Preliminary Report to the Alaska Board of Fisheries

COLLAPSED OR RECOVERING SHELLFISH FISHERIES

IN THE STATE OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
Division of Commercial Fisheries
Regional Information Report[1] 1J02-06

— OCTOBER 1999 —

1 The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data, this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

TABLE OF CONTENTS

SOUTHEAST ALASKA, REGION I

SOUTHEAST ALASKA GOLDEN KING CRAB

Historical Harvest Synopsis

Golden king crab harvests in southeast Alaska have fluctuated widely in the past 25 years, reaching peak levels in the 1980s, followed by a collapse in the early 1990s (figure below). The fishery is now on the rise again due to strong recruitment in the past several years. Entry was limited in 1985. There are currently 70 eligible permits, 14 more than the optimal maximum established by the Commercial Fisheries Entry Commission (CFEC).

Management and Research Program

The fishery is managed inseason to stay within guideline harvest ranges for each of 5 fishing areas in central and northern southeast Alaska. Fish tickets are tallied and as guideline harvest levels (GHLs) are approached, fishermen and processors are contacted to determine the poundage of the most recent harvests. Closures dates are selected that allow fishers to pull their pots when tide changes are minimal, if possible.

Research is limited to infrequent dockside sampling of catches to monitor recruitment strength. When recruitment is strong, we are able to allow more liberal harvests, and when recruitment is weak, harvests will be more conservative.

Cause of the Collapse

The department believes that the collapse was due at least in part to overharvest as a result of an inadequate management and research program. In a strict sense, the fishery collapsed because recruitment of young males was inadequate to replace those harvested or those that died due to other causes, and it is difficult to know which source of mortality was more important. In hindsight, however, annual harvests were probably too high to have been sustainable.

When the fishery for golden king crab started in the early 1970s there was a 600,000 pound quota, far exceeding the market demand and annual catches. This was changed to a more conservative and realistic guideline harvest range of 50,000 to 200,000 pounds in 1978, a time when the fishermen were gaining experience with gear and fishing techniques, but when exvessel prices were low.

The growth phase of the fishery was facilitated by an accommodating Board in the 1980s. The upper end of the GHR was increased to 500,000 pounds in 1981 in response to requests from the industry when the value was increasing and the fleet's ability was sufficient to harvest the available stock throughout the region. The upper end of the GHR was increased to 825,000 pounds in 1987 and then to 1,200,000 pounds in 1988, in both cases at the request of the industry. In hindsight, the catches had peaked, and the lack of recruitment seen in catches at the time bore out to be a widespread recruitment decline. The rebuilding of the stock in the late 1990s is evidence of another favorable period for reproduction and/or survival of younger males that began in the early 1990s.

What Do We Plan To Do?

The first step has already been taken by the Board and by the department in 1998, and that was to institute more conservative guideline harvest ranges for each of 5 management areas, totaling 500,000 pounds on the upper end. This is the level that the department believes may be fished when stock assessment information is adequate to reliably know that stock sizes are large and recruitment is strong. The harvest strategy is to allow harvests below the upper end of the GHR when stock status is less than ideal, or when our ability to assess the stock is limited, as is currently the situation.

The department is not able to conduct an annual survey to estimate abundance under current funding levels. Instead, we will augment our port sampling program with occasional onboard observations of catches on an opportunistic basis and continue to manage below the upper end of the GHR. This is a conservative approach to setting harvest levels as required in 5 AAC 34.114. The intent of this approach is to carry over sufficient numbers of large male crabs each year to maintain reproductive viability, and to avoid stock collapses in the future.

SOUTHEAST ALASKA ABALONE

Historical Harvest Synopsis

The commercial fishery for northern abalone (*Haliotis kamtschatkana*) in Alaska was short-lived. The 25-year history was marked by peak catches in the late 1970s and early 1980s, followed by a steep decline and a long slide towards total closure in 1995 (Figure below). Size restrictions and

seasonal catch limits were imposed in an increasingly restrictive sequence that proved ineffective to alter the downward trend.

A 76 mm (3 in) minimum size was in effect since at least 1963. This limit was variously modified through 1979, when a regionwide limit of 95 mm (3.75 in) was set in an attempt to preserve reproductive potential following the initial explosion of catch in 1978. The regionwide limit was further raised to 102 mm in 1994 once the stock decline was clear.

GHLs were first put in place at the peak of the fishery in the 1980/81 season. These guideline levels were reduced repeatedly in the subsequent 15 years until the final closure in 1995. The first GHL was 225,000 pounds with the GHL in the final year reduced to 15,000 pounds. Fishing time was first reduced from 12 months to 9 in 1980. Total fishing time in the final year, 1995, was reduced to 6 days.

There were no limits to the number of divers participating in the fishery. The rise in participation to approximately 100 divers by the early 1990s was an important factor in eventual closure of the fishery. The allowable catch in this decade was too small to provide for an orderly, manageable fishery with 100 or more participants under open access regulations.

Management and Research Program

Except for catch and effort statistics and some limited tagging efforts, the department has never had a stock assessment program for abalone in Alaska. Department divers conduct urchin and sea cucumber surveys in areas that were traditional abalone grounds, and through these observations we are able to subjectively gauge the status of abalone stocks.

Cause of the Collapse

The fishery collapsed almost certainly because of excessive harvests in the late 1970s and early 1980s. Similar collapses have occurred in stocks of the same species in British Columbia and Washington State. There was not a sufficient stock assessment or research program in place when the Alaska fishery boomed and there was insufficient support to develop a program within the department. Further, there was inadequate understanding among the global research community of the special vulnerabilities of abalone populations to overharvest. These attributes include a very limited larval dispersal distance, such that local populations can become effectively extinct with little chance for larvae to colonize from elsewhere. Also, abalones aggregate, and will move in from marginal habitat as individuals are removed from prime habitat. This behavior leads to false conclusions that harvests are sustainable until, seemingly by surprise, they are all gone.

The decline of abalone is probably a long-term condition now that sea otters have expanded to occupy much of their former range. Otter populations have grown exponentially since their reintroduction into outer coastal waters of southeast Alaska in the 1960s (Figure below), and there are only a few pockets of abalone habitat that have not yet seen a resurgence of otters. The

two species share the same environment. Otters are uniquely adapted to prey on abalone and it is clear that abalone cannot co-exist in commercial quantities with sea otters.

What Do We Plan To Do?

The abalone fishery will remain closed. If the stock recovers and funding becomes available, the department will work with the industry to develop a research plan and management program that will allow an orderly and sustainable fishery. The Southeast Regional Dive Fishery Association has indicated their strong support for such a program.

YAKUTAT TANNER CRAB

Historical Harvest Synopsis

Tanner crab harvests in the Yakutat area attained high levels in the 1970s and crashed in the early 1980s (Figure below). These crabs were caught mostly in the gullies and trenches offshore of the major bays. The character of the fishery changed with declining harvests. Most of the harvests in the heyday of the fishery were by large, modern, Bering Sea style vessels that also participated in much larger Westward Area Tanner crab fisheries. Pot dumping, a fishing technique where a pot was brought aboard and emptied directly into the hold with no sorting, occurred even after the minimum legal size was established. Recently, mostly smaller local vessels have participated on a sporadic basis. Larger vessels from Southeast Alaska or Prince William Sound occasionally entered the fishery to see if stocks were improving.

Management and Research Program

There was only a minimal management and research program for this fishery. The season was left open during the regulatory period of January 15 through May 1 to allow fishers to prospect, with the expectation that we could use the catch information to monitor stock status and potential recovery of the fishery.

A small number of skipper interviews were conducted through 1994. This program was discontinued due to the difficulty of tracking the handful of landings, particularly with the recent (1999) decision to close the Yakutat office in the winter for budgetary reasons. Tanner crab size at maturity, growth, and other important biological parameters are not known in the Yakutat Area.

Regulations include a minimum legal size of 5.5 inches in carapace width, a GHL of 1 million pounds, and a pot limit of 100. Area D is a nonexclusive registration area.

Cause of the Collapse

The cause of the collapse is not known with certainty; however, the very large and mostly unrestricted catches are suspected to be the primary factor. Other factors such as variable growth, variable recruitment, predation, and handling mortalities were probably important as well. The department lacked basic research information and stock assessment data on these factors. The fact that the stock is on the northern edge of the range may have been a contributing factor.

Minimum legal size and GHL were not established until 1976. From the 1976/77 through the 1983/84 season, the GHL was 3.0 million pounds; a level never achieved during the unrestricted early fisheries. The GHL was not reduced below 1.0 million pounds until the 1994/95 season, when, in hindsight, it was too late. The fact that it was never necessary to close the season by emergency order (to stay below the GHL) is an indication that the regulatory GHL exceeded available legal stock size.

What Do We Plan To Do?

The department plans to close the fishery in January 2000 by emergency order until sufficient interest is expressed by the industry and sufficient funding becomes available to establish a research and management program that will be adequate to provide for a sustained yield. The trend in harvests since the 1980s is not encouraging, and no recovery is in sight.

YAKUTAT DUNGENESS CRAB

Historical Harvest Synopsis

Dungeness crab harvests in the Yakutat area have oscillated sharply in the past three decades, reaching annual peaks of 2 to 5 million pounds each decade before a subsequent crash (Figure below). The harvests are primarily from the nearshore zone of the outer coast. A small fishery occurs in the major bays, primarily Yakutat Bay.

Management and Research Program

There was a limited but active inseason management program for this fishery. We monitored the harvests and obtained size frequencies of landed crab during the first two to three weeks after the opening on May 15 to decide if the stock has recovered sufficiently to allow increased harvests. If catch rates were slow and recruitment was weak, the fishery was closed.

Only males 6.5 inches or larger in carapace width were allowed to be retained, and the pot limit is 400. Area D is a superexclusive registration area.

Cause of the Collapse

The collapse appears to be cyclic, on a decadal basis. It is therefore possible that stock abundance is controlled in large part by environmental conditions. However, given the lack of research information on this population, any attribution of causes is conjectural, and the large harvests must be considered a potentially important cause, possibly exacerbating any natural fluctuations. Also, the recent collapse has persisted far longer than the two previous declines. It is clear that simple 3-S (size, sex, and season) management is not adequate to provide for sustained harvests.

What Do We Plan To Do?

Our ability to monitor this fishery and to sample the landings has eroded with declining state funding. Resources are also lacking to conduct research or to do stock assessment surveys. Therefore, the department plans to close the fishery in May 2000 by emergency order until sufficient interest is expressed by the industry and sufficient funding becomes available to establish a research and management program that will be adequate to provide for a sustained yield.

COOK INLET AND PRINCE WILLIAM SOUND, REGION II

COOK INLET TANNER CRAB

Historical Harvest Synopsis

The Cook Inlet Management Area, Statistical Area H, includes all waters west of Cape Fairfield (148° E 50' W long.) and north of Cape Douglas (58° E 51' N lat.). ADF&G has management authority for these crab resources, and has divided the management area into six shellfish districts: Southern, Kamishak, Barren Islands, Outer, Eastern, and Central. For Tanner crab management, the Kamishak and Barren Island Districts have typically been managed as a single unit and the Outer and Eastern Districts have similarly been managed as a single unit; that is, they have opened and closed concurrently. Few Tanner crabs are found in the Outer, Eastern, or Central Districts.

