CAPELIN

Mallotus villosus Müller, 1776
(Osmeridae)

Global rank GNR – recommended change to G5 (12Sep2005)
State rank S5 (12Sep2005)
State rank reasons
Widespread and abundant in coastal areas, although Gulf of Alaska stocks have undergone dramatic fluctuations since the mid-1970s. Current trend appears to be stable although abundance information is likely imprecise. Possible threats include ecosystem shifts caused by climate change, incidental bycatch in commercial fisheries, and contamination of spawning habitat (e.g., oil spills).

Taxonomy
Atlantic and Pacific stocks once considered separate species (*Mallotus villosus* and *M. catervarious* Pennant, respectively); now considered one species, *M. villosus* (McAllister 1963). Systematic relationships in the family Osmeridae are debated, but genus *Osmerus* generally considered a close relative of *Mallotus* (Mecklenburg et al. 2002). Russian literature sometimes refers to a Pacific subspecies, *M. v. socialis*, not generally recognized (Pahlke 1985).

General description
Slender, silvery blue, olive-green or yellow-green colored, small-scaled fish that grow to a maximum length of 25 cm (Carscadden 1981, Mecklenburg et al. 2002, Nelson 2003). Head is pointed, lower jaw extends beyond the upper, pectoral rays numerous (usually 17-20). Back and head darken at spawning time, and males develop a ridge of raised scales lending a hairy appearance to the lateral line and base of anal fin. Pronounced sexual dimorphism; in addition to spawning ridges, males also have much longer pectoral fins.
Length (cm) range 13-25
Weight (g) 15-40 (average)

Reproduction
Spawning occurs in Alaska and much of the Pacific during mid-May to late July; in the Atlantic, varies with location from April to August (Carscadden 1981, Pahlke 1985, Brown 2002, Nakashima and Wheeler 2002). Capelin move inshore to spawn on coarse sand and/or gravel beaches at age 2-3 when they are between 110-170 mm (Winters 1970, Hart 1973, Carscadden et

al. 1997). Spawning generally occurs at depths less than 75 m (Pahlke 1985), although demersal spawning to depths of 280 m has been reported in Newfoundland (see sources in Nakashima and Wheeler 2002). Spawning activity is limited by surface water temperature, generally occurs between 5 to 10°C (12°C apparently the upper limit; Nakashima and Wheeler 2002), normally at night or on overcast days (Pahlke 1985, Brown 2002).

While spawning, each female is accompanied by two males that press her between them. Females release between 6,000-14,500 eggs. Most capelin die shortly after spawning, but there is evidence from the Atlantic that some females may reproduce more than once (Flynn and Burton 2003). Eggs incubate in beach sand and gravel; generally hatch at 15-30 days though longer incubation periods may result from varying conditions (Carscadden 1981, Pahlke 1985). Sexual maturity at around 3 years (range 1-4 years); females mature earlier than males; lifespan rarely greater than 5 years (Naumenko 1996).

Ecology
Capelin are a high energy food source and play a key role in marine food webs, transferring energy to higher level predators such as large fishes (e.g., cod, herring, and halibut), marine mammals (e.g., humpback whale, Steller sea lion), and birds (e.g., Common Murre, Black-legged Kittiwake) (Montevecchi and Piatt 1984, Erikstad 1990, Gjøsæter 1998, Payne et al. 1999). Predation can be high during and after spawning events (e.g., large predatory fish, such as halibut, gorge themselves on spawning capelin). Compete with Arctic cod for food (Gjøsæter 1998). Declines in marine mammal and bird populations in the Gulf of Alaska and Barents Sea have been linked to shifts in abundance and composition of forage fish stocks which included drastic capelin declines (Barrett and Krasnov 1996, Hansen 1997, Anderson and Piatt 1999). Species is sensitive to changes in the marine environment, having fairly

narrow temperature preferences; consequently, considered an indicator species for climate change (Piatt and Anderson 1996, Abookire and Piatt 2005).

Economy

Historically harvested for roe, dog food, bait and fertilizer in Canada, Russia, Norway and Alaska (Carscadden 1981, Wespestad 1987); currently commercially harvested in Canada and Europe (FAO 2005, Mongabay 2005).

