


MEMORANDUM

TO: Council and AP Members
FROM: Chris Oliver 
Executive Director
DATE: June 1, 2005
SUBJECT: Gulf of Alaska Groundfish Rationalization

ESTIMATED TIME 6 HOURS (for all C-2 items)
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ACTION REQUIRED

- (b) Review preliminary alternatives for Tanner crab bycatch

BACKGROUND

The Council is considering bycatch reduction measures for crab and salmon species in the GOA groundfish fisheries. Analysis of these measures is to be included as part of the comprehensive GOA groundfish fisheries rationalization analysis. The Council has approved draft alternatives (attached Item C-2(b)(1)) for red king crab, *C. Bairdi* Tanner crab, 'other' salmon and Chinook salmon species. In February 2005, the Council further refined these alternatives by revising the Chinook salmon alternatives and removing "other king crab" from the analysis as bycatch reduction measures for this species at this time seemed unnecessary.

In order to eventually move forward with an analysis of these alternatives, the Council will need to specify trigger limits and closure areas as included for each species under alternatives 2 and 3. To facilitate this clarification, staff is using *C. Bairdi* Tanner crab as an example for preliminary discussion of how trigger limits and closure areas will be defined for this species, and for a general methodological approach that may be utilized in refining these time and area closures options for the remaining species for analytical purposes. A discussion paper to this effect is attached as Item C-2(b)(2).

GOA groundfish Rationalization:

Alternatives for bycatch reduction of salmon and crab species (as modified by the Council
February 2005)

Chinook Salmon

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for salmon. Specific areas with high bycatch (or high bycatch rates) are closed seasonally (could be for an extended period of time) if or when a trigger limit is reached by the pollock fishery.
- Alternative 3: Seasonal closure to all trawl fishing in areas with high bycatch or high bycatch rates.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Other Salmon

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for other salmon. Specific areas with high bycatch (or high bycatch rates) are closed seasonally (could be for an extended period of time) if or when a trigger limit is reached by the pollock trawl fishery (and potentially additional areas for flatfish trawling).
- Alternative 3: Seasonal closure to all trawl fishing in areas with high bycatch or high bycatch rates.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Tanner Crab

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for Tanner crab. Specific areas with high bycatch (or high bycatch rates) are closed to flatfish trawling for the remainder of the year if or when a trigger limit is reached by the flatfish fishery.
- Alternative 3: Year-round bottom trawl closure in areas with high bycatch or high bycatch rates of Tanner crab.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Red King Crab

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for red king crab. Specific areas with high bycatch (or high bycatch rates) are closed to flatfish trawling (and potentially other areas for P. cod longline and pot gear) for the remainder of the year if or when a trigger limit is reached by the fishery.
- Alternative 3: Year-round bottom trawl closure in areas with high bycatch or high bycatch rates of red king crab.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Methodology for GOA Bycatch Reduction Measures

Staff Discussion Paper *GOA Groundfish Rationalization* *June 2005*

Overview

The Council is considering bycatch reduction measures for crab and salmon species in the GOA in conjunction with the proposed analysis to comprehensively rationalize the GOA groundfish fisheries. The Council has approved draft alternatives (see appendix 1) for red king crab, *C. Bairdi* Tanner crab, 'other' salmon and Chinook salmon species. In February 2005, the Council further refined these alternatives by revising the Chinook salmon alternatives and removing "other king crab" from the analysis as bycatch reduction measures for this species at this time seemed unnecessary.

In order to move forward with an analysis of these alternatives, the Council will need to specify trigger limits and closure areas for each species under alternatives 2 and 3. The information in this paper is organized to highlight information needs and clarifications which will be necessary for an analysis of bycatch reduction measures in the GOA groundfish fisheries. Information has been provided for *C. Bairdi* Tanner crab as a starting point for discussion of defining trigger limits and closure areas, and a general methodological approach that may be utilized in refining these time and area closures options for the remaining species.

Review of Alternatives

The following alternatives are contained in the draft suite of alternatives for bycatch reduction of *C. Bairdi* Tanner crab species in the GOA groundfish fisheries:

Tanner Crab

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for Tanner crab. Specific areas with high bycatch (or high bycatch rates) are closed to flatfish trawling (and potentially other areas for P. cod longline and pot gear) for the remainder of the year if or when a trigger limit is reached by the flatfish fishery.
- Alternative 3: Year-round bottom trawl closure in areas with high bycatch or high bycatch rates of Tanner crab.
- Alternative 4: Voluntary bycatch coop for hotspot management.

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Bycatch of Tanner crabs by fishery

An examination of the seasonal and annual bycatch of *C. Bairdi* Tanner crabs since 1993, with a specific focus on the recent period (since 2000) was conducted to identify the appropriate limits and the fisheries for which these limits should apply.

The bycatch of *C. bairdi* Tanner crabs in GOA groundfish fisheries has fluctuated through the time series, from a low of less than 50,000 crabs in 1994 to a high of over 300,000 crabs in 1997 (Figure A).

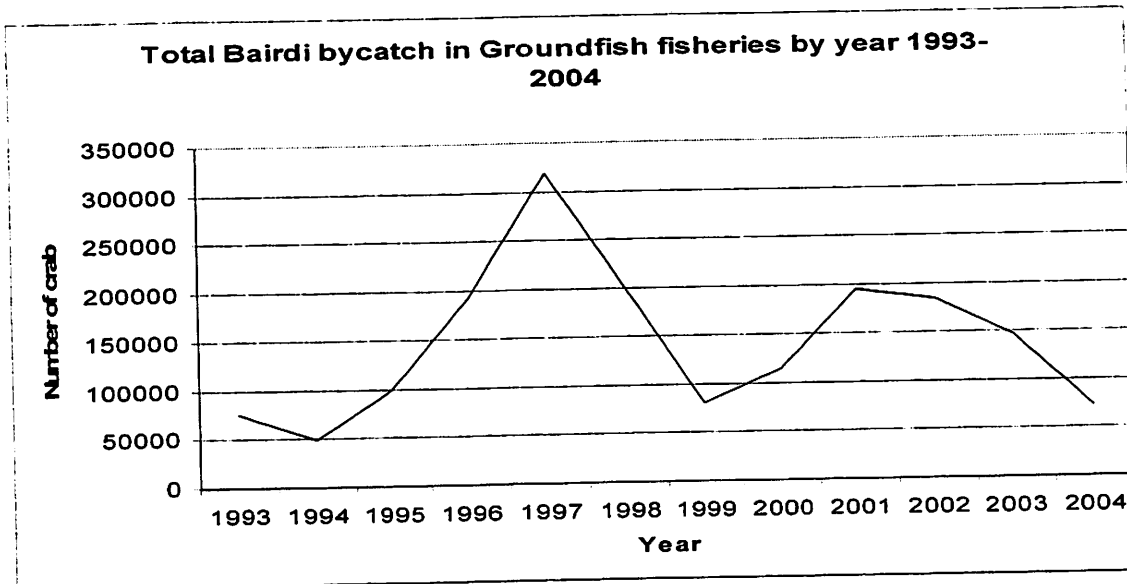


Figure A: Total bycatch of *C. Bairdi* Tanner crabs in all GOA groundfish fisheries 1993-2004

