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Species Ecologically Related to North Pacific Salmonids

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ABSTRACT

"Ecologically-related species" means living marine species which are associated with anadromous stocks found in the Convention Area, including but not restricted to both predators and prey of anadromous stocks. The North Pacific Anadromous Fish Commission is concerned with biological interactions of salmonids, i.e., species that are important prey, predators or competitors of anadromous species; and technical interactions in which anadromous species interact with fisheries. A list of example species is presented.

Species Ecologically Related to North Pacific Salmonids

Article II(1) of the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean defines "anadromous fish" as those listed in Part I of the Convention Annex which migrate into the Convention Area, and "anadromous stocks" means the stocks thereof. Part I of the Annex contains the following list of species:

Anadromous Species

Chum salmon	<i>Oncorhynchus keta</i>
Coho salmon	<i>Oncorhynchus kisutch</i>
Pink salmon	<i>Oncorhynchus gorbuscha</i>
Sockeye salmon	<i>Oncorhynchus nerka</i>
Chinook salmon	<i>Oncorhynchus tshawytscha</i>
Cherry salmon	<i>Oncorhynchus masou</i>
Steelhead trout	<i>Oncorhynchus mykiss</i>

Ecologically-Related Species -- "Ecologically-related species" means living marine species which are associated with anadromous stocks found in the Convention Area, including but not restricted to both predators and prey of anadromous stocks. The Commission is concerned with species that are important prey, predators or competitors of anadromous species; and those that interact with their fisheries. Following is a short list of examples. It is by no means complete and species are anticipated to be added to it from time to time.

Other anadromous Species

Dolly varden	<i>Salvelinus malma malma</i>
Cutthroat trout	<i>Oncorhynchus clarki</i>
Arctic char	<i>Salvelinus alpinus</i>

Invertebrates

Neon flying squid	<i>Ommastrephes bartrami</i>
Boreal club-hook squid	<i>Onychoteuthis borealijaponica</i>
Eight-armed squid	<i>Gonatopsis borealis</i>
Japanese common squid	<i>Todarodes pacificus</i>

Fishes

Pacific lamprey	<i>Lampetra tridentatus</i>
Bullhead, Horn sharks	<i>Heterodontiformes</i>
Basking shark	<i>Cetorhinus maximus</i>
Salmon shark	<i>Lamna ditropis</i>
Southern shark	<i>Galeorhinus zyopterus</i>
Blue shark	<i>Prionace glauca</i>
Spiny dogfish	<i>Squalus acanthias</i>
Ratfish	<i>Hydrolagus colliei</i>
American shad	<i>Alosa sapidissima</i>
Pacific herring	<i>Clupea harengus</i>
Northern anchovy	<i>Engraulis mordax</i>
Pacific sardine	<i>Sardinops sagax</i>
Dolly Varden	<i>Salvelinus malma</i>
Arctic char	<i>Salvelinus alpinus</i>
Smelts	<i>Osmeridae</i>
Surf smelt	<i>Hypomesus pretiosus</i>
Capelin	<i>Mallotus villosus</i>
Rainbow smelt	<i>Osmerus mordax</i>
Eulachon	<i>Thaleichthys pacificus</i>
Longnose lancetfish	<i>Alepisaurus ferox</i>
Daggertooth	<i>Anotopterus pharao</i>
Lanternfishes	<i>Myctophidae</i>

