

Capelin – *Mallotus villosus*

Overall Vulnerability Rank = Low

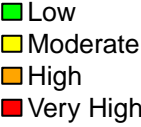
Biological Sensitivity = Moderate

Climate Exposure = Low

Sensitivity Data Quality = 58% of scores ≥ 2

Exposure Data Quality = 64% of scores ≥ 2

<i>Mallotus villosus</i>		Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
Sensitivity attributes	Habitat Specificity	2.8	2.0	
	Prey Specificity	1.6	2.2	
	Adult Mobility	1.6	2.0	
	Dispersal of Early Life Stages	1.8	1.6	
	Early Life History Survival and Settlement Requirements	2.8	1.6	
	Complexity in Reproductive Strategy	3.0	2.2	
	Spawning Cycle	2.4	2.0	
	Sensitivity to Temperature	3.4	2.4	
	Sensitivity to Ocean Acidification	2.4	2.0	
	Population Growth Rate	1.5	1.6	
	Stock Size/Status	2.0	1.4	
	Other Stressors	2.2	1.6	
	Sensitivity Score	Moderate		
Exposure factors	Sea Surface Temperature	2.1	2.2	
	Sea Surface Temperature (variance)	1.3	2.2	
	Bottom Temperature	2.1	3.0	
	Bottom Temperature (variance)	1.3	3.0	
	Salinity	1.7	2.0	
	Salinity (variance)	2.2	2.0	
	Ocean Acidification	4.0	3.0	
	Ocean Acidification (variance)	1.2	3.0	
	Phytoplankton Biomass	1.9	1.2	
	Phytoplankton Biomass (variance)	1.9	1.2	
	Plankton Bloom Timing	1.3	1.0	
	Plankton Bloom Timing (variance)	1.9	1.0	
	Large Zooplankton Biomass	1.7	1.2	
	Large Zooplankton Biomass (variance)	1.7	1.2	
	Mixed Layer Depth	1.2	1.0	
	Mixed Layer Depth (variance)	1.5	1.0	
	Currents	1.3	2.0	
	Currents (variance)	1.4	2.0	
	Air Temperature	2.0	2.5	
	Air Temperature (variance)	1.0	2.5	
	Precipitation	NA	NA	
	Precipitation (variance)	NA	NA	
	Sea Surface Height	1.3	2.5	
	Sea Surface Height (variance)	1.3	2.5	
	Exposure Score	Low		
Overall Vulnerability Rank		Low		



For assistance with this document, please contact NOAA Fisheries Office of Science and Technology at (301) 427-8100 or visit <https://www.fisheries.noaa.gov/contact/office-science-and-technology>

## **Capelin (*Mallotus villosus*)**

Overall Climate Vulnerability Rank: **Low**. (99% certainty from bootstrap analysis).

Climate Exposure: **Low**. With the exception of ocean acidification (4.0), all exposure factors had scores less than 2.5.

Biological Sensitivity: **Moderate**. Sensitivity to temperature (3.4) had “high” sensitivity, whereas complexity in reproductive strategy (3.0), early life history survival (2.8), and habitat specificity (2.8) had “moderate” sensitivity.

Potential for distribution change: **High** (99% certainty from bootstrap analysis). Three attributes (adult mobility, dispersal of early life stages, and sensitivity to temperature) indicated high potential for distribution change.

Directional Effect in the Eastern Bering Sea: Projected climate change in the eastern Bering Sea is expected to have a negative effect on capelin, with 100% certainty in expert scores.

Data Quality: 58% of the sensitivity attributes, and 64% of the exposure factors, had average data quality scores of 2 or greater (indicating at least “moderate” data quality).

Climate Effects on Abundance and Distribution: Both the abundance and distribution of capelin in the EBS appear to have been influenced by changes in ocean temperature. Bottom trawl survey (BTS) catch-per-unit-effort (CPUE) was higher during periods when temperatures were below the long-term average (Ormseth 2015). During cold periods capelin in the BTS also appeared to have a wider spatial distribution. Similar results were obtained in surface-trawl surveys conducted by the AFSC during 2003-2011 (Andrews et al. 2016), as capelin CPUE was higher in cold years (2006-2011) than in warm years (2003-2005), and capelin were distributed farther north during warm years. These observations suggest that capelin are likely to experience changes in abundance and distribution as a result of long-term ocean warming.