During these years, the highest bycatch of Tanner crabs occurred in 1997, where elevated bycatch in both trawl and pot sectors was observed (Figure B). The highest numbers of Tanner crab taken as bycatch occur primarily in the trawl fisheries (specifically the Pacific cod trawl and flatfish trawl) and in the pot fishery for Pacific cod. The relative numbers taken over this time period by the combined trawl fisheries (again primarily for Pacific cod and flatfish) as well as the bycatch taken in the Pacific cod pot fishery are shown in Figure B. In recent years the trawl contribution to bycatch has been much higher than the pot contribution to bycatch.

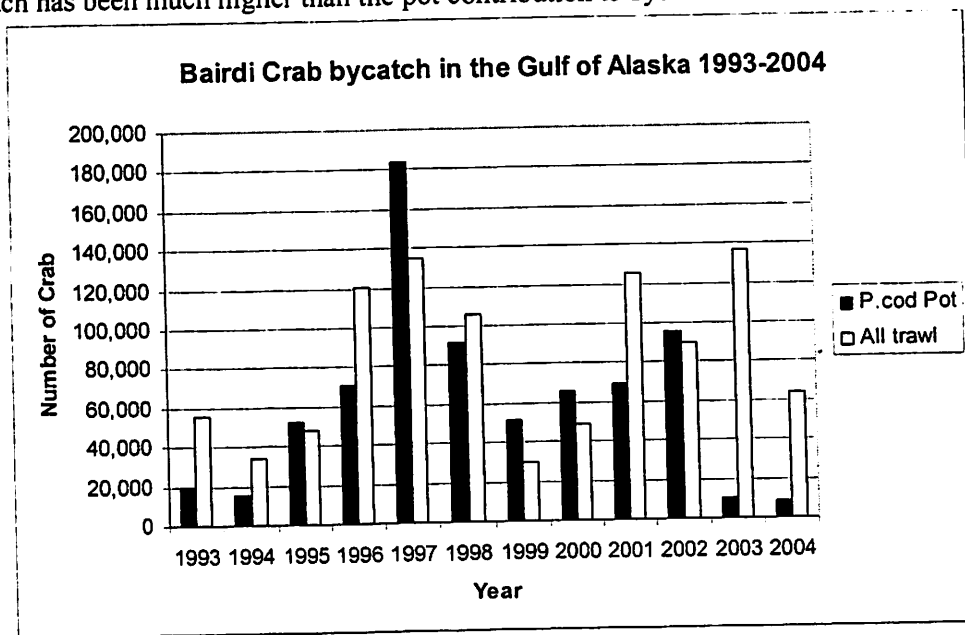


Figure B: Overall annual bycatch of *C. Bairdi* Tanner crab by trawl and pot fishery sectors (1993-2004)

The table below shows the annual amounts of Tanner crabs taken by different fishery sectors since 2000.

Table 1: Bycatch of *C. bairdi* Tanner crabs in Gulf of Alaska groundfish fisheries by gear type and target fishery, 2000-2004

Gear and Fishery	Year:				
	2000	2001	2002	2003	2004
Longline:					
Pacific cod	167	14	17	0	0
Other species	1	17	5	0	0
sablefish	0	0	0	20	26
Pot:					
Pacific cod	65,786	69,091	95,766	10,076	8,918
Trawl:					
pollock	1,821	11,362	774	7	2,432
Pacific cod	11,177	46,822	4,905	2,519	1,180
Flatfish:					
DWF	45	2,533	185	0	0
SWF	18,924	13,164	33,914	59,600	10,016
Flathead sole	3,015	45,269	26,924	17,330	7,275
Arrowtooth flounder	10,610	2,194	14,626	28,337	32,992
Rex sole	2,897	2,145	7,198	28,780	9,014
rockfish	226	2,394	905	183	1,416
other species	0	0	0	13	0
Total Trawl	48,715	125,883	89,431	136,769	64,325
Total GOA	114,669	195,005	185,219	146,865	73,269

Overall from 2000-2004, trawl fisheries account for about 65% of the *C. bairdi* Tanner crabs taken as bycatch in GOA groundfish fisheries, with the fisheries using pot gear accounting for about 35% of the *C. bairdi* Tanner crab bycatch. Within the trawl fisheries, combined flatfish fisheries make up 81% of the total trawl contribution on average from 2000-2004, or 53% of the total average for those years. Pacific cod trawl fisheries make up 14% of the total trawl

contribution. Trawl fisheries, particularly the flatfish fisheries experienced a dramatic increase in *C. bairdi* Tanner bycatch in 2003.

The average percent contribution by gear type for *C. bairdi* Tanner crab are: 65% for combined trawl fisheries, 35% for pot fisheries and <0.01% for all longline fisheries (Table 1). Bycatch of *C. bairdi* Tanner crabs in the Pacific cod pot fishery was notably higher from 2000-2002 but decreased dramatically in 2003 and 2004. Further examination of the location of the pot cod fishery (and flatfish trawl fishery) would possibly provide an explanation for the relative decrease in crab bycatch in the pot cod fishery and increase in the flatfish fishery. No data were available in order to further examine the location of effort in these fleets over this time period at this point. However this will be an important aspect for examination in the forthcoming analysis. The relative observer coverage in these fleets is notably limited, particularly in the Pacific cod pot fishery.

Contribution to bycatch by the state waters cod fishery

An examination was made of the state waters Pacific cod fishery contribution to the *C. bairdi* Tanner crab bycatch amounts and the relative amount of observed trips in this fishery (Table 2).

