APPENDIX F.3

ESSENTIAL FISH HABITAT ASSESSMENT REPORT

for the Bering Sea and Aleutian Islands

King and Tanner Crabs

April 2005

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NMFS Alaska Region
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NOAA Fisheries
National Marine Fisheries Service

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Introduction

In 1996, the Sustainable Fisheries Act amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to require the description and identification of Essential Fish Habitat (EFH) in Fishery Management Plans (FMPs), adverse impacts on EFH, and actions to conserve and enhance EFH. National Marine Fisheries Service (NMFS) developed guidelines to assist Fishery Management Councils in fulfilling the requirements set forth by the Act.

Essential fish habitat means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

With respect to type, the information available for almost all species is primarily broad geographic distributions based on specific samples from surveys and fisheries, which have not been linked with habitat characteristics. Furthermore, NMFS' ability to precisely define the habitat (and its location) of each life stage of each managed groundfish species in terms of its oceanographic (temperature, salinity, nutrient, current), trophic (presence of food, absence of predators), and physical (depth, substrate, latitude, and longitude) characteristics is very limited. Consequently, the information included in the habitat descriptions for each species and life stage is restricted primarily to their position in the water column (e.g., demersal, pelagic), broad biogeographic and bathymetric areas (e.g., 100 to 200 meter [m] zone, south of the Pribilof Islands and throughout the Aleutian Islands [AI]) and occasional references to known bottom types associations.

Identification of EFH for some species included historical range information. Traditional knowledge and sampling data have indicated that fish distributions may contract and expand due to a variety of factors including, but not limited to, temperature changes, current patterns, changes in population size, and changes in predator and prey distribution.

Background

In preparation of the 1999 EFH Environmental Assessment, EFH Technical Teams, consisting of scientific stock assessment authors, compiled scientific information and prepared the 1999 Habitat Assessment Reports. These reports provided the scientific information baseline to describe EFH. Recent scientific evidence has not proved to change existing life history profiles of the federally managed species. However, where new information does exist, new data help fill information gaps in the region's limited habitat data environment.

Stock assessment authors used information contained in these summaries and personal knowledge, along with data contained in reference atlases (NOAA 1987, 1990; Council 1997a,b), fishery and survey data (Allen and Smith 1988, Wolotira et al. 1993, NOAA 1998), and fish identification books (Hart 1973, Eschmeyer and Herald 1983, Mecklenburg and Thorsteinson 2002), to describe EFH for each life stage using best scientific judgment and interpretation; see Table 1.

Species Profiles and Habitat Descriptions

FMPs must describe EFH in text, map EFH distributions, and include tables, which provide information on habitat and biological requirements for each life history stage of the species; see Tables 2 to 4. Information contained in this report details life history information for federally managed fish species. This collection of scientific information is interpreted, then referenced to describe and delineate EFH for each species by life history stage using the geographic information system (GIS). EFH text and map descriptions are not compiled in this report due to differences in the characteristics of a species life history and the overall distribution of the species. Specific EFH text descriptions and maps are in Appendix D.

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Wolotira, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984. U.S. Dep. Commerce., NOAA Tech. Memo. NMFS-AFSC-6, 184 p.

General Life History Information for Crab

Shallow inshore areas (less than 50 m deep) are very important to king crab reproduction as they move onshore to molt and mate. Tanner crabs also occupy shallower depths during molting and mating. All BSAI crab are highly vulnerable to predation and damage during molting when they shed their exoskeleton. Female king crab molt annually to mate, while Tanner and snow crab exhibit terminal molt and carry sperm for future clutch fertilization. The habitat occupied by molting and mating crab differs

from that occupied by mature crabs during the remainder of the year. The crab technical team noted that protection of crab in molting mating habitat during this sensitive life history stage is important.

Larval stages are distributed according to vertical swimming abilities and the currents, mixing, or stratification of the water column. Generally, the larval stages occupy the upper 30 m, often in the mixed layer near the sea surface. As the larvae molt and grow into more active swimming stages, they can seek a preferred depth. After molting through multiple larval stages, crabs settle on the bottom. Settlement on habitat with adequate shelter, food, and temperature is imperative to survival of first settling crabs. Young of the year red and blue king crabs require nearshore shallow habitat with significant cover that offers protection (e.g., sea stars, anemones, macroalgae, shell hash, cobble, shale) to this frequently molting life stage. Early juvenile stage Tanner and snow crab also occupy shallow waters and are found on mud habitat. Late Juvenile stage crabs are most active at night when they feed and molt. The crab technical team emphasized the importance of shallow areas to all early juvenile stage crabs and, in particular, the importance to red and blue king crabs of high relief habitat nearshore with extensive biogenic assemblages. The area north and adjacent to the Alaska Peninsula (Unimak Island to Port Moller), the eastern portion of Bristol Bay, and nearshore areas of the Pribilof and Saint Matthew Islands are locations known to be particularly important for king crab spawning and juvenile rearing.

Egg Stage: Female king and Tanner crab extrude eggs, carry, and nurture them outside the maternal body. The number of eggs developed by the female increases with body size and is linked to nutrition at favorable temperatures. Information on egg bearing females is used to define habitat for the egg stage of crabs.

Larval Stage: Successful hatching of king and Tanner crab larvae is a function of both temperature and concentration of diatoms, so the presence of larvae in the water column can vary. Larvae are planktonic. Their sustained horizontal swimming is inconsequential compared to horizontal advection by oceanographic conditions. Larvae vertically migrate within the water column to feed. Diel vertical migration may be a retention mechanism to transport larvae inshore.