The Southern District Tanner crab fishery occurs primarily in the relatively protected waters of Kachemak Bay. The commercial Tanner crab fishery began in the mid 1960s when this species was harvested incidentally to red king crab. The first large harvest of Tanner crab was 1.4 million lb from the Southern District in the 1968–1969 season. Fishing effort quickly expanded to other Cook Inlet districts, and a peak harvest of 8.0 million lb from all districts in the management area was reached during the 1973–1974 season. Southern District catches cycled at approximately six-to-seven year intervals with large harvests of 2.9 million lb in 1972–1973, 2.8 million lb in 1977–1978, 1.2 million lb in 1984–1985, and 0.5 million lb in 1993. Commercial fishing for Tanner crab in the Southern District was closed in the 1989 and 1990 seasons, and has remained closed since 1995.

Kamishak Bay and Barren Islands Districts are managed as a single unit because survey, fishery, and tag recovery information indicate these two districts contain a single stock of Tanner crab. Historical catch following full development of the fishery and implementation of the legal minimum size has ranged from 0.4 to 3.3 million lb Tanner crab. Harvests in the Kamishak and Barren Islands Districts ranged from 12,398 lb in 1968–1969 to 4.7 million lb in 1973–1974. The fishery was closed in 1989 and has remained closed since 1992.

Management and Research Program

Management of Tanner crab in the Cook Inlet Management Area was historically based on fisheries performance, using catch-per-unit-of-effort (CPUE) as an index of stock abundance. The initial management approach only allowed males to be harvested. As the fisheries developed, fishing pressure intensified and gear efficiency improved. This led to adoption of regulations to improve fishery manageability and provide for stock conservation. Seasonal closures were first implemented in 1973, and minimum size regulations were established in 1976. Beginning in 1987, the fishing season was changed so that it no longer overlapped two calendar years; the season opened by regulation on January 15 and closed by emergency order. Several additional regulations that have been adopted for all Tanner crab fisheries in the Cook Inlet Management Area include: (1) superexclusive vessel registration; (2) vessel registration prior to the season opening; (3) gear storage for 30 days before and 30 days after a season in waters 15 fathoms or less; (4) a 75-pot limit per vessel; (5) buoy identification tags to assist with pot limit enforcement; (6) a minimum of four 4 3/4-

in escape rings on all pots; (7) a season opening date of January 15; (8) retention of only male Tanner crab with a carapace width of 5 ½ in (140 mm) or larger; and (5) biodegradable escape mechanisms on crab pots.

Beginning in 1974 in the Southern District, annual pot surveys were used to develop an index of abundance and set the harvest level for subsequent commercial fisheries. Mean catch of legal male Tanner crab in Southern District pot surveys ranged from 39.8 crab per pot in 1977 to 11.4 crab per pot in 1988. Pot surveys were discontinued after 1990 and trawl surveys have been used annually since 1990 to estimate population abundance of Tanner crab from which a GHL is set. Annual abundance of male crab has averaged 1.4 million sublegal male crab and 360,000 legal male crab. Annual abundance of legal male crab has remained substantially below the historical mean since 1994. Abundance of female Tanner crab has ranged from 1.4 million crab in 1991 to 388,000 crab in 1998, with a mean of 944,000 crab among all years. The 1998 survey produced both the lowest total female abundance and the lowest percent mature females (18.2%) in the history of Southern District trawl surveys.

Beginning in 1975 in the Kamishak and Barren Island Districts, annual pot surveys were used to develop an index of abundance and set the harvest level for subsequent Tanner crab commercial fisheries. Mean catch of legal male Tanner crab in pot surveys ranged from 27.8 crab per pot in 1975 to 1.9 crab per pot in 1983 and 1987. Catch rates of sublegal males ranged from 62.2 crab per pot in 1978 to 13.1 crab per pot in 1984. Pot surveys were discontinued after 1990 and trawl surveys have been used annually to estimate abundance of Tanner crab from which the GHL is set. Tanner crab abundance has averaged 3.0 million sublegal and 293,000 legal male crab among all survey years. Annual abundance of legal male Tanner crab has ranged from 594,000 in 1990 to 111,000 in 1993. Estimated abundance of female Tanner crab in the Kamishak and Barren Islands Districts has ranged from 2.6 million in 1990 to 305,000 in 1998. The estimated abundance of 7,900 mature female crab in 1998 represented a substantial decrease from historical levels.

Cause of the Collapse

Explanations of the collapse and failure to recover of the Tanner crab populations in Cook Inlet include environmental and fishing factors. Unfavorable environmental conditions such as warm ocean temperatures may be a contributing factor to the sharp decline and continued low abundance of Tanner crabs in the management area by favoring the production of predators and providing suboptimal environmental conditions for survival of crab larvae. Overfishing occurred of legal size male crab including the effects of incidental fishing mortality associated with the handling of females and sublegal males and "ghost" fishing by lost and derelict pots. Tanner crab are a relatively long lived species and it appears that recruitment of significant numbers into the fishery occurs infrequently.

What Do We Plan To Do?

Existing regulations should continue to be included as components of the management strategy for Tanner crab in Cook Inlet. The department also recommends inclusion of the following: (1) a harvest rate scaled relative to population biomass; (2) a minimum stock size threshold (MSST); and (3) establishment of a time-certain registration deadline so that fishing potential can be evaluated to ensure fishing pressure does not force the population biomass below MSST. Under the proposed harvest strategy, if the estimate of legal males equals or exceeds B_{msy}, (biomass at

MSY) the stock may be harvested at an annual exploitation rate of 20% of the estimated legal males. If the legal male population equals or exceeds MSST but is less than B_{msy}, a fishing mortality of one-half the maximum allowed at MSY is recommended. This corresponds to an annual exploitation rate of 10% of the estimated legal males. When 90% of the estimated legal male Tanner crab population is less than MSST, no commercial harvest will be allowed. The use of 90% of MSST as a benchmark is intended to prevent the fishery from driving the population below MSST and would be particularly important in the initial years after a stock has recovered from being below MSST.

Under this scenario, the Southern District would not have opened to commercial Tanner crab fishing in 1990, 1991 or 1994. Although the trawl survey estimate of legal males exceeded MSST in 1993, we would not have opened the fishery, because a 10% harvest rate would have forced the population below MSST. Under this scenario, the Kamishak and Barren Islands Districts would not have opened to commercial Tanner crab fishing in 1990 or 1991.

The above draft management plan was submitted to the Board of Fisheries at the 1999 King and Tanner Crab meeting. It was tabled waiting for inclusion of a management strategy for the sport and personal use fisheries in the Southern District (Kachemak Bay).

COOK INLET KING CRAB

Historical Harvest Synopsis

There are two species of king crab found in the Cook Inlet Management Area (H), red and golden. Red is the dominant species with golden found only in a scattered distribution in the outer portion of the management area in the Gulf of Alaska. Most of the red king crab fishery has occurred either in the Southern District or the Kamishak/Barren Islands Districts. Very little catch has come from the Outer District and none has been documented from the Eastern or Central Districts.

Earliest recorded commercial landings of king crab occurred in 1937 though commercial fishing for this species remained at a relatively low level through the 1940s. By the mid 1950s, harvest levels rose to approximately 2.0 million lb per year. During the 1960s fishing expanded to the Kamishak Bay District and boats were harvesting up to 8 million lb per year. From the late 1960s through 1976 the seasonal catches ranged from 2.5 to 4.8 million lb. Since that time catches have generally declined. The commercial fishery has been closed due to low abundance since the 1981–1982 season in the Southern District and the 1983–1984 season in the Kamishak/Barren Islands Districts.

Management and Research Program

Similar to the Cook Inlet Tanner crab fishery, regulations for king crab were developed along with the fishery. Most regulations are consistent among all districts with king crab fisheries in the Cook Inlet Area and include: (1) superexclusive vessel registration; (2) vessel registration prior to the season opening; (3) gear storage for 30 days before and 30 days after a season in waters 15 fathoms or less; (4) a 75-pot limit, except a 40-pot limit is in effect if the GHL is less than 1.5 million lb; (5) buoy identification tags to assist with the pot limit enforcement; (6) season dates of August 1 through March 15; (7) retention of only male king crab with a minimum carapace width of 7.0 inches (178 mm), except a season with a minimum carapace width of 8.0 inches (203 mm) may be

established by emergency order; and (8) retention of male golden king crab only under terms of a commissioner's permit.

Historically, the commercial season opened on August 1. The season opening date was changed to July 15 during 1983 to 1987, and then was moved back to August 1 in 1988. The minimum legal size of 7.0 in (178 mm) carapace width was established for all species of king crabs in 1963. The provision allowing an 8.0 in (203 mm) season to be opened and closed by emergency order was adopted in 1976. Fisheries were historically managed for a guideline harvest range (GHR) based upon pot survey indices.

Pot surveys were conducted in the Southern District since 1974 and in Kamishak District since 1975 to develop annual abundance indices used to set the commercial harvest levels for the subsequent fisheries. Catch rates of legal male king crab in the Southern District ranged from 0.4 crab per pot in 1982 to 3.4 crab per pot in 1978. Catches of female king crab also declined from 46.4 crab per pot in 1977 to 0.1 crab per pot in 1990. In Kamishak District catches of legal male king crab ranged from 0.3 crab per pot in 1986 to 27.0 crab per pot in 1975. Catch rates for female king crab also declined from 37.6 crab per pot in 1977 to 1.0 crab per pot in 1988.

Pot surveys were replaced by annual trawl surveys in the Southern, Kamishak and Barren Islands Districts in 1990. Red king crabs are not abundant and have a patchy distribution, as is evidenced by the variability in trawl survey catches. Population abundance estimates have not been calculated and survey results are treated as an index of king crab abundance. In the Southern District total catch of male crab has ranged from 105 in 1991 to 0 in 1998. Most king crabs captured during surveys have been of legal size. In the Kamishak and Barren Islands Districts total catch of male crab has ranged from 46 in 1997 to 3 in 1994, with a 1998 catch of 14 crab. Most of the catch in recent years has been comprised of sublegal king crab, although more legal size crab were caught in the early 1990s.

Cause of the Collapse

There are several reasonable explanations for the decline in abundance of Cook Inlet king crab stocks and their failure to recover. Over fishing, in that removals exceeded recruitment, must have occurred to fish down the stocks to the level prior to complete closure. Next, environmental conditions may have changed, causing greater mortality of king crab larvae and their forage base as well as increased production of crab predators such as gadoid fishes. King crab is also a long-lived species and recruitment of significant numbers of individuals into the fishery may occur infrequently. This would have called for a more conservative approach to harvest than did occur.

What Do We Plan to Do?

The Cook Inlet king crab population remains severely depressed and all crab are needed to sustain the limited existing productivity. Because a stock recovery is not anticipated in the near term, a regulatory closure of all fisheries was requested at the 1999 King and Tanner Crab Board of Fisheries meeting. Commercial, sport, and personal use fisheries for king crab are now closed by regulation. The stock will continue to be monitored through trawl surveys. When recovery of the population is evident, a management plan will be developed for consideration by the board and user groups. At that time, the department will evaluate a variety of survey options to determine the best alternatives relative to available assessment tools.