Table 2 : State Pacific cod observer data, crab bycatch numbers, observed vessels only (source, ADF&G)

Area	Year	Observed trips	Pots lifted	Tanner Crab	King crab	Cod catch		Tanner/mt	king/mt
						Whole pounds	Metric tons		
Kodiak	1997	1	333	11	0	36,432	16.53	0.67	0.00
Kodiak	1998	1	261	4	9	20,418	9.26	0.43	0.97
Kodiak	1999	3	1006	48	0	69,257	31.42	1.53	0.00
Kodiak	2001	1	200	171	0	6,638	3.01	56.79	0.00
South Peninsula	1998	1	174	1	0	47,453	21.53	0.05	0.00
South Peninsula	1999	1	240	0	0	40,952	18.58	0.00	0.00
South Peninsula	2000	2	419	0	0	126,908	57.57	0.00	0.00
South Peninsula	2001	2	619	52	0	130,771	59.32	0.88	0.00
South Peninsula	2002	1	58	1	0	10,248	4.65	0.22	0.00
South Peninsula	2004	1	30	1	0	13,099	5.94	0.17	0.00
Chignik	2003	1	268	42	0	28,297	12.84	3.27	0.00

Preliminary data were obtained by ADF&G for three locations in the Western GOA: Kodiak, South Peninsula and Chignik. Data were available for various years in each location. In the Kodiak region, data were obtained for 1997, 1998, 1999, 2001 and 2004. Of these years, 2001 showed the highest number of Tanner crab, 171 crab. It was noted by ADF&G that this was obtained in only one observed trip. In the S. Peninsula region, the highest number of Tanner crab was obtained in 2001 where 52 crab were caught as compared with 0 to 1 in all other years for which data were obtained for this region (1998-2004). For Chignik, 2003 was the only year for which preliminary data were available. Here 42 crabs were obtained as bycatch. The state waters bycatch numbers for *C. bairdi* Tanner crab are still low in comparison to total *C. bairdi* Tanner numbers in the GOA. Currently due to the absence of a full state onboard observer program less than 1% of the state waters fishery is observed.

Methodology for Estimating Trigger Limits

Average bycatch numbers, both long-term and in recent years, will aid in the consideration of an appropriate trigger limit for time and area closures. The average (1993-2004) number of *C.*

bairdi Tanner crabs caught as bycatch in the GOA groundfish fisheries is 144,067. Of these, 82,789 were taken on average in the combined trawl fisheries, while 61,278 were taken in the P. cod pot fisheries. Since 2004, as shown in Table 1, the average number of crabs in combined trawl fisheries is 93,025 which is slightly higher than the longer-term average. For comparison, the 2000-2004 average number of crabs taken in the pot fisheries is 49,927 which is lower than the long-term average. Again there was a dramatic decrease in the amount of Tanner crabs taken in the P. cod pot fishery in 2003 and 2004 and this decrease lowers the average from 2000-2004 considerably as compared with the long-term average.

The time period of analysis of bycatch will need to be considered in determining both trigger limits and area closures. If average bycatch numbers were considered as a first step for analysis of appropriate trigger limits, the following questions would need to be addressed: Over what time period should the average be defined? Should the trigger number differentiate between gear types (e.g. separate limits for pot and trawl gear) or should it be an aggregate number for both? For example, using the average numbers discussed above, a trigger could be defined for the trawl fisheries of 83,000 Tanner crabs per year and 61,000 for pot gear. If this were the case, since 2000 the trawl sector would have exceeded this trigger in 2001, 2002 and 2003 and the pot sector would have exceeded their trigger in 2000, 2001 and 2002. If the number were an aggregate for both gear types, for example at 144,000 crabs, this number would have been exceeded in 2001, 2002 and 2003.

Another methodology for consideration in establishing potential trigger limits could be to establish limits which are either based on an estimate of, or float as a percentage of, the overall biomass of PSC species. This approach has been utilized in the BSAI groundfish fisheries using a stair-step procedure for crab species such as red king crab, an abundance-based zonal approach for *C. bairdi* Tanner crab and as a percentage of annual biomass estimates for snow crab. Biomass-based limits require a good understanding of the relative stock status for that species. A brief overview of abundance information is provided in a latter section of this paper (see "Overview of Tanner crab biology and stock status in the GOA"). A full description of stock status and the relative understanding of the health and vulnerability of crab stocks in the GOA will be included in the forthcoming analysis of these measures and will be integral to determining the appropriate mechanism for establishing trigger limits.

Seasonality of Tanner crab bycatch:

Seasonality is another consideration in establishing limits on crab bycatch or trigger amounts for time and area closures. The bycatch of Tanner crabs by week in all groundfish fisheries in 2003 (Figure C) and 2004 (Figure D) with the associated groundfish catch in mt are provided in the histograms below.

Bycatch amounts of *C. bairdi* Tanner crab taken in trawl fisheries appear to fluctuate temporally in direct response to groundfish catches, particularly catches of Pacific cod and flatfish, which are managed on a quarterly basis, with the trawl fishery beginning on January 20th each year. The seasons for trawl gear increased to 5 beginning in 2001. Bycatch of Tanner crabs in 2003 (in numbers of crabs) increased dramatically in mid-March due to bycatch in the combined flatfish fishery, and was high from late April through May and once again in mid-October (Figure C), each time in the flatfish fisheries. Peaks by week were seen in specific fisheries, e.g., in the flathead sole fishery (March), Shallow water flatfish (April-May) and Arrowtooth flounder fisheries (October).