Migration

Capelin spend most of their lives offshore, moving inshore only to spawn. In the Barents Sea, seasonal migration is associated with winter advance (southward) and summer retreat (northward) of the productive polar ice front, with inshore movements during spawning (Gjøsæter 1998, Hjermann et al. 2004). Off coastal Newfoundland and Labrador, Canada, larvae migrate offshore, then south during winter; adults move northward during spring on their return to spawning beaches (Nakashima 1992). In the Bering, Chukchi, and Beaufort Seas, Alaska, adult capelin are found nearshore only during summer spawning months; during other times of the year they occur far offshore near the Pribilof Islands and continental shelf break (see sources in Pahlke 1985, Fritz et al. 1993).

Distinct vertical migrations are observed in the Barents Sea during spring and fall, when adult capelin are found near the bottom during daylight hours and near the surface at night. Migrations are less distinct in winter and summer when changes in light intensity are minimal. Capelin occur in upper and intermediate layers during winter before spawning and migrate vertically without diurnal rhythm during summer (Gjøsæter 1998).

Food

Planktonic crustaceans, copepods, euphausiids, amphipods, marine worms, and small fishes. Important forage species include *Calanus* and *Pseudocalanus* copepods, *Thysanoessa inermis* and *T. raschii* (euphausiids) and amphipods *Themisto* spp. (Gjøsæter 1998).

Habitat

General habitat:

Marine, pelagic; from surface to depths exceeding 200 m in coastal areas and on offshore banks (Mecklenburg et al. 2002). Adults commonly associated with the continental shelf off Alaska except in Southeast Alaska where species is found nearshore in areas where the shelf is narrow (Brown 2002). In Alaska, capelin distribution appears to be temperature dependent, the fish preferring bottom temperatures of less than 4°C (Brodeur et al. 1999). In the Atlantic and the Bering Sea, commonly associated with polar ice front; low water temperatures and high productivity at ice edge may create optimal feeding zones.

Spawning habitat: Spawning activity strictly limited by water temperature; range 1.4 - 12°C (Pahlke 1985, Nakashima and Wheeler 2002). Preferred spawning substrate is sand/gravel ranging from 0.5 to 25 mm in diameter (Pahlke 1985, Wespestad 1987). Spawning beaches are generally gently sloping, sometimes with heavy wave action (Pahlke 1985).

Global range

Circumboreal-Arctic. Beaufort Sea to Strait of Juan de Fuca in eastern Pacific, across southern Arctic Canada, and south in western Atlantic to Cape Cod, Massachusetts. Western Pacific to Japan and Korea, Sea of Okhotsk (Mecklenburg et al. 2002). Five independent stocks likely in the Bering Sea (Naumenko 1996), 4 or 5 stocks believed to occur off Newfoundland in the Atlantic Ocean (Carscadden 1981, Nakashima 1992). Often associated with the polar ice edge.

State range

Entire Alaska coastline. In the Bering Sea, adult distribution is associated with the polar ice front. In the Gulf of Alaska, which remains ice-free year-round, capelin overwinter in bays (Nelson 2003). During summer feeding period, adult distribution in relation to shore appears to be related to the width of the continental shelf. Over the broad shelf in the eastern Bering Sea, commonly found several 100 km offshore, and move inshore only to spawn. Nearshore distribution in the Gulf of Alaska is opposite the reported movement offshore by older larvae and immature capelin in the eastern Bering Sea. In regions of the Gulf of Alaska where the shelf is narrow (e.g., Southeast Alaska), capelin are widely distributed near shore and in bays and fjords during summer. In areas where the shelf is wider (e.g., Prince William Sound), have been observed ranging out over the shelf 100 km from shore. Near Kodiak, concentrate in nearshore bays and fjords during summer (see Brown 2002 and references therein).

Global abundance
The Barents Sea stock is potentially the largest capelin stock in the world, reaching 6-8 million tons in some years (Gjøsæter 1998, Ushakov and Prozorkevich 2002). Various estimates exist for Northeast Pacific stocks: Wolotira et al. (1977) estimated 190 mt (metric tons) for Norton Sound and the southeast Chukchi Sea; Laevastu and Favorite (1978) estimated 4.3 million tons (of primarily capelin and sand lance *Ammodytes hexapterus*) in the eastern Bering Sea; Trumble (1973) estimated 250,000-500,000 tons for the entire Northeast Pacific stock (calculated as a proportion of the Atlantic stock) and Wespestad (1987) estimated 500,000 mt for the same region in 1986. Biomass estimates from groundfish surveys conducted in the western, central and eastern Gulf of Alaska in 2003 were 18 mt, 2,258 mt, and 298 mt, respectively (Nelson 2003).

