Bering Sea Aleutian Islands Salmon Bycatch:

February 2007 Staff Discussion Paper

In October 2005, the Council took final action on amendment 84, electing to exempt vessels participating in a voluntary rolling hot spot (VRHS) system from regulatory salmon savings area closures. In conjunction with this action, in December 2005 the Council revised the existing draft suite of alternatives for the next phase of the salmon bycatch analysis (currently referred to as amendment 84B). This amendment package is intended to follow up on remaining measures that were not analyzed under amendment 84. In April 2006, the SSC convened a workshop to better inform the Council regarding the current status of available information on salmon genetics, bycatch patterns and status of AYK salmon stocks in order to assist in the development of alternatives. At that time, the Council reiterated their intention to move forward with amendment package B-1 as a priority with the timeline for the analysis allowing for the inclusion of new information as it becomes available on the genetics of stock origin for incidentally caught salmon species.

This paper reviews the following: pollock fishery and salmon bycatch patterns by species; patterns of spatial persistence in salmon bycatch from 2001-2006 by species; preliminary analysis of patterns in age/length of salmon bycatch by species; a discussion of alternatives for establishing trigger caps as catch limits by species; and a review of alternatives before the Council under forthcoming bycatch reduction amendment analyses. This information is summarized here to facilitate the process of refining the alternatives under the forthcoming amendment package B-1 prior to an analysis of these alternatives.

Overview of pollock fishery characteristics and salmon bycatch patterns

The pollock fishery is split into “A” and “B” seasons. A-season commences on Jan 20th and extends until late March or early April, until about 40% of the available quota (TAC) is reached. This fishery is focused on the SE portion of the EBS and targets pre-spawning fish. The B-season opens in June and continues generally until mid-October for the remaining 60% of the quota. This fishery is typically spread over the outer shelf edge of the Bering Sea extending to the Russian border.

Chinook salmon are commonly taken incidentally by pollock trawl gear during both A and B-seasons. Chum salmon are primarily taken during the B season. Regulatory salmon savings areas by species are shown in figure 1.

The level of observer coverage in the pollock fishery is very high, with most fishing operations being recorded and examined for bycatch. Pollock catches have averaged 1.47 million t during 2001-2006. Seasonal production rates (fleet wide cumulative pollock catches) during this period are similar, but the observed hours fished is more variable[1] (Figure 2). In contrast, the cumulative

[1] Note: these data are preliminary and investigation is being done in conjunction with a draft paper by D. Stram and J. Ianelli for the AYKSSI Symposium in February 2007. Some of this investigation will be summarized in the forthcoming paper in proceedings of that conference.

seasonal salmon catch levels in the pollock fishery have shown a high degree of variability (Figure 3). Here the catch per observed hour of fishing for pollock is higher in the A season, but has been relatively stable over time whereas the catch per observed hour fishing has increased dramatically for both Chinook and chum salmon (Figure 4).

There are three sectors of the pollock fleet: catcher-vessels that deliver catches to shore-side processing plants, catcher-vessels that deliver to at-sea processing motherships, and vessels that catch and processor their fish on board (catcher-processors). By regulation, catcher-processors are restricted from some near-shore areas since shore-based catcher vessels have greater limitations on the locations they can fish. This dynamic impacts the bycatch levels of salmon which generally tend to be higher in shore-based catcher vessels. For example, the incidence rate of salmon encounters for catcher vessels has increased in both sectors but the rate for catcher processors has averaged about 17% compared to 42% for catcher vessels (Figure 5).

Day-night difference in pollock behavior and catchability are apparent from these data. Characterizing the average daily effort, there about 75% are fewer tows during the evening and that the tows that do occur, tend to be longer in duration (Figure 6). Both pollock and salmon have somewhat higher catch rates during mid-day, but salmon rates drop (relatively speaking) more during night (Figure 7).

Spatially, the density of Chinook salmon bycatch during the A season is concentrated to fewer areas than where pollock are caught, which indicates that Chinook salmon are not uniformly distributed relative to pollock (Figure 8). During the B-season, bycatch of Chinook salmon is much more along the fringes of where pollock catches are concentrated (Figure 9).

Chum salmon (for the B-season fishery when the majority of the bycatch occurs) spatial distribution in the pollock fishery is concentrated south of the Pribilof Islands, even in years where the pollock fishery is concentrated more northerly (Figure 10).

2006 Chinook salmon bycatch

Bycatch of Chinook salmon in the BSAI pollock trawl fishery has been elevated since 2003 and continued to show increases in the A season for 2006. Chinook bycatch in the pollock pelagic trawl fishery as reported by NMFS Catch Accounting as of March 18th, was 59,512. For comparison with similar timing in the previous year (March 26, 2005), 25,400 Chinook had been taken in the pollock pelagic trawl fishery. NMFS closed the Chinook Salmon Savings Areas at noon on February 15, 2006 (Attachment 1). These areas remained closed until noon on April 15th. Per regulations, the areas then reopened until noon on September 1st, 2006 and then closed through December 31st, 2006.