Codfishes
 Pacific cod
 Walleye pollock
 Pacific hake
 Eelpouts
 Smoothscale rattail
 Pacific saury
 Oreo
 Threespine stickleback
 Pacific ocean perch
 Copper rockfish
 Black rockfish
 Bocaccio
 Greenlings
 Rock greenling
 Lingcod
 Atka mackerel
 Sablefish
 Skilfish
 Sculpins
 Crested sculpin
 Red Irish lord
 Poachers
 Lumpfish and snailfish
 Smooth lumpsucker
 Pacific spiny lumpsucker
 Jack mackerel
 Pelagic armorhead
 Pacific pomfret
 Pacific sandfish
 Ronquils
 Combtooth blennies
 Wolf-eel
 Prowfish
 Ragfish
 Sandlance
 Cutlassfishes
 Chub mackerel
 Righteye flounders
 Arrowtooth flounder
 Rock sole
 Yellowfin sole
 Starry flounder
 Pacific halibut
 Ocean sunfish
 Albacore tuna
 Swordfish
 Flyingfishes
 Pilotfish
 Yellowtail
 Dolphinfish
 Skipjack tuna
 Pacific mackerel
 Striped marlin
 Smalleye squaretail

Marine Mammals

Northern fur seal
 Dall's porpoise
 Northern right-whale dolphin
 Pacific white-sided dolphin
 Killer whale

Gadidae
Gadus macrocephalus
Theragra chalcogramma
Merluccius productus
 Zoarcidae
Coryphaenoides cyclolepis
Cololabis saira
Allocyttus verrucosus
Gasterosteus aculeatus
Sebastes alutus
Sebastes caurinus
Sebastes melanops
Sebastes paucispinis
 Hexagrammidae
Hexagrammos lagocephalus
Ophiodon elongatus
Pleurogrammus monopterygius
Anoplopoma fimbria
Erilepis zonifer
 Cottidae
Blepsias bilobus
Hemilepidotus hemilepidotus
 Agonidae
 Cyclopteridae
Aptocyclus ventricosus
Eumicrotremus orbis
Trachurus symmetricus
Pentaceros richardsoni
Bramma japonica
Trichodon trichodon
 Bathymasteridae
 Blennidae
Anarrhichthys ocellatus
Zaprora silenus
Icosteus aenigmaticus
Ammodytes hexapterus
 Trichiuridae
Scomber japonicus
 Pleuronectidae
Atheresthes stomias
Lepidopsetta bilineata
Limanda aspera
Platichthys stellatus
Hippoglossus stenolepis
Mola mola
Thunnus alalunga
Xiphias gladius
 FAMILY EXOCOETIDAE
Naucrates ductor
Seriola lalandi
Coryphaena hippurus
Euthynnus pelamis
Scomber japonicus
Tetrapturus audax
Tetragonurus cuvieri

Callorhinus ursinus
Phocoenoides dalli
Lissodelphis borealis
Lagenorhynchus obliquidens
Orcinus orca

Beluga whale
Northern Sea lion
Harbor porpoise
Pacific harbor seal

Delphinapterus leucas
Eumetopias jubatus
Phocoena phocoena
Phoca vitulina

Marine Birds

Black-footed albatross
Laysan albatross
Northern fulmar
Short-tailed shearwater
Sooty shearwater
Black legged kittiwake
Arctic tern
Common murre
Thick-billed murre
Tufted puffin

Diomedea nigripes
Diomedea immutabilis
Fulmarus glacialis
Puffinus tenuirostris
Puffinus griseus
Rissa tridactyla
Sterna paradisaea
Uria aalge
Uria lomvia
Lunda cirrhata

In addition to the above short list of species ecologically related to anadromous species there is an extensive variety of marine prey of salmonids (Table 1.). The various degrees of association of salmonids and their marine prey has been documented in the literature from 1900 to 1959 by Maxfield (1967) who listed over 1400 references. Holmberg (1969) reviewed the salmonid literature published during 1960-64. Some of the more recent literature appears in Table 2.

