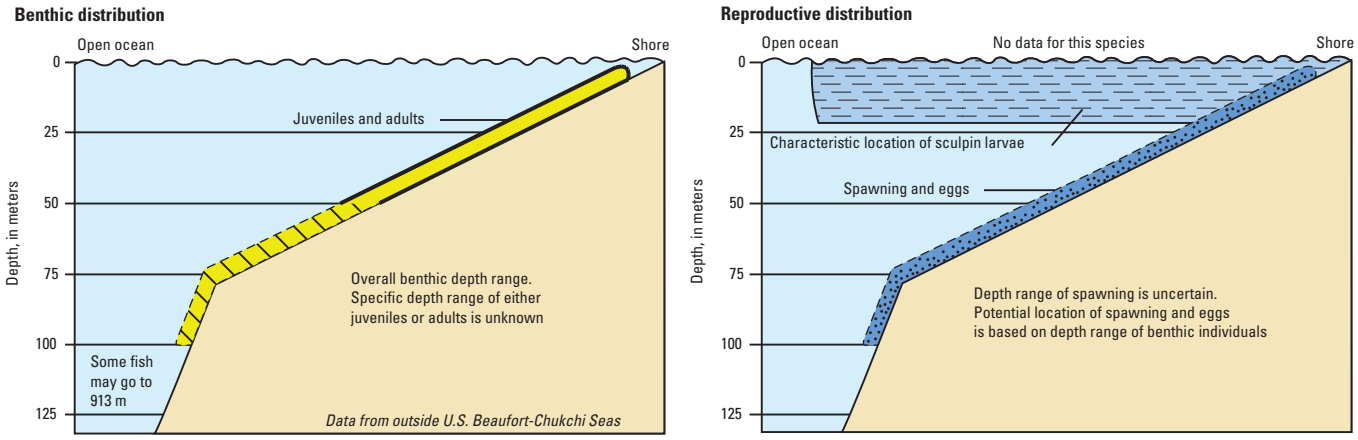


Base modified from USGS and other digital data. U.S.-Russia Maritime Boundary follows the EEZ/200-mile limit line, western edge. Coordinate reference system: projection, Lambert Azimuthal Equal Area; latitude of origin, 75.0°; horizontal datum, North American Datum of 1983.

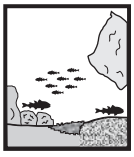
Geographic distribution of Okhotsk Hookear Sculpin (*Artediellus ochotensis*), within Arctic Outer Continental Shelf Planning Areas [3] based on review of published literature and specimens from historical and recent collections [2, 4].

Depth Range: Benthic, at least 4–100 m [1] and perhaps to 913 m [5]. Typically less than 50 m [1].

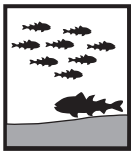
Artediellus ochotensis
Okhotsh Hookear Sculpin



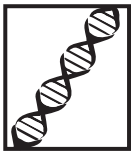
Benthic distribution and reproductive distribution of Okhotsh Hookear Sculpin (*Artediellus ochotensis*).



Habitats and Life History
Eggs—Size: Unknown. Time to hatching: Unknown. Habitat: Likely benthic [1].
Larvae—Size at hatching: Unknown. Size at juvenile transformation: Unknown. Days to juvenile transformation: Unknown. Habitat: Pelagic [1].
Juveniles—Age and size: Unknown. Habitat: Benthic [1].
Adults—Age and size at first maturity: Unknown. Maximum age: Unknown. Maximum size: 10.2 cm TL [1]. Habitat: Unknown.
Substrate—Unknown.
Physical/chemical—Temperature: Unknown. Salinity: Marine [1].



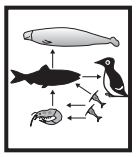
Behavior
Diel—Unknown.
Seasonal—Unknown.
Reproductive—Unknown.
Schooling—Unknown.
Feeding—Unknown.



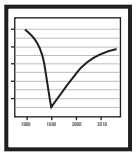
Populations or Stocks
There have been no studies.

Reproduction
Mode—Separate sexes; oviparous [7].
Spawning season—Unknown.
Fecundity—Unknown.

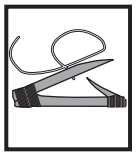
Food and Feeding
Food items—Unknown.
Trophic level—3.33 (standard error 0.40) [8].