This is the first time since its implementation that the Chinook closure has been triggered during the A season. In previous years, the Chinook closure has triggered in the B-season in 2003, 2004 and 2005. The timing of triggering the limit (26,825 for the non-CDQ fleet) determines the timing of the closure:

1. If the limit is triggered before April 15, the areas close immediately through April 15. After April 15, the areas re-open, but are again closed from September 1-December 31.
2. If the limit is reached after April 15, but before September 1, the areas would close on September 1 through the end of the year.
3. If the limit is reached after September 1, the areas close immediately through the end of the year.

Proposed changes to the intercooperative agreement as discussed in the EA/RIR/IRFA for amendment 84 (NPFMC 2005) became effective in 2006 and were not dependant upon implementation of regulations to promulgate amendment 84. Some of these measures included the removal of the stand-down period for A-season Chinook hot spot closures, an in-season Base Rate adjustment, and continuation of hot spot closures following a triggered regulatory closure.

The season began on January 20th, 2006 and the first hot spot closure announcement was sent to the fleet on January 30th (effective January 31st). Chinook bycatch rates appeared elevated from 2005 within the first week of 2006 fishing (Karl Haflinger, pers. comm.) An in-season Base Rate adjustment occurred on February 14th and increased the Base Rate from the value upon which the fleet had been managed against until that point (John Gruver, Karl Haflinger, pers. comm.). As of February 15th, the non-CDQ fleet was prohibited from fishing within the Chinook Salmon Savings Areas. Intercooperative closures continued to be enacted outside of the savings area closure throughout the A-season (Karl Haflinger, pers. comm.).

The Chinook bycatch in the B season continued to escalate. As of September 16, 2006, 66,272 Chinook salmon had been taken. For comparison with 2005, as of September 24, 2005 42,788 Chinook had been taken. The total number of Chinook taken in 2005 was 67,856. The total number in 2006 was 87,524. The Chinook salmon savings area was re-closed on September 1, 2006 for the remainder of the year following the triggering of the closure (prior to April 15, 2006) during the A season. The exemption EFP took effect August 3rd for both the Chum and Chinook salmon savings areas so the fleet was able to fish within the closure in the B season after this time. An EFP will allow the fleet to fish under the exemption in 2007.

Under the revised ICA management agreement for 2006, Chinook closures in the B season are “core closures” meaning that they apply to the fleet as a whole. Several core closures were enacted throughout the B season. The Base Rate for Chinook is 0.05 throughout the season. There is no base rate adjustment for Chinook during the B season.

2006 Chum salmon bycatch

Bycatch of non-Chinook salmon in 2006 was lower than the previous year. The total amount in 2006 was 327,690. The total amount taken in 2005 was 703,131, the highest amount of non-Chinook (which is primarily comprised of chum salmon and so referred to as chum) bycatch in the fishery to date. Of this only 17,581 had been taken within the CVOA since August 14th. The accounting period for the trigger begins August 14th and only includes chum salmon from within the CVOA. The Chum salmon savings area did not trigger in 2006.

The exemption EFP took effect on August 3rd, 2006. Weekly closures were enacted throughout the B-season for chum bycatch management under the ICA. The Base Rate was 0.19 at the beginning of the season and was first modified on July 20th based upon an average of the previous three weeks. Thereafter the base rate was modified weekly, using a three week running average.

Anecdotal reports from the fleet indicate that fishing opportunities both inside and outside of the savings areas were difficult in 2006, with either long tows being required west of the savings areas with high bycatch or short tows with low bycatch to the northwest (J. Gruver, pers. comm.). Pollock fishing rates inside of the savings area in the B season were not as good as in previous years. An EFP for 2007 will be issued and the fleet will operate under the EFP exemption in 2007 until regulations for Amendment 84 are implemented.

Spatial analysis of bycatch

Two preliminary spatial investigations of bycatch are provided here[2]. An overview of relative trends in salmon length-frequency data are presented here in order to evaluate inter-annual and monthly trends in consistency by sex, size and species. Length-frequency information is available from 1998-2006.

An investigation of bycatch and fishing effort by two week intervals from 2001-2006 is provided in order to evaluate the issue of the relative persistence of hot spots in temporal and spatial duration. This may help assist the Council in identifying appropriate areas and time periods for the analysis of new closure systems.

Salmon size distribution

The seasonal size composition of Chinook salmon in the pollock fishery shows two modes, one at about 52 cm and the other at about 66 cm during the winter months with some indication of increasing size within the year (Figure 11). From July – September, the smaller mode is less apparent but does appear again in October at about 49 cm.

For chum salmon, the seasonal size composition in the pollock fishery is unimodal, with apparent growth from a mode at about 60 cm in July to 66 cm by October (Figure 12). Length frequencies from other times of year are based on relatively fewer samples and tend to be less than 40cm. Interestingly, chum salmon from June have a modal value of about 68cm and appear to be different than those from subsequent months.

The sex ratio of Chinook salmon as bycatch in the pollock fishery tends to favor females over males, particularly in the size range greater than 55 cm (Figure 13). Chinook less than that size tend to be males more than females, particularly during the summer and fall (B-season). Chum salmon tend to be more males overall than females with females appearing smaller than males (Figure 14). Over time, the trends in these observed sex ratios have remained fairly consistent (Figure 15).