Life History Synopsis: Capelin are distributed along the entire coastline of Alaska and south along British Columbia to the Strait of Juan de Fuca (Brown 2002, Naumenko 1996). In the EBS they are distributed mainly on the inner and middle domains of the continental shelf where bottom depth is less than 100 m (Ormseth 2015). In the North Pacific Ocean, capelin can grow to a maximum of 25 cm at age 4. Most capelin spawn at age 3 or 4, when they are 11 to 17 cm (Pahlke 1985). Spawning in Norton Sound and northern Bristol Bay, and around Kodiak Island occurs in intertidal zones of coarse sand and fine gravel during spring. Few capelin survive spawning. Capelin maturation age in the Barents Sea was found to be a function of growth rate, with fast-growing cohorts reaching maturity at an earlier age than slow-growing cohorts (Huse, 1998). In the Bering Sea, adult capelin distribution has been associated with the annual extent of sea ice (Cianelli and Bailey 2005). Analysis of larval capelin distribution suggest that capelin spawn inshore during summer and that larvae are subsequently advected from bays in the coastal zone to the continental shelf either by entrainment in freshwater runoff and/or by tidal flushing (Doyle 2002). Larger capelin larvae (>30 m) appear to actively migrate to the surface layer.

Capelin are a major prey item for groundfish, seabirds, and marine mammals. A review of capelin occurrence in groundfish stomachs from the EBS during 1970-2001 indicated that the major fish predators of capelin were arrowtooth flounder, Pacific cod, Pacific halibut, and walleye pollock (Yang et al 2005). The size frequency of capelin in fish stomachs varied substantially from year to year, although age-0 individuals (standard length < 70 mm) were least commonly observed. Estimates of total capelin consumed by fish predators during the summer feeding season in the EBS ranged from 19,115 t in 1994 to 47,988 t in 1993. Annual variation in capelin consumption was attributed primarily to changes in predator biomass, but also to variation in capelin biomass and physical oceanographic factors.

For the purposes of conservation and management, capelin are included in a “forage fish” group that includes other smelts and sand lances. This group is managed as an Ecosystem Component, and commercial harvesting of capelin has been prohibited since 1998. Capelin are caught incidentally in several directed fisheries (e.g. walleye pollock), but deliveries can contain no more than 2% capelin by weight.

#### Literature Cited:

- Andrews, A.G. III, W.W. Strasburger, E.V. Farley Jr., J.M. Murphy, K.O. Coyle. 2016. Effects of warm and cold climate conditions on capelin (*Mallotus villosus*) and Pacific herring (*Clupea pallasii*) in the eastern Bering Sea. *Deep Sea Res II* 134:235-246.
- Brown, E.D. 2002. Life history, distribution, and size structure of Pacific, capelin in Prince William Sound and the northern Gulf of Alaska. *ICES J Mar Sci* 59:983-996.
- Cianelli, L., and K.M. Bailey. 2005. Landscape dynamics and resulting species interactions: the cod-capelin system in the southeastern Bering Sea. *Mar Ecol Prog Ser* 291:227-236.
- Doyle, M.J., M.S. Busby, J.T. Duffy-Anderson, S.J. Piquelle, and A.C. Matarese. 2002. Early life history of capelin (*Mallotus villosus*) in the northwest Gulf of Alaska: a historical perspective based on larval collections October 1977-March 1979. *ICES J Mar Sci* 59:997-1005.
- Huse, G. 1998. Sex-specific life history strategies in capelin (*Mallotus villosus*)? *Can J Fish Aquatic Sci* 55: 631-638.
- Naumenko, E.A. 1996. Distribution, biology, condition, and abundance of capelin (*Mallotus villosus* socialis) of the Bering Sea. *In Ecology of the Bering Sea: a review of Russian literature*, pp 237-256. Ed. by O.A. Mathisen and K.O. Coyle, Alaska Sea Grant Report 96-01. 306pp.
- Ormseth, O.A. 2015. Appendix: Status of forage species in the Bering Sea and Aleutian Islands. *In Plan Team for Groundfish Fisheries of the Bering Sea and Aleutian Islands* (compiler), Stock assessment and fishery evaluation report for the groundfish resources of the Bering

Sea and Aleutian Islands Regions, p. 1225-1270. North Pacific Fishery Management Council, 605 W. 4th Avenue Suite 306, Anchorage, AK 99501.

Pahlke, K.A. 1985. Preliminary studies of capelin (*Mallotus villosus*) in Alaskan waters. Alaska Dept. Fish and Game, Info. Leaf. 250. 64 p.

Yang, M.-S., K. Aydin, A. Grieg, G. Lang, and P. Livingston. 2005. Historical review of capelin (*Mallotus villosus*) consumption in the Gulf of Alaska and eastern Bering Sea. U.S. Dept. of Comm., NOAA Tech. Memo. NMFS-AFSC-155, 89p.