Biological Interactions
Predators—*In the mid-eastern U.S. Chukchi Sea, Artediellus sp. are occasionally eaten by ringed seals* [9].
Competitors—Presumably a wide range of other zoobenthos feeders such as Arctic Cod, Walleye Pollock, other sculpins, poachers, and eelpouts.

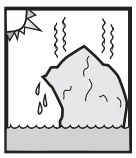


Resilience
High, minimum population doubling time less than 15 months (Preliminary *K* or Fecundity) [8].

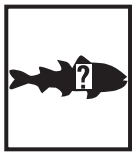


Traditional and Cultural Importance
None reported.

Commercial Fisheries
Currently, Okhotsk Hookear Sculpin are not commercially harvested.



Potential Effects of Climate Change
As with other boreal Pacific species, climate warming would be expected to increase its abundance in the U.S. Chukchi Sea and possibly expand its range into the U.S. Beaufort Sea.



Areas for Future Research [B]
Little is known about the ecology and life history of this species. Research needs in the study area include: (1) depth and location of pelagic larvae; (2) depth, location, and timing of young-of-the-year benthic recruitment; (3) preferred depth ranges for juveniles and adults; (4) spawning season; (5) seasonal and ontogenetic movements; (6) population studies; (7) prey; and (8) predators.

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Hamecon (*Artediellus scaber*)

Knipowitsch, 1907

Family Cottidae

Colloquial Name: *None in U.S. Chukchi and Beaufort Seas.*

Ecological Role: Largely unknown. However, the Hamecon is unlikely to represent a significant prey resource to higher-level organisms, but it is an important subsistence resource in some Alaskan communities.

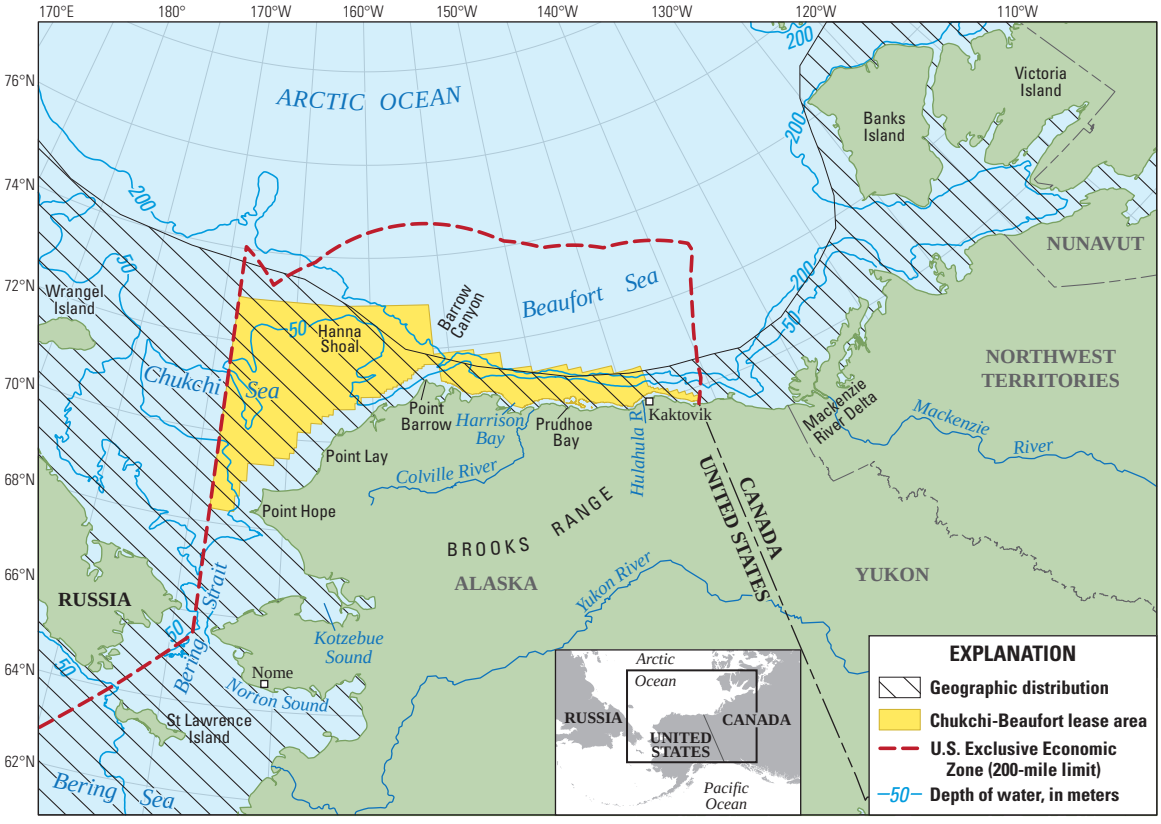
Physical Description/Attributes: Grayish brown with large blotches and bars; fins have orange bars. Males have a dark blotch on posterior part of first dorsal fin. For specific diagnostic characteristics, see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 491) [1]. Swim bladder: Absent [1]. Antifreeze glycoproteins in blood serum: Unknown.