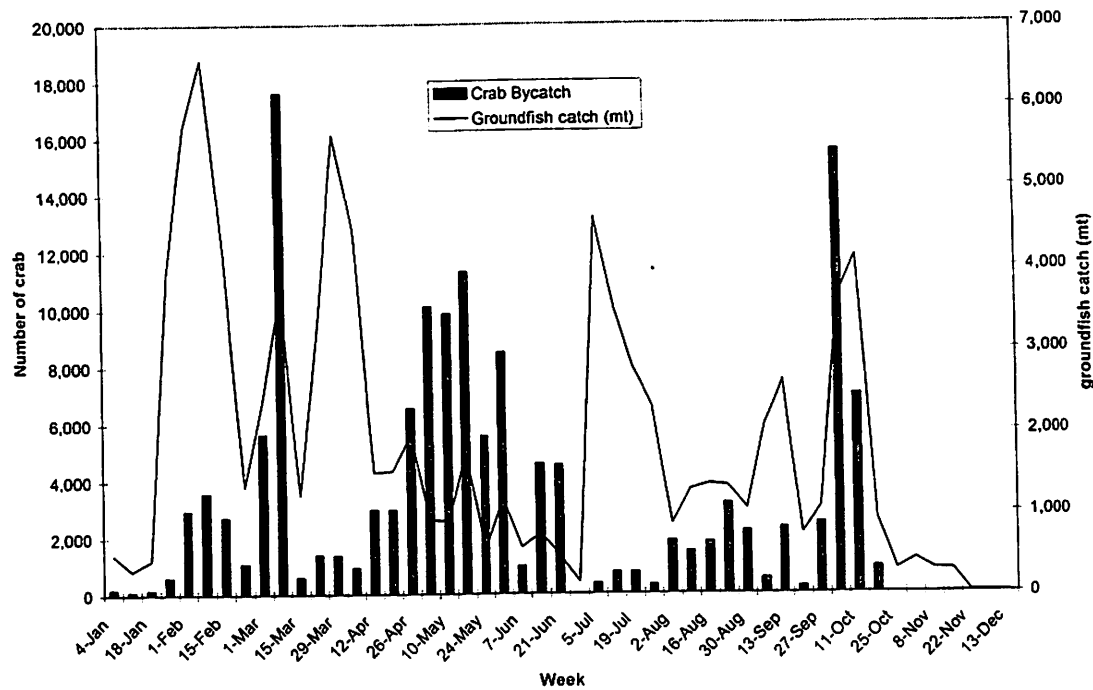


Figure C: Bycatch of *C. Bairdi* Tanner crab and associated groundfish catch in 2003

Bycatch of *C. bairdi* Tanner crabs in 2004 was highest (in numbers of crab) during March and early April (shallow water flatfish), corresponding to seasonal release of the halibut PSC apportionment for use in the flatfish fishery with an additional spike in late July (Arrowtooth flounder).

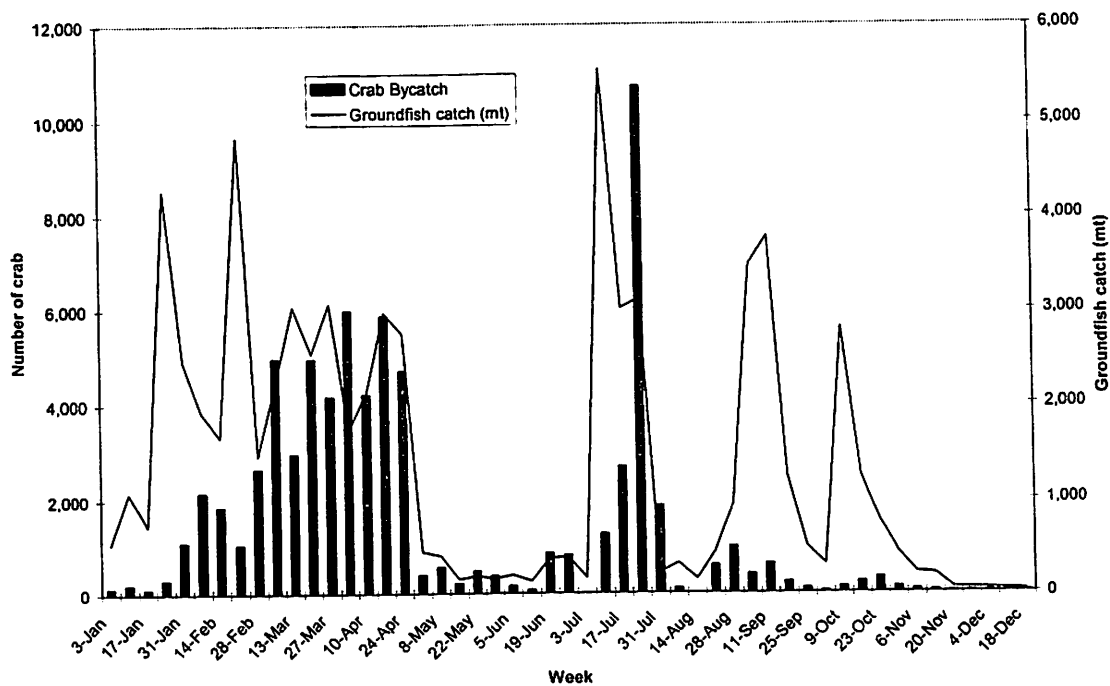


Figure D: Bycatch of *C. Bairdi* Tanner crab and associated groundfish catch in 2004

As seen in Figures C and D, bycatch in the trawl fisheries varies seasonally which is attributed to the fishing practices as a result of the seasonal release of the Halibut PSC in the GOA

Overview of Tanner crab biology and stock status in the GOA

Crab management in the GOA is solely managed by the State of Alaska. Abundance estimates are produced by region (where possible). For most regions actual abundance estimates are limited and commercial fishing has been closed. Commercial fishing for *C. Bairdi* in 2004 occurred in areas of the Kodiak District, the Chignik District and the South Peninsula District.

Population estimates are available for these districts: the Kodiak District population is estimated at approximately 175.9 million crabs, for S. Peninsula 14.3 million crabs, and Chignik 12.7 million crabs (Worton 2002). GHs by region were the following in 2004: Kodiak (all regions combined) 1,750,000 (pounds), Chignik 400,000 pounds and South Peninsula 300,000 pounds.

The Kamishak and Barren Islands District of the Cook Inlet management region has also been closed to commercial fishing (since 1991) due to concerns of low crab abundance. There is limited data to assess the Outer, Eastern, and Central Districts of the Cook Inlet management region and both regions have been closed to commercial fishing (since 1998 for Central and 1993 for Eastern/Outer). For the Southeast region, a population survey was begun in 1997/1998 to evaluate regional distribution of *C. bairdi* Tanner crab stocks and the relative abundance estimates. However, at present, no estimates of overall *C. bairdi* Tanner crab abundance in the region are available.

Review of existing closures

In consideration of additional time and area closures in the GOA groundfish fisheries, it is important to review and consider the interaction of the existing closures in this region. Figure 1 shows the existing state and federal closures in the GOA management area. The timing and purpose of each closure are summarized below (dates in parentheses indicate the year of implementation of the closure).

Kodiak red king crab closures: Type I and Type II (1993)

Trawl closure areas, designed to protect Kodiak red king crab because of the poor condition of the king crab resource off Kodiak and because trawl bycatch and mortality rates are highest during the spring months when king crab migrate inshore for reproduction. The molting period off Kodiak begins around February 15 and ends by June 15. Type I areas have very high king crab concentrations and, to promote rebuilding of the crab stocks, are closed all year to all trawling except with pelagic gear. Type II areas have lower crab concentrations and are only closed to non-pelagic gear from February 15 through June 15.

Steller Sea Lion (SSL) 3nm No Transit Zone- (2003) Groundfish fishing closures related to SSL conservation establish 3 nm no-transit zones surrounding rookeries to protect endangered Steller sea lions.

