Pacific and Arctic Lampreys

Pacific Lamprey (*Entosphenus tridentatus*)

(Gairdner, 1836)

Family Petromyzontidae

Pacific Lamprey (*Entosphenus tridentatus*). Photograph by René Reyes, Bureau of Reclamation.

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

Colloquial Name: None within U.S. Chukchi and Beaufort Seas.

Ecological Role: Its rarity in the U.S. Chukchi Sea and absence from the U.S. Beaufort Sea implies an insignificant role in regional ecosystem dynamics.

Physical Description/Attributes: Elongate, eel-like body, blue-black to dark brown dorsally, pale or silver ventrally. For specific diagnostic characteristics, see *Fishes of Alaska*, (Mecklenburg and others, 2002, p. 61, as *Lampetra tridentata*) [1]. Swim bladder: Absent [2]. Antifreeze glycoproteins in blood serum: Unknown.

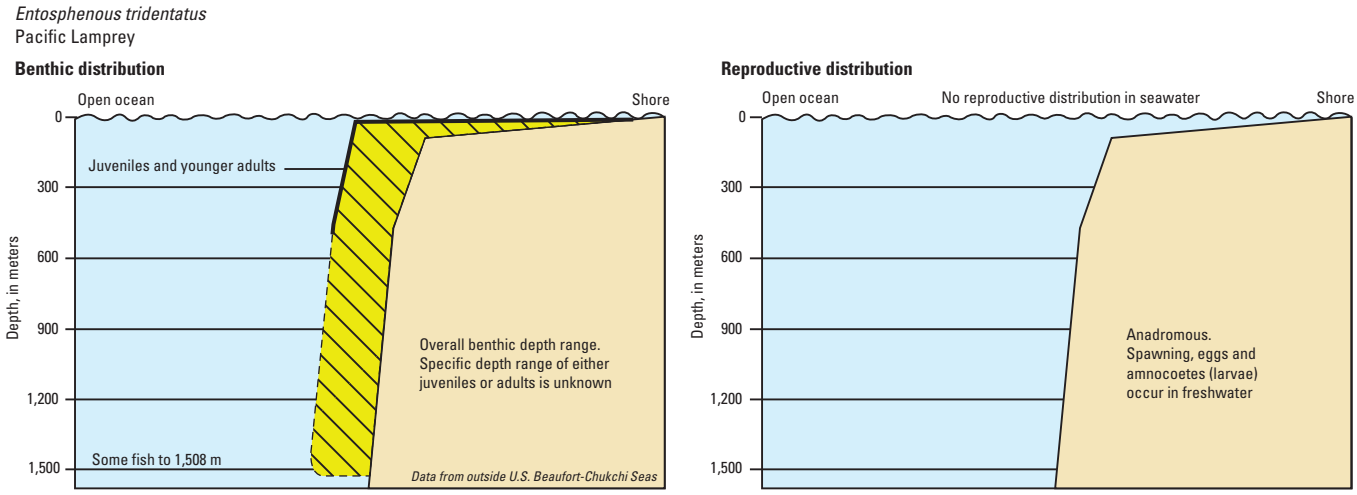
Range: *Eastern U.S. Chukchi Sea* [1, 3]. Elsewhere, from Bering Sea south to Punta Canoas, northern Baja California, Commander Islands, and Pacific coast of Kamchatka Peninsula, Russia, and Honshu, Japan [1].

Relative Abundance: *Rare in U.S. Chukchi Sea, with one record near Cape Lisburne, Alaska* [1, 3]. Common in southeastern Bering Sea [6]. Widespread at least as far southward as Honshu, Japan [7]. Rare to occasional in marine waters off Commander Islands and Pacific coasts of Kamchatka Peninsula, Russia, and Hokkaido, Japan [1].

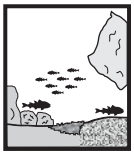
Base modified from USGS and other digital data. U.S.-Russia Maritime Boundary follows the EEZ/200-mile limit line, western edge. Coordinate reference system: projection, Lambert Azimuthal Equal Area; latitude of origin, 75.0°; horizontal datum, North American Datum of 1983.

Geographic distribution of Pacific Lamprey (*Entosphenus tridentatus*), within Arctic Outer Continental Shelf Planning Areas [4] based on review of published literature and specimens from historical and recent collections [3, 5].