State abundance
Relative abundance varies greatly throughout species' range and from year to year (Pahlke 1985). In Alaska, capelin are notably abundant around eastern Kodiak Island, in the eastern Bering Sea, and in the southeastern Bering Sea along the Alaska Peninsula (Brown 2002). Various biomass estimates exist for Alaska capelin stocks: Wolotira et al. (1977) estimated 190 mt (metric tons) for Norton Sound and the southeast Chukchi Sea; Laevastu and Favorite (1978) estimated 4.3 million tons (of primarily capelin and sand lance *Ammodytes hexapterus*) in the eastern Bering Sea. Biomass estimates from groundfish surveys conducted in the western, central and eastern Gulf of Alaska in 2003 were 18 mt, 2,258 mt, and 298 mt, respectively (Nelson 2003).

Global trend
Fluctuates dramatically (Gjøsæter 1998, Naumenko 1996); past trends have not always been recognized before stocks crashed.

North Atlantic: In 2003, the Barents Sea capelin stock was estimated at only 530,000 tons, compared to 2.2 million tons in 2002 (Gjøsæter et al. 2003). A sharp decline in the Barents Sea capelin stock was also observed in 1984-1986 and 1992-1994 (Gjøsæter 1998, Yndstad and Stene 2002, Hjermann et al. 2004).

North Pacific: In the Gulf of Alaska, capelin appear to have been historically abundant and dominated small-mesh trawl catches until the late 1970s (Brown 2002). Gulf of Alaska stocks peaked in 1974, followed by a second peak in 1980 (Anderson et al. 1996); after 1980, capelin disappeared from survey catches and as of 1997 had yet to reappear in surveys in any significant numbers (Anderson et al. 1996, Piatt and Anderson 1996). However, Brown (2002) reports an apparent comeback in capelin stocks since the mid-1990s in Prince William Sound and the Gulf of Alaska interface, where large spawning aggregations have recently been documented.

State trend
In the Gulf of Alaska, capelin appear to have been historically abundant and dominated small-mesh trawl catches until the late 1970s (Brown 2002). Gulf of Alaska stocks peaked in 1974, followed by a second peak in 1980 (Anderson et al. 1996); after 1980, capelin disappeared from survey catches and as of 1997 had yet to reappear in surveys in any significant numbers (Anderson et al. 1996, Piatt and Anderson 1996). Although biomass estimates remain substantially lower than historical highs, groundfish surveys in the Gulf of Alaska indicate a general increase in capelin biomass from 1984 (387 mt in central GOA, 7 mt in eastern GOA) to 2003 (2,258 mt and 298 mt, respectively); however, biomass estimates for other locations in the Gulf (e.g., Pavlof Bay) indicate the reverse (Pavlof Bay: 1972 CPUE = 23.264 kg/km^2, 2001 CPUE = 0.003 kg/km^2; Nelson 2003). Brown (2002) reports an apparent comeback in capelin stocks since the mid-1990s in Prince William Sound and the Gulf of Alaska interface, where large spawning aggregations have recently been documented.

State protection
Amendments to the Gulf of Alaska and Bering Sea and Aleutian Islands Groundfish Fishery Management Plans prohibit the directed commercial fishery of any species in the forage fish category, and limits forage fish bycatch to 2% (Nelson 2003).

Global threats
Threats include ecosystem shifts caused by climate change, overharvest of some stocks, incidental bycatch in fisheries that target other species, and contamination of spawning habitat (e.g., oil spills).

State threats
Threats include ecosystem shifts caused by climate change, incidental bycatch in fisheries for

other species, and contamination of spawning habitat by oil spills.