SSL no pollock trawl zones- (2003) Groundfish fishing closures related to SSL conservation establish 10 nautical mile (nm) fishing closures surrounding rookeries to protect endangered Steller sea lions.

SSL: Chiniak Research no trawl zone- (2004) Research area designed for localized depletion studies for pollock. Trawling is restricted between August 1st and September 20th.

Scallop closures (1995) Year round closure to scallop dredging to reduce high bycatch of other species (i.e., crabs) and avoid and protect biologically critical areas such as nursery areas for groundfish and shellfish.

Prince William Sound rookeries no fishing zone (2003) Groundfish fishing closures related to SSL conservation include two rookeries in the PWS area, Seal Rocks (60° 09.78' N. lat., 146° 50.30' W. long.) and Wooded Island (Fish Island) (59° 52.90' N. lat., 147° 20.65' W. long.). Directed commercial fishing for groundfish is closed to all vessels within 3 nautical miles of each of these rookeries.

Cook Inlet bottom trawl closure- (2001) Prohibits non-pelagic trawling in Cook Inlet to control crab bycatch mortality and protect crab habitat in an areas with depressed king and Tanner crab stocks.

State Water no bottom trawling-(2000) State managed area provides year round protection from all bottom trawl gear. Closes all state waters (0-3nm) to commercial bottom trawling to protect nearshore habitats and species.

Southeast Alaska no trawl closure-(1998) Year round trawl closure E. of 140° initiated as part the license limitation program.

Fishery bycatch data and Tanner crab survey abundance

A preliminary examination was made of fishing locations and bycatch rates in conjunction with abundance information in order to highlight how information is utilized in designing time and area closures.

Figure 2 shows the overall fishing effort in the GOA groundfish trawl fishery from 1998-2002. Effort is patchily distributed along the continental shelf and slope throughout the central and western management areas. The southeast management area in the GOA is closed to trawling and hence no effort is depicted in this region. Note that longline and pot effort are not included in this example.

ADF&G conducts annual surveys for king and Tanner crab in the Gulf of Alaska. The locations where these surveys are conducted are shown in Figure 3. The ADF&G survey region concentrates on areas of known crab population abundance. The surveys were initially designed to estimate populations of Tanner crab and red king crab for fishery management purposes and thus, the survey coverage is limited to areas of historic or presumed crab habitat with survey tows most intensely concentrated in the nearshore areas and in bays (Blackburn and Pengilly 1994).

Tanner crab abundance information for 2002 (aggregate all crabs) is shown in Figure 4 for the area around Kodiak Island. Survey data segregates crab abundance into size categories for total legal males, sub-legal and juvenile males, adult females and juvenile females by survey station. The concentration of crabs by life history stage is an important consideration in evaluating which areas are most vulnerable to fishing pressure. For the purposes of this example only, these data have been aggregated into a total number of crabs by location, however for an ensuing analysis these data would be examined by life history stage as well.

Data were available to depict the locations of Tanner crab bycatch in the P. cod trawl fisheries and the flatfish trawl fisheries (Figure 5). Data were not available at this time to depict the

locations or bycatch rate by the P. cod pot fishery, the other fishery which showed the highest percentage of Tanner crab bycatch by fishery. Any future analysis would need to consider the rates of bycatch (and associated mortality) of all fisheries contributing to the overall bycatch of Tanner crabs.

Example methodology

Overlaying fishery bycatch data with abundance data provides an overview of where vulnerable areas to fishing pressure may be located. The locations of trawl (P. cod and flatfish) bycatch and the 2002 abundance estimates for Tanner crab are shown together in Figure 6.

Using this overlay information, three areas are highlighted as possible example regions where time and area closures might be considered (Figure 7). It should be noted however that there is additional information that would be considered in any analysis of proposed closure areas. This overlay provides one means of evaluating available information. These areas are highlighted for example consideration only as they have high bycatch rates together with a concentration of crab abundance. Additional data on crab life history stages at these regions is not depicted here.

Time and area closures are often specified seasonally at time periods where the species under consideration tends to be most vulnerable to fishing pressure. Figure 8 depicts an overlay of crab abundance information and trawl bycatch locations by first and second quarter of the fishing year. As discussed previously, information from 2003 (Figure C) and 2004 (Figure D) indicates that Tanner crab bycatch is highest during this time period. In designing appropriate time and area closures it will be necessary to also examine the seasonality of the bycatch by area and the relative vulnerability of the crab population by life history stage in areas of concentrated bycatch. Closures may be considered under alternative 2 which close only for select periods of time, as per the existing Type I and Type II red king crab closures which close during critical molting periods for areas of lower concentration (Type II) or year-round for regions of higher concentration (Type I). Thus any proposed closures should examine the relative concentration of Tanner crabs in that area, the vulnerable life-history stages, timing of vulnerable molting periods as well as the relative bycatch rate of the fishery by season.

Additional Considerations

In consultation with ADF&G staff regarding the direction and information needs for the proposed analysis, several additional ideas and concerns were highlighted. The low percentage of unobserved vessels remains a considerable challenge for accurate estimation of crab and salmon bycatch in the GOA groundfish fishery. Does catch composition change between observed and non-observed vessels? Are the available data on crab and salmon bycatch in the GOA sufficient and if not is initiation of a research program possible within a reasonable timeframe (perhaps of 5 years)? And finally, particularly in lieu of the difficulty in catch accounting in the absence of an observer for much of the GOA fleet, a modified measure was discussed for inclusion in the suite of alternatives for analysis. A hybrid measure could be considered whereby once areas are identified for time and area closures, vessels which carry an observer could potentially be exempted from these closures for purposes of gaining additional information where data are lacking.

Summary

These trigger limits and areas as discussed are put forward for example purposes only at this point, and are intended to highlight the information and clarifications that will be necessary in an analysis of proposed year-round and triggered seasonal closures. Many clarifications will be necessary to move forward with an analysis of time and area closures for GOA Tanner crab and other prohibited species under consideration.

References

Blackburn, J., and D. Pengilly. 1994. A summary of estimated population trends of seven most abundant groundfish species in trawl surveys conducted by Alaska Department of Fish and Game in the Kodiak and Alaska Peninsula areas, 1988 through 1993. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 4K94-31, Kodiak.

Spalinger, K. 2004. Bottom trawl survey of crab and groundfish: Kodiak, Chignik, South Peninsula, and Eastern Aleutians Management Districts, 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K04-32, Kodiak.

Worton, C. 2002. Bottom Trawl Survey of Crab and Groundfish: Kodiak, Chignik and South Peninsula Management Areas, 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K02-51, Kodiak.