Table 1. List of marine prey ecologically related to Pacific salmon. Representative taxa are grouped as fish, pelagic invertebrates, epibenthic invertebrates, miscellaneous (rare and incidental) invertebrates, and drift insects. Presence of a taxon (indicated by an x) does not reflect its relative importance by weight, volume, number, or frequency of occurrence, nor the life history stage of predator or prey. Abbreviations: unid. = unidentified.¹

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chinook
Fish					
Teleostei					
Fish eggs	x	x			
Unid. fish larvae	x	x	x	x	x
Clupeidae (herrings)					
<i>Clupeia harengus pallasii</i> (Pacific herring)	x		x	x	x
<i>Sardinops caerulea</i> (pilchard)					x
<i>S. melanosticta</i>				x	
<i>S. sagax</i> (Pacific sardine)				x	
Engraulidae					
<i>Engraulis japonicus</i> (anchovy)	x			x	x
<i>E. mordax mordax</i> (northern anchovy)				x	x
Salmonidae (salmon)					
<i>O. gorbuscha</i> (pink)				x	
<i>O. keta</i> (chum)				x	x
<i>O. kisutch</i> (coho)				x	
<i>O. nerka</i> (sockeye)				x	
Osmeridae (smelts)					
<i>Hypomesus pretiosus</i> (surf smelt)			x	x	
<i>Mallotus villosus</i> (capelin)	x	x	x	x	x
<i>Thaleichthys pacificus</i> (eulachon) (eulachon)	x		x	x	x
Bathylagidae					
<i>Bathylagus stilbius</i> (northern smoothtongue)	x				x
Myctophidae (lantern fishes)					
<i>Lampanyctus ritteri</i>		x	x	x	x
<i>Protomyctophum thompsoni</i>		x	x		
<i>Stenobrachius leucopsarus</i> (northern lampfish)	x		x	x	x
<i>S. nannochir</i>	x		x		
<i>Tarletonbeania crenularis</i> (blue lanternfish)					x
Gadidae					
<i>Merluccius productus</i> (Pacific hake)	x		x	x	x

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chin-ook
<i>Theragra chalcogramma</i> (Walleye pollock)	x	x	x	x	x
Scomberesocidae (sauries)				x	x
<i>Cololabis saira</i> (Pacific saury)				x	x
Gasterosteidae (sticklebacks)				x	
<i>Gasterosteus aculeatus</i> (3-spine stickleback)				x	
Trichodontidae (sandfishes)				x	
<i>Trichodon trichodon</i> (Pacific sandfish)				x	
Bathymasteridae (ronquils)					x
Stichaeidae (pricklebacks)	x			x	x
Pholidae (gunnels)				?	
Anarhichadidae (wolffishes)				x	x
<i>Anarrhichthys ocellatus</i> (wolf-eel)				x	x
Zaproridae (prowfishes)				x	x
<i>Zaprora silenus</i>				x	x
Ammodytidae (sand lances)	x	x	x	x	x
<i>Ammodytes hexapterus</i> (Pacific sandlance)	x	x	x	x	x
<i>A. personatus</i>		x			
Gobiidae	x				
Scombridae				x	
<i>Scomber japonicus</i> (chub mackerel)				x	
Scorpaenidae (rockfishes)			x	x	x
<i>Sebastes alutus</i> (Pacific Ocean perch)					x
<i>S. caurinus</i> (copper)				x	x
<i>S. zacentrus</i> (sharpchin)				x	x
Anoplopomatidae					
<i>Anoplopoma fimbria</i> (black cod)				x	x
Hexagrammidae (greenlings)				x	
<i>Hexagrammos decagrammus</i> (kelp greenling)	x			x	
<i>Hexagrammos lagocephalus</i> (rock greenling)				x	
<i>Ophiodon elongatus</i> (ling cod)				x	
<i>Pleurogrammus monoptyerygius</i> (Atka mackerel)		x			