Early Juvenile Stage: The early juvenile stage includes crabs first settling on the bottom (glacothoe and megalops), young of the year crabs, and crabs up to a size approximating age 2. Habitat relief is obligatory for red and blue king crabs of this life stage. Individuals less than 20 mm carapace length (CL) typically are distributed in nearshore waters among niches provided by sea star arms, anemones, shell hash, rocks, and other bottom relief. Early juvenile Tanner crab settle on mud and are known to occur there during summer, but are not easily found in this habitat in winter.

Late Juvenile Stage: The late juvenile stage for crab is defined as the size at about age 2 to the first size of functional maturity. Late juvenile crabs typically are found further offshore in cooler water than early juvenile crabs. Smaller red king crabs of this life stage form pods during the day that break apart during the night when the crabs forage and molt. As these crabs increase in size, podding behavior declines, and the animals are found to forage throughout the day.

Mature Stage: Mature crabs are defined as those crabs of a size that is functionally mature. Functional maturity is based on size observed in mating pairs of crabs. This maturity definition differs from morphometric maturity based on chela height and physiological maturity when sperm or eggs can be produced. The mature stage includes crabs from the first size of functional maturity to senescence.

Table 1. Summary Table of Major References and Atlases

	References					
Species	NOAA 1988	Epifanio 1988	NOAA 1990	Wolotira et al. 1993	Council Witherell 1996	Tyler and Kruse 1996;1997
Red king crab	X	X	X	X	X	X
Blue king crab	X	X	X	X	X	X
Golden king crab	X	X	X	X	X	X
Tanner crab	X	X	X	X	X	X
Snow crab	X	X	X		X	X

Abbreviations used in the EFH report tables to specify location, depth, bottom type, and other oceanographic features.

Location

ICS = inner continental shelf (1-50 m)
MCS = middle continental shelf (50-100 m)
OCS = outer continental shelf (100-200 m)
USP = upper slope (200-1000 m)
LSP = lower slope (1000-3000 m)
BSN= basin (>3000 m)

BCH = beach (intertidal)
BAY = nearshore bays, give depth if appropriate (e.g., fjords)
IP = island passes (areas of high current), give depth if appropriate

Water column

D = demersal (found on bottom)
SD/SP =semi-demersal or semi-pelagic if slightly greater or less than 50 percent on or off bottom
P = pelagic (found off bottom, not necessarily associated with a particular bottom type)
N = neustonic (found near surface)

Bottom Type

M = mud
S = sand
R = rock
SM = sandy mud
CB = cobble
C = coral
MS = muddy sand
G = gravel
K = kelp
SAV = subaquatic vegetation (e.g., eelgrass, not kelp)

Oceanographic Features

UP = upwelling
G = gyres
F = fronts
E = edges
CL = thermocline or pycnocline

General

U = Unknown
N/A = not applicable

Table 2. Summary of Habitat Associations for BSAI Crab

BSAI Crab		Nearshore				Shelf			Slope						Stratum Reference							Location						
						Inner	Middle	Outer	Upper		Inter-mediate		Lower	Basin												Pelagic		
Species	Life Stage	Freshwater	Estuarine	Intertidal	Subtidal	1-50m	51-100m	101-200m	201-300m	301-500m	501-700m	701-1000m	1001-3000m	>3000m	Shallows	Island Pass	Bay/Fjord	Bank	Flat	Edge	Gully	Surafce	Near surface	Semi-demersal	Demersal	1-200m (epi)	201-1000m (meso)	>1000m (bathy)
Blue King Crab	M					x	x	x																	x			
	LJ					x	x	x																	x			
	EJ					x	x																		x			
	L					x	x																			x		
	E					x	x	x																	x			
Golden King Crab	M							x	x	x	x	x				x		x							x			
	LJ												x	x				x							x			
	EJ												x	x											x			
	L																									x		
	E							x	x	x	x							x							x			
Red King Crab	M					x	x	x																	x			
	LJ					x	x	x																	x			
	EJ					x	x																		x			
	L					x	x																			x		
	E					x	x	x																	x			
Snow Crab	M					x	x	x																	x			
	LJ					x	x	x																	x			
	EJ					x	x																		x			
	L					x	x																			x		
	E					x	x	x																	x			
Tanner	M					x	x	x	x	x	x						x	x							x			
	LJ			x	x	x	x	x	x	x								x							x			
	EJ				x	x	x	x	x	x								x							x			
	L		x	x	x	x	x																			x		
	E				x	x	x	x	x	x	x	x													x			