COOK INLET DUNGENESS CRAB

Historical Harvest Synopsis

The majority of the commercial, sport, and personal use Dungeness crab fishing in Cook Inlet has occurred in the Southern District which includes Kachemak Bay. Although low level, sporadic effort has occurred since statehood, commercial catch and effort first increased significantly in 1978 when 1.2 million lb were taken by 49 vessels. Subsequently favorable market conditions and the need of fishermen to find alternative fisheries have kept effort high. Since 1978 annual harvests have ranged from a low of 29,502 lb in 1990 to a high of 2.1 million lb in 1979. The commercial fishery has been closed in the Southern District since 1991 due to low overall abundance. Effort has ranged from 1 vessel in 1993, 1994, and 1995 to 108 vessels in 1982.

Management and Research Program

Statewide biological regulations for the commercial Dungeness fisheries consist of a males only harvest and a minimum legal size of 6.5 in carapace width. Gear regulations include a provision for two 4 3/8-in escape rings per pot and a biodegradable twine escape mechanism. Limited entry was adopted for the Cook Inlet Dungeness Fishery in 1993. The limit was set at 103 pot fishers and 2 ring net fishers. The fishery is managed as a 3-S (size, sex, and season) fishery.

The 1994 Board of Fisheries substantially changed the regulatory structure used to manage the Cook Inlet Management Area commercial Dungeness crab fishery. The Southern District was divided into 2 subdistricts: Subdistrict 1, which includes the waters east of Homer Spit, and Subdistrict 2, which includes the waters west of Homer Spit. Commercial fishing seasons and depth limitations for the Southern District were also set. Subdistrict 1 is open August 1 through August 31 in waters of 10 fathoms or less only. Subdistrict 2 is open from July 15 through August 31 in waters of 40 fathoms or less only. The season for the remaining districts of the Cook Inlet Management Area is June 1 through December 31, and from January 15, or the beginning of the commercial Tanner crab season, whichever is later, through March 15. Pot limits with a buoy tag and color code requirement were established as 150 pots for the Southern District of which only 50 pots may be used in Subdistrict 1. Dungeness crab line cannot be floating on the water surface unless it is the line connecting the main buoy to the auxiliary buoy.

In 1990 the department began a pot survey to further document the molt timing of the catchable Dungeness crab population and to establish an index of abundance. This survey in tandem with the crab trawl survey indicated one or two significant year classes moving toward the fishery which have failed to grow into legal-sized crab. These year classes exhibited an extremely high level of skipmolting in 1992, 1993, and 1994, the years when they should have fully recruited into the fishery. Department pot survey catches of sub-legal and legal male crabs have declined dramatically from 9.4 and 8.8 crabs per pot respectively, in 1992 to 0.08 and 0.17 crabs per pot in 1997.

In 1997 the Board of Fisheries adopted a management plan which closed the commercial Dungeness fishery (5 AAC 32.390). The Board was concerned that inadequate information exists regarding the biology and stock status of Dungeness crab to ensure that the commercial fishery can be conducted in a sustainable manner.

Cause of the Collapse

Outside of natural population fluctuations, three fishing related factors have had a notable negative impact on this fishery:

1) Depression of the stock due to handling and trapping mortality that was the result of fishing during and immediately after the molting period.

2) Extremely high effort over long seasons with the resultant high annual fishing mortality due to ease of access by both commercial and recreational fishermen.

3) Violation of the 150 pot limit by a portion of the fleet.

The combination of extended heavy fishing pressure and fishing during and immediately after the major molting period for adult males has played the most significant part in the sharp decline in the Dungeness crab harvest just prior to total fishery closure. Mortalities associated with handling and trapping may not have been significant during the 1960s and early 1970s when effort levels were low and stock abundance was high. Since then the level of fishing accelerated, not only in amount of vessels and pots, but also in the amount of time each year that the gear was deployed resulting in increasing undocumented mortality on both target and non-target portions of the stock

What Do We Plan to Do?

Despite long-term closure of the commercial fishery, the Dungeness crab population in the Southern District (Kachemak Bay) has continued to decline. Although localized aggregations of Dungeness crab may exist, the department is concerned about the need to protect the existing population to maximize reproductive opportunity at a time when ecological conditions have improved. Because a stock recovery is not anticipated in the near term and all crab are needed to sustain the limited existing productivity, closure of the sport and personal use fisheries will be requested at the 1999 Dungeness Board of Fisheries meeting. The stock will continue to be monitored through trawl surveys and biennial pot surveys. When recovery of the population is evident and key elements of a fishery management plan identified in 5 AAC 32.390 are addressed, a management plan will be developed for consideration by the board and user groups.

COOK INLET TRAWL SHRIMP FISHERY

Historical Harvest Synopsis

Cook Inlet is separated into two shrimp registration areas: Area H, which includes the Southern, Kamishak, and Barren Islands Districts; and Area G, which includes the Outer and Eastern Districts. Pink shrimp (*Pandalus borealis*) historically made up the bulk of the commercial harvest in Area G, with sidestripes (*Pandalopsis dispar*) seasonally making up a smaller but often significant portion of the catch. Humpy shrimp (*Pandalus goniurus*) have at times comprised up to half of the harvest, but this species appears to undergo erratic population fluctuations; contributions to the most recent fisheries have been negligible. Coonstripe shrimp (*P. hypsinotus*) consistently made up less than 5 percent of the catch.

All of the commercial trawl shrimp fisheries in Area H have occurred in the Southern District. Harvests reached the 5 million lb level in the late 1960s and remained near that point through the early 1980s. Low stock abundance resulted in partial closures of the fishery during the mid 1980s and total closure beginning in the fall of 1986. Effort has varied from a low of one vessel during 1968 to a high of 23 in 1981. Prior to 1983, most commercial fishing occurred west of Homer Spit, but between 1983 and 1986 virtually all effort shifted to the area east of Homer Spit. The fishery has been closed since 1986.

The first year of significant harvest in Area G occurred in the 1982–1983 season when 4 vessels caught 239,584 lb. The catch increased steadily for the next 2 seasons to a peak harvest of just under 2.0 million lb taken by 11 vessels during the 1984–1985 season. Before 1992, pink shrimp comprised 90 percent of the harvests; the remaining 10 percent was sidestripe shrimp. Trawl CPUE was never high, rarely approaching 1,000 lb per hour. Logbook information collected over time indicates that fishermen in Area G made long tows, often with extremely low catch results. From 1992 through 1996 the delivered catch was comprised entirely of sidestripes as the vessels targeted on these more valuable animals. Once again, long tows and low CPUE were characteristic of this fishery.

Management and Research Program

The Southern District (Kachemak Bay) trawl shrimp fishery was characterized by superexclusive registration and management under the Kachemak Bay Trawl Shrimp Management Plan. This plan had three basic features: (1) an annual GHL determined from stock assessment surveys, (2) annual harvest spread out over the entire fishing season utilizing 3 separate regulatory sub-seasons and (3) sub-season harvest spread out in equal weekly guideline harvests.

Also, two areas were closed to trawl shrimp fishing: the first includes the majority of upper Kachemak Bay east of Homer Spit, originally established because the area consistently contained small, juvenile pink shrimp; the second includes Tutka Bay and Sadie Cove, established because the area encompassed by these bays lent itself to the potential of overharvest.

Trawl shrimp surveys have been conducted in Kachemak Bay since 1971. These surveys, which determine each season's GHL, have indicated significant declines in abundance and distribution of all pandalid shrimp stocks in Kachemak Bay since the late 1970s. These declines led to the aforementioned commercial closures beginning in 1986.

Prior to 1985, the fishery for shrimp trawling in Area G was open year-round. A regulatory season, beginning June 1 and ending February 28, was adopted by the Board of Fisheries for Area G in the spring of 1985. Natural and fishery induced fluctuations in sidestripe stock abundance remain poorly understood in the Outer and Eastern Districts of Area G. Therefore, the guideline harvest range was set broadly at 0 to 100,000 lb per district. Fishery performance and dockside samples were used in determining the status of the stock and ultimate management.

In 1997, the Alaska Board of Fisheries adopted the Cook Inlet Area Shrimp Fisheries Management Plan (5 AAC 31.390) and the Outer Cook Inlet Area Shrimp Fisheries Management Plan (5 AAC 31.490). These plans closed all fisheries for shrimp in Cook Inlet until the board has approved a management plan. Again the Board was concerned that inadequate information exists regarding the biology and stock status of shrimp in the Cook Inlet Area to ensure that commercial, sport, and personal use fisheries can be conducted in a sustainable manner.

Cause of the Collapse

While the extent to which fishing contributed to the collapse of the pandalid shrimp populations in Area H of Cook Inlet is unknown it is reasonable to believe that the harvest levels of the 1970s and early 1980s were not sustainable. Their failure to recover may be because environmental conditions have changed, causing greater mortality of shrimp larvae and their forage base as well as increased production of shrimp predators such as gadoid fishes.

What Do We Plan to Do?

Despite long-term closure of fisheries, pandalid shrimp stocks in Area H of Cook Inlet remain depressed. Commercial, sport, and personal use fisheries for shrimp are now closed by regulation. Stocks will continue to be monitored through trawl surveys. When recovery of the population is evident, a management plan will be developed for consideration by the board and user groups.

Although healthy localized aggregations of shrimp may exist in Area G, the department lacks any assessment tool. Because a harvestable surplus could not be demonstrated the Board of Fisheries also closed in regulation all fisheries for shrimp in Area G. If an assessment is developed and a harvestable surplus identified the department will develop a management plan for consideration by the board and all user groups.

COOK INLET POT SHRIMP FISHERY

Historical Harvest Synopsis

Similar to trawl shrimp, the Cook Inlet Management Area is separated into 2 distinct registration areas for the pot shrimp fishery: Area H, consisting of the Southern, Kamishak, and Barren Islands Districts; and Area G, consisting of the Outer and Eastern Districts. Historically the major pot shrimp fishery occurred in the Southern District (Kachemak Bay). The target species in Area H was the coonstripe shrimp, the most abundant pot caught shrimp in Kachemak Bay. Spot shrimp (Pandalus platyceros) also occur in the bay but their contribution to the fishery was generally negligible. In Area G the target species was the spot shrimp; coonstripe and pink shrimp were harvested to a lesser extent. In Area G spot shrimp comprised 57 to 94 percent of the catch and averaged 83 percent

In Area H, commercial catch figures show that the fishery suffered steep declines in annual harvest until the closure in 1988, ranging from 801,000 lb in 1973-74 to 5,323 in 1988–1989. The fishery has been closed to commercial harvest since 1988. Since 1977 in Area G catch and effort have remained low, never exceeding the peak harvest of 20,500 lb of whole shrimp caught by 8 vessels in 1989.

Management and Research Program

Each regulatory fishing season, which began June 1 and ended March 31, was managed via three separate sub-seasons with appropriate GHLs set for each sub-season.