Annually, the bimodality of the Chinook salmon length frequencies is apparent and is consistent over time (Figure 16, 17). This suggests that the population structure of Chinook salmon is consistent. For chum salmon, the inter-annual variability is greater with larger fish apparent in some years (e.g., 2002 and 2006) but with a consistent mode at about 55cm (Figure 18). This may be due to different salmon stock components appearing as bycatch in the pollock fishery.

Bycatch patterns and persistence of hot spots:

NMFS observer data are utilized to characterize density of salmon bycatch in conjunction with pollock catch (Figures 19-33). Data have been scaled for relative catch across all years. Bycatch data and pollock catch are aggregated spatially for two-week intervals from 2001-2006 to look at the temporal nature of bycatch. The SSC suggested that examination on shorter temporal scales would be beneficial to evaluate the persistence of hot spots.

[2] Note: these data are preliminary and investigation is being done in conjunction with a draft paper by D. Stram and J. Ianelli for the AYKSSI Symposium in February 2007. Some of this investigation will be summarized in the forthcoming paper in proceedings of that conference.

Chinook salmon bycatch has increased since 2003. Extending the time period of spatial analysis back to 2001 allows for some comparison with a time period in which bycatch was lower. Pollock catch is also shown to compare possible changes in fishing patterns over this time period (Figures 19-24). Investigations of fishing pattern changes are complicated by the impact of regulatory closures (both Chinook and chum SSAs) since 2002. However, with the exception of 2006, no regulatory closures were enacted in the A season. In recent years it appears the highest density of catch within the CVOA occurs in the first two weeks of February (Figures 25, 26). In 2006, the Chinook SSA triggered in the A season and was closed on February 15th through April (attachment 1). Thus, examination of fishing patterns for 2006 shows no effort inside the Chinook SSA following this closure.

Comparison of 2004-2006 aggregated A season catch of salmon (Figure 9) with bi-weekly catch over the same time period (Figure 26) gives an indication of the persistence of bycatch hot spots over the A season. Specifically in 2004 and 2005, the area which in aggregate over the season appears high (within the southeastern Chinook SSA, Figure 9) seems to be temporally only in existence for 2 weeks (in 2004) and 4 weeks (in 2005)(Figure 26). A similar area showed a high density of salmon catch in 2002 over the same time period (Figure 25). In 2006, the area of aggregate high density within the Chinook SSA persists for only two weeks in February while the area closer to the Horseshoe and the Pribilofs is maintained for a longer time period (Figure 26).

During the B season for Chinook, the highest density of bycatch appears to be from the first two weeks in October (Figures 29,30). While highest densities during this time period are apparent from 2004 through 2006, this time period is also consistently high in 2001through 2003 (Figure 29). The spatial location of highest bycatch density is not consistent from one year to the next, either on shorter time frames or aggregated by season (Figure 10, Figure 30).

Chum salmon bycatch has been increasing since 2002. The highest chum bycatch occurred in 2005. High bycatch density for chum occurs throughout August and September (Figures 31-34). Spatially, consistent hot spots are observed in August just outside of the CVOA in 2004-2006 (Figure 32) Temporally there does not seem to be any consistency (by two week intervals examined) in time of catch for the same periods in different years (Figure 32). Chum catch may have higher inter-annual variability both spatially and temporally than Chinook catch.

Amendment Package 84B

Alternatives that are currently contained in the “Amendment 84B” measures were bifurcated from the Council’s suite of alternatives for Amendment 84 in February 2005, in order to facilitate an expedited analysis of amendment 84. The Council then chose to split the remaining measures into different amendment packages (B-1 and B-2) and identified package B-1 as a higher priority for analysis. The problem statement is intended to be applicable to both amendment packages.

Problem Statement

The Council adopted the following revised problem statement for the analysis:

The Council and NMFS have initiated action to exempt AFA qualified and CDQ vessels participating in the intercooperative voluntary rolling hotspot system (VRHS) from regulatory Bering Sea salmon bycatch savings areas. Analysis and refinement of the current salmon savings areas may be necessary in the event pollock vessels either surrender or lose their exemption and return to fishing under the regulatory salmon bycatch program.

Further, alternatives to the VRHS system and/or the regulatory salmon bycatch program should be developed to assess whether they would be more effective in reducing salmon bycatch. The following amendment packages are not intended to preclude the intercooperative annual review as required under Amendment 84.

The problem statement is two-fold in its purpose. The first aspect to it is the need for refinement of the current salmon savings areas under the exemption (i.e., amendment 84 regulations) system. Under the exemption, there is the possibility that vessels either surrender their exemption and choose to fish outside of the VRHS system[3], or they lose their exemption by violating the terms of the agreement. In either case, these vessels are then subject to salmon savings area closures. At present they would be subject to the existing system of closures which analysis in amendment 84 suggested might be exacerbating salmon bycatch in some years (NPFMC 2005). If new closure areas were adopted while the exemption is underway and the exemption system failed (either for some or all vessels) it would be the new closures to which vessels would need to adhere. The intention is for new closure systems to be more responsive to current bycatch information than the previous regulatory closures are at present. Developing new closures is an alternative under amendment package B-1.