Depth Range: Over continental shelf and slope, near surface to 1,508 m. Most abundant at depths less than 500 m and pelagically most abundant above 100 m [7].



Benthic and reproductive distribution of Pacific Lamprey (*Entosphenus tridentatus*).



Habitats and Life History

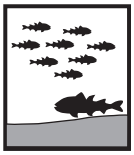
Eggs—Size: Small, 1.1–1.2 mm [8]. Time to hatching: 10–24 days, depending on temperature [9, 10]. Habitat: Freshwater, benthic [3]; attached to rocks among gravel nests near riffles in rivers [9, 11].

Larvae (ammocoetes)—Size at hatching: About 4–5 mm TL [12]. Size at juvenile transformation: From 4.7–17.0 cm [9, 13]. Days to juvenile transformation: 3–7 years [11]. Actual transformation process can take 85–126 days [14]. Habitat: Freshwater, benthic [3]; in gravel redds approximately 2–3 weeks after hatching, then drifts downstream and burrows into soft sediments of slow, shallow depositional areas along stream banks and in pools and eddies [15, 16].

Juveniles (macropthalmia)—Age and size: From 3 to 4.5–8 years [13, 15, 16]. Habitat: Pelagic and benthic in marine water [3]. Marine (parasitic) phase not well understood. Over continental shelf and slope sometimes far offshore [11]. Resides in ocean for 20 months up to 3.5 years, depending on area [7, 13, 17].

Adults—Age and size at first maturity: Unknown. Likely from 4.5–8 years [10–12]. Size at First Maturity: Size varies from 13–72 cm TL [13]. Maximum age: 9 years [18]. Maximum size: 85 cm TL and at least 0.5 kg [7, 11]. Habitat: Freshwater streams and rivers for a few months up to several years before spawning [3, 19]. Substrate: Unknown in ocean. Sandy gravel for spawning. Soft sediment for larval rearing [15, 16].

Physical/chemical—Temperature: Unknown at sea. Spawns between 13 and 18 °C [12]. Salinity: Fresh to marine waters [1].



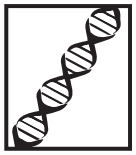
Behavior

Diel—In the ocean, makes daily vertical migrations into pelagic zone, higher at night perhaps to feed [7]. Ammocoete downstream migrations and adult upstream migrations are primarily at night [9, 19].

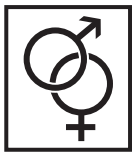
Seasonal—Ammocoete generally transform into juveniles during July through late November [15, 16]. Ammocoetes migrate downstream year-round but mainly from autumn through spring. Migration times differ among populations. In British Columbia, Canada, after leaving their mud-silt habitat they reside in gravel and boulder fields in moderate to strong current streams and then enter seawater from December–June (occasionally earlier than December or later than June) [13]. Adults generally return to freshwater rivers and streams in late spring and early summer (April–June in British Columbia) [13] and reside there from a few months to several years before spawning [19]. Generally, spawning begins the following spring and summer (about May–July) depending on river system [19].

Reproductive—Semelparous, most die within a month after spawning [16], though some seem to spawn at least twice [20]. Spawning occurs in low-gradient streams in sandy gravel usually at riffle heads and in pool tailouts [15, 19]. Males initiate nest building and then joined by females. Nests are constructed by fish attaching to rocks to lift them out of the nest and by digging down within the nest to line the bottom with loose sand for egg attachment [19]. Adults attach themselves side by side to a rock or to each other and release sperm and eggs.

Fertilized eggs drift into nests and attach to rocks. Some adults then cover eggs with rocks or debris [11].
Schooling—Unknown at sea. At times, tends to congregate in certain areas in freshwater rivers [9].
Feeding—Freshwater ammocoetes are burrowing filter feeders [9]. Macropthalmia begin parasitic feeding on fish during seaward migrations [19]. They are parasitic feeders, attaching themselves to fishes using their toothed tongues to penetrate scales and skin to suck out body fluid and blood. While feeding, anticoagulants are produced which prevents host's blood from coagulating [19, 21]. In general, host fish are not killed as various surveys show high incidences of fish with scars. For instance, off the Fraser River, British Columbia, Canada, 66 percent of Sockeye Salmon and 20 percent Coho Salmon had Pacific Lamprey wounds. Lampreys generally attack ventrally and anteriorly, leaving one to three holes, with younger fish creating more holes. They have been shown in the laboratory to hang on to a host for several days [13]. Feeding ceases during upstream migrations [22].