In Area H, prior to 1986, GHLs were determined by the Department's two annual pot shrimp surveys as well as by voluntary commercial fishery performance information. Pot shrimp surveys were subsequently eliminated in the Cook Inlet Area, however, fishery performance data in the form of voluntary logbooks were collected consistently during 1986 and 1987 and were the sole criteria used to judge stock status during those years. After that, to determine the status of the coonstripe shrimp stock the department relied on data obtained from the trawl shrimp survey and voluntary information from personal use fishermen. The 1995 trawl survey indicated a population estimate of less than 4,000 lb of coonstripe shrimp for Kachemak Bay. These results showed a depressed stock when compared to historical survey catches that generated population estimates up to 1.0 million lb. Furthermore, voluntary information offered by personal use fishermen since 1988 has indicated very poor catches when compared to historical averages. The personal use shrimp pot fishery was closed beginning April, 1996.

Prior to its regulatory closure there were neither season restrictions nor biological regulations governing the pot shrimp fishery in Area G. Despite the extensive coastal area, historical information collected from this fishery indicates that the measurable stocks of spot and coonstripe shrimp occur within some (but not all) bays and are of limited abundance. Fish ticket and voluntary fisherman interview information are the only sources of data used to evaluate the Area G pot shrimp fishery. This information will be evaluated inseason to determine if any restrictive management action is necessary.

Beginning January 1996, all commercial pots were required to be partly covered by rigid mesh, which must have 7/8-in minimum diameter openings. This regulation was designed to reduce handling of small non-marketable shrimp thereby decreasing avoidable fishing mortality.

In 1997, the Alaska Board of Fisheries adopted the Cook Inlet Area Shrimp Fisheries Management Plan (5 AAC 31.390) and the Outer Cook Inlet Area Shrimp Fisheries Management Plan (5 AAC 31.490). These plans closed all fisheries for shrimp in Cook Inlet until the board has approved a management plan. Again the Board was concerned that inadequate information exists regarding the biology and stock status of shrimp in the Cook Inlet Area to ensure that commercial, sport, and personal use fisheries can be conducted in a sustainable manner.

Cause of the Collapse

While the extent to which pot fishing contributed to the collapse of the pandalid shrimp populations in Area H of Cook Inlet is unknown, it is reasonable to believe that the harvest levels of the 1970s and early 1980s were not sustainable. Their failure to recover may be because environmental conditions have changed, causing greater mortality of shrimp larvae and their forage base as well as increased production of shrimp predators such as gadoid fishes.

What Do We Plan to Do?

Despite long-term closure of fisheries, pandalid shrimp stocks remain depressed in Area H of Cook Inlet. Commercial, sport, and personal use fisheries for shrimp are now closed by regulation. The stock will continue to be monitored through trawl surveys. When recovery of the population is evident, a management plan will be developed for consideration by the board and user groups.

Although healthy localized aggregations of pandalid shrimp may exist in Area G, the department lacks any assessment tool. Because a harvestable surplus could not be demonstrated the Board of Fisheries also closed in regulation all fisheries for pandalid shrimp in Area G of Cook Inlet. If an assessment tool is developed and a harvestable surplus identified the department will develop a management plan for consideration by the board and all user groups.

PRINCE WILLIAM SOUND TANNER CRAB

Historical Harvest Synopsis

The Prince William Sound (PWS) area is divided into four Tanner crab management districts. The Northern and Hinchinbrook Districts include most of the waters inside PWS proper, while the Eastern and Western Districts encompass waters of the Gulf of Alaska and southwestern PWS. Historically, the commercial Tanner crab harvest was equally divided between the Gulf of Alaska and PWS portions of the management area.

The PWS commercial Tanner crab fishery began in 1968 when 1.2 million pounds were landed. The harvest peaked in the 1972–1973 season at 13.9 million lb, prior to adoption of the minimum legal size restriction in 1976. Harvests decreased during the late 1970s and early 1980s, followed by district closures during 1984 and 1985. Small postrecruit fisheries occurred from 1986 to 1988 during which harvests remained relatively stable at approximately 500,000 pounds. However, harvest patterns among districts changed with dramatic declines in Western District harvests and no catches in the Eastern District. The commercial fishery has remained closed due to low abundance since 1989.

Management and Research Program

The PWS Tanner crab fishery is superexclusive, with a gear limit not to exceed 75 king and Tanner pots per vessel, a buoy tag requirement, a harvest restricted to male crab with a minimum carapace width of 5.3 in (135 mm). The regulatory fishing season opens January 15 and closes March 31.

Sport, personal use, and subsistence Tanner crab fisheries have remained open throughout much of PWS despite low abundance. There are no closed seasons and daily possession and bag limits are 20 male crabs. Only male Tanner crab having a carapace width of 5.3 in (135 mm) or larger may be retained in personal use and subsistence fisheries while male crab 5.5 in (140 mm) or larger may be retained in sport fisheries. Legal gears for sport and personal use fishing includes pots, ring nets, dive gear, dip nets, and hooked or hookless hand lines. Pot gear is limited to 5 pots per person and 10 pots per vessel for all non-commercial fisheries. However any legal gear type defined in regulation (5 AAC 39.105) may be used in the subsistence harvest of Tanner

crabs. All pots are required to have a biodegradable escape mechanism but there is no requirement for escape rings.

The department has closed commercial and subsistence fisheries for Tanner crab by emergency order within the Hinchinbrook Entrance and Orca Bay portions of PWS since 1982. The personal use fishery in this area has also been closed annually since 1987. The waters of Orca Bay and the north Montague area are key production areas for Tanner crab in PWS. Both areas have historically provided newly mature male and female Tanner crabs. The north Montague area has been closed to all harvest of Tanner crabs since 1991 and Orca Bay area since 1984. The closures were effected to rebuild the stock and provide protection to juvenile and newly mature crabs. The department has also closed the entire PWS Management Area to the commercial harvest of Tanner crab annually since 1989.

The department has operated assessment programs for Tanner crab within the Prince William Sound Management Area since 1977. Surveys were conducted with pot gear through 1991. The objective of surveys was to provide indices of legal and sublegal male Tanner crab, and to monitor reproductive success of female Tanner crab. This information was used to determine relative stock condition, as well as to set preseason harvest guidelines for the commercial fishery. Pot survey data indicated a steady decline in the number of male and female Tanner crab. During the years pot surveys were conducted, the mean number of Tanner crab captured per pot decreased 86 percent.

Recognizing the inherent weaknesses of pot surveys, such as soak variation and the relative nature of the indices, the department implemented trawl surveys in 1991. Population estimates generated from ADF&G trawl surveys demonstrate that Tanner crab abundance in PWS is still declining. Estimated abundance of legal male crab in the Northern and Hinchinbrook Districts decreased from 108,624 in 1993 to 24,864 in 1995 and 10,674 in 1997. The estimates of legal crab reflect both poor recruitment to the legal segment of the stock and declining numbers of old-shell recruit crabs. Low abundance estimates of new-shell legal male crab are the result of successive weak prerecruit classes and skip molting in the prerecruit-1 and smaller size classes.

Cause of the Collapse

Three reasonable explanations for the decline in abundance of the PWS Tanner crab stock exist, two of which concern fishing effects. First, overharvest of immature and mature males may have occurred along with increased fishing mortality of females prior to the creation of a male-only fishery with a minimum carapace size limit of 5.3 inches in 1976. For example, the 3.8 million pound harvest in 1974 included 2.7 million pounds of crab smaller than the current minimum size limit. Second, fishing related crab mortality was probably greater prior to 1982 when seasons were longer. From 1974 through 1981, fishing was allowed seven months each year, so crabs were exposed to a greater chance of being harvested as well as more handling mortality of undersized and female crabs. Third, environmental conditions may have changed, causing greater mortality of Tanner crab larvae and their forage base as well as increased production of crab predators such as gadoid fishes.

What Do We Plan to Do?

Despite long-term closure of fisheries, Tanner crab stocks have continued to decline. Although healthy localized aggregations of Tanner crab may exist, the department is concerned about the

need to protect the existing population to maximize reproductive opportunity at a time when ecological conditions have improved. Because a stock recovery is not anticipated in the near term and all crab are needed to sustain the limited existing productivity, a regulatory closure of all fisheries was requested at the 1999 King and Tanner Crab Board of Fisheries meeting. Commercial, subsistence, sport, and personal use fisheries for Tanner crab are now closed by regulation. The stock will continue to be monitored through trawl surveys. When recovery of the population is evident, the department will develop a management plan for consideration by the board and user groups.

PRINCE WILLIAM SOUND KING CRAB

Historical Harvest Synopsis

Red king crab are sparsely distributed throughout PWS with historic concentrations occurring in the eastern Sound and Hinchinbrook Entrance. Blue king crab are found in the Port Wells and Harriman Fjord areas; small aggregations may also occur in the glacial fjords of western PWS. Golden king crab are found primarily in western PWS at depths of 150–400 fathoms. Waters in the Gulf of Alaska portion of the management area have no documented concentrations of king crab, except for a very sparse distribution of golden king crab.

Commercial harvests of king crab from PWS date to 1960 when 246,965 pounds were landed. Catch reporting by species did not begin until the 1979–1980 season. The harvest of 296,200 lb in 1972 is believed to be primarily blue king crab. During the period 1979–1984, stocks of both blue and red king crabs declined. Fisheries for both species remained closed from the 1984–1985 season to the 1991–1992 season. This period of closures coincided with the development of the golden king crab fishery from 1982–1989. Fishery performance data indicate the stock of golden crab is relatively small as observed by the low catch per unit of effort coupled with declines in average weight, size, and geographic distribution. The commercial golden king crab fishery remained closed for the 1992–1993 and 1993–1994 seasons, but was reopened during the 1994–1995 season. Two vessels participated in the fishery and the harvest remains confidential due to the number of participants. However, both catches were very low. All king crab fisheries have remained closed since 1995.

Management and Research Program

The PWS king crab fishery is designated as superexclusive. The minimum legal carapace width is 7.0 in (178 mm) for red and golden male king crabs, and 5.9 in (150 mm) for male blue king crab. The regulatory season provides two open periods: October 1 to December 20 and January 15 to March 15.

The non-commercial king and Tanner crab fisheries share many similarities. The fisheries have remained open year around despite low abundance. Minimum legal sizes are identical to commercial fishery specifications. Legal gear and gear limits are identical to those cited for non-commercial Tanner crab fishing. Similarly, subsistence gear types are very liberal. The daily possession and bag limit is 6 king crab

Since the early 1980s, the department has issued numerous emergency order closures to conserve king crab stocks. All fishing in Hinchinbrook Entrance and Orca Bay was closed by emergency

order from 1982 to the present due to low abundance and to protect low king and Tanner crab stocks. Likewise, the north Montague area has been closed to all fishing since 1991. Aside from the very low-level harvests in the "informational" fishery in 1991–1992, commercial fisheries for red and blue king crab were closed from 1984–1985 to the present. Similarly, except for the fishery in 1994–1995, the commercial golden king crab fishery was closed from 1992 to the present. These closures were effected to rebuild the stock and provide protection to juvenile and newly mature crabs. Despite the long-term closure of these areas, king crab stocks have continued to decline.

The department does not assess golden king crab stocks. In 1988, the Alaska Board of Fisheries adopted a guideline harvest range (GHR) of 40,000–60,000 lb for golden king crab in PWS. The GHR was adopted to help stabilize the declines in average size, weight, and distribution of the legal segment of the golden king crab stock that had been observed since the fishery began 1982. The GHR was apparently established too late because the 1989–1990 and 1991–1992 fisheries failed to attain even the low end of the range. Fishery performance data from the 1994–1995 season demonstrated that golden king crab stocks in PWS remained at a low level of abundance. The same data provided no indication of impending recruitment to the legal segment of the stock. The reported catch of sub-legal male and female crab was very low. The commercial fishery for golden king crab has remained closed since the 1994–1995 season.