The second aspect of the problem statement addresses the need to evaluate the efficacy of the VRHS system. In order to evaluate the adequacy of this program adopted by the Council, the Council noted that it would evaluate operation of this system against alternative measures for bycatch reduction. These alternative measures would be new closures (with or without the exemption in place), and individual vessel bycatch accountability programs. New closures are part of amendment package B-1 while vessel bycatch accountability programs are under package B-2. Thus two opportunities would exist for the Council to evaluate the efficacy of the exemption program adopted under amendment 84: review of the analysis for package B-1, and review of the analysis for package B-2.

Alternatives

The following alternatives were refined by the Council in December 2005. These alternatives were bifurcated given that it may be more feasible (timing-wise) to analyze them as different amendment packages.

Amendment Package B-1

Establish new regulatory salmon savings systems taking into account the most recent available salmon bycatch data. In developing alternatives include an analysis of the need and implementation strategy for appropriate cap**s** as bycatch control measures. This package should be completed first and implemented when ready so that salmon savings regulations are based on the best available information.

> Option: Adjust the Chinook and non-Chinook regulatory closure areas periodically based on the most current bycatch data available, such as the 2-3 year rolling average of bycatch rates by species and area.

Amendment Package B-2

Develop a regulatory individual vessel salmon bycatch accountability program.

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[3] The exemption is not dependant on participation by a specified number of entities in the fleet. Some cooperatives may elect to fish without an exemption and be subject to closures if triggered. Others may choose to operate within the VRHS system and retain an exemption to the regulatory closures.

Option A: managed at the individual level
Option B: managed at the co-op level
Option C: Either Option A or Option B for each AFA pollock sector.

Suboption 1: Implement the individual vessel salmon bycatch accountability program.
i) Immediately, if it was determined to be more effective in reducing salmon bycatch than the VRHS system.
ii) After 3 years if it is determined the VRHS system has failed to achieve the desired level of bycatch reduction.

Suboption 2: Analyze the need and implementation strategy for appropriate cap**s** as bycatch control measures.
(note Suboptions 1 and 2 apply to Options A, B and C)

Discussion of amendment package B-1

Amendment package B-1 would establish new regulatory salmon savings area closures based on current salmon bycatch data. Analysis of this alternative would require similar analyses to that which comprised the original amendments (21b, 35 and 58) establishing the regulatory closure areas. The analysis involved in proposing specific closure areas as well as analyzing the environmental and economic effects of moving the fleet away from these new specified closures is extensive.

The language in this alternative was specifically worded as "salmon savings systems" rather than closure areas to allow for innovative ideas in constructing new closures. There would likely be a series of alternative measures put forward to the Council which may include fixed triggered closures, biomass-based (i.e., floating) triggered closures, rotational closures or other means of constructing scientifically-appropriate salmon savings systems using the best information available. Advice from the SSC would be sought in crafting these alternatives and draft measures would be brought forward for Council review throughout the analytical process to determine the appropriate measures for inclusion in the alternatives.

The Council, in December 2005, modified the option under amendment package B-1 such that the regulatory salmon savings areas may be adjusted periodically based upon Council review. What this option provides is the flexibility to adjust the closure boundaries as analyzed and adopted under B-1 based upon information presented to the Council on both the effectiveness of those closures as well as the relative rates of bycatch of salmon species over time. Under the exemption agreement for amendment 84, the Council will receive an annual report from the Inter-Cooperative Agreement participants on the effectiveness of bycatch reduction under the VRHS system. In conjunction with this, the Council may request staff to produce an annual report on salmon bycatch trends. If the Council decides upon review of these reports that it would be prudent to adjust the closure configuration, the Council could then decide to pursue the regulatory amendment to do so.

Amendment package B-1 would also evaluate the need and implementation strategy of an appropriate bycatch cap on chum and Chinook salmon species in BSAI trawl fisheries. Appropriate caps could be included as a trigger mechanism for a closure system, or as an alternative measure to an area closure. In April, 2005, the SSC noted that a great deal of analysis would be required to support implementation of a voluntary rolling hot spot closure system (VRHS) such as is under consideration in amendment 84. The SSC suggested that in the following amendment, analysis of additional protection measures such as a bycatch cap would be appropriate. In their minutes from the June 2005 meeting, the SSC recommended "*an expanded examination of an appropriate limit on salmon bycatch that considers such factors as region of origin and, at least for salmon of Alaskan origin, total run sizes and the allocated quantities of salmon to subsistence, commercial and sport users as well as escapement goals*" (SSC minutes, June 2005).

The SSC convened a workshop on BSAI salmon bycatch at the April 2006 meeting. Minutes from the workshop are included as attachment 2. The workshop included presentations on bycatch in the pollock fishery, BASIS survey research, genetic identification of bycatch in BSAI trawl fisheries, stock status overview of AYK salmon species and information on incentives for salmon bycatch avoidance. The presentations were followed by moderated discussion to aid in the development of bycatch management alternatives. Some objectives of the workshop discussion were to evaluate the ability to craft biomass-based caps for salmon species; to discuss innovative ideas for salmon savings systems which are responsive to changing conditions; and to delineate appropriate milestones and standards for effective bycatch reduction. Another bycatch workshop, presenting updated information on bycatch patterns, stock of origin and additional information related to salmon bycatch patterns is planned in conjunction with the April 2007 SSC meeting.