Hamecon (*Artediellus scaber*), 83 mm TL, western Chukchi Sea, 2004. Photograph by C.W. Mecklenburg, Point Stephens Research.

Range: *U.S. Chukchi and Beaufort Seas.* Elsewhere in Alaska, in eastern Bering Sea to south of St. Lawrence Island. Worldwide, in western Bering Sea south to Cape Navarin, Russia; through Arctic Ocean eastward to Somerset Island, Canada, and westward to Barents and Kara Seas [1, 2].

Relative Abundance: Common, *although patchily distributed in U.S. Chukchi Sea at least as far north as 71°N*. [5–8]. Common *in westernmost Beaufort Sea, although abundance in rest of Alaskan Beaufort Sea is unknown as few have been taken in nearshore areas* [5–7, 9, 10]. Elsewhere, common in Canadian Beaufort Sea at Herschel Island, Yukon Territory [11] and in Russian Chukchi Sea [7].

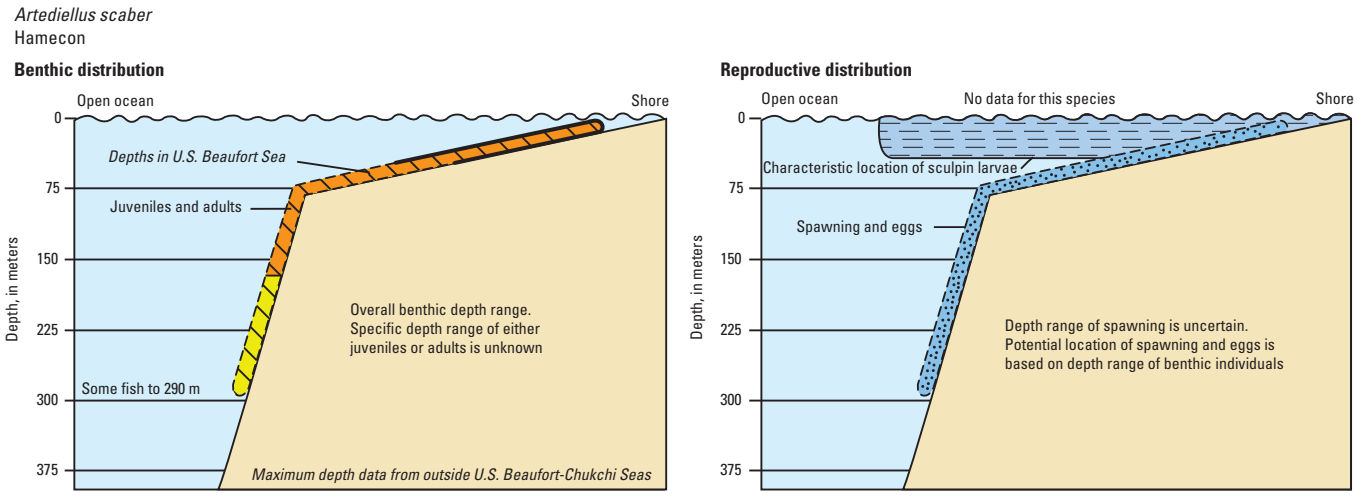
Hamecon
Artediellus scaber



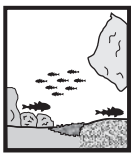
Base modified from USGS and other digital data. U.S.-Russia Maritime Boundary follows the EEZ/200-mile limit line, western edge. Coordinate reference system: projection, Lambert Azimuthal Equal Area; latitude of origin, 75.0°; horizontal datum, North American Datum of 1983.