Blue king crab primarily occur in the extreme northwest portion of PWS. The department does not assess the abundance of blue king crab. The blue king crab fishery has remained closed by emergency order following poor fishery performance during the 1991–1992 season. Fishermen targeting blue king crab during the 1991–1992 season reported few undersize male or female crabs. Increased recruitment from immigration is unlikely because even historic aggregations were small and widely dispersed. Therefore, a recovery of the blue king crab stock is not expected in the near future.

Red king crab were widely distributed within the inside waters of PWS. The department assessed the abundance of red king crab within the eastern portion of PWS in conjunction with Tanner crab surveys since 1977. The frequency of king crab captures is believed to be an index of their abundance. During the years pot surveys were conducted, king crab catches ranged from a high of 193 crab in 1978 to 0 crab in 1991. Low catches of red king crab in the more recent trawl survey suggest that trawl gear may compare with pot gear in sampling efficiency for red king crab. Taken collectively the data demonstrate that red king crab populations within this area have been depressed since 1983 and are unlikely to recover in the near future.

Cause of the Collapse

There are several reasonable explanations for the decline in abundance of PWS king crab stocks and their failure to recover. Over fishing, in that removals exceeded recruitment, must have occurred to fish down the stocks to the level prior to complete closure. Next, environmental conditions may have changed, causing greater mortality of king crab larvae and their forage base as well as increased production of crab predators such as gadoid fishes. King crab is also a long-lived species and recruitment of significant numbers of individuals into the fishery may occur infrequently. This would have called for a more conservative approach to harvest than did occur.

What Do We Plan to Do?

Despite long-term closure of fisheries, red and blue king crab stocks remain depressed. The department is concerned about the need to protect the existing population to maximize reproductive opportunity at a time when ecological conditions have improved. Because a stock recovery is not anticipated in the near term and all crab are needed to sustain the limited existing productivity, a regulatory closure of all fisheries was requested at the 1999 King and Tanner Crab Board of Fisheries meeting. Commercial, subsistence, sport, and personal use fisheries for king crab are now closed by regulation. The red king crab stock will continue to be monitored through trawl surveys. When recovery of the population is evident, a management plan will be developed for consideration by the board and user groups.

Although healthy localized aggregations of golden king crab may exist, the department lacks any assessment tool. Because a harvestable surplus could not be demonstrated the Board of Fisheries also closed in regulation all fisheries for golden king crab in PWS. If an assessment tool is developed and a harvestable surplus identified the department will develop a management plan for consideration by the board and all user groups.

PRINCE WILLIAM SOUND DUNGENESS CRAB

Historical Harvest Synopsis

The Prince William Sound Management Area is divided into three Dungeness crab fishing districts. The three districts are Orca Inlet, Copper River, and Northern district. Historically, the major Dungeness crab harvests have come from the Orca Inlet and Copper River Districts. Dungeness crabs were also harvested from the Orca Bay portion of the Northern District and in western Prince William Sound. These harvests, however, have been proportionately small.

Orca Inlet, which is immediately adjacent to the community of Cordova, once provided a fishery that allowed participation by small vessels in an area protected from adverse sea conditions. Harvests have ranged from over 1.0 million lb in the early 1960s to 35,000 lb in 1976. The Orca Inlet District has been closed since 1980.

The Copper River District fishery occurs along the eastern portion of the Copper River delta and in the Controller Bay area. The recent 10 year (1983–1992) average annual catch and effort were approximately 590,000 lb and 12 vessels. The harvest peaked at 1.5 million pounds in 1981 declining to 70,000 pounds in 1991. The Copper River District fishery has been closed since 1992.

Management and Research Program

Statewide Dungeness regulations provide for a male only harvest with a minimum legal size of 6.5 in. Gear requirements include a biodegradable escape mechanism and two 4 $^{3}/_{8}$-in escape rings. Regulations which are specific to the PWS management area include superexclusive registration, a 250 pot limit for the Northern and Copper River Districts, and a 100 pot limit for the Orca Inlet District. The fishery is managed as a 3-S fishery (sex, size, and season).

Beginning in 1987, split regulatory seasons were implemented in the Copper River District with open season dates of March 20 to May 20 and July 25 to December 31. The regulatory closure extends from May 20 to July 25 and is designed to protect the stock from handling mortality during the soft shell period following the annual adult male molt. Additionally, the Controller Bay area closes on October 15. The early fall closure is designed to reduce gear loss and consequent mortality from storms in this area of shallow water.

The department conducted an annual survey in the Orca Inlet district from 1977 to 1994 using pots. In 1995, due to low abundance, the survey was changed to a biennial event. The department began a Dungeness pot survey in 1985, conducted annually prior to the July 25 opening date in the Copper River District. If 10 percent or greater of the crabs are in a soft-shell condition the fishery was delayed and another survey was conducted in mid-August. Legal male catch per pot has declined from 16 in 1986 to 0.25 in 1998. The survey provided an index of abundance which declined with declining catches and forms one component of the justification for continued closure.

Cause of the Collapse

The major reason for the continued suppression of the Dungeness crab population in Orca Inlet is predation by the sea otter. The otters arrived in large numbers during 1980 and immediately impacted the Dungeness crab stock. A sea otter predator/prey relationship study conducted in the late 1970s showed that when Dungeness crabs are available, an otter is capable of eating 10 crabs per day.

Again the hypotheses available to explain the decline and failure to recover for the Copper River Dungeness stock include periodic recruitment, climatic change (change in rates of predation, disease, or larval survival) and overfishing. For example the most recent large-scale recruitment event occurred in 1986. While the extent to which fishing contributed to the collapse of the Dungeness crab population in the Copper River District is unknown, it is true that seasons continued despite a lack of obvious recruitment. Therefore it is reasonable to believe that the harvest levels of the 1970s and 1980s were not sustainable. Finally, PWS Dungeness crab are at the northern extent of known Dungeness range, a factor that may have implications for both growth and recruitment.

What Do We Plan to Do?

Despite long-term closure of fisheries, Dungeness crab stocks in PWS remain depressed. The department is concerned about the need to protect the existing population to maximize reproductive opportunity at a time when ecological conditions have improved. Because a stock recovery is not anticipated in the near term and all crab are needed to sustain the limited existing productivity, a regulatory closure of all fisheries will be requested at the 2000 Dungeness Crab Board of Fisheries meeting. The Dungeness crab stock will continue to be monitored through pot surveys. When recovery of the population is evident, a management plan will be developed for consideration by the board and user groups.

PRINCE WILLIAM SOUND SPOT SHRIMP

Historical Harvest Synopsis

The Prince William Sound Management Area is divided into two shrimp pot fishing areas, the Eastern Area and the Traditional Harvest Area (THA). The shrimp pot fishery targeted spot shrimp and to a limited extent coonstripe shrimp. Nearly all harvest came from the THA.

The Traditional Harvest Area encompasses the northern shore of PWS from Port Valdez to Whittier and all of western and southwestern PWS including Montague Strait. Commercial shrimp landings were first documented in 1960 when 4,100 lb were harvested. Early seasons lasted the entire year. From 1960 through 1977, catch varied from no reported harvest in 1962 and 1966 to a high of 20,000 lb in 1974. The shrimp pot fishery expanded rapidly after 1978 with increases in both catch and effort. Growth of the fishery was greatest from 1978 through 1982. During this period local markets were established and the major harvest areas located. Landings increased from 12,000 lb in 1978 to 178,000 lb in 1982. Similarly, effort increased from 9 to 57 vessels during this period.

During the period 1982–1984 the open season was reduced to April 1 through November 30 with a guideline harvest range of 75,000 to 145,000 lb. Despite the shortened fishing season catch and effort increased to 214,000 lb and 79 vessels.

In subsequent seasons, catch and effort reached historical highs of 290,653 lb in 1986 and 86 vessels in 1987. By 1989 catch and effort had declined to a low of 29,315 lb from 33 vessels. A limited spot shrimp fishery was held in 1991 with a conservative guideline harvest range of 10,000 to 40,000 lb. The 1991 fishery closed after 46 days of fishing and the harvest totaled 17,255 lb taken by 14 vessels making 44 landings. Fishery performance data from the 1991 fishery indicated that the stock was at a very low level. The commercial spot shrimp season has remained closed in the THA since due to low abundance.

Management and Research Program

Statewide shrimp regulations specify buoy marking, maximum tunnel size, and a biodegradable escape mechanism. In 1984 the BOF adopted a spot shrimp management plan which recognized the need for a conservative management policy for the THA. Among other things the plan called for seasons avoiding peak egg bearing periods and guideline harvest ranges. This resulted in two open seasons per year (March 15 – June 30 and August 15 – December 15) and a GHR of 75,000 to 100,000 lb per season. During the spring 1994 meeting the BOF lowered the GHR for PWS shrimp to 0–100,000 lb. Additional regulations specific to shrimp fishing with pot gear include a limit of 150 pots per vessel and pots with a definable side must have at least two adjacent sides completely composed of rigid mesh that allows the unaided passage of a 7/8-in dowel. Round pots must have the rigid mesh covering a minimum of 50% of the vertical surface area of the pot.

In 1989 the department began a survey in the THA to assess spot shrimp. Six stations in the northern, western, and southwestern portions of PWS have been surveyed annually with pot gear since 1989. Two experimental stations in southwestern PWS were added in 1991. Data from the survey, specifically CPUE and sex ratios, were used in making management decisions regarding the 1991 fishery and in subsequent years when no fishery occurred. The spot shrimp survey showed a decline in CPUE of spot shrimp from 1.3 lb in 1989 to 0.3 lb in 1998. The percentage of egg bearing

females captured has varied throughout the course of the survey from 20% in 1994 to a low of 4.1 percent in 1995. The percentage of egg bearing females in the 1998 survey was 5.4%.

Cause of the Collapse

The department studied PWS spot shrimp as part of the damage assessment arising from the *Exxon Valdez* oil spill. From that study it was deduced that the decline in spot shrimp was from overfishing. Tagging studies conducted in the mid 1980s showed that PWS spot shrimp are long-lived and slow-growing, characteristics that emphasized the need to keep fishing mortality low. Serial depletion was most likely occurring in that fishers moved to keep CPUE high masking the decline in abundance until it was widespread. Spot shrimp are also remarkably sedentary making them particularly susceptible to serial depletion. The fishery is also size or female selective in that spot shrimp begin life as males and grow and mature into females. Similar to other shellfish along the margins of the Gulf of Alaska, climatic conditions are probably hindering recovery.

What Do We Plan to Do?

Past management strategies failed to provide for a sustainable fishery and despite long-term closure of fisheries, the spot shrimp population in PWS remains depressed. The department is concerned about the need to protect the existing population to maximize reproductive opportunity at a time when ecological conditions have improved. Because a stock recovery is not anticipated in the near term and most spot shrimp are needed to sustain the limited existing productivity, a regulatory closure of the commercial fishery will be requested at the 2000 Shrimp Board of Fisheries meeting. Therefore the department has requested that the Board of Fisheries close the PWS pot shrimp fishery by regulation and reopen upon rebuilding of the population and adoption of a new management plan. The new management plan should address the hazards of serial depletion, account for spatial stock structure, slow growth, and sedentary nature of the spot shrimp, and the female-selective nature of the fishery.