Process for determining trigger caps for salmon species

There are different methods for determining prohibited species catch limits that have been utilized by the Council under various FMPs. At this point in time, the Council has not expressed any interest in pursuing hard caps for salmon in the pollock fishery, thus all caps under consideration are understood to be trigger caps associated with some closure configuration.

Three different formulations of caps are considered here: biomass-based caps, fixed caps and stair-step caps. The issues and potential difficulties associated with each are summarized below.

Biomass-based caps:
Alternatives under both forthcoming amendment packages (84B-1 and 84B-2) include the consideration of a biomass-based cap on salmon species bycatch. Biomass-based caps are used by the Council for herring in the BSAI where an overall herring PSC bycatch cap of 1 percent of the EBS biomass of herring has been implemented. This cap is apportioned by fishery categories. An annual stock assessment for herring is used in estimating the total biomass for calculating this cap.

For salmon, however, this becomes more complicated given the necessity of utilizing information both on various salmon stocks and the relative contribution of those stocks to the bycatch. The current status of knowledge to formulate some form of floating biomass-based cap may preclude this for the time being (see attached SSC discussion as noted earlier in this document).

Progress is being made by ADF&G in improved enumeration of salmon and by various scientists in the identification of incidentally caught salmon to stock of origin. Both of these are necessary in order to craft a meaningful abundance index which relates the regional run size of salmon species to their stock of origin when encountered as bycatch in the pollock fishery. A meaningful biomass-based salmon cap would need to incorporate a relationship correlating the stock size of a particular run and the encounter rate as bycatch in the trawl fishery. Once this relationship can be established, the cap can float as a proportion of abundance and more accurately reflect changing conditions for salmon abundance. Information that should be incorporated into a cap system would be:

- Indication of run size by stock
- Stock of origin information for bycaught salmon including trends in origin by region (shelf, slope), season and age.

On-going projects are very encouraging in ascertaining this information. More precise data on stock size and stock of origin will be available in the future. Many current estimates of stock origin are from trawl bycatch samples from the late 1990s and recent preliminary studies indicate that bycatch patterns and stock of origin results vary by season as well as annually (and by region and age of fish). An estimate could be made based on the best science presently available, if adequate adjustments could be made as the science improves. Additional on-going projects such as surveys from the BASIS program may eventually allow for some projections to be made of future returns to Alaskan rivers.

The Council may choose to include a biomass-based cap in the alternatives for analysis of trigger caps at a later time as information becomes available. This cap would need to be frameworked in its application such that information that is utilized on run size and stock of origin can be updated periodically as information improves.

Fixed caps

Currently the regulatory closure areas are triggered by fixed caps. These caps (29,000[4] Chinook SSA and 42,000[5] for 'other" salmon within the Catcher Vessel Operational Area (CVOA) during the accounting period) were implemented under amendments 21b (ADF&G 1995a), 35(ADF&G 1995b) and 58 (NMFS 1999) to the BSAI FMP.

The original Chinook limit of 48,000 fish under amendment 21b was crafted based upon analysis of a range of bycatch rates per metric ton of groundfish of 0.004 to 0.024 resulting in a range of fixed values under consideration of 8,000 to 48,000 fish (ADF&G 1995a). The high end of this range was chosen at the time as the trigger limit for the associated closures. In selecting this number, the Council recognized that this would only close the salmon savings areas for Chinook in years of very high bycatch given that this amount was higher than bycatch in all years considered with the exception of 1991 (ADF&G 1995a). Amendment 58 then reduced the limit incrementally over three years from 48,000 to 29,000 and changed the accounting period to begin on January 1 (NMFS 1999). Public concerns had been raised to the Council at that time by western Alaskan groups that a more restrictive cap was necessary in order to enact the closure in additional years. The analysis evaluated a cap reduction to 36,000 fish and then reduced this number by the relative contribution to the bycatch by the Pacific cod fishery (~7,000 Chinook per year at that time), which led to the current cap number of 29,000 fish (NMFS 1999).

For 'other' salmon, the original cap of 42,000 fish was implemented by emergency rule in April, 1994. This cap represented 50 percent of the average number of 'other' salmon incidentally caught within the CVOA during the period considered for the analysis (1991-1993). Catch of salmon within the CVOA represented 80% of the total 'other' salmon bycatch in any of the years

[4] This number is inclusive of the allocation to CDQ groups. Non-CDQ Chinook salmon limit is 26,825.

[5] This number is inclusive of the allocation to CDQ groups. Non-CDQ 'other salmon' limit is 38,850.

considered (ADF&G 1995). The cap was retained in the preferred alternative for the Chum SSAs under amendment 35 to the BSAI groundfish FMP.