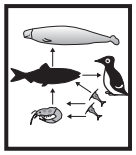


Populations or Stocks
There have been no studies within the study area. Elsewhere, recent studies show low levels of genetic differentiation between populations separated by large geographic distances [19].

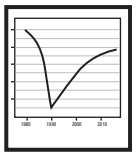


Reproduction
Mode—Oviparous, external fertilization [1].
Spawning season—Differs with regions, spawning earlier farther north. April–July in British Columbia [12]; in southern California occurs as early as January and may continue into at least May [23].
Fecundity—10,000–238,000 eggs [12, 16].

Food and Feeding
Food items–Ammocoetes: Detritus, diatoms and algae [19]. Parasitic macropthalmia and adults: Fishes and mammals including Greenland and Pacific Halibut, Arrowtooth and Kamchatka Flounders; Sablefish, Pacific Hake, Walleye Pollock, Pacific Cod, and Lingcod; Pink, Sockeye, Coho, and Chinook Salmon; Steelhead; Yellowmouth and Rougheye Rockfish; and cetaceans [13, 22]. Off Russia, Greenland Halibut were the most common prey [22].
Trophic level: 4.5 (standard error ±0.80) [18].



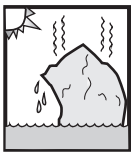
Biological Interactions
Predators—Fishes including Sablefish, rockfishes, various sharks, and White Sturgeon [11, 16, 24–26]. Ammocoetes are eaten by Coho Salmon [16]. Larger fish eaten by harbor seals, California sea lion, Steller sea lion, northern elephant seal, northern fur seal, sperm whales, Pacific White-sided Dolphin, minks, California Gulls, Ring-billed Gulls, Western Gulls, Foster's Terns, Great Blue Herons, and Common Murres [13, 16, 27–31, 32, 33].
Competitors: Pacific Lamprey in seawater [21].



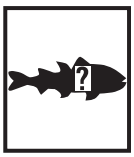
Resilience
Low, minimum population doubling time: 4.5–14 years (t_m 6–8; Fecundity=10,000–106,000) [18].

Traditional and Cultural Importance
None reported.

Commercial Fisheries
Currently, Pacific Lamprey are not commercially harvested.



Potential Effects of Climate Change
Unknown.



Areas for Future Research [B]
Little is known about the ecology and life history of this species in the U.S. Arctic. Research needs include: (1) locations of spawning areas, (2) spawning season, (3) size and age at maturity, (4) seasonal and ontogenetic movements, (5) population studies, (6) prey, and (7) predators.

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Arctic Lamprey (*Lethenteron camtschaticum*)
(Tilesius, 1811)

Family Petromyzontidae

Arctic Lamprey (*Lethenteron camtschaticum*), 176 mm TL, Norton Sound, northeastern Bering Sea, 2002. Photograph by C.W. Mecklenburg, Point Stephens Research.

Colloquial Name: Iñupiat: *Nimiqiaq* [24]

Ecological Role: The extent of this lamprey's parasitisms is *unknown in U.S. Chukchi and Beaufort Seas*.