PRINCE WILLIAM SOUND RAZOR CLAMS

Historical Harvest Synopsis

Beginning in 1916 and continuing into the mid 1950s, Cordova was known as the “razor clam capital of the world.” Although historical fishery statistics are imprecise, it appears that the majority of razor clams were harvested from Orca Inlet and the western Copper River Delta. The eastern Copper River Delta, which includes Kanak Island, was not a substantial contributor to the early harvests. Catches during this time ranged from 3.6 million lb in 1917 to a frequent harvest of over 1.0 million lb.

Beginning in the 1950's and continuing into the early 1980s, commercial demand for razor clams shifted to Dungeness crab bait. Coincident with the market shift, the PWS razor clam industry experienced a period of decline. The demand for razor clams for human consumption increased again in 1983 when a decline in clam abundance in Washington state led to an expanded fishery in Prince William Sound. Since 1983 the majority of the clam harvest has been taken at Kanak Island beach with minor amounts coming from Softuk and Katalla beaches on the eastern Delta. Yearly harvests

during the 1980's attained a maximum of 170,000 lb in 1984 declining to 7,000 in 1988 with a recent ten year (1979 - 1988) average harvest of 48,000 lb by an average 16 diggers. No one has harvested razor clams since 1988 except in 1994 when fewer than 3 diggers participated resulting in confidential harvest records.

Management and Research Program

The department currently monitors commercial razor clam harvests via fish ticket information. If effort increases at Kanak Island, the department will monitor the stock via catch per unit of effort data. The non-commercial harvest from the Copper River Delta is monitored through a permit system which requires a harvest report.

A guideline harvest range of 100,000 to 150,000 lb is in effect for the combined commercial and sport/subsistence harvests from Kanak Island. By regulation, clams harvested from Kanak Island must be used for human consumption as food. There is a 4 $^{1}/_{2}$ in (114 mm) minimum legal size for all commercially harvested razor clams. On the Copper River Delta, noncommercially harvested razor clams also have a minimum legal size of 4 $^{1}/_{2}$ in (114 mm). Razor clams from Kanak beach receive annual certification by the Alaska Department of Environmental Conservation (ADEC). Certification allows bivalves to be sold for human consumption.

Cause of the Collapse

The decline in razor clam harvest in Orca Bay and western Copper River delta was attributable to a variety of factors including; a market shift from the West coast to the East coast clam fishery and substrate change caused by alteration in the Copper River outflow which severely affected juvenile survival. Subsequent to this the "Good Friday Earthquake" in 1964 caused significant uplift in prime razor clam habitat in Orca Inlet. This loss of habitat resulted in record low harvests in the 70's and early 80's and caused a shift in clam digging effort to the east side of the Copper River delta and Controller Bay area. Although the department does not conduct population estimates, reports from non-commercial diggers indicate that razor clam abundance has declined over the previous five years in the eastern delta, Katalla, and Controller Bay areas. This information is supported by the lack of interest from commercial diggers and the low number of permits issued in recent years.

What Do We Plan to Do?

The department does not assess the abundance of razor clams in Prince William Sound. Currently there are no areas within PWS that are certified for clam harvest by the Alaska Department of Environmental Conservation. No harvest of the razor clam resource would be permitted until regulatory requirements of both ADEC and ADF&G are met. However, if the fishery is redeveloped at Kanak Island, the department will monitor the stock via catch per unit of effort data.

KODIAK & WESTWARD, REGION IV

GULF OF ALASKA TANNER CRAB

Historical Harvest Synopsis

The Gulf of Alaska Tanner crab *Chionoecetes bairdi* fisheries in the Kodiak, Chignik, and South Peninsula began in 1967/68. Harvests in all areas were initially small, however the Tanner crab fishery grew quickly and by 1975/76 harvest ranged between 5 and 33 million pounds per district.

In the Kodiak Area, harvest declined from 11.8 million pounds in 1980/81 to 3.5 million pounds by 1989/90. Lack of significant recruitment to the fishery resulted in continued decline in harvests in the Kodiak Area, with eventual total area-wide closures from the 1994/95 season to the present.

In the Chignik Area harvest declined from a peak of 6.9 million pounds in 1975/76 to 3.5 million pounds in 1983. Harvests fell below 700,000 pounds in 1984 and continually decreased over the rest of the decade. Chignik also experienced lack of recruitment to the fishery and continued decline in harvest levels until the first Chignik Area closure in 1990 which has continued to the present.

The South Peninsula Tanner crab harvest peaked in 1978/79 at 8.7 million pounds. Harvest declined to a level of 1.1 to 4.5 million pounds over the 1980's. However, abundance of crab and lack of recruitment saw the fishery decline to just over 1.0 million pounds in 1989. The fishery was not opened in 1990 and has remained closed since.

Management and Research Program

Significant revision to the harvest strategy of Tanner crab in the Kodiak, Chignik, and South Peninsula Districts was submitted by the department and adopted by the BOF in 1999. The resulting actions taken produced **5 AAC 35.507 Kodiak, Chignik, and South Peninsula Districts *C. bairdi* Tanner Crab, Harvest Strategies**. The elements of which:

- Establish thresholds for opening sections and districts based on preseason survey results meeting or exceeding specified abundance levels
- Exploits available surplus at different rates pending the molting mature male abundance as determined by preseason surveys
- Specifies variable pot limits pending the total GHL
- Contains conservative criteria for reopening sections which have been closed in the previous fishing year
- For the Kodiak area, restricts time in which gear can be operated from 0800 to 1759 hours, daily during fishery openings

- Opens the Chignik District only when the South Peninsula District is also open

- Seeks to consider manageability of the fishery, reliability of the abundance estimates, and uses the best information available in opening any section to fishing.

In addition, general specifications and restrictions set in regulation specify restrictions on legal size males. Commercial seasons are also set outside the molting and mating period of Tanner crabs, with each section or district opening on January 15.

Annual trawl surveys conducted in the Kodiak, Chignik, and South Peninsula Areas are being used to determine if thresholds for season openings have been met. Recent survey results have indicated wide distribution of Tanner crab at low or depressed levels, although some local areas have seen the rebuilding of stocks and increased survival of crabs into the larger size classes. The department has observed no abnormalities in female egg clutches and has recorded a high incidence of 1 and 2 year old crabs.

Both the Alaska Dept. of Fish and Game and the National Marine Fisheries Service (NMFS) continue to conduct research on Tanner crabs in the Gulf of Alaska. Most notable in recent years is the discovery by NMFS of spawning aggregates in deep water of Chiniak Bay near the city of Kodiak. These aggregates have been observed by submarine and remotely operated video (ROV) equipment in the same area and at approximately the same time of year. As our understanding of these aggregates improve, the identification of areas for refuges to protect these aggregates from fishing activities may be possible.

A joint project by ADF&G and NMFS studied the seasonal distribution of Tanner crab and their predators in Marmot Bay, on northeast Kodiak Island. Stomach samples taken from the predators should help us understand the role predation plays in controlling Tanner crab populations. That study also looked at the quantity of sperm packets being held by the female Tanner crabs. Results from that study should show if reproduction is being limited by the amount of mature male crabs available for mating. ADF&G is also instigating a seabed mapping project to help identify the actual amount of habitat available for Tanner crabs and other species. The Quester Tangent system records and analyses the signal from the vessel's echosounder to form bathymetric and bottom-type map.

Initial genetic studies on Tanner crabs state-wide have recently been completed. They indicate some genetic differences between crab from the Bering Sea, Gulf of Alaska, and Southeast Alaska. Advancing genetic techniques may allow for further discrimination among "stocks" established for management purposes.

Just published by the University of Alaska Sea Grant Program is a "Biological Field Techniques for Chionoecetes Crabs." This field guide should go a long way in standardizing information currently being collected on Tanner crabs and other *Chionoecetes* species.

Cause of the Collapse

The almost simultaneous collapse of Tanner crab stocks across the central and western Gulf of Alaska, indicates that environmental factors, probably in combination with fishing pressure, play a key role in driving population levels. The mechanisms that underlie the decline and maintain the Tanner crab stocks at relatively low levels are still poorly understood, however, so speculation on the timing of stock recovery to previous levels is difficult. Tanner crab are still wide-spread

across this broad area and the decline since the early 1980s has not been uniform. Certain local areas have actually experienced a minor rebuilding in recent years.

What do we plan to do?

The new management plans recently enacted should provide adequate guidance to the Department on the threshold levels needed to prosecute a fishery and also on the appropriate harvest rate for different stock levels.

GULF OF ALASKA TRAWL SHRIMP

Historical Harvest Synopsis

The Westward Region trawl shrimp fishery began around Kodiak in 1958 with a harvest of 32,000 pounds. By the early 1960s, the fishery had expanded to catches of 10 to 12 million pounds with an average of 12 vessels participating annually. Commercial harvest peaked in the Kodiak District in 1971 when 49 vessels harvested 82.2 million pounds with an exvessel fishery value of $3.2 million. The number of commercial fishing vessels targeting shrimp continued to increase in Kodiak, peaking at 75 vessels in 1974/75. The commercial harvest, however, would continue to decrease over the late 1970s to 12.8 million pounds in 1979/80. A small increase in participation and harvest would occur in 1980/81 through 1982/83. Abundance would decline sharply after this and by the mid 1980s area closures and severely depressed stocks resulted in decreased participation and little if any harvest. Since 1985/86, minimal effort and harvest have occurred in areas offshore that have remained open to exploratory fishing.

Shrimp trawl harvests in the Chignik and South Peninsula Districts began in the late 1960s but these areas were not heavily exploited until 1973/74. In that season 74.5 million pounds were harvested by 45 vessels for an exvessel fishery value of 5.5 million dollars. Effort would increase in both districts for the next few years peaking in 1977/78. Harvest in the Chignik District would remain in the mid to low 20 million pound range until 1980. Harvest in the South Peninsula District would peak in 1977/78 at 45.0 million pounds then decrease drastically in the two years to follow. Inshore areas along the South Peninsula District were closed due to low stock abundance by 1980/81. As stocks declined in the Chignik District harvest fell below 71,000 pounds in 1981/82. No harvest has occurred in the remaining open offshore areas of either Chignik or the South Peninsula since 1981/82.

Management and Research Program

The current management plan for the trawl shrimp fisheries in the Westward Region can be found under **5 AAC 31.590 Westward Area Shrimp Fisheries Management Plan**. The South Peninsula District and portions of the Chignik District, which do not fall under this management plan, have inshore areas and embayments open and closed by emergency order. These areas have not been opened by the department since the early 1980s due to low stock abundance. The

offshore, general sections of all districts remain open with seasons established in regulation **5 AAC 31.510 Fishing Seasons for Registration Area J.** The department requires logbooks and conducts confidential interviews with fishers that participate in the offshore season.