BSAI Crab		Physical Oceanography					Substrate												
Species	Life Stage	Upwelling areas	Gyres	Thermo/pycnocline	Fronts	Edges (ice, bath)	Organic Debris	Mud	Sand	Gravel	Mud & sand	Mud & gravel	Sand & mud	Gravel & mud	Gravel & sand	Gravel & sand & mud	Gravel & mud & sand	Cobble	Rock
Blue King Crab	M								x	x								x	x
	LJ								x	x								x	x
	EJ																		
	L																		
	E								x	x								x	x
Golden King Crab	M								x	x								x	x
	LJ								x	x								x	x
	EJ																		
	L																		
	E								x	x								x	x
Red King Crab	M						x	x	x	x	x	x	x	x	x	x	x		
	LJ						x	x	x	x	x	x	x	x	x	x	x		
	EJ									x								x	x
	L																		
	E						x	x	x	x	x	x	x	x	x	x	x		
Snow Crab	M						x	x	x	x	x	x	x	x	x	x	x		
	LJ						x	x	x	x	x	x	x	x	x	x	x		
	EJ						x	x	x	x	x	x	x	x	x	x	x		
	L																		
	E						x	x	x	x	x	x	x	x	x	x	x		
Tanner	M				x		x	x	x	x	x	x	x	x	x	x	x	x	
	LJ			x	x		x	x	x	x	x	x	x	x	x	x	x	x	
	EJ						x	x	x	x	x	x	x	x	x	x	x	x	
	L				x														
	E				x		x	x	x	x	x	x	x	x	x	x	x	x	

BSAI Crab		Structure										Community Associations												Oceanographic Properties			
Species	Life Stage	Bars	Sinks	Slumps\Rockfalls\Debris	Channels	Ledges	Pinnacles	Seamounts	Reefs	Vertical Walls	Man-made	Algal Cover	Anenomes	Enchinoderms	Soft Coral	Hard Coral	Mollusca	Drift Algae\Kelp	Kelp	Polychaetes	Sea Grasses	Sea Onions	Tunicates	Temperature (Celsius)	Salinity (ppt)	Oxygen Conc (ppm)	Life Stage
Blue King Crab	M			x	x	x	x		x	x			x	x	x		x			x							M
	LJ			x	x	x	x		x	x			x	x	x		x			x							LJ
	EJ																										EJ
	L																										L
	E			x	x	x	x		x	x			x	x	x		x			x							E
Golden King Crab	M			x	x	x	x	x	x	x			x	x	x		x			x				<5	>30		M
	LJ			x	x	x	x		x	x			x	x	x		x			x				<5	>30		LJ
	EJ																							<5	>30		EJ
	L																							<5	>30		L
	E			x	x	x	x		x	x			x	x	x		x			x				<5	>30		E
Red King Crab	M												x	x	x		x			x							M
	LJ												x	x	x		x			x							LJ
	EJ																										EJ
	L																										L
	E												x	x	x		x			x							E
Snow Crab	M																										M
	LJ																										LJ
	EJ																										EJ
	L																										L
	E																										E
Tanner	M	x	x	x	x			x			x		x	x	x	x	x	x	x	x		x	x	>4	>30		M
	LJ	x	x	x	x						x		x	x	x	x	x	x	x	x		x	x	>4	>30		LJ
	EJ	x	x	x	x						x		x	x	x	x	x	x	x	x		x	x	>4	>30		EJ
	L																							>4	>30		L
	E	x	x	x	x						x		x	x	x	x	x	x	x	x		x	x	>4	>30		E

Table 3. Summary of Reproductive Traits of BSAI Crab

BSAI Crab		Reproductive Traits																													
		Age at Maturity				Fertilization/Egg Development					Spawning Behavior						Spawning Season														
		Female		Male																											
Species	Life Stage	50%	100%	50%	100%	External	Internal	Oviparous	Ovoviviparous	Viviparous	Batch Spawner	Broadcast Spawner	Egg Case Deposition	Nest Builder	Egg/Young Guarder	Egg/Young Bearer	January	February	March	April	May	June	July	August	September	October	November	December				
Blue King Crab	M	6+			6+	X		X								X	X	X	X	X	X	X	X								
	LJ																														
	EJ																														
	L																														
	E																														
Golden King Crab	M	6+			6+	X		X								X	X	X	X	X	X	X	X	X	X	X	X	X			
	LJ																														
	EJ																														
	L																														
	E																														
Red King Crab	M	7 to 8		7 to 10		X		X								X	X	X	X	X	X	X	X								
	LJ																														
	EJ																														
	L																														
	E																														
Snow Crab	M	5 to 6		6 to 8		X	X	X								X	X	X	X	X	X	X									
	LJ																														
	EJ																														
	L																														
	E																														
Tanner Crab	M	5 to 6		6 to 8		X	X	X								X	X	X	X	X	X	X									
	LJ																														
	EJ																														
	L																														
	E																														

Snow and tanner crab fertilization is internal. Eggs are extruded and carried externally until hatching. King crab fertilization and egg carrying are external.

Table 4. Summary of Predator and Prey Relationships for BSAI Crab

BSAI Crab — Predator to

Species	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Salmon	Cod	Pollock	Halibut
Blue King Crab	M	X				X			X			X	X			X	X	X												
	LJ	X				X			X			X	X			X	X	X												
	EJ																													
	L																													
	E																													
Golden King Crab	M	X				X			X			X	X			X	X	X	X											
	LJ	X				X			X			X	X			X	X	X												
	EJ																													
	L																													
	E																													
Red King Crab	M	X				X			X			X	X			X	X	X												
	LJ	X				X			X			X	X			X	X	X												
	EJ																													
	L																													
	E																													
Snow Crab	M	X				X			X			X	X			X	X	X												
	J	X				X			X			X	X			X	X	X												
	L																													
Tanner Crab	M	X				X			X			X	X			X	X	X												
	LJ	X				X			X			X	X			X	X	X												
	EJ																													
	L	X			X	X																								
	E																													