Capelin and other forage fish species exhibited a variable population trend resulting from decadal shifts in temperature, and a possible decline during the most recent warm regime in the Gulf of Alaska (late 1970s; Anderson and Piatt 1999). In the Barents Sea, indirect climatic forcing was responsible for a decline in capelin stocks when warmer temperatures increased production of herring and cod that prey on juvenile capelin (Hjermann et al. 2004). Capelin growth is related to zooplankton abundance (Gjøsæter et al. 2002); increases in ocean temperatures could affect primary production and the spatial and temporal availability of zooplankton. Another potential impact of climatic warming is a northward shift in the polar ice edge, an important feeding habitat for capelin throughout much of their range in the Beaufort and Chukchi Seas. A shift in the ice edge could result in longer migrations to spawning beaches and potentially reduce the amount of this habitat available. Current data suggest climatic warming is the largest threat faced by this northern fish species, but the degree and severity of potential impacts are unknown (Carscadden and Nakashima 1997, Davoren and Montevecchi 2003).

Although capelin are not targeted by commercial fisheries in the Pacific, they are taken incidentally as bycatch. Forage fishes normally comprise only a small percentage of commercial fisheries catches; however, from 1997 to 2001 osmerids (i.e. smelts, including capelin) contributed over 90% of total forage fish bycatch in most years in the Gulf of Alaska (Nelson 2003). Specific capelin bycatch amounts are unknown.

Pollution from oil spills often concentrates in intertidal and beach zones; this habitat is critical for capelin spawning and larval development and the species is susceptible to adverse effects from degradation of subtidal habitats. No studies of the specific effects of oil pollution on capelin have been published but research on herring suggests oil pollution is a viable threat.

Global research needs

Continued study of response to climatic and environmental changes and the importance of Pacific capelin in marine ecosystems is needed. Baseline information needed on life history and spawning dynamics. In the North Pacific, research needed on assessing the importance of capelin in marine food webs.

State research needs

Continued study of response to climatic and environmental changes and the importance of Pacific capelin in marine ecosystems is needed. Baseline information needed on life history and spawning dynamics. In the North Pacific, research needed on assessing the importance of capelin in marine food webs.

Global inventory needs

In the North Pacific, most estimates of capelin abundance are based on opportunistic data from surveys that target other commercially important species; capelin-specific, long-term surveys are required to adequately estimate population size. Regular inventories would provide estimates of population size and trends to direct management decisions. Determine natural variation in population size over inter-annual, annual and decadal or longer periods, and identify trends outside this variation.

State inventory needs

Most estimates of capelin abundance are based on opportunistic data from surveys that target commercially important species; capelin-specific, long-term surveys are required to adequately estimate population size and health. Aerial surveys for demersal aggregations and spawning activity may be a cost-effective method for assessing population size and trends (Brown 2002). In the commercial fishery observer program, forage fishes are generally only identified to family; observer training to allow identification to species level would provide improved data about commercial catch and bycatch trends.

Global conservation and management needs

Utilize all effective methods for surveying capelin populations on a long-term basis; closely track population trends and their association with trends in environmental conditions and other marine trophic levels.

State conservation and management needs

Promote study of capelin response to environmental changes, closely monitor population trends and their association with trends in environmental conditions and other marine trophic levels. Establish long-term monitoring programs at index sites throughout Alaska, and supplement this information with data from fishery observer programs. Identify, map and protect key spawning locations and other intertidal habitats; promote public awareness of the importance of these habitats, especially during the spawning season. A commercial fishery for capelin in Alaska should not be permitted without reliable estimates of population size and assessment of population trends with verification that current trends are increasing and careful consideration of the foraging requirements of capelin predator populations.

LITERATURE CITED

Abookire, A.A. and J.F. Piatt. 2005. Oceanographic conditions structure forage fishes into lipid-rich and lipid-poor communities in lower Cook Inlet, Alaska, USA. Marine Ecology Progress Series 287:229-240.

Anderson, P.J. and J.F. Piatt. 1999. Community reorganization in the Gulf of Alaska following ocean climate regime shift. Marine Ecology Progress Series 189:117-123.

Anderson, P.J., J.E. Blackburn, W.R. Bechtol and B.A. Johnson. 1996. Synthesis and analysis of Gulf of Alaska small-mesh trawl data 1953-1995. *Exxon Valdez* Oil Spill Restoration Project Report, Restoration Project (APEX) 96163L.

Barrett, R.T. and Y.V. Krasnov. 1996. Recent responses to changes in stocks of prey species by seabirds breeding in the southern Barents Sea. ICES Journal of Marine Science 53:713-722.