Fixed caps calculated as some percentage of updated bycatch numbers could be considered by the Council until such a time as a meaningful abundance index for salmon allows for explicit harvest rate limits. Revised caps should evaluate a range of years (e.g., 2001-2006) and allow for some flexibility in the incorporation of extreme values (high or low) in bycatch. Harvest limits might vary by season and by sector. For example, the assumption that 80% of the other salmon catch occurs within the CVOA should be reevaluated to see if changes in fishing practices have altered this assumption. The limits could be defined by specific areas or an entire fishery depending on the alternative. The distribution of bycatch rates stratified by time of year and specific areas could be analyzed to develop a set of rules to avoid excessive bycatch. For example, if a stratum bycatch rate exceeded an extreme-value cutoff (e.g., catch rates above the 90^{th} percentile for that stratum) a closure could be triggered. This would mediate hot-spot effects. For overall catch limits, central tendencies (e.g., means) of the distributions could be computed and integrated over all regions to determine if the absolute bycatch level warranted a fleet-wide closure. The methods for establishing harvest limits require evaluation and could be based on updated patterns in salmon abundance (e.g., a three-year moving average).

Stair-step caps

Stair-step caps have been utilized for other prohibited species in the BSAI groundfish FMP. Example stair-step caps for crab species are triggers for time/area closures. A PSC limit is established for snow crab in a defined area that fluctuates with abundance except at high and low stock sizes. The PSC cap is established at 0.1133% of the total Bering Sea abundance (as indicated by the NMFS trawl survey), with a minimum PSC of 4.5 million snow crabs and a maximum PSC of 13 million snow crabs. Snow crab taken within the "C. opilio Bycatch Limitation Zone" (COBLZ) accrue towards the PSC limits established for individual trawl fisheries. Upon attainment of a snow crab PSC limit apportioned to a particular trawl target fishery, that fishery is prohibited from fishing within the COBLZ.

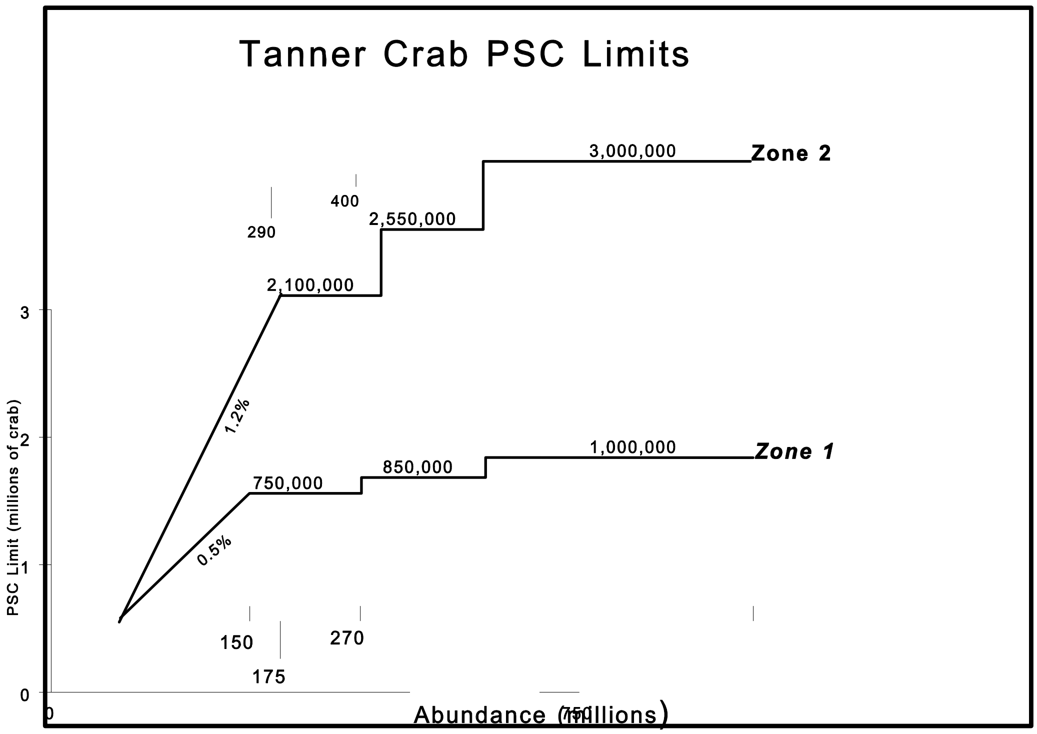
PSC limits are also stair-stepped for Bristol Bay red king crab and for *bairdi* Tanner crab. Stairstep measures in place for Tanner crab are shown in the table below. These limits are established in Zones 1 and 2 based on total abundance of *bairdi* crab as indicated by the NMFS trawl survey. Attainment of Tanner crab limits closes the respective fishery in the zone in which the limit was attained.

PSC limits for bairdi Tanner crab

Zone	Abundance	PSC Limit
Zone 1	0-150 million crabs	0.5% of abundance
	150-270 million crabs	750,000
	270-400 million crabs	850,000
	over 400 million crabs	1,000,000
Zone 2	0-175 million crabs	1.2% of abundance
	175-290 million crabs	2,100,000
	290-400 million crabs	2,550,000
	over 400 million crabs	3,000,000

The process by which these caps were initially established was a combination of proposals for limits put forward by the State of Alaska, recommendations from the Crab Plan Team and by committee discussions amongst interested stakeholders. For Tanner crab, proposed lower threshold limits were based upon the average observed bycatch for the stock at that level of abundance (NPFMC 1996). The upper range of the limit was based on negotiated amounts when the stock was at a high abundance in 1988 (NPFMC 1996). The middle "step" level was established at an intermediary level between steps 1 and 3.