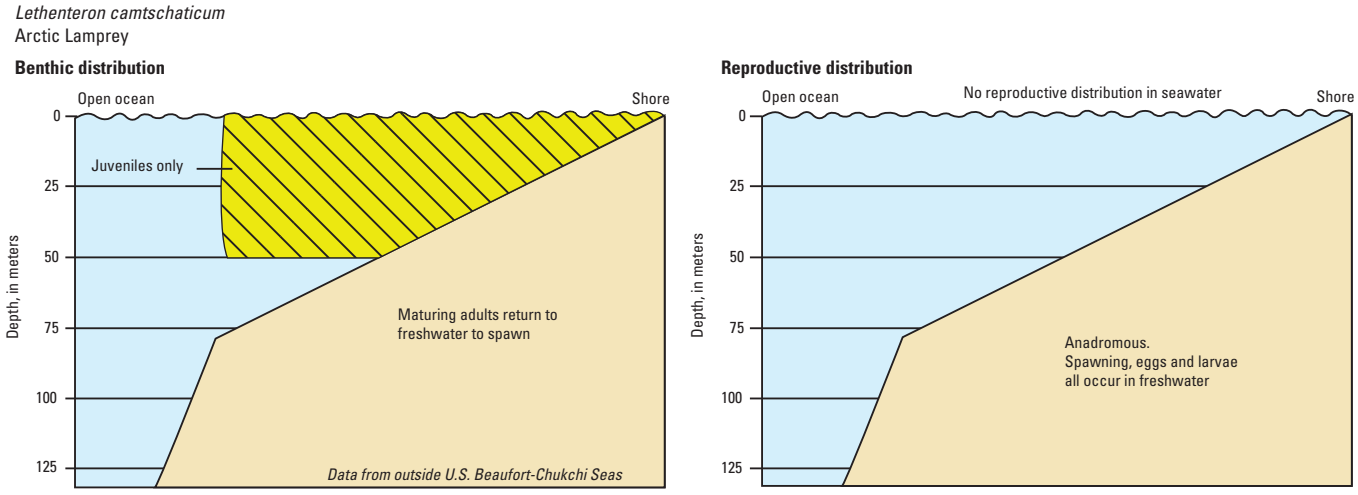
Physical Description/Attributes: Elongate, eel-like body, blue-black to dark brown dorsally, silvery when fresh on sides and ventral surface, with blackish blotch on second dorsal fin and on tail. For specific diagnostic characteristics see *Fishes of Alaska* (Mecklenburg and others, 2002, p. 62) [1]. Swim bladder: Absent [2]. Antifreeze glycoproteins in blood serum: Unknown.

Range: *U.S. Chukchi and Beaufort Seas* [3]. Elsewhere in Alaska, south through Bering Sea to Kenai Peninsula, Gulf of Alaska. Worldwide, White Sea and coasts of southern Barents Sea eastward off Siberia to Beaufort Sea off Anderson River, Canada; in western Pacific Ocean, south to Honshu, Japan, and Korean Peninsula, and East-Finnmark, Norway, in eastern Atlantic Ocean. Not in western Atlantic [3].

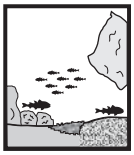
Relative Abundance: *Apparently common in some drainages of the U.S. Chukchi and Beaufort Seas. However, abundance in these drainages and in marine waters is poorly described. Presence at sea is typically indicated by wounds on pelagic fishes*. The most common lamprey in Alaska and, although abundance patterns are unknown, thought to occur in high numbers in localized areas [1, 6]. Common in Sea of Japan and around Sakhalin Island, Russia [7, 8].

Geographic distribution of Arctic Lamprey (*Lethenteron camtschaticum*) within Arctic Outer Continental Shelf Planning Areas [4] based on review of published literature and specimens from historical and recent collections [3, 5].

Depth Range: Anadromous. Pelagic at sea over continental shelf to bottom depth of 50 m [1].



Benthic and reproductive distribution of Arctic Lamprey (*Lethenteron camtschaticum*).



Habitats and Life History

There are two life-history types, anadromous-parasitic and fluvial-nonparasitic. Eggs and ammocoete larvae of both types are demersal in freshwater lakes and streams. There are three juvenile/adult forms: typically anadromous, anadromous early maturing forma praecox (predominantly males), and resident freshwater. Both forms of anadromous fish are pelagic and migrate to sea. When mature they return to freshwater to spawn. The non-parasitic resident fish remain exclusively in fresh water until spawning [1, 9, 10].

Eggs—Size: As large as 1.25 mm, average of 0.8 mm [9]. Time to hatching: About 1 month after spawning [9]. Habitat: Pebble-sandy bottoms in rivers.

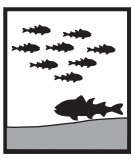
Ammocoetes (larvae)—Size at hatching: 6.8 mm long. Size at juvenile transformation: 13.1–16.8 cm [9]. Time to juvenile transformation: 4 years and longer [9]. Habitat: Sedentary burrowers in river and lake bottoms [11].

Juveniles/smolts (anadromous forms)—Age and size: 4–5 years. Transformation to smolt stage takes approximately 6 months and ends in downstream migration to the sea [10]. Size ranges from 13.0–16.8 to as long as 16.5–21.7 cm TL and from 2.8–4.4 to about 3.1–9.1 g. [10]. Habitat: Pelagic, in downstream migrations to the sea [10].

