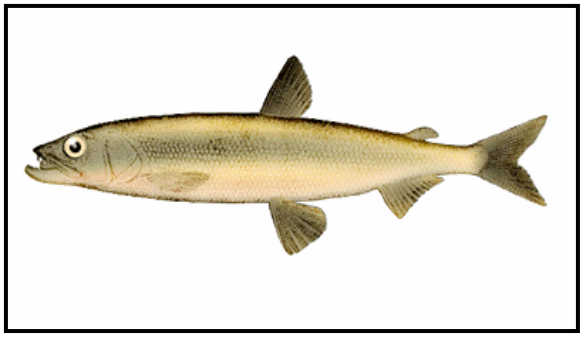
RAINBOW SMELT

TAXONOMY



Scientific name: *Osmerus mordax* (Mitchill, 1814)
Common name: rainbow smelt
Family: Osmeridae
Taxonomic comments:
Both sea-run (anadromous) and lake-resident (lacustrine) populations occur; lacustrine populations include "dwarf-" and "normal-sized" life-history types, which in at least some instances are reproductively isolated; however, geographic proximity, rather than morphotype, appears to be the major determinant of genetic affinities among populations; smelt ecotypes evidently are polyphyletic resulting from multiple independent divergences of life-history types throughout northeastern North America (Taylor and Bentzen 1993, Taylor 2001).

Some lacustrine populations of dwarf rainbow smelt in Quebec, New Brunswick, and Maine were regarded as a separate species, *O. spectrum*, by Lanteigne and McAllister (1983). However, the 1991 and 2004 AFS checklists did not accept *O. spectrum* as a valid species because of the apparent multiple independent origins of the dwarf form (Robins et al. 1991, Nelson et al. 2004).

See Begle (1991) for a classification and phylogeny of osmeroid fishes based on morphology.

DESCRIPTION

Basic description: An anadromous smelt.

Diagnostic characteristics:
A small smelt, body elongate, compressed and slender. Presence of small adipose fin and strong canine teeth make this species easy to identify. Olive green speckled with black dorsally, silvery band (often with purple, blue or pink iridescence) laterally, white ventrally. Relatively few anal rays; pelvic fin origin below or slightly posterior to dorsal fin origin. Scales thin and easily rubbed off. Spawning males develop numerous small nuptial tubercles on head, body and fins.
Length (cm): 25

Reproduction:
Spawns in spring, usually peaking with bimonthly spring tides, when water temperatures reach 4.4°C or higher, depending on local conditions (Hulbert 1974). Eggs typically deposited on sand, gravel, small boulders, and aquatic vegetation. Eggs hatch in 2-3

weeks. May first breed at age of 1 year in south, usually at 2 years or older in north (Buckley 1989). Spawned out fish, especially males, die after spawning; however, some may survive to spawn the following year, and it is likely that a few may spawn several times during their lives (see sources in Morrow 1980). Maximum lifespan reported at 6-7 years (Morrow 1980, FishBase 2006).

Ecology:
An abundant forage fish, preyed on by many commercially and recreationally valuable coastal marine species, such as striped bass and bluefish; provides forage for several species of salmon and trout in the Great Lakes; supports an important coastal and estuarine sport fishery throughout most of range, particularly in the Great Lakes, New England, and Eastern Canada (Buckley 1989).

Begins to school when about 19 mm long. Major predators on eggs in the Great Lakes are mummichog and fourspine stickleback (Buckley 1989).

Migration:
Some populations are anadromous; others are resident in lakes. Anadromous populations migrate usually a short distance (a few km) upstream to spawn in freshwater streams, although upstream migrations of >1,000 km have been observed in Siberia (Berg 1948 in Morrow 1980); resident freshwater populations may move short distances to nearby streams to spawn.

Food:
Larvae and juveniles in coastal waters eat copepods and other planktonic crustaceans; larger juveniles and adults feed on euphausiids, amphipods, polychaetes, and fishes (Buckley 1989). In the Great Lakes, larvae feed mainly on dipteran larvae, crustaceans, and fishes; in Lake Michigan, diet of adults and juveniles largely comprised of *mysids* in winter and young-of-the-year and yearling alewives in spring and summer (Buckley 1989). Feeding virtually ceases during spawning (Morrow 1980).