Triennial trawl surveys are conducted around Kodiak Island and portions of the Alaska Mainland, the latest being completed in 1998. These surveys are used to determine area swept indices of relative abundance, species, and sex composition. These indices are compared to established minimum acceptable biomass indices (MABI) that have been established for specified sections. The MABI is the threshold of abundance that must be met to allow commercial fishing to occur in a given section. All areas surveyed in the past 10 years have been categorized as severely depressed stocks falling well below the MABI. As a result, all surveyed areas have remained closed since the early 1980s. Some minimal effort and harvest has occurred in the offshore section of the Kodiak District, which is unsurveyed. Information collected from the commercial effort in these open areas indicates no recovery of shrimp stocks.

Cause of the Collapse

A number of basic shifts have occurred in the Gulf of Alaska ecosystem which are well documented and could account for the decline of shrimp stocks. In the late 1970s and early 1980s, a shift in oceanographic conditions occurred moving average sea temperatures above those considered optimal for shrimp survival and recruitment. At the same time, the abundance of gadids and flatfishes, known shrimp predators, greatly increased in the nearshore areas.

During this period, commercial fishing was fully exploiting stocks throughout the Westward Region. Given that shrimp are a short-lived species, fishery removals paired with poor recruitment, and increased predation could easily explain the decline of the populations seen in the mid 1980s. Establishing a cause and effect relationship between these factors and the status of the shrimp stocks, however, remains speculative. For similar reasons, predicting the recovery of the shrimp stocks is difficult.

What do we plan to do?

As required in **5 AAC 31.590 Westward Area Shrimp Fisheries Management Plan**, a board approved management plan must be in place prior to reopening the North Afognak and Mainland Sections of Kodiak and certain sections of the Chignik Area. If indications from the triennial trawl survey suggest substantial recovery of shrimp stocks, the department will draft a management plan that is consistent with **5 AAC 31.590** for submission to the BOF. Other sections will be monitored to determine biomass levels relative to the MABI. The department will continue to collect fishery and biological information from offshore locations, however these efforts remain low and sporadic.

GULF OF ALASKA RED KING CRAB

Historical Harvest Synopsis

Red king crab *Paralithodes camtschaticus* were first landed commercially in Kodiak in 1936, however catches were not officially recorded until 1950. In the ten years that followed, the

annual harvest increased from 60,000 to 21 million pounds. In 1965/66 the catches peaked at 94.4 million pounds of red king crab in the Kodiak District. Catches would continually decrease over the next 10 years, then show a slight increase for the years of 1974–1977 with an average harvest of 21 million pounds harvested. Catches would oscillate again through the late 1970s and early 1980s with a marked decrease being seen in the 1982/83 season. The commercial fishery was closed in 1983/84 and has remained closed. During the period from 1960 to the present, the red king crab fishery has seen a variety of season opening and size limit changes. Most recently the BOF moved to restrict the subsistence harvest of king crab to three per family per year in the Kodiak area.

Red king crab harvest along the Alaska Peninsula began in 1947. The historic high catch of 22.6 million pounds occurred in 1966. Harvest would remain stable at around 4 million pounds for the next decade. In 1977/78, catches were dramatically reduced with approximately 950,000 pounds being harvested. Harvest would increase again in the early 1980s as a result of favorable recruitment in the late 1970s, however the recruitment appears to have been an isolated incident and stocks began to diminish thereafter. As a result of declining recruitment to the legal size, the red king crab fishery was closed in 1983/84 and has remained closed.

Management and Research Program

Annual trawl surveys conducted by the department in the Kodiak, Chignik, and South Peninsula Areas are used to determine relative abundance of king crabs. King crab stocks are still well below levels needed to sustain a commercial fishery, however recent trawl surveys indicate king crabs are being captured in an increasing number of locations.

Research in the Region on king crab has included a variety of studies. Artificial collectors have been devised which assess the strength of recruitment of king crabs when they first settle to the bottom. Genetic work has been accomplished which distinguished between stocks of king crab in Southeast Alaska, the Gulf of Alaska and the Bering Sea. Telemetry studies in Woman's Bay near the city of Kodiak have been able to track the seasonal movements of king crabs using radio beacons. Length-based analysis of historic catch and survey data has been completed for Kodiak king crabs and is planned also for the Alaska Peninsula.

Cause of the Collapse

No significant recruitment event has occurred for the Westward Region Gulf of Alaska red king crab stocks since 1979. Crab from that event provided the harvest that lasted through the early 1980s. As with other shellfish species, king crab were subjected to a changing oceanographic regime during that period. Fishing pressure, decreased larval survival, and increased predation probably all contributed to the decline of the stocks. Determining the exact mechanisms involved and predicting stock recovery is not possible at this time.

What do we plan to do?

A comprehensive harvest strategy was developed in March 1990 for the red king crab fishery around Kodiak Island. The harvest strategy considers preseason survey levels of fertilized females and mature males. The harvest strategy uses thresholds, a 20% mature male harvest rate,

and a maximum allowable legal male harvest rate of 60% to determine a targeted male harvest rate in a statistical area, district, or section. At such times that the thresholds are not met, no commercial fishery is held. The details of this harvest strategy are contained in ADF&G Special Publication No. 7, D. Pengilly and D. Schmidt, January 1995. Though this harvest strategy does not establish thresholds for the South Peninsula, the department would employ very similar methodology in determining if sufficient numbers of crabs exist for a commercial fishery in that area. Additionally, the same exploitation criteria would be employed for fishery openings in the South Peninsula.

KODIAK AREA CLAMS

Historical Harvest Synopsis

Razor clams *Siliqua* sp. and some hard-shell species of clams had been harvested in the Kodiak Area since the early 1920s. Though many Kodiak Island beaches were explored with some success, the principal harvest occurred about 70 miles northwest of Kodiak in the Kukak Bay, Hallo Bay, Big River, and Swikshak Beach regions of the Alaska Peninsula. Digging continued on a somewhat regular basis until the early 1960s when a combination of increasing federal and state clam processing regulations, combined with poor market conditions, and the 1964 earthquake precipitated a decline in harvest. Commercial harvesting of clams for human consumption has never become reestablished. The certification program conducted by the Alaska Department of Environmental Conservation ended in July 1980. Currently, there are no dam beaches in the Kodiak Area certified as safe for human consumption.

Many of the principal harvest areas along the Alaska Peninsula are adjacent to the Katmai National Monument, which includes all the land above mean high water from Cape Douglas to Cape Kubagakli. Commercial activity within the monument is restricted by the current policy of the U.S. Park Service that dictates a ban on camping in the monument in support of a business enterprise.

Commercial harvest peaked in 1960 with over 400 thousand pounds taken. After the 1964 earthquake, harvests declined to the 150–200,000 pound level in the early 1970s and continued to decline over the next two decades. Recent personal communications by subsistence harvesters have indicated that most of the once productive beaches along the Alaska Peninsula are still low in abundance.

Management and Research Program

Clams are managed by the terms of a commissioner's permit as specified in **5 AAC 38.035 Closure of Miscellaneous Shellfish Registration Areas and Reopening Procedures**. In 1986 the BOF adopted a regulation prohibiting hydraulic mechanical dredges from harvesting clams in the Kodiak Area east of Kilokak Rocks. Razor clams must meet the statewide minimum size of 4.5 in. There has been no commercial activity since 1986.

Extensive beach transect surveys of razor clam stocks were conducted by the department in the late 1960s and early 1970s during the peak of harvest effort. ADF&G has not conducted stock assessments or research on razor clams in the Westward Region since that time.

Cause of the Collapse

Much of the collapse of the Razor clam population in the Kodiak Area has been attributed to the 1964 earthquake. Commercial removal of razor clams had all but ceased by 1975, yet the stocks continued to decline to their current severely depressed status. Since the earthquake the composition of the beaches that once held the Kodiak Area's largest clam populations have changed from a loose, deep sand structure to a hard packed thinner layer of sand. It is hypothesized that the earthquake caused a change in the tidal patterns and/or the erosion effect upon the productive beaches and the ensuing loss of habitat precipitated the decline in clam populations.

What do we plan to do?

Recovery of the Kodiak razor clam population is not likely without a change in clam habitat.

EASTERN ALEUTIAN DISTRICT TANNER CRAB

Historical Harvest Synopsis

The Eastern Aleutian District has not supported large harvests of Tanner crabs *Chionoecetes bairdi* as evidenced by the small commercial catch in only a few major bays and inlets. The harvest over the last 26 years has typically remained under a million pounds per year. Only in the three consecutive seasons 1976/1977 through 1978/1979 did the harvest exceed a million pounds, reaching a peak of 2.5 million pounds in the 1977/1978 season. Vessel participation was low in 1973 with only six vessels, and reached a high of 31 in 1982 when the fishery was in decline. Vessel participation had declined in 1991 to five vessels and consequently the harvest reached a low of 50,038 pounds. The 1994 summer survey revealed an 87% decrease in abundance of Tanner crabs from the 1991 survey, and the 1995 season was closed to commercial fishing. The survey in 1995 showed a slight increase in juvenile males and immature female crabs over the 1994 results yet the abundance of legal male crabs continued its dramatic decline compared to levels observed in the 1991 survey. Hence, the fishery has remained closed for conservation measures since 1995.

Management and Research Program

The department has conducted trawl surveys to assess the *C. bairdi* stock in selected portions of the Eastern Aleutian District on a triennial basis since 1990. Previous to 1990, pot surveys were conducted to generate a relative abundance index with no specific GHL. The fishery was regulated around a population estimate until the 1990 and 1991 trawl surveys indicated the population could support a GHL in the 100,000 pound range. Management has since been based

on an abundance estimate from the surveys and fishery performance. Regulations require a minimum size of 5.5 in, males only harvested, and a regulated season (January 15th to March 31st), unless closed by emergency order.

The federal Fisheries Management Plan (FMP) specifies the harvest rate and the maximum sustainable yield (MSY) level based on historical harvests. The MSY was set at 700,000 pounds, assuming both males and females are taken. Preliminary results from the 1999 trawl survey indicate an increase of mature biomass with the majority residing around Akutan Island. However, other areas of the population remain low compared to historic levels.

Cause of the Collapse

The recruitment failure below the level considered necessary to allow fishing occurred for unknown reasons.

What Do We Plan to Do?

The department intends to close the fishery for the 1999/2000 season until the Crab Plan Team has reviewed stock assessment and management options. The department should also develop, for Board and public review, a harvest strategy to provide stock rebuilding measures and a minimum guideline harvest threshold similar to the Eastern Bering Sea Tanner crab *Chionoecetes bairdi* harvest strategy.

WESTERN ALEUTIAN DISTRICT TANNER CRAB

Historical Harvest Synopsis

The *Chionoecetes bairdi* Tanner crab fishery in the Western Aleutian District, has historically occurred in conjunction with the directed red king crab fishery in that area. The commercial harvest of Tanner crabs has ranged from a peak of 838,697 pounds in the 1981/1982 season to a low of 7,825 pounds in the 1991/1992 season. The catch in the 1981–1982 season was influenced by the change in the Adak red king crab fishery opening date from January 15 to November 1. That same year, vessels fishing in the Adak brown king crab fishery explored new grounds near Attu Island and discovered a healthy population of Tanner crabs. Approximately 53% of the entire 1981–1982 Western Aleutian Tanner crab harvest was taken from this area by 17 vessels. The following season in 1982/1983, the harvest decreased 42% with a peak of 61 vessels. Fishing effort dropped to one vessel in the 1995/1996 season. There has been no reported harvest in five out of the past seven years.