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chinook
Cottidae (sculpins)	x			x	x
<i>Hemilepidotus</i> spp. (Irish lords)			x	x	x
<i>Hemitripterus bolini</i> (big mouth sculpin)					x
Cyclopteridae					
<i>Eumicrotremus orbis</i> (Pacific spiny lumpsucker)					x
Bothidae (lefteye flounders)					
<i>Citharichthys</i> spp. (sanddabs)				x	
Pleuronectidae (righteye flounders)		x		x	x
<i>Atheresthes stomias</i> (arrowtooth flounder)					x
<i>Hippoglossus stenolepis</i> (Pacific halibut)					x
<i>Iopsetta isolepis</i> (butter sole)				x	
<i>Pleuronectes platessa</i> (starry flounder)			x		
<i>Psettichthys melanostictus</i> (sand sole)				x	
Agonidae (poachers)	x		x		
Pelagic Invertebrates					
Cnidaria (jellyfish)					
Hydromedusae	x	x	x	x	x
Ctenophora (comb jellies)					
<i>Beroe cucumis</i>		x	x		
<i>Mertensia ovum</i>		x			
Annelida (segmented worms)					
Polychaeta					
Spionidae	x	x	x		
Syllidae	x	x			
Tomopteridae				x	
Oligochaeta					x
Mollusca					
Gastropoda					
Unid. larvae and juveniles	x	x			
Thecosomata (pteropods)	x	x	x	x	x
<i>Limacina helicina</i>	x	x	x	x	x
<i>Clio pyramidata</i>				x	
<i>Clione limacina</i>	x	x	x		
Cephalopoda					
Octopoda					
<i>Octopus</i> spp.				x	x

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chinook
Teuthoidea (squids)	x	x	x	x	x
Gonatidae	x		x		
<i>Berryteuthis magister</i>					x
<i>B. anonymus</i>			x		
<i>Gonatopsis borealis</i>				x	x
<i>Gonatus</i> spp.	x		x	x	x
Loliginidae					
<i>Loligo opalescens</i>				x	x
Arthropoda					
Crustacea					
Branchiopoda					
Cladocera	x	x	x		x
<i>Evadne</i> sp.	x	x			
<i>Podon</i> sp.	x	x			
Copepoda	x	x	x	x	x
Calanoida					
Calanidae					
<i>Calanus</i> spp.	x	x		x	x
<i>Neocalanus</i> spp.	x	x			
Centropagidae					
<i>Centropages abdominalis</i>			x		
Eucalanidae					
<i>Eucalanus bungii</i>				x	
Euchaetidae					
<i>Euchaeta elongata</i>	x				
Metridiidae					
<i>Metridia</i> spp.			x		
Pontellidae					
<i>Epilabidocera longipedata</i>				x	
Pseudocalanidae					
<i>Pseudocalanus</i> spp.	x	x			
Temoridae					
<i>Eurytemora</i> sp.			x		
Cyclopoida	x	x			
Monstrilloida	x				
Cirripedia					
Barnacle larvae (nauplius)	x	x	x	x	
Malacostraca					
Mysidacea	x	x	x		
<i>Necmysis</i> sp.				x	x

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chin-ook
Amphipoda	x	x	x	x	x
Caprellidea	x				x
Gammaridea					
Lysianassidae					
<i>Cyphocaris challengerii</i>	x				
Hyperiidea	x	x	x	x	x
Hyperiidae					
<i>Hyperia</i> spp.	x	x			x
<i>Hyperoche</i> spp.	x				x
<i>Themisto</i> spp.	x	x	x		
<i>T. japonica</i>		x		x	
<i>T. libellula</i>				x	x
<i>T. pacifica</i>	x	x	x	x	x
Phrosinidae					
<i>Primno macropa</i>	x			x	x
Vibiliidae					
<i>Vibilia</i> sp.					x
Decapoda					
Unid. larvae and juveniles general	x	x	x	x	x
Caridean (shrimp) larvae	x	x	x		
Anomura (stone and king crabs)			x		
Lithodidae (rock crabs)	x		x		x
<i>Paralithodes camtschatica</i>			x		
Paguridae (hermit crabs)	x			x	x
Brachyura (true crabs)	x	x	x	x	x
Cancriidae					
<i>Cancer</i> spp.	x			x	
Majidae					
<i>Chionocetes</i> spp.	x				
<i>Oregonia gracilis</i>	x	x		x	
Pinnotheridae (pea crabs)				x	x
Euphausiacea (krill)					
Unid. larvae and juveniles	x	x	x		
Euphausiidae	x	x	x	x	x
<i>Euphausia pacifica</i>			x	x	x
<i>Thysanoessa inermis</i>			x		
<i>T. longipes</i>	x		x	x	x
<i>T. raschi</i>	x			x	x
<i>T. spinifera</i>	x	x	x	x	x
Bryzoa					
Larvae (cyphonautes)	x	x			