Phenology:
In the Great Lakes, active feeding began at dusk and ceased by nightfall (Buckley 1989). Spawning generally occurs at night, but daytime spawning has been reported for both anadromous and landlocked populations (Rupp 1959, McKenzie 1964).

Habitat:
Midwaters of lakes, inshore coastal waters, rivers and estuaries. Generally found within 2 km of shore along coast, close to the surface and in water less than 6 m deep (Buckley 1989), although has been reported to depths of 150 m (Mecklenburg et al. 2002) and 425 m (Allen and Smith 1988). Some populations are anadromous, others entirely freshwater. Schools of young move into shallow water at night, deeper channels the during day (Buckley 1989). Spawns in streams (to at least 25 km from lake) or on gravel of lake shores. In coastal streams, most spawn above head of tide (Buckley 1989). In some areas, a single individual may spawn in several streams during a single breeding season. Salinities of 12-14 ppt are fatal to eggs. Eggs attach to gravel on bottom. Larvae

drift downstream, concentrate near surface; later tend to congregate on bottom in deeper areas, except at night when they move to surface apparently to feed (Buckley 1989).

STATUS

Global rank: G5 (12Sep1996)
Global rank reasons:
Secure – widespread and abundant.

State rank: S3S5 (28Apr2006)
State rank reasons:
Widespread distribution. Abundant where species occurs locally; overall population unknown but considered scarce. Potential threats include pollution and alteration of freshwater and marine habitats. Effects of climate change on marine environment unknown, but of concern.

DISTRIBUTION AND ABUNDANCE

Range:
Global range:
Native in Atlantic coastal drainages from about the Delaware River, Pennsylvania, to the Gulf of St. Lawrence and Lake Melville, Newfoundland (Labrador), and west through the Great Lakes, Arctic, and Pacific drainages from Bathurst Inlet, Northwest Territories, to Vancouver Island, British Columbia. Also in Old World. Occurs naturally in lakes and ponds in New Hampshire, Maine, New Brunswick, Nova Scotia, and Newfoundland (Buckley 1989). Introduced in many areas of eastern and central North America, including Great Lakes watershed; seasonally present in main channels of Missouri, Mississippi, Ohio, and Illinois rivers from Kentucky to Montana and south to Louisiana (Page and Burr 1991). Common, locally abundant.

State range:
Occurs along the entire coast of Alaska, but less common in the Gulf of Alaska (Mecklenburg et al. 2002), and has not been recorded between Lituya Bay and the tip of the Alaska Peninsula (Morrow 1980). Also known from St. Lawrence Island (Morrow 1980).

Abundance:
Global abundance:
Species is locally and seasonally abundant wherever it is present, except perhaps the most extreme limits of its range (Morrow 1980).

State abundance:
Considered scarce in Alaska, although likely locally and seasonally abundant where it is present (Morrow 1980). Abundant in winter in Harrison Bay near the mouth of the Colville River; least common in the Gulf of Alaska (see sources in Mecklenburg et al. 2002).

Trends:

Global trends:
In New England, annual commercial landings reached 550,000 kg in 1889, then decreased to 215,250 kg in 1951-1954 and declined further to 69,700 kg in 1969-1971 (see sources in Morrow 1980).

State trends:
Unknown.

EXISTING PROTECTION

Global protection:
No official protection throughout range; in the U.S. harvest may be managed by commercial and sport fishery regulations. East Coast population added to the NMFS Species of Concern list (15 April 2004).

State protection:
No official protections in Alaska.

CHALLENGES

Global challenges:
Potential threats include overharvest and/or unmonitored harvest in commercial and sport fisheries, pollution or alteration of both freshwater and marine habitats (e.g., from oil spills, wastewater effluent, or obstruction by dams) and possibly environmental impacts associated with global climate change. Commercial harvest declines in New England (see Global trend comments) believed to be the result of pollution and obstructions in spawning streams as well as decreased consumer demand (Morrow 1980).

State challenges:
Potential threats include pollution or alteration of freshwater, estuarine and marine habitats (e.g., from oil spills, wastewater effluent) and possible environmental impacts associated with global climate change. Habitat alteration from water diversions, dams, timber harvest, mining, and sedimentation may impact smelt survival by reducing instream flow, restricting fish passage, and degrading water quality (ADFG 2005). The effects of broad-scale climate shifts on marine ecological conditions that could impact rainbow smelt populations in Alaska are unknown, but of concern (ADFG 2005).