Geographic distribution of Hamecon (*Artediellus scaber*), within Arctic Outer Continental Shelf Planning Areas [3] based on review of published literature and specimens from historical and recent collections [2, 4].

Depth Range: *At depths of 4–159 m, mostly shallower than 55 m* [2]. Elsewhere, overall depth range given for benthic individuals is 7 m [9] to 290 m [12], although depths greater than 159 m are likely in error [2].

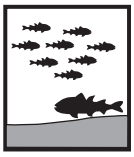


Benthic and reproductive distribution of Hamecon (*Artediellus scaber*).



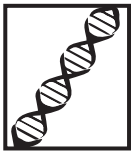
Habitats and Life History

Eggs—Size: Unknown. Time to hatching: Unknown. Habitat: Benthic [13].
Larvae—Size at hatching: Unknown. Size at juvenile transformation: *Young-of-the-year may recruit to nearshore waters at lengths of 2.0 cm TL* [9]. Days to juvenile transformation: Unknown. Habitat: Pelagic [1].
Juveniles—Age and size: Unknown and *2.0–5.6 cm TL* [9, 14]. Habitat: Benthic [1].
Adults—Age and size at first maturity: *Females larger than 5.6 cm TL are mature (about 3 or 4 years)* [14]. Maximum age: *At least seven years* [13, 14]. Maximum size: 11.4 cm TL [15]. Habitat: Benthic, in coastal waters [13].
Substrate—Over sand, mud, and around rocks [7, 13]. *Larger individuals may be found in deeper parts of species' depth range* [9].
Physical/chemical—Temperature: -1.8–9.8 °C or more [4]. Salinity: Brackish and marine, primarily brackish [16]. *In U.S. Chukchi Sea, documented as much as 32.41 parts per thousand* [7]. Off Russia and in western Chukchi Sea, documented between 10 and 32.87 parts per thousand [7, 13],



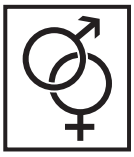
Behavior

Diel—Unknown.
Seasonal—Unknown.
Reproductive—Unknown.
Schooling—Unknown.
Feeding—Unknown.



Populations or Stocks

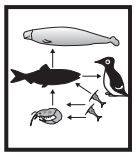
There have been no studies.



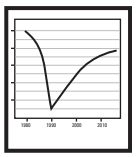
Reproduction

Mode—Separate sexes; oviparous [17].
Spawning season—Reproduction appears to take place at least in the autumn [13].
Fecundity—*Females produce between 50 and 100 eggs* [14].

Food and Feeding
Food items—*Benthic individuals eat a variety of benthic and epibenthic prey, most importantly polychaetes and gammarid amphipods, as well as mysids, cumaceans, euphausiids, hyperiid amphipods, and isopods* [14]. Food habits of larvae unknown.
Trophic level—3.5 (standard error 0.38) [18].

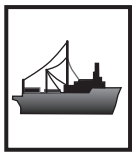


Biological Interactions
Predators—*In the mid-eastern U.S. Chukchi Sea Artediellus sp. are occasionally eaten by ringed seals* [19].
Competitors—Presumably a wide range of other zoobenthos feeders such as Arctic Cod, Walleye Pollock, other sculpins, poachers, and eelpouts.

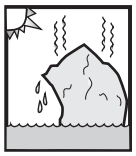


Resilience
High, minimum population doubling time less than 15 months (Preliminary *K* or Fecundity) [18].

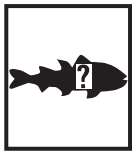
Traditional and Cultural Importance
None reported



Commercial Fisheries
Currently, Hamecon are not commercially harvested.



Potential Effects of Climate Change
An essentially Arctic species, climate warming would be expected to contract this species' range northward from the Bering Sea.



Areas for Future Research [B]
Little is known about the ecology and life history of this species in the study area. Research needs include: (1) depth and location of pelagic larvae; (2) depth, location, and timing of young-of-the-year benthic recruitment; (3) preferred depth ranges for juveniles and adults; (4) spawning season; (5) seasonal and ontogenetic movements; (6) population studies; (7) prey; and (8) predators.