Management and Research Program

After the historical peak harvest in 1981/1982, the Western Aleutian Tanner crab fishery was moved to a November 1 opening, concurrent with the red king crab fishery in that area. The closing date, by regulation since 1990, has been March 31. Management is based on harvesting

males only, a minimum size of 5.5 in. No stock assessment surveys are conducted for the Western Aleutian Tanner crab population.

The federal FMP specifies the harvest rate and the MSY level based on historical harvests. The MSY was set at 400,000 pounds, assuming both males and females are taken.

Cause of the Collapse

The Western Aleutian Tanner crab catch has declined over the past 17 years for unknown reasons. Fluctuating levels of effort and changes in areas fished during that time period have confounded interpretation of population trends for this stock.

What Do We Plan to Do?

The department intends to close the fishery for the 1999/2000 season until the Crab Plan Team has reviewed stock assessment and management options The strategy is expected to consider impacts of the rebuilding on the Aleutian red king crab stock. The department should also develop, for Board and public review, a harvest strategy to provide stock rebuilding measures and a minimum guideline harvest threshold similar to the Eastern Bering Sea Tanner crab *Chionoecetes bairdi* harvest strategy.

ALEUTIAN ISLANDS RED KING CRAB

Historical Harvest Synopsis

Historically, the red king crab *Paralithodes camtschaticus* resource in the Aleutian Islands was harvested in two registration areas. The Adak Registration area (Area R) consisted of those waters in the Aleutian Islands west of 171° W long. while the Dutch Harbor registration area (Area O) contained those waters east of 171° W long. In addition, as the fleet moved westward, a third management area, Area S was established for the waters around Amchitka Island and the Petrel Banks. Area S was created in 1967 and was merged into Area R in 1978. At the March 1996 Alaska Board of Fisheries (BOF) meeting, the BOF established the Aleutian Islands king crab registration area (Area O) by combining the existing Dutch Harbor and Adak areas. This action was directed at golden king crab management and was not expected to impact red king crab stocks in the Aleutian Islands.

Domestic fisheries for red king crabs in both the Adak and Dutch Harbor registration areas began in 1961, with effort and harvest increasing rapidly in both areas. The Adak area reached a peak harvest of 21.2 million pounds in 1964/65, while maximum production in the Dutch Harbor area was reached in 1966/67 with a harvest of 33 million pounds. Harvest levels generally declined in both areas following the 1960's, and by the 1982/83 season the harvest in the Dutch Harbor area had dropped to 430,000 pounds. Commercial fishing for red king crabs in that portion of the Aleutian Islands has remained closed since the 1982/83 season. The Adak fishery remained open until the 1995/96 season when only 39,000 pounds were harvested.

Since the 1995/96 season, commercial fishing has occurred only during the 1998/99 season. In order to assess the status of red king crab stocks in portions of the Aleutian Islands where the ADF&G has gained little recent abundance information, the Aleutian Islands king crab registration area was opened to commercial red king crab fishing on November 1, 1998. A limited commercial fishery was opened in two areas of the Aleutian Islands with the provision that animals not harvested be tagged and released; in addition, vessel operators were required to document all red king crab fishing activities in a pilot house log. East of 179° W long., a GHL of 5,000 pounds was established and west of 179° E long., a GHL of 10,000 pounds was set. Closed waters included the Petrel Banks, or the area between 179° E long. and 179° W long. The ADF&G did not open the Petrel Banks in 1998/99 since prior efforts had provided some population data from that area. Three vessels registered for the fishery, but only one made landings. The GHL was not reached and the fishery was closed on July 31, 1999. The GHL was set using historic catch information. Observers were required on all vessels participating in the 1998/99 fishery.

Management and Research Program

Recent harvest goals have been based on historic catch data, although throughout the 1970s and into the mid-80s GHL ranges were established using a blend of pot survey results and fisheries data. GHLs were often modified inseason based on fishery performance. Historic fishery GHLs set in the late 1970s ranged from 8.0 to 26 million pounds for Dutch Harbor and from 0.5 to 3.0 million pounds in Adak.

When both the red and brown king crab seasons are open concurrently, red king crabs may be retained from longlined brown king crab pots provided the pots were fished in waters deeper than 100 fathoms. Otherwise, red king crabs may only be taken from red king crab pots fished in a single line fashion. There is no pot limit for king crab fisheries in the Aleutian Islands. Observers have been required on all crab catcher-processor vessels since 1988 and on catcher vessels targeting red and golden king crabs in the Aleutian Islands since 1995. Observer coverage on golden king crab vessels provides red king crab bycatch from that fishery, although red king crab catch in brown king crab gear is minimal due to the limited overlap in distribution of the two species. In the directed red king crab fishery, observer coverage provides data on retained and non-retained crabs as well as data related to fishing patterns.

Most shellfish research in the Aleutian Islands has been directed at crab stocks inhabiting the eastern Aleutian Islands. Systematic pot surveys were conducted in this area during the 1970s and early to mid 80s. A number of red king crab tagging studies were also conducted during this time period. Bottom trawl surveys of the waters around Unalaska Island were conducted in 1991, 1994, 1995 and 1999. Recent bottom trawl surveys have not captured large numbers of king crabs. In 1995, only two red king crabs were caught, thus no population estimate could be generated. During the 1999 survey, 72 red king crabs were caught, one of which was a legal male. All others were pre-recruit males and small females captured in a single tow. This catch, while encouraging, does not appear to constitute a rebuilding event.

In 1996 and 1997, a catcher-processor was permitted to target red king crabs on the Petrel Banks during their directed golden king crab fishing. The goals of this project were to enumerate, tag and collect biological data from all red king crabs captured and to recapture tagged individuals. While the tagging was too limited to provide quantitative stock assessment data, it did provide some data related to migration, molting cycle and seasonal distribution.

A total of 926 crabs were tagged over a two year period along the north side of Amchitka Island and south side of Semisopochnoi Island. Among captured crabs, 440 were legal males and 160 were females, 89% of legal crabs were new shell. Recovery efforts yielded 15 tagged crabs, six of which were legal males.

The limited data available for red king crabs in the western Aleutian Islands does not indicate that stocks are recovering in that area. Currently, there is no reason to believe that red king crab stocks in the Aleutian Islands will recover to commercially exploitable levels in the immediate future.

Cause of the Collapse

The cause of the Aleutian Islands red king crab stock collapse is not clearly understood, but it is likely that overfishing has played a key role in the collapse of this stock. Bycatch of red king crabs in other fisheries does not appear to be a significant source of red king crab mortality in the Aleutian Islands.

What Do We Plan to Do?

To further enhance recovery efforts, the BOF took action at the March 1999 meeting regarding the sport, personal use and subsistence king crab fisheries in the Aleutian Islands east of 168° W long. Regulations closing the sport and personal use fisheries and reducing the daily bag limit of subsistence king crabs from six to one crabs per day were adopted by the BOF. The BOF also adopted regulations requiring that subsistence king and Tanner fishers in the Aleutian Islands east of 168° W. long. obtain a subsistence permit before commencement of fishing operations.

Given limited stock status information, efforts should be directed towards obtaining stock status information and developing a conservative rebuilding and management plan through the BOF and Crab Plan Team process. The department intends to close the fishery for the 1999/2000 season until the Crab Plan Team has reviewed stock assessment and management options. The ADF&G should also develop, for BOF and public review, a harvest strategy to provide stock rebuilding measures and a minimum guideline harvest threshold similar to the Eastern Bering Sea Tanner crab *Chionoecetes bairdi* harvest strategy.

ALEUTIAN ISLANDS AND BERING SEA SHRIMP

Historical Harvest Synopsis

The Aleutian District consists of all Bering Sea and Aleutian Islands waters west of the longitude of Cape Sarichef. During the 1960s the Aleutian District supported a large foreign shrimp fishery. A Russian and Japanese fleet harvested up to 30,000 mt per year in the area northwest of the Pribilof Islands.

In 1972 a domestic shrimp fishery began in the Aleutian District. It was primarily a trawl fishery targeting pink shrimp (*Pandalus borealis*) in the vicinity of Unalaska Island. During the 1976 season effort reached eight vessels with a harvest of 3.7 million pounds. Harvest peaked in

1977/78 when seven vessels landed 6.7 million pounds. The fishery around Unalaska Island was drastically curtailed after the 1982/83 season due to low stock abundance. The only recorded harvest since 1983 has come form the area northwest of the Pribilof Islands. In 1992, four vessels landed 72,000 pounds. In 1999 two vessels harvested shrimp, therefore catch information is confidential. Initial catches during the 1999 fishery were primarily of pink shrimp. However, as the fishery progressed, the fleet began to target sidestripe shrimp (*Panadalopis dispar*) until they became the dominant species in the catch. The department closed the fishery because of a lack of information to establish GHLs.

The North Peninsula District consists of the Bering Sea east of the longitude of Cape Sarichef. No vessels have participated in the North Peninsula District pot or trawl shrimp fishery from 1995 through 1998; however, one vessel did register in 1995. No other harvest information has been recorded.

Management and Research Program

Current regulations allow for commercial shrimp fishing in the Aleutian District all year, with the exception of the Unalaska Bay, Makushin Bay, Usof Bay and Beaver Inlet sections which are closed by emergency order (**5 AAC 31.510 (5) (A). FISHING SEASONS FOR REGISTRATION AREA J**). The North Peninsula District pot and trawl shrimp fishery is currently open (**5 AAC 31.510 (4). FISHING SEASONS FOR REGISTRATION AREA J**). At this time there are no GHLs.

The Alaska Department of Fish and Game (ADF&G) currently has little biological or population data for the Aleutian Island and Bering Sea shrimp populations. Current trawl surveys in these areas do not target shrimp and are at different depths then the 1999 fishery occurred. Current information for these areas is limited to the commercial harvest in 1992 and 1999 in the area northwest of the Pribilof Islands. It is believed that shrimp abundance remains low in the Unalaska Bay, Makushin Bay, Usof Bay, and Beaver Inlet sections.

For the North Peninsula District there is no survey or catch information available to indicate stock health. At this time shrimp harvest in the Aleutian and North Peninsula Districts are closed because stock assessment data is unavailable.

Cause of the Collapse

Several factors likely lead to the collapse of the shrimp stock in the Aleutian and North Peninsula Districts. Predation is one factor that could have played a role in the shrimp collapse. Starting in 1982, fishermen in the area around Unalaska complained of large numbers of small fish (juvenile cod and pollock) in their catch. In 1983, a short survey of Makusin Bay produced 60 pounds of shrimp and 1,210 pounds of four to eight inch pollock.

It is unknown if the shrimp stocks have recovered in the Aleutian and North Peninsula Districts. The 1999 Aleutian District shrimp harvest was significantly larger then the 1992 harvest.

What Do We Plan to Do?

Management plans need to be developed for both the Aleutian and North Peninsula Shrimp Districts. Areas that need to be addressed, in order to implement a management plan, are:

- Basic biology of pink and sidestripe shrimp from the Bering Sea
- Perform stock assessment
- Staff availability to monitor and observers
- Set seasons
- Redefine Management Areas (Separate the Aleutian Islands and the Bering Sea)