BSAI Crab — Prey of

Species	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pac fic Cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Skate	Hailbut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Tererstrial Mammals
Blue King Crab	M								X							X														
	LJ								X							X														
	EJ								X							X														
	L																													
	E																													
Golden King Crab	M								X							X														
	LJ								X							X														
	EJ								X							X														
	L																													
	E																													
Red King Crab	M								X							X														
	LJ								X							X														
	EJ								X							X														
	L																													
	E																													
Snow Crab	M								X																					
	J								X			X	X		X	X														
	L																													
Tanner Crab	M								X																					
	LJ								X		X	X	X		X	X														
	EJ								X		X	X	X		X	X														
	L	X		X		X	X	X																						
	E																													

Habitat Description for Red King Crab

(Paralithodes camtschaticus)

Management Plan Area BSAI

Life History and General Distribution

Red king crab (*Paralithodes camtshaticus*) is widely distributed throughout the BS and AI, GOA, Sea of Okhotsk, and along the Kamchatka shelf. Red king crab are typically at depths <100 fathoms (fm). King crab molt multiple times per year through age 3 after which molting is annual. At larger sizes, king crab may skip molt as growth slows. Females grow slower and do not get as large as males. In Bristol Bay, 50 percent maturity is attained by males at 12 cm CL and 9 cm CL by females (about 7 years). Female red king crab in the Norton Sound area reach 50 percent maturity at 6.8 cm and do not attain maximum sizes found in other areas. Size at 50 percent maturity for females in the western Aleutians is 8.9 cm CL. Natural mortality of adult red king crab is assumed to be about 18 percent per year (M=0.2), due to old age, disease, and predation.

Fishery

The red king crab fisheries are prosecuted using mesh covered pots (generally 7 or 8 feet square) set on single lines. Mean age at recruitment is about 8 to 9 years. Two discrete populations of red king crab are actively fished in the BSAI region: Bristol Bay and Norton Sound. A third population surrounding the AI was managed separately as Adak and Dutch Harbor stocks until 1996 when the management areas were combined. The fishery on the Adak stock was closed in 1996, and the fishery on the Dutch Harbor stock has closed since the 1983 to 1984 season. These fisheries historically occurred in the winter and spring. Red king crab are allowed as bycatch during golden king crab fisheries in those areas. Other populations of red king crab are fished in the Pribilof Islands area, St. Matthew, and St. Lawrence Island area, but are managed in conjunction with the predominant blue king crab fisheries. Red king crab stocks are managed separately to accommodate different life histories and fishery characteristics. Male only red king crab >16.5 cm CL are allowed to be taken from Bristol Bay and the Pribilof and AI. The minimum size limit for harvest of male only crab from the Norton Sound and the St. Matthew and St. Lawrence Island population is 12 cm. The season in Bristol Bay begins on November 1 and generally has lasted less than 10 days in recent years. Bycatch in red king crab fisheries consists primarily of Tanner crab and nonlegal red king crab. The commercial fishery for red king crab in Norton Sound occurs in the summer, opening July 1, and a winter through-the-ice fishery opens November 15 and closes May 15.

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

Relevant Trophic Information

Pacific cod is the main predator on red king crabs. Walleye pollock, yellowfin sole, and Pacific halibut are minor consumers of pelagic larvae, settling larvae, and larger crabs, respectively. Juvenile crab may be cannibalistic during molting.

Aapproximate Upper Size Limit of Juvenile Fish (in cm): The size at 50 percent maturity is 7 and 9 cm CL for female and male red king crabs, respectively, from Norton Sound and St. Matthew and

St. Lawrence Islands; it is 9 and 12 cm, respectively, for Bristol Bay and the Pribilof and Aleutian Islands.

Habitat and Biological Associations

Egg: Egg hatch of larvae is synchronized with the spring phytoplankton bloom in southeast Alaska suggesting temporal sensitivity in the transition from benthic to planktonic habitat. Also see mature phase description; eggs are carried by adult female crab.

Larvae: Red king crab larvae spend 2 to 3 months in pelagic larval stages before settling to the benthic life stage. Reverse diel migration and feeding patterns of larvae coincide with the distribution of food sources.

Early Juvenile: Early juvenile stage red king crabs are solitary and need high relief habitat or coarse substrate such as boulders, cobble, shell hash, and living substrates such as bryozoans and stalked ascidians. Young-of-the-year crabs occur at depths of 50 m or less.

Late Juvenile: Late juvenile stage red king crabs ages of 2 and 4 years exhibit decreasing reliance on habitat and a tendency for the crab to form pods consisting of thousands of crabs. Late juvenile crab associate with deeper waters and migrate to shallower water for molting and mating in the spring. Aggregation behavior continues into adulthood.

Mature: Mature red king crabs exhibit seasonal migration to shallow waters for reproduction. The remainder of the year, red king crabs are found in deeper waters. In Bristol Bay, red king crabs mate when they enter shallower waters (<50 m), generally beginning in January and continuing through June. Males grasp females just prior to female molting, after which the eggs (43,000 to 500,000 eggs) are fertilized and extruded on the female's abdomen. The female red king crab carries the eggs for 11 months before they hatch, generally in April.

Additional Information Sources

ADF&G, Dutch Harbor, AK, Larry Boyle.
ADF&G, Dutch Harbor, AK, Rance Morrison, Robert Gish.