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Antlered Sculpin (*Enophrys diceraus*)

(Pallas, 1787)

Family Cottidae

Antlered Sculpin (*Enophrys diceraus*), 101 mm TL, Chukchi Sea, 2007. Photograph by C.W. Mecklenburg, Point Stephens Research.

Colloquial Name: *None in U.S. Chukchi and Beaufort Seas.*

Ecological Role: Antlered Sculpin are common in the U.S. Chukchi Sea and uncommon in the U.S. Beaufort Sea. Their respective roles in marine ecosystem dynamics, although unknown, probably are more significant than many other species, and correspond to this abundance pattern.

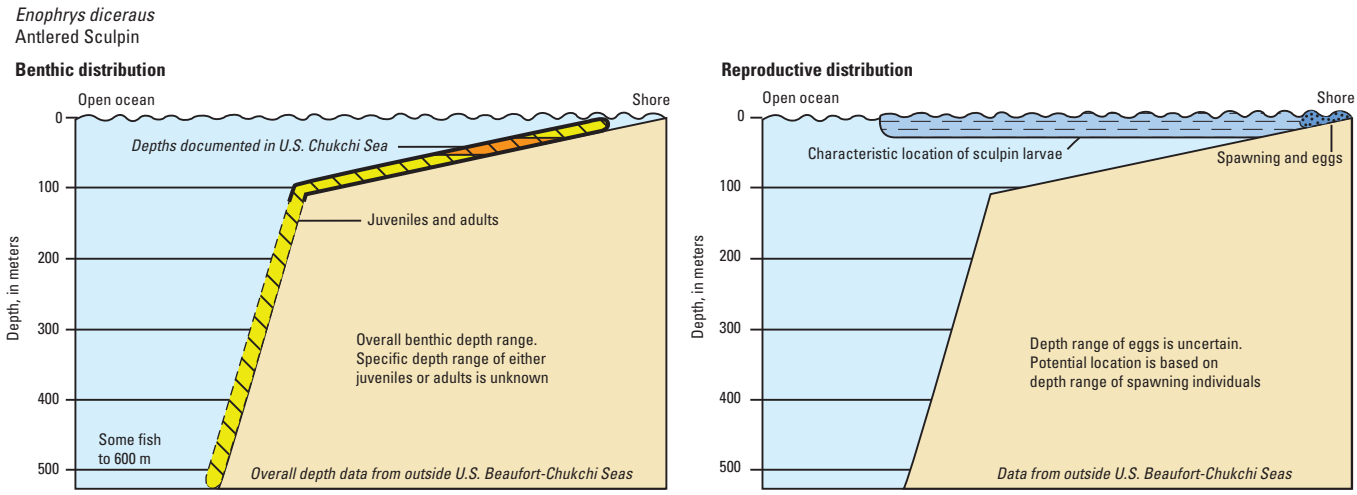
Physical Description/Attributes: Greenish and reddish brown mottling on back and sides on cream or pale yellow background. Often with three or four vague dark bands and some marbling and spotting and fins are barred [1]. Spawning males have dark dorsal, pectoral, and caudal fins [2]. For specific diagnostic characteristics, see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 472) [1]. Swim bladder: Absent [1]. Antifreeze glycoproteins in blood serum: Unknown.

Range: *In U.S. Chukchi Sea* [1, 3] *and western U.S. Beaufort Sea* [4]. Elsewhere in Alaska, in Bering Sea and Commander (Russia)–Aleutian islands chain, southeastwards to Fort Tongass, Alaska. Worldwide, in Sea of Japan to Sea of Okhotsk [1].

Relative Abundance: *Fairly common in the northeastern U.S. Chukchi Sea* [7, 8]. Elsewhere, common from the Sea of Japan [9] and Sea of Okhotsk [10] to Bering Sea [11].

Geographic distribution of Antlered Sculpin (*Enophrys diceraus*), within Arctic Outer Continental Shelf Planning Areas [5] based on review of published literature and specimens from historical and recent collections [3, 6].

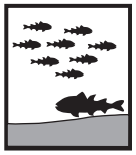
Depth Range: *Documented at 26–50 m in U.S. Chukchi Sea* [7, 12]. In other areas, primarily between 2–120 m deep [3, 13], but has been reported to 600 m in Peter the Great Bay, Sea of Japan [13]. Depth range of larvae and juveniles is unknown. Spawning occurs in nearshore waters as shallow as 2–15 m [2, 13].