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chinook
Chordata					
Urochordata			x		
Larvacea					
<i>Oikopleura</i> spp.	x	x	x	x	
<i>Fritillaria</i> spp.	x	x			
Salpida	x	x	x		
Chaetognatha	x	x	x	x	
Epibenthic Invertebrates					
Annelida (segmented worms)					
Nereidae (eg., <i>Nereis</i> spp.)					x
Mollusca					
Bivalvia (clams)					
Bivalves, unid. juvenile	x	x	x		
Gastropoda (snails)					
Gastropods, unid. juvenile	x	x			
Arthropoda					
Crustacea					
Cirripedia					
Barnacle cyprid	x	x	x	x	
Copepoda					
Harpacticoida					
Harpacticidae					
<i>Harpacticus</i> spp.	x	x			x
Tachidiidae					
<i>Danielssenia typica</i>				x	x
Thalestridae					
<i>Dactylopodia</i> sp.	x	x			
Tisbiidae					
<i>Tisbe</i> spp.	x	x			
<i>Zaus</i> spp.	x	x			
Malacostraca					
Amphipoda					
Gammaridea					
Atylidae					
<i>Atylus tridens</i>				x	x
Anisogammaridae					
<i>Anisogammarus</i> sp.				x	
<i>Eogammarus</i> spp.					x
Calliopidae		x			
Corophiidae					
<i>Corophium</i> spp.					x

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chinook
Eusiriidae					
<i>Eusirus</i> sp.	x				
Caridea (shrimps)	x	x			x
Pandalidae					
<i>Pandalus jordani</i>				x	x
Pasiphaeidae					
<i>Pasiphaea pacifica</i>					x
Crangonidae				x	
<i>Sclerocrangon alata</i>					x
Cumacea (eg., <i>Cumella</i> spp.)	x	x	x	x	x
Isopoda	x	x	x	x	x
Sphaeromatidae					
<i>Gnorimosphaeroma oregonense</i>	x			x	
Insecta					
Collembola	x	x		x	
Diptera					
Chironomidea	x	x		x	x
Miscellaneous Invertebrates					
Porifera (sponges)					
<i>Esperiopsis digitata</i>		x			x
Nematoda	x	x			
Platyhelminthes					
Turbellaria	x				
Arthropoda					
Crustacea					
Cirripedia					
Barnacle molt	x	x			x
<i>Pollicipes polymerus</i>				x	
(adult gooseneck barnacle)					
Isopoda (Aegidae)					
<i>Rocinela angustata</i>					x
Ostracoda	x	x	x		
Unidentified eggs and larvae	x	x			
Chelicerata					
Arachnida					
Halacaridae (mites)	x	x			
Pycnogonida (sea spider)	x				
Uniramia					
Chilopoda (centipedes)	x				

Table 1. (Continued)

Prey Taxa	Predator Species				
	Pink	Chum	Sock-eye	Coho	Chinook
Drift Insects					
Arthropoda					
Uniramia					
Insecta					
General	x	x	x	x	x
Diptera	x	x			x

Table 2. Selected references to marine prey ecologically related to Pacific salmonids. Representative taxa include fish, pelagic invertebrates, epibenthic invertebrates, miscellaneous (rare and incidental) invertebrates, and drift insects.

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