SPECIES: Red King Crab, *Paralithodes camtschaticus*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceanographic Features	Other
Eggs	11 mo	NA	May-April	NA	NA	NA	F	
Larvae	3-5 mo	Diatoms, Phytoplankton Copepod nauplii	April-August	MCS, JCS	P	NA	F	
Juveniles	1 to 5-6 yrs	Diatoms Hydroids	All year	ICS, MCS, BCH, BAY	D	SAV (epifauna), R, CB, G	F	Found among biogenic assemblages (sea onions, tube worms, bryozoans, ascidians, sea stars)
Adults	5-6+ yrs	Mollusks, echinoderms, polychaetes, decapod, crustaceans, Algae, urchins, hydroids, sea stars	Spawning Jan-June	MCS, ICS, BAY, BCH	D	S, M, CB, G	F	

Habitat Description for Blue King Crab

(Paralithodes platypus)

Management Plan Area BSAI

Life History and General Distribution

Blue king crab (*Paralithodes platypus*) has a discontinuous distribution throughout its range (Hokkaido, Japan to Southeast Alaska). In the BS, discrete populations exist in the cooler waters around the Pribilof Islands, St. Matthew Island, and St. Lawrence Island. Smaller populations have been found in Herendeen Bay and around Nunivak and King Island, as well as isolated populations in the GOA. Blue king crab molt multiple times as juveniles. In the Pribilof area, 50 percent maturity of females is attained at 9.6 cm CL, which occurs at about 5 years of age. Blue king crab in the St. Matthew area mature at smaller sizes (50 percent maturity at 8.1 cm CL for females) and do not get as large overall. Skip molting occurs with increasing probability for those males larger than 10 cm CL and is more prevalent for St. Matthew Island crab. Larger female blue king crab have a biennial ovarian cycle and a 14-month embryonic period. Unlike red king crab, juvenile blue king crab do not form pods, instead relying on cryptic coloration for protection from predators. Adult male blue king crab occur at an average depth of 70 m and an average temperature of 0.6ºC.

Fishery

The blue king crab fisheries are prosecuted using mesh covered pots (generally 7 or 8 feet square) set on single lines. Two discrete stocks of blue king crab are fished: the Pribilof Islands and the St. Matthew Island stocks. These blue king crab fisheries have occurred in September in recent years. Bycatch in the blue king crab fisheries consist almost entirely of non-legal blue king crabs. Male only crabs >16.5 cm carapace width (CW) are harvested in the Pribilof Islands, while the St. Matthew Islands fishery is managed with a minimum size limit of 140 mm.

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

Relevant Trophic Information

Pacific cod is a predator on blue king crabs.

Approximate Upper Size Limit of Juvenile Fish (in cm): The size at 50 percent maturity is 9- and 12-cm CL for female and male crabs from the Pribilof Islands, and 8- and 10.5-cm CL for St. Matthew Island.

Habitat and Biological Associations

<u>*Egg*</u>: See mature phase description; eggs are carried by adult female crab.

<u>*Larvae*</u>: Blue king crab larvae spend 3.5 to 4 months in pelagic larval stages before settling to the benthic life stage. Larvae are found in waters between 40 to 60 m deep.

Early Juvenile: Early juvenile blue king crabs require area found in substrate characterized by gravel and cobble overlaid with shell hash and sponge, hydroid, and barnacle assemblages. These habitat areas have been found at 40 to 60 m around the Pribilof Islands.

Late Juvenile: Late juvenile blue king crab are found in nearshore rocky habitat with shell hash.

Mature: Mature blue king crabs occur most often between 45 and 75 m deep on mud-sand substrate adjacent to gravel rocky bottom. Female crabs are found in a habitat with a high percentage of shell hash. Mating occurs in mid-spring. Larger older females reproduce biennially, while small females tend to reproduce annually. Fecundity of females range from 50,000 to 200,000 eggs per female. It has been suggested that spawning may depend on the availability of nearshore rocky-cobble substrate for protection of females. Larger older crabs disperse farther offshore and are thought to migrate inshore for molting and mating.

Additional Information Sources

ADF&G, Dutch Harbor, AK, Larry Boyle.
ADF&G, Dutch Harbor, AK, Rance Morrison.

SPECIES: Blue King Crab, *Paralithodes platypus*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	14 mo.	NA	Starting April-May	NA	NA	NA	F	
Larvae	3.5 to 4 mo.		April-July	MCS, ICS	P	NA	F	
Juveniles	to about 5 years		All year	MCS, ICS	D	CB, G, R	F	
Adults	5+ years		Spawning Feb-Jun	MCS, ICS	D	S, M, CB, G, R	F	

Habitat Description for Golden King Crab

(Lithodes aequispina)

Management Plan Area BSAI

Life History and General Distribution

Golden king crab (*Lithodes aequispina*), also called brown king crab, range from Japan to British Columbia. In the BS and AI, golden king crab are found at depths from 100 to 1,000 m, generally in high relief habitat such as inter-island passes, and they are usually slope-dwelling. Size at sexual maturity depends on latitude and ranges from 9.8 to 11 cm CL, with crabs in the northern areas maturing at smaller sizes. Females carry up to 20,000 eggs, depending on their size. The season of reproduction appears to be protracted and may be year-round.