Appendix 1: Draft PSC alternatives for reduction of salmon and crab species (as modified by the Council February 2005) included in the Council's suite of alternatives for GOA groundfish rationalization

Chinook Salmon

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for salmon. Specific areas with high bycatch (or high bycatch rates) are closed seasonally (could be for an extended period of time) if or when a trigger limit is reached by the pollock fishery.
- Alternative 3: Seasonal closure to all trawl fishing in areas with high bycatch or high bycatch rates.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Other Salmon

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for other salmon. Specific areas with high bycatch (or high bycatch rates) are closed seasonally (could be for an extended period of time) if or when a trigger limit is reached by the pollock trawl fishery (and potentially additional areas for flatfish trawling).
- Alternative 3: Seasonal closure to all trawl fishing in areas with high bycatch or high bycatch rates.
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Tanner Crab

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for Tanner crab. Specific areas with high bycatch (or high bycatch rates) are closed to flatfish trawling for the remainder of the year if or when a trigger limit is reached by the flatfish fishery.
- Alternative 3: Year-round bottom trawl closure in areas with high bycatch or high bycatch rates of Tanner crab.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Red King Crab

- Alternative 1: Status Quo (no bycatch controls).
- Alternative 2: Trigger bycatch limits for red king crab. Specific areas with high bycatch (or high bycatch rates) are closed to flatfish trawling (and potentially other areas for P. cod longline and pot gear) for the remainder of the year if or when a trigger limit is reached by the fishery.
- Alternative 3: Year-round bottom trawl closure in areas with high bycatch or high bycatch rates of red king crab.
- Alternative 4: Voluntary bycatch coop for hotspot management.

Figure 1. Existing Fishery Closures in the Gulf of Alaska including both federal and state managed thru 2005.

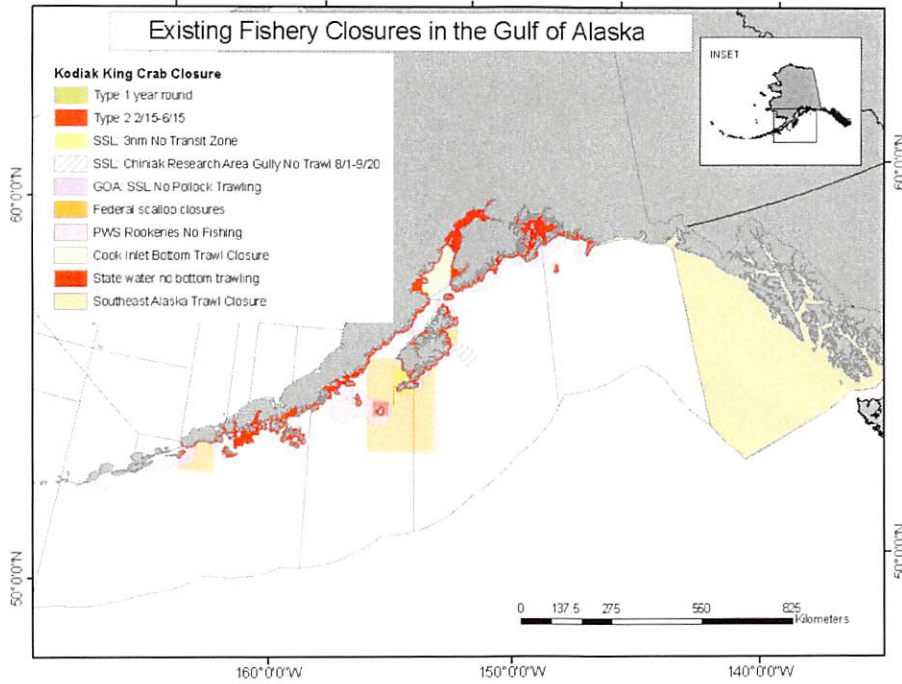


Figure 2. Locations of observed bottom trawl fishing effort between 1998-2002 displayed in number of trawls/ 25km².

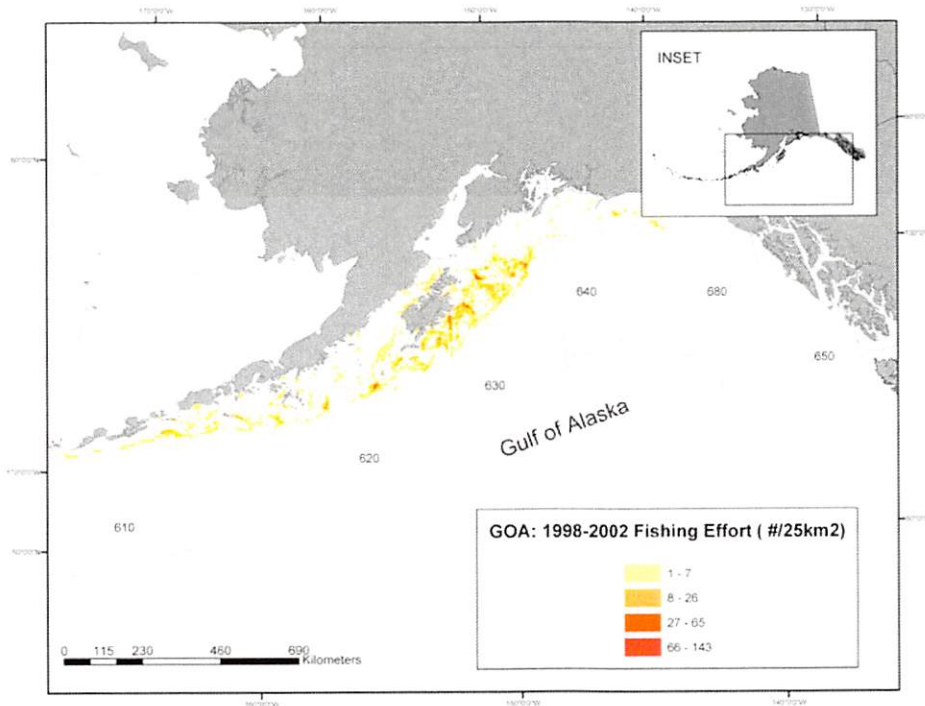


Figure 3. Locations where ADF&G conduct Tanner and King crab abundance surveys.