These limits were then further modified by amendment 41 whereby the current stairstep levels were approved as negotiated by industry representatives (NPFMC 1997). This negotiation process was the following: In June, 1996, the Council formed an industry workgroup to review proposed PSC limits for Tanner and snow crab as detailed in the analysis for amendment 37 (red king crab PSC amendment). This Council work group consisted of three crab fishery representatives, three trawl fishery representatives, and one shoreside processing representative.



The group met over two days in August 1996 and came to consensus on bycatch limits for *bairdi* Tanner crab. The stairstep PSC limits, as shown (table and figure above) were agreed upon by the workgroup and were primarily developed from historical bycatch data.

A similar negotiated cap could be considered for salmon species. The Council may wish to designate a small (e.g. 6 person) workgroup with the expressed intent that this group must come to consensus on an acceptable interim cap for salmon. The work group should be of a small enough size that negotiation during a meeting is possible and with a defined chairman that is preferably outside of the interest groups represented on the workgroup. A schedule should be established by the Council for the timing of deciding upon a cap proposal for the analysis. The interim cap would be tied to closures of areas as determined by spatial analyses similar to the fixed caps as described previously.

Decisions for the Council at this meeting

If the Council decides to move forward with a timeline for analysis of amendment package B-1 at this meeting, the Council may wish to refine the alternatives to provide staff direction for this analysis. Specifically the Council should provide direction on the following:

Salmon bycatch caps:

Process for determining caps:
1. Council appointed workgroup develops caps for analysis
2. Analysts develop alternative caps for analysis
3. Combination of 1 and 2

Types of trigger caps under consideration (by species):
1. Biomass-based caps (understanding that information is lacking thus a framework would be designed for incorporation of additional information as it becomes available)
2. Fixed caps: updated fixed values caps
   - option to include a rolling average based on an appropriate timeframe (e.g. 3 years)
3. Stair-step caps using some measure of abundance
4. Combination of 1, 2, 3

Spatial analysis of candidate closure areas:

Time/area closures:
1. Evaluate discrete areas with individual trigger limits by area
   - Option to close during discrete temporal periods only
2. Evaluate discrete areas with aggregate trigger limits to close all areas
   - Option to close during discrete temporal periods only
3. Combination of 1 and 2

Exemption:

Should the exemption for participants in the VRHS system (as approved under amendment 84) be included as an option which applies to all alternatives?

Literature cited

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List of Tables

List of Figures

Tables

Table 1. Raw observer-data totals of pollock catch (t) and salmon (numbers) by seasons. Note that official totals will differ due to expansions to unobserved operations.

	A Season (Jan-May)			B Season (Jun – Dec)			Total	Total	Total
Year	Pollock	Chinook	Chum	Pollock	Chinook	Chum	Pollock	Chinook	Chum
1990	405,672	3,847	159	583,119	3,039	9,924	988,791	6,886	10,083
1991	328,831	12,078	295	435,318	2,226	12,250	764,149	14,304	12,545
1992	308,989	14,985	645	487,893	7,595	25,762	796,882	22,581	26,407
1993	358,098	12,456	201	474,089	7,898	133,073	832,188	20,354	133,274
1994	392,624	15,179	383	514,568	3,562	67,759	907,192	18,741	68,141
1995	447,995	6,978	377	482,919	2,347	29,912	930,914	9,325	30,289
1996	367,290	24,346	147	421,396	13,328	51,825	788,686	37,673	51,971
1997	343,402	8,100	1,263	398,346	23,192	43,529	741,748	31,292	44,791
1998	384,397	11,527	3,784	413,731	27,492	30,758	798,129	39,019	34,543
1999	331,664	8,441	111	478,312	8,595	30,067	809,976	17,036	30,178
2000	371,911	5,272	238	567,065	4,437	44,617	938,976	9,709	44,855
2001	469,254	17,402	2,291	682,142	13,205	45,621	1,151,396	30,607	47,912
2002	499,437	18,502	1,033	744,601	11,336	64,376	1,244,039	29,838	65,409
2003	519,043	28,721	3,408	755,783	12,940	134,160	1,274,826	41,661	137,568
2004	510,953	21,301	391	732,256	23,994	345,032	1,243,208	45,295	345,423
2005	511,460	27,006	519	747,335	32,423	496,726	1,258,795	59,429	497,245
2006	534,293	54,450	2,308	765,460	23,703	222,115	1,299,753	78,153	224,423

Table 2. Raw observer-data totals of pollock catch (t) by A (Jan-May) and B (June-Dec) seasons and by regions (S=south of 56°, M=56° - 58°, N=north of 58°). Note that official totals will differ due to expansions to unobserved operations.