Brodeur, R.D., M.T. Wilson, G.E. Walters, and I.V. Melnikov. 1999. Chapter 24: Forage fishes in the Bering Sea: distribution, species associations, and biomass trends. Pp. 509-536 in: Loughlin, T.R. and K. Ohtani (Eds.). Dynamics of the Bering Sea: a summary of physical, chemical, and biological characteristics and a synopsis of research on the Bering Sea. Alaska Sea Grant College Program Report AK-SG-99-03. Fairbanks, AK.

Brown, E.D. 2002. Life history, distribution, and size structure of Pacific capelin in Prince William Sound and the northern Gulf of Alaska. ICES Journal of Marine Science 59:983-996.

Carscadden, J.E. 1981. Underwater world: capelin. Communications Directorate, Department of Fisheries and Oceans Canada, Ottawa, ONT.

Carscadden, J. and B.S. Nakashima. 1997. Abundance and changes in distribution, biology, and behavior of capelin in response to cooler waters of the 1990s. Pp. 457-468 in: Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems, University of Alaska Sea Grant College Program Report No. 97-01. Fairbanks, AK.

Carscadden, J., B.S. Nakashima, and K.T. Frank. 1997. Effects of fish length on the timing of peak spawning in capelin (*Mallotus villosus*). Can. J. Fish. Aqua. Sci. 54: 781-787.

Davoren, G.K., and W.A. Montevecchi. 2003. Signals from seabirds indicate changing biology of capelin stocks. Marine Ecology Progress Series 258:253-261.

Erikstad, K.E. 1990. Winter diets of four seabird species in the Barents Sea after a crash in the capelin stock. Polar Biol. 10: 619-627.

Flynn, S.R., and M.P.M. Burton. 2003. Gametogenesis in capelin, *Mallotus villosus* (Müller), in the northwest Atlantic Ocean. Can. J. Zool. 81:1511-1523.

Food and Agriculture Organization of the United Nations (FAO). 2005. World Fishery Statistics, Fisheries Global Information System (FIGIS). Available online at: http://www.fao.org/figis/servlet/static?dom=root&xml=tseries/index.xml. Accessed 23Sep2005.

Fritz, L.W., V.G. Wespestad and J.S. Collie. 1993. Distribution and abundance trends of forage fishes in the Bering Sea and Gulf of Alaska. Pp. 30-44 in: Is it food? Addressing marine mammal and seabird declines: workshop summary. Alaska Sea Grant College Program Report AK-SG-93-01. Fairbanks, AK.

Gjøsæter, H. 1998. The population biology and exploitation of capelin (*Mallotus villosus*) in the Barents Sea. Sarsia 83:453-496.

Gjøsæter, H., P. Dalpadado, and A. Hassel. 2002. Growth of Barents Sea capelin (*Mallotus villosus*) in relation to zooplankton abundance. ICES Journal of Marine Science 59:959-967.

Gjøsæter, H., B. Bogstad and S. Tjelmeland. 2003. Barents Sea capelin – down but hardly out. Institute of Marine Research Newsletter, 10/10/03.

Hansen, D.J. 1997. Shrimp fishery and capelin decline may influence decline of harbor seal (*Phoca vitulina*) and northern sea lion (*Eumatopias jubatus*) in western Gulf of Alaska. Pp. 197-207 in: Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems, University of Alaska Sea Grant College Program Report No. 97-01. Fairbanks, AK.

Hart, J. L. 1973. Pacific Fishes of Canada. Bull. Fish. Res. Bd. Can. 180:1-730.

Hjermann, D.O., N.C. Stenseth, and G. Ottersen. 2004. Indirect climatic forcing of the Barents Sea capelin: a cohort effect. Marine Ecology Progress Series 273:229-238.

Laevastu, T. and F. Favorite. 1978. Fish biomass parameter estimations. Northwest and Alaska Fisheries Center, U.S. Dept. of Commerce, NOAA, NMFS. Seattle, WA.

McAllister, D.E. 1963. A revision of the smelt family Osmeridae. Nat. Mus. Can. Bull. No. 191.

Mecklenburg, C.W., T.A. Mecklenburg and L.K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society. Bethesda, MD. 1,037 pp.

Mongabay. 2005. Where are the fish? Ocean fisheries in trouble, meeting in Canada to discuss fate of global marine fisheries. Mongabay.com. Available online at: http://news.mongabay.com/2005/0504_rhett_butler.html. Accessed 23Sep2005.