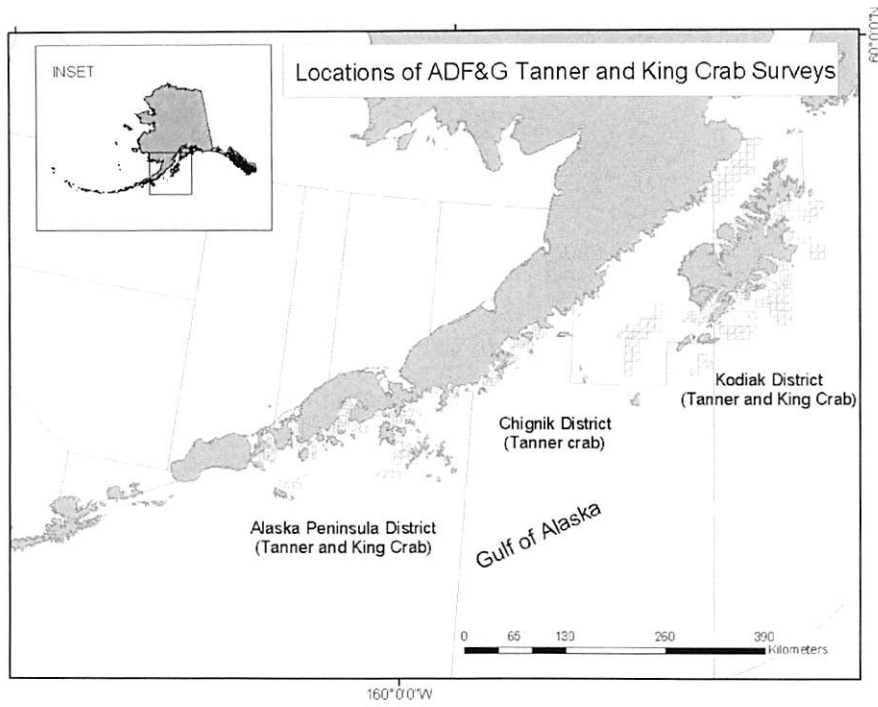


Figure 4. 2002 ADF&G survey locations of Tanner Crab in numbers in the Kodiak District.

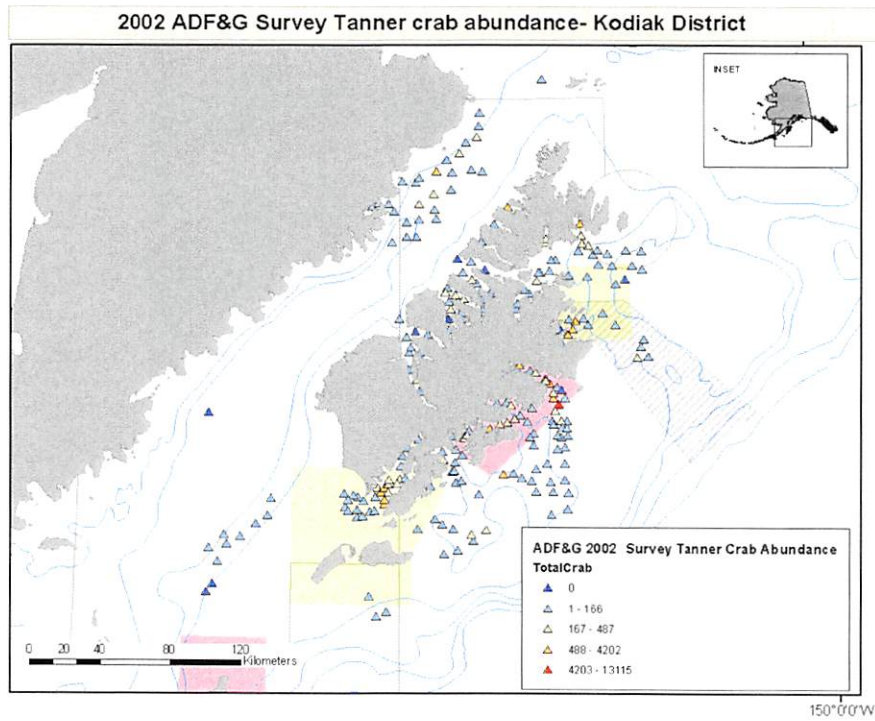


Figure 5. Locations of observed Tanner bycatch in the P. Cod and flatfish trawl fisheries 2000-2002.

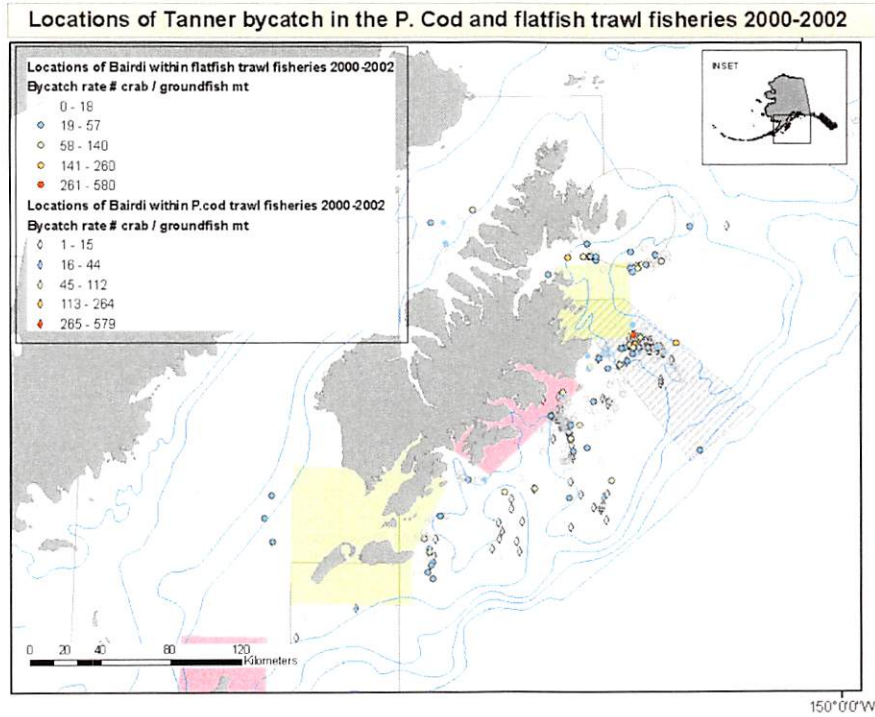


Figure 6. Locations of Tanner bycatch in the trawl fisheries 2000-2002 and the ADF&G 2002 survey information.