Adults—Age and size at first maturity: 7 years for anadromous form, 6 years for forma praecox and 5 years for freshwater residents. Typically, anadromous form is 25.0–35.0 cm TL and 30–88 g for males and 17.4–33.0 cm TL and 30–75 g for females [9, 10]. Anadromous forma praecox (predominantly males) is 14.5–22.0 cm TL and 3.2–15 g [9]. Freshwater residents are 11.3–13.9 cm and 1.6–5.0 g for males, and 110–141 cm TL and 2.1–4.5 g for females. Maximum age: Same as age at first maturity. Maximum size: 62.5 cm TL (anadromous form) [1]. Habitat: Anadromous form migrates downstream and becomes pelagic in shallow marine waters over continental shelf. Forma praecox remains in seawater from several months to 1 year, whereas typically anadromous lamprey remain as much as 1 year longer [9].

Substrate—In freshwater, gravel-sand for spawning and muddy sediments for ammocoete rearing [1].

Physical/chemical—Temperature: Spawning occurs between 12 and 15 °C in southwestern Alaska [12]. Salinity: Marine and fresh waters.



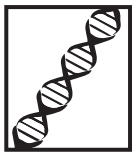
Behavior

Diel—Ammocoetes are primarily active at night and burrow into sediments during day [6].

Seasonal—Metamorphosed ammocoetes migrate downstream to sea during August–November in Alaska [10] and May–July in Russia [9].

Reproductive—Adults migrate upstream to spawn in spring. Redds are constructed in riffles with pebbly-gravel bottom where sand prevails [10]. Redds are made by lampreys sucking on to rocks and swimming them away [13]. There is group spawning behavior in fast currents and paired behavior in slow, nearshore zones. In group

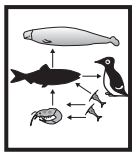
behavior, 6–44 individuals attach themselves by sucking on to each other and drifting downstream. Numerous males may attach to one female. Afterwards, individuals return to spawning redds. Females lay several batches of eggs in redd. One batch of eggs may be fertilized by several males. After spawning, fish stir up silt and small stones to cover the eggs [13]. Adults die after spawning [1].
Schooling—Migrating adults frequently congregate in large numbers, particularly around obstructions [14].
Feeding—Ammocoetes are filter feeders, whereas anadromous juveniles and adults are parasitic, feeding on other fish tissues and blood. Freshwater residents cease feeding upon sexual maturity [9, 10].



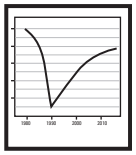
Populations or Stocks
There have been no studies.

Reproduction
Mode—Separate sexes, oviparous [9, 13].
Spawning season—Spring in southwestern Alaska, generally late May to early July [12].
Fecundity: 12,272–34,586 eggs [9].

Food and Feeding
Food items—Ammocoetes filter-feed on small aquatic invertebrates, algae and fine organic debris [9]. Adults parasitize fish, including Pacific salmon, Starry Flounder, Saffron Cod, Least Cisco, Arctic Cisco, Broad Whitefish, Pacific Herring and smelt [11, 15–17].
Trophic level—4.5 (standard error ±0.81) [18].

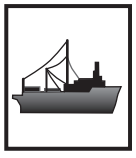


Biological Interactions
Predators—All life stages are preyed on by various fishes including Burbot, Northern Pike, Dolly Varden, and Inconnu; also taken by gulls, especially when lamprey are concentrated in shallow streams during migration [19].
Competitors—Pacific Lamprey in seawater [14]. In Alaska, often found co-occurring with Alaskan Brook Lamprey (*L. alaskensis*) [1].

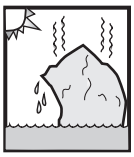


Resilience
Low, minimum population doubling time: 4.5–14 years (t_m 4–5) [18].

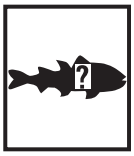
Traditional and Cultural Importance
None reported. Alaskan Natives on the Yukon and Kuskokwim Rivers have taken them in quantity for food using dip nets and sharped sticks [20, 21]. A small commercial fishery on the Yukon River was started in 2003 [6]. Commercially harvested in Sea of Okhotsk [22].



Commercial Fisheries
Currently, in Alaska, Arctic Lamprey are not commercially fished.



Potential Effects of Climate Change
Unknown.



Areas for Future Research [B]
Little is known about the ecology of this species from this 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.

Remarks

This is the most abundant and widely distributed lamprey in Alaska [23].

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