Fishery

The golden king crab fisheries are prosecuted using mesh covered pots set on longlines to minimize gear loss. The primary fishery is in the AI, with minor catches coming from localized areas in the BS and GOA. Until 1996, the golden king crabs in the AI were managed as two separate stocks: Adak and Dutch Harbor. The fishing season opens September 1 and male crab >15.2 cm are harvested. Golden king crab are harvested in the BS under conditions of a permit issued by the Commissioner of the Alaska Department of Fish and Game. Bycatch consists almost exclusively of non-legal golden king crab. Escape rings were adopted by the Alaska Board of Fisheries in 1996 to reduce capture and handling mortality of non-target crab; a minimum of four 5.5-inch rings are required on pots used in golden king crab fisheries.

Relevant Trophic Information None

Approximate Upper Size Limit of Juvenile Fish (in cm): The size (CL) at 50 percent maturity for females and males: Aleutians 11 and 12.5 cm, Pribilofs 10 and 10.7 cm, Northern BS 9.8 and 9.2 cm.

Habitat and Biological Associations

Golden king crabs occur on hard bottom, over steep rocky slopes, and on narrow ledges. Strong currents are prevalent. Golden king crabs coexist with abundant quantities of epifauna: sponges, hydroids, coral, sea stars, bryozoans, and brittle stars.

Egg: Information is limited. See mature phase description; eggs are carried by adult female crab.

Larvae: Information is not available.

Early Juvenile: Information is not available.

Late Juvenile: Late juvenile golden king crabs are found throughout the depth range of the species. Abundance of late juvenile crab increases with depth, and these crab are most abundant at depths >548 m.

Mature: Mature golden king crabs occur at all depths within their distribution. Males tend to congregate in somewhat shallower waters than females, and this segregation appears to be maintained throughout the year. Legal male crabs are most abundant between 274 and 639 m. Abundance of sub-legal males increases at depth >364 m. Female abundance is greatest at intermediate depths between 274 and 364 m.

Additional Information Sources

ADF&G, Dutch Harbor, AK, Larry Boyle.
ADF&G, Dutch Harbor, AK, Robert Gish.

SPECIES: Golden King Crab, *Lithodes aequispina*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		n/a	all year	LSP	D			
Larvae	U		all year	U	P			
Juveniles			all year		D			
Adults		Ophiuroids, sponges, plants	Spawning Feb.-Aug.	LSP BSN	D			

Habitat Description for Scarlet King Crab

(Lithodes couesi)

Management Plan Area BSAI

Life History and General Distribution

Little information is available on the biology of the scarlet king crab (*Lithodes couesi*), found in the BS and AI area. Based on data from the GOA, this species occurs in deep water, primarily on the continental slope. Spawning may be asynchronous. Females can produce up to 5,000 eggs, depending on female size.

Fishery

Scarlet king crab are harvested by longlining mesh covered pots. Directed fishing may occur only under conditions of a permit issued by the Commissioner of the Alaska Department of Fish and Game. Scarlet king crab are also taken incidentally in the golden king crab fishery.

Relevant Trophic Information None

Approximate Upper Size Limit of Juvenile Fish (in cm): The size (CL) of 50 percent maturity for female and males is 8 cm and 9.1 cm.

Habitat and Biological Associations

Scarlet king crab are associated with steep rocky outcrops and narrow ledges. Strong currents are prevalent.

Egg: Information is limited. See mature phase description; eggs are carried by adult female crab.

Larvae: Information is not available.

Early Juvenile: Information is not available.

Late Juvenile: Information is not available.

Mature: Information is limited. Mature scarlet king crabs are caught incidentally in the golden king crab and *C. tanneri* fisheries.

Additional Information Sources

ADF&G, Dutch Harbor, AK, Larry Boyle.
ADF&G, Dutch Harbor, AK, Robert Gish.

SPECIES: Scarlet King Crab, *Lithodes couesi*

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs								
Larvae								
Juveniles								
Adults								

Habitat Description for Tanner Crab

(Chionoecetes bairdi)

Management Plan and Area BSAI

Life History and General Distribution

Tanner crab (*Chionoecetes bairdi*) are distributed on the continental shelf of the North Pacific Ocean and BS from Kamchatka to Oregon. Off Alaska, Tanner crab are concentrated around the Pribilof Islands and immediately north of the Alaska Peninsula. They are found in lower abundance in the GOA. Size at 50 percent maturity, as measured by CW is 11 cm for males and 9 cm for females in the BS. The corresponding age of maturity for male Tanner crab is approximately 6 to 8 years. Mature male Tanner crabs may skip a year of molting as they attain maturity. Natural mortality of adult Tanner crab is assumed to be about 25 percent per year (M=0.3).

Fishery

The Tanner crab fisheries are prosecuted using mesh covered pots (generally 7 or 8 feet square) set on single lines. Mean age at recruitment is 8 to 9 years. Male crab >14 cm CW may be harvested. Fisheries operate on three separate stocks: EBS, eastern AI, and western AI. The directed fishery was closed in 1996 due to low CPUE relative to pre-season expectations. The Tanner crab stocks of the AI are very small, and populations are found in only a few large bays and inlets. As such, the fisheries are limited, occurring during the winter. No commercial fishery was allowed for Tanner crabs in either the east or west AI in 1995 and 1996. The directed fishery for BS Tanner crab opens 7 days after closure of the Bristol Bay red king crab fishery. However, retention of Tanner crab is allowed during the Bristol Bay red king crab fishery that opens November 1. Bycatch in the directed fishery consists of primarily of non-legal Tanner crab and red king crab. A 3-inch maximum tunnel height opening for Tanner crab pots is required to inhibit the bycatch of red king crab. Also, escape rings are required to reduce capture and handling mortality of all non-target crab; a minimum of four 5-inch rings are required on pots used in Tanner crab fisheries.