Benthic and reproductive distribution of Antlered Sculpin (*Enophrys diceraus*).

Habitats and Life History

Eggs—Size: 1.7–2.2 mm in diameter [2, 13]. Time to hatching: Unknown. Habitat: Nearshore, on rocks [2, 13].
Larvae—Size at hatching: 6.5–6.9 mm. Larvae hatch in spring [2, 13]. Size at juvenile transformation: 1.3–2.2 cm TL in Sea of Japan [2]. Days to juvenile transformation: Unknown. Habitat: Pelagic [2].
Juveniles—Age and size: Age unknown and 1.3–2.2 cm TL to 18–21 cm TL [2, 13]. Habitat: Benthic [2].
Adults—Age and size at first maturity: Most mature at 18–21 cm TL and males grow larger than females [2, 13]. Maximum age: Unknown. Maximum size: 38 cm (15.2 in) TL [13]. Habitat: Benthic. In Prince William Sound, mainly found along protected beachlines and in shallow embayments dominated by seaweed and seagrasses [14]. Large aggregations have also been found over soft sea floors in Sea of Japan [13].
Substrate—*Shell hash, rocks, mixed gravel, sand, and mud* [12, 13].
Physical/chemical—Temperature: Between -1.5 and 10 °C, but may prefer temperatures greater than 0 °C [2, 12, 13, 15]. Salinity: Marine [2].



Behavior

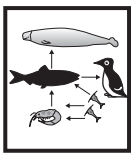
Diel—Unknown.
Seasonal—In Sea of Okhotsk it moves into deeper waters in winter [13].
Reproductive—In Sea of Japan, spawning occurs nearshore on rocks. In autumn, large mature males migrate into spawning areas first, followed by smaller mature males and, lastly, females. Juvenile fish do not inhabit the spawning grounds. Females lay eggs on rocks and these are guarded by adult fish, most likely males. Multiple females may lay their eggs in one nest and egg masses can be as large as 30 × 20 cm [2, 13]. Following spawning migrations occur offshore into deeper waters [13, 16].
Schooling—Unknown.
Feeding—Unknown.

Populations or Stocks

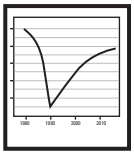
There have been no studies.

Reproduction
Mode—Separate sexes; oviparous [17].
Spawning season—*Unknown in U.S. Chukchi and Beaufort Seas.* Elsewhere, spawning is from November to February [2, 13] and in April and May in the more northerly waters of Sea of Japan [18]. Fecundity: Females produce between 9,523 and 17,160 crimson, orange, or purple eggs [2].

Food and Feeding
Food items—Food habits of larvae unknown. Benthic individuals eat a wide range of benthic prey. Important food items are crustaceans (for example, gammarid amphipods, brachyuran, and hermit crabs), limpets, sea urchins, and brittle stars [14, 16, 18].
Trophic level—3.26 (standard error 0.43) [19].



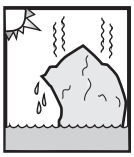
Biological Interactions
Predation—Off Kamchatka Peninsula, Russia, both great and plain sculpins eat this species [20]. At Tee Harbor, southeastern Alaska, commonly eaten by river otters [21].
Competitors—Presumably a wide range of other zoobenthic feeders such as Arctic Cod, Walleye Pollock, other sculpins, poachers, and eelpouts.



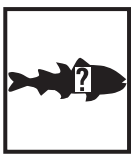
Resilience
Low, minimum population doubling time 4.5–14 years (Preliminary *K* or Fecundity) [19].

Traditional and Cultural Importance
None reported.

Commercial Fisheries
Currently, Antlered Sculpin are not commercially harvested.



Potential Effects of Climate Change
A boreal Pacific species that appears to be common in the Gulf of Alaska, and Bering Sea, and common in the northeastern Chukchi Sea, Antlered Sculpin would be expected to increase in abundance in abundance of shelf areas of both seas.



Areas for Future Research [B]
Little is known about the ecology and life history of this species in Arctic Alaska. Research needs for this species include: (1) depth and location of pelagic larvae; (2) depth, location, and timing of young-of-the-year benthic recruitment; (3) preferred depth ranges for juveniles and adults; (4) spawning season; (5) seasonal and ontogenetic movements; (6) population studies; (7) prey; and (8) predators.

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