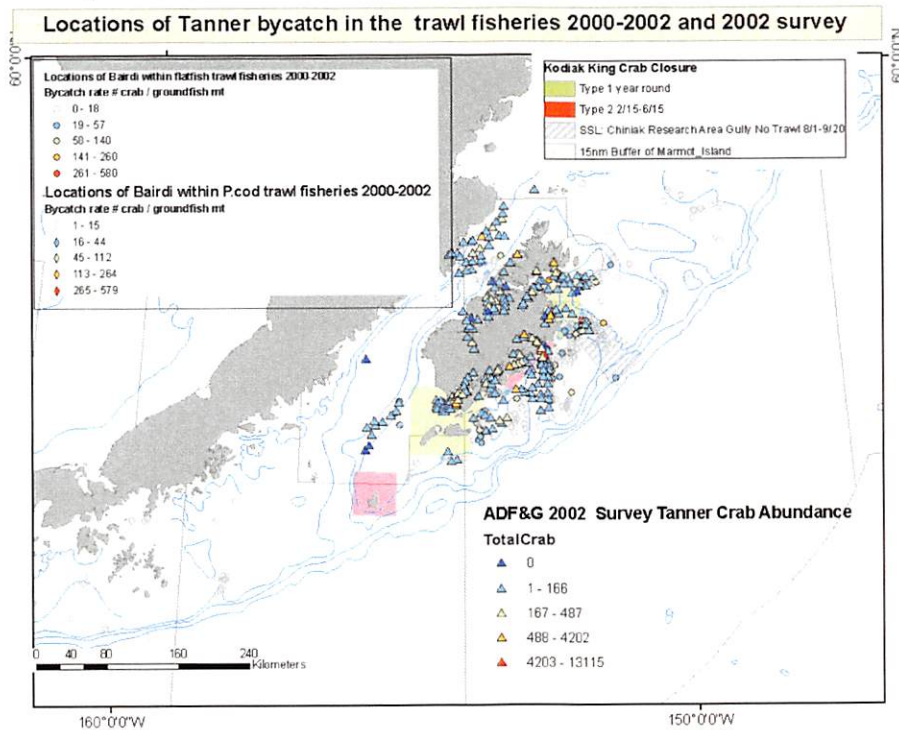


Figure 7. Example methodology for spatial analysis showing concepts for intersecting fishing effort and survey data, and seasonal timing of fisheries.

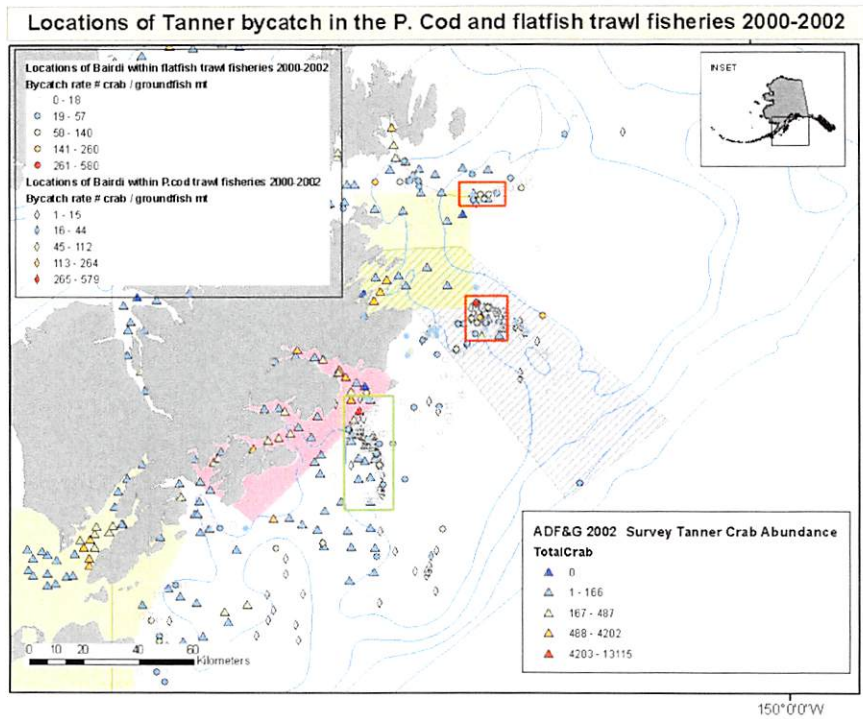
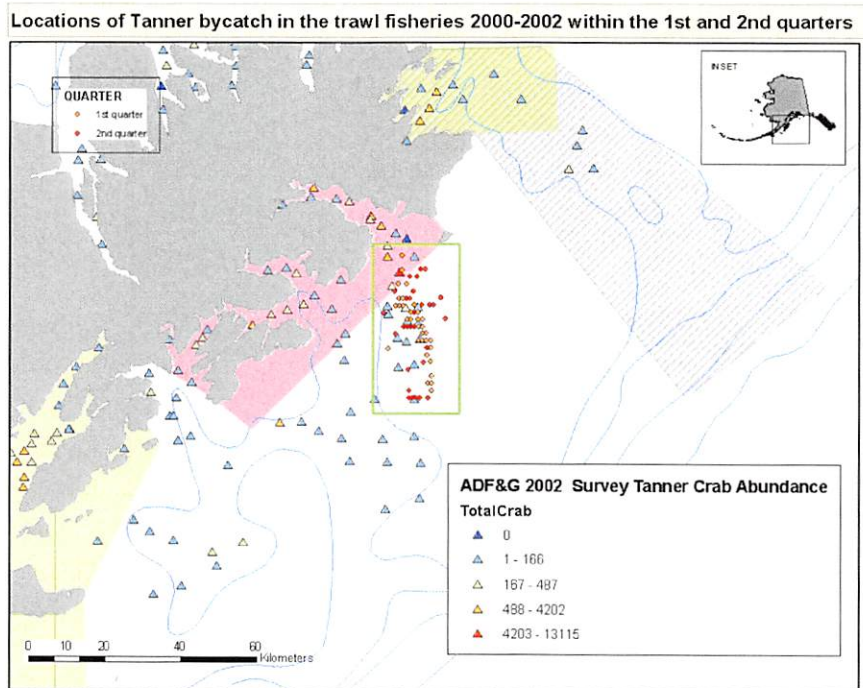


Figure 8. Example methodology for spatial analysis to select high bycatch rates by fishing seasons.



Next Steps for Refining Analysis

- Define time period for determining trigger limits (e.g., average of 2002-2004, or 1998-2005)
- Different trigger limits for each gear type (pot, trawl)?
- Duration of triggered closure (e.g., remainder of year or season)?
- Consider floating, biomass-based limits?
- How to account for:
 - Different discard mortality rates for each gear type?
 - Relative levels of observer coverage in each fishery?
- Possible additional alternative: exemption from closure areas if observer is on board