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

Relevant Trophic Information

Pacific cod is the main predator on Tanner crabs in terms of biomass. Predators consume primarily age 0 and 1 juvenile Tanner crab with a less than 7-cm CW. However, flathead sole, rock sole, halibut, skates, and yellowfin sole are important in terms of numbers of small crab. Larval predators include salmon, herring, jellyfish, and chaetognaths. Cannibalism has been observed in laboratory environments among juvenile crabs during molting.

Approximate Upper Size Limit of Juvenile Fish (in cm): The size at 50 percent maturity is 9- and 11-cm CW for female and male crabs.

Habitat and Biological Associations

Egg: See mature phase description; eggs are carried by adult female crab.

Larvae: Larvae of *C. bairdi* Tanner crabs are typically found in the BSAI water column from 0 to 100 m in early summer. They are strong swimmers and perform diel migrations in the water column (down at night). They usually stay near the depth of the chlorophyll maximum during the day. The last larval stage settles onto the bottom mud.

Early Juvenile: Early juvenile *C. bairdi* Tanner crabs occur at depths of 10 to 20 m in mud habitat in summer and are known to burrow or associate with many types of cover. Early juvenile *C. bairdi* Tanner crabs are not easily found in winter.

Late Juvenile: The preferred habitat for late juvenile *C. bairdi* Tanner crabs is mud. Late juvenile Tanner crab migrate offshore of their early juvenile nursery habitat.

Mature: Mature *C. bairdi* Tanner crabs migrate inshore, and mating is known to occur from February through June. Mature female *C. bairdi* Tanner crabs have been observed in high density mating aggregations, or pods, consisting of hundreds of crabs per mound. These mounds may provide protection from predators and also attract males for mating. Mating need not occur every year, as female *C. bairdi* Tanner crabs can retain viable sperm in spermathecae up to 2 years or more. Females carry clutches of 50,000 to 400,000 eggs and nurture the embryos for 1 year after fertilization. Primiparous females may carry the fertilized eggs for as long as 1.5 years. Brooding occurs in 100 to 150 m depths.

Additional Information Sources

ADF&G, Dutch Harbor, AK, Larry Boyle.
ADF&G, Kodiak, AK, Al Spalinger.

SPECIES: Tanner Crab, *Chionoecetes bairdi*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	1 year	NA	April-March	NA	NA	NA	F	
Larvae	2 to 7 mo.	Diatoms Algae Zooplankton	Summer	MCS, ICS	P	NA	F	
Juveniles	1 to 6 years	Crustaceans polychaetes mollusks diatoms algae hydroids	All year	MCS, ICS, BAY, BCH	D	M	F	
Adults	6+ years	Polychaetes crustaceans mollusks hydroids alsae diatoms	Spawning Jan. To June (peak April-May)	MCS, ICS	D	M	F	

Habitat Description for Snow Crab

(Chionoecetes opilio)

Management Plan and Area BSAI

Life History and General Distribution

Snow crabs (*Chionoecetes opilio*) are distributed on the continental shelf of the BS, Chukchi Sea, and in the western Atlantic Ocean as far south as Maine. Snow crab are not present in the GOA. In the BS, snow crabs are common at depths less than 200 m. The EBS population within U.S. waters is managed as a single stock; however, the distribution of the population extends into Russian waters to an unknown degree. While 50 percent of the females are mature at 5-cm CW, the mean size of mature females varies from year to year over a range of 6.3- to 7.2-cm CW. Females cease growing with a terminal molt upon reaching maturity and rarely exceed 8 cm CW. The median size of maturity for males is about 8.5-cm CW (approximately 6 to 8 years old). Males larger than 6 cm grow at about 2 cm per molt, up to an estimated maximum size of 14.5-cm CW, but individual growth rates vary widely. Natural mortality of adult snow crab is assumed to be about 25 percent per year (M=0.3).

Fishery

The snow crab fishery is prosecuted using mesh covered pots (generally 7 or 8 feet square) set on single lines. Male only crab greater than 7.8-cm CW may be harvested; however, a market minimum size of about 10.2 cm CW is generally observed. Most male snow crab probably enter the fishery at around age 6 to 8 years. Snow crab are probably one stock in the BS. The season opening date is January 15. A 3-inch maximum tunnel height opening for snow crab pots is required to inhibit the bycatch of red king crab. A minimum of four 3.75-inch escape rings are required on snow crab pots to reduce capture and handling mortality of non-target crab. Bycatch in the snow crab fishery consists primarily of *C. bairdi* and non-legal *C. opilio*.

Bottom trawls and dredges could disrupt nursery and adult feeding areas.

Relevant Trophic Information

Pacific cod, sculpins, skates, and halibut are the main predators on snow crabs in terms of biomass. Snow crabs less than 7-cm CW are most commonly consumed. Other predators include yellowfin sole, flathead sole, Alaska plaice, walleye pollock, rock sole, bearded seals, and walrus. Juvenile snow crabs have been observed to be cannibalistic during molting in laboratory environments.

Approximate Upper Size Limit of Juvenile Fish (in cm): The size at 50 percent maturity is 5- and 8.5-cm CW for female and male crabs, respectively.

Habitat and Biological Associations

Egg: See mature phase description; eggs are carried by adult female crab.