Montevecchi, W. A. and J. Piatt. 1984. Composition and energy content of mature inshore spawning capelin (*Mallotus villosus*): implications for seabird predators. Comp. Biochem. Physiol. Vol. 78A:15-20.

Nakashima, B.S. 1992. Patterns in coastal migration and stock structure of capelin (*Mallotus villosus*). Can. J. Fish. Aqua. Sci. 49:2423-2429.

Nakashima, B.S. and J.P. Wheeler. 2002. Capelin (*Mallotus villosus*) spawning behaviour in Newfoundland waters – the interaction between beach and demersal spawning. ICES Journal of Marine Science 59:909-916.

Naumenko, E.A. 1996. Distribution, biological condition, and abundance of capelin (*Mallotus villosus socialis*) in the Bering Sea. Pp. 237-256 in: Mathisen, O.A. and K.O. Coyle (Eds.). Ecology of the Bering Sea: a review of Russian literature. Alaska Sea Grant Report No. 96-01. Alaska Sea Grant College Program, University of Alaska Fairbanks, Fairbanks, AK.

Nelson, M. 2003. Gulf of Alaska forage fish assessment, appendix A: forage fish species in the Gulf of Alaska. Available online at: http://www.afsc.noaa.gov/refm/docs/2003/GOAappendixA.pdf. Accessed 27Jul2004.

Pahlke, K.A. 1985. Preliminary studies of capelin (*Mallotus villosus*) in Alaskan waters. Alaska Department of Fish and Game informational leaflet No. 250, Juneau, AK.

Payne, S.A., B.A. Johnson, and R.S. Otto. 1999. Proximate composition of some north-eastern Pacific forage fish species. Fisheries Oceanography 8:159-177.

Piatt, J.F. and P. Anderson. 1996. Response of Common Murres to the *Exxon Valdez* oil spill and long-term changes in the Gulf of Alaska marine ecosystem. Pp. 720-737 in: Rice, D., R.B. Spies, D.A. Wolfe, and B.A. Wright (Eds), Proceedings of the *Exxon Valdez* oil spill symposium. American Fisheries Society Symposium 18.

Trumble, R.J. 1973. Distribution, relative abundance, and general biology of selected underutilized fishery resources of the eastern North Pacific Ocean. M.S. Thesis, University of Washington, Seattle, WA.

Ushakov, N.G., and D.V. Prozorkevich. 2002. The Barents Sea capelin – a review of trophic interrelations and fisheries. ICES Journal of Marine Science 59:1046-1052.

Wespestad, V.G. 1987. Population dynamics of Pacific herring (*Clupea pallasii*), capelin (*Mallotus villosus*), and other coastal pelagic fishes in the eastern Bering Sea. Pp. 55-60 in: Forage fishes of the southeastern Bering Sea: proceedings of a conference. U.S. Department of the Interior Minerals Management Service, OCS Study MMS 87-0017.

Winters, G. H. 1970. Biological changes in coastal capelin from the over-wintering to the spawning condition. J. Fish. Res. Bd. Can. Vol.27: 2215-2224.

Wolotira, R.J., T.M. Sample, and M. Morin. 1977. Demersal fish and shellfish resources of Norton Sound, the Southeastern Chukchi Sea, and adjacent waters in the baseline year 1976. Northwest and Alaska Fisheries Center, U.S. Dept. of Commerce, NOAA, NMFS. Seattle, WA.

Yndestad, H. and A. Stene. 2002. System dynamics of Barents Sea capelin. ICES J. Mar. Sci. 59: 1155-1166.

Acknowledgements

State Conservation Status, Element Ecology & Life History Author(s): McClory, J.G. and T.A. Gotthardt,
Alaska Natural Heritage Program, Environment and Natural Resources Institute, University of Alaska Anchorage, 707 A Street, Anchorage, AK 99501, http://aknhp.uaa.alaska.edu.
State Conservation Status, Element Ecology & Life History Edition Date: 29Nov2005

Reviewer(s): Bruce Wright, Conservation Science Institute, Wasilla, AK and Mayumi Arimitsu, USGS, Juneau, AK.

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.

Illustration credit: obtained online at: http://www.oceanchoice.com/pelagics.html.