RESEARCH AND INVENTORY NEEDS

Global research needs:
Research needed on life history, oceanic population structure, migration patterns, trophic ecology and habitat requirements for both anadromous and lake-resident populations.

State research needs:
Research needed on general life history, population structure, migration patterns, and habitat requirements for all life history phases including instream flow needs and marine population requirements. Collect biological samples to find size, sex ratio, and age structure (ADFG 2005). An important forage species for upper level predators; trophic ecology needs study.

Global inventory needs:
See State inventory needs.

State inventory needs:
Alaskan population is poorly documented; information needed on general distribution, abundance and trends. Surveys to measure abundance and identify trends should be conducted at index locations. Survey river mouths to the determine limits of upstream spawning habitat (ADFG 2005).

CONSERVATION AND MANAGEMENT NEEDS

Global conservation and management needs:
See State conservation and management needs.

State conservation and management needs:
Harvest levels are currently not monitored – develop protocols to monitor locations, timing, magnitude and level of harvest. Identify and map important habitat areas (marine, estuarine and freshwater) from literature review and survey data (ADFG 2005).

LITERATURE CITED

Alaska Department of Fish and Game (ADFG). 2005. Freshwater fish- introduction, and Anadromous smelts. In: Our wealth maintained: a strategy for conserving Alaska's diverse wildlife and fish resources, a Comprehensive Wildlife Conservation Strategy emphasizing Alaska's nongame species. Anchorage, AK.

Allen, M.J. and J.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and northeastern Pacific. NOAA Tech. Rep. NMFS 66, 151 p.

Begle, D. P. 1991. Relationships of the osmeroid fishes and the use of reductive characters in phylogenetic analysis. Systematic Zoology 40:33-53.

Buckley, J. L. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)--rainbow smelt. U.S. Fish Wildl. Serv.

FishBase. 2006. FishBase: a global information system on fishes. Available online at: http://filaman.ifm-geomar.de/search.php. Accessed 15Mar2006.

Hulbert, P. J. 1974. Factors affecting spawning site selection and hatching success in anadromous rainbow smelt (*Osmerus mordax*, Mitchill). M.S. Thesis, University of Maine, Orono, MN. 43 pp.

Lanteigne, J., and D. E. McAllister. 1983. The pygmy smelt, *Osmerus spectrum* Cope, 1870, a forgotten sibling species of eastern North American fish. Syllogeus, National Museum of Canada, Ottawa, Ontario, Canada. No. 45.

McKenzie, R. A. 1964. Smelt life history and fishery in the Miramichi River, New Brunswick. Fisheries Research Board of Canada, Ottawa. 77 pp.

Mecklenburg, C.W., T.A. Mecklenburg and L.K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, MD.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Alaska Northwest Publishing Co., Anchorage, AK. 248 pp.

Nelson, J. S., E. J. Crossman, H. Espinosa-Perez, L. T. Findley, C. R. Gilbert, R. N. Lea, and J. D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, MD. 386 pp.

Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Company, Boston, MA. 432 pp.

Robins, C. R., et al. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.

Rupp, R. S. 1959. Variation in the life history of the American rainbow smelt in inland waters of Maine. Transactions of the American Fisheries Society 88, 241–252.

Taylor, E. B. 2001. Status of the sympatric smelt (genus Osmerus) populations of Lake Utopia, New Brunswick. Canadian Field-Naturalist 115:131-137.

Taylor, E. B., and P. Bentzen. 1993. Evidence for multiple origins and sympatric divergence of trophic ecotypes of smelt (*Osmerus*) in northeastern North America. Evolution 47:813-832.

Acknowledgements

State Conservation Status, Element Ecology & Life History Author(s): Schoen, S., T.A.Gotthardt and J.G. McClory, Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, Anchorage, AK, http://aknhp.uaa.alaska.edu.
State Conservation Status, Element Ecology & Life History Edition Date: 16May2006

Life history and Global level information were obtained from the on-line database, NatureServe Explorer (www.natureserve.org/explorer). In many cases, life history and Global information were updated for this species account by Alaska Natural Heritage Program zoologist, Tracey Gotthardt. All Global level modifications will be sent to NatureServe to update the on-line version.

Global Element Ecology & Life History Edition Date: 03Dec1993
Global Element Ecology & Life History Author(s): Hammerson, G.

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