Larvae: Larvae of *C. opilio* snow crab are found in early summer and exhibit diel migration. The last of three larval stages settles onto bottom in nursery areas.

Early Juvenile: Shallow water areas of the EBS are considered nursery areas for *C. opilio* snow crabs and are confined to the mid-shelf area due to the thermal limits of early and late juvenile life stages.

Late Juvenile: A geographic cline in size of *C. opilio* snow crabs indicates that a large number of morphometrically immature crabs occur in shallow waters less than 80 m.

Mature: Female *C. opilio* snow crabs are acknowledged to attain terminal molt status at maturity. Primiparous female snow crabs mate January through June and may exhibit longer egg development period and lower fecundity than multiparous female crabs. Multiparous female snow crabs can store spermatophores in seminal vesicles and fertilize subsequent egg clutches without mating. At least two clutches can be fertilized from stored spermatophores, but the frequency of this occurring in nature is not known. Females carry clutches of approximately 36,000 eggs and nurture the embryos for approximately 1 year after fertilization. However, fecundity may decrease up to 50 percent between the time of egg extrusion and hatching, presumably due to predation, parasitism, abrasion, or decay of unfertilized eggs. Brooding probably occurs in depths greater than 50 m.

Additional Information Sources

ADF&G, Dutch Harbor, AK, Rance Morrison.
ADF&G, Dutch Harbor, AK, Larry Boyle.

SPECIES: Snow Crab, *Chionoecetes opilio*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	1 year	NA		NA	NA	NA	F	
Larvae	2 to 7 mo.	Diatoms algae zooplankton	Spring, summer	ICS, MCS	P	NA	F	
Juveniles	1 to 4 years	Crustaceans polychaetes mollusks diatoms algae hydroids	All year	ICS, MCS, OCS	D	M	F	
Adults	4+ years	Ploychaetes brittle stars mollusks crustaceans hydroids algae diatoms	Spawning Jan. To June (peak April-May)	ICS, MCS, OCS	D	M	F	

Habitat Description for Grooved Tanner Crab

(Chionoecetes tanneri)

Management Plan Area BSAI

Life History and General Distribution

In the eastern North Pacific Ocean, the grooved Tanner crab (*Chionoecetes tanneri*) ranges from northern Mexico to Kamchatka. Little information is available on the biology of the grooved Tanner crab. This species occurs in deep water and is not common at depths exceeding 300 m. Male and female crabs are found at similar depths. Male and female grooved Tanner crab generally reach maturity at 11.9- and 7.9-cm CW, respectively.

Fishery

Directed harvest of grooved Tanner crab has been sporadic since the first reported landings in 1988. Crabs are taken in mesh covered pots deployed on a longline. Harvest can occur only under conditions of a permit issued by the Commissioner of the Alaska Department of Fish and Game.

Relevant Trophic Information None.

Approximate Upper Size Limit of Juvenile Fish (in cm): Size at 50 percent maturity is 11.9-cm CW for males and 7.9-cm CW for females.

Habitat and Biological Associations

Egg: Information is not available.

Larvae: Information is not available.

Early Juvenile: Information is not available.

Late Juvenile: Information is not available.

Mature: In the EBS, mature male grooved Tanner crabs may be found somewhat more shallow than mature females, but male and female crabs do not show clear segregation by depth.

Additional Information Source

ADF&G, Dutch Harbor, AK., Larry Boyle, Rance Morrison.

SPECIES: Grooved Tanner Crab, *Chionoecetes tanneri*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs								
Larvae								
Juveniles								
Adults		Polychaetes, crustaceans, ophiuroids						

Habitat Description for Triangle Tanner Crab

Chionoecetes angulatus

Management Plan Area BSAI

Life History and General Distribution

In the eastern North Pacific Ocean, the distribution of triangle Tanner crab (*Chionoecetes angulatus*) ranges from Oregon to the Sea of Okhotsk. This species occurs on the continental slope in waters deeper than 300 m and has been reported as deep as 2,974 m in the EBS. A survey limited to a particular depth range found that mature male crabs inhabit depths around 647 m shallower than the mean depth of 748 m for female crabs. Size at 50 percent maturity for male triangle Tanner crabs is 9.1-cm CW and 5.8-cm CW for females.

Fishery

A directed fishery for triangle Tanner crab was documented for the first time in 1995. Prior to 1995, these crab had been harvested as bycatch in the *C. tanneri* fishery. Directed harvest is allowed only under the conditions of a permit issued by the Commissioner of the Alaska Department of Fish and Game. Crab are taken in mesh covered pots deployed on a longline.

Relevant Trophic Information None.

Approximate Upper Size Limit of Juvenile Fish (in cm): In the EBS, male triangle Tanner crabs reach size at 50 percent maturity at 9.1-cm CW and females at 5.8-cm CW.

Habitat and Biological Associations

Egg: Information is not available.

Larvae: Information is not available.

Early Juvenile: Information is not available.

Late Juvenile: Information is not available.

Mature: The mean depth of mature male triangle Tanner crabs (647 m) is significantly less than for mature females (748 m), indicating some pattern of sexual segregation by depth.

Additional Information Source

ADF&G, Dutch Harbor, AK., Larry Boyle and Rance Morrison.

SPECIES: Triangle Tanner Crab, *Chionoecetes angulatus*

Life Stage	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs								
Larvae								
Juveniles								
Adults				USP LSP BSN				

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