Pollock		A season		A season		B Season		B season	
Year	S	M	N	Total	S	M	N	Total	Total
1990	184,184	207,371	14,117	405,672	183,125	39,066	360,928	583,119	988,791
1991	319,867	5,170	3,794	328,831	109,778	104,509	221,031	435,318	764,149
1992	182,282	125,318	1,389	308,989	242,314	115,252	130,327	487,893	796,882
1993	213,110	139,474	5,514	358,098	245,733	215,936	12,420	474,089	832,188
1994	370,990	14,480	7,154	392,624	251,738	223,049	39,781	514,568	907,192
1995	424,979	20,937	2,079	447,995	256,390	169,122	57,407	482,919	930,914
1996	232,996	132,538	1,756	367,290	233,448	120,225	67,723	421,396	788,686
1997	256,186	82,961	4,254	343,402	166,871	31,421	200,055	398,346	741,748
1998	334,529	44,810	5,058	384,397	171,018	181,147	61,566	413,731	798,128
1999	178,140	151,221	2,302	331,664	162,896	144,067	171,349	478,312	809,976
2000	152,243	212,481	7,186	371,911	32,720	391,267	143,078	567,065	938,976
2001	160,500	306,641	2,113	469,254	319,255	220,851	142,036	682,142	1,151,396
2002	307,361	191,605	471	499,437	366,526	226,692	151,384	744,601	1,244,039
2003	281,511	216,564	20,968	519,043	326,796	179,089	249,898	755,783	1,274,826
2004	235,685	274,346	922	510,953	298,815	174,995	258,446	732,256	1,243,208
2005	257,133	252,959	1,367	511,460	166,893	169,121	411,321	747,335	1,258,795
2006	307,757	224,709	1,827	534,293	119,284	106,226	539,949	765,460	1,299,753

Table 3. Raw observer-data totals of salmon catch (numbers) by A (Jan-May) and B (June-Dec) seasons and by regions (S=south of 56°, M=56° - 58°, N=north of 58°). Note that official totals will differ due to expansions to unobserved operations.

Chinook	A season			A season	B Season			B season	
Year	S	M	N	Total	S	M	N	Total	Total
1990	2,690	951	206	3,847	1,720	947	372	3,039	6,886
1991	11,526	440	112	12,078	1,194	931	101	2,226	14,304
1992	10,926	3,949	110	14,985	6,882	651	62	7,595	22,581
1993	7,814	3,372	1,271	12,456	3,297	4,395	206	7,898	20,354
1994	13,913	869	397	15,179	1,534	1,445	584	3,562	18,741
1995	6,523	380	74	6,978	1,602	615	130	2,347	9,325
1996	22,021	1,946	379	24,346	11,582	1,025	721	13,328	37,673
1997	6,449	1,498	154	8,100	16,759	1,854	4,579	23,192	31,292
1998	10,555	872	100	11,527	21,879	5,165	448	27,492	39,019
1999	4,130	4,094	217	8,441	2,995	4,331	1,269	8,595	17,036
2000	2,187	1,300	1,785	5,272	163	1,290	2,984	4,437	9,709
2001	7,034	10,130	238	17,402	5,950	6,779	476	13,205	30,607
2002	14,608	3,790	104	18,502	9,749	1,423	164	11,336	29,838
2003	19,467	8,927	327	28,721	4,750	5,743	2,447	12,940	41,661
2004	11,332	9,562	407	21,301	13,663	6,169	4,162	23,994	45,295
2005	16,656	9,471	879	27,006	17,577	9,828	5,018	32,423	59,429
2006	31,276	22,757	417	54,450	15,642	5,567	2,494	23,703	78,153

Chum	A season			A season	B Season			B season	
Year	S	M	N	Total	S	M	N	Total	Total
1990	94	65	0	159	5,365	357	4,202	9,924	10,083
1991	294	1	0	295	7,231	3,824	1,195	12,250	12,545
1992	633	12	0	645	20,388	5,347	27	25,762	26,407
1993	138	23	40	201	98,120	34,587	366	133,073	133,274
1994	373	1	9	383	49,130	16,727	1,902	67,759	68,141
1995	375	2	0	377	14,255	15,303	354	29,912	30,289
1996	139	7	1	147	28,964	1,637	21,224	51,825	51,971
1997	1,246	16	0	1,263	20,668	3,983	18,878	43,529	44,791
1998	3,764	15	5	3,784	25,987	4,291	480	30,758	34,543
1999	49	62	0	111	25,020	4,249	798	30,067	30,178
2000	208	24	6	238	14,656	27,072	2,889	44,617	44,855
2001	1,121	1,170	0	2,291	28,850	14,520	2,251	45,621	47,912
2002	975	56	2	1,033	54,165	7,710	2,501	64,376	65,409
2003	2,438	961	9	3,408	95,393	25,081	13,686	134,160	137,568
2004	180	211	0	391	209,521	109,331	26,180	345,032	345,423
2005	113	406	0	519	313,119	83,490	100,117	496,726	497,245
2006	1,760	401	147	2,308	134,030	74,213	13,872	222,115	224,423

Table 4. *Chinook* ***salmon length frequency samples by A (Jan-May) and B (June-Dec) seasons and by regions (S=south of 56°, M=56° - 58°, N=north of 58°).***

	A season				B season				Grand
Region	S	M	N	Total	S	M	N	Total	Total
1998	2,008	91	39	2,138	3,550	519	171	4,240	6,378
1999	736	368	16	1,120	394	225	615	1,234	2,354
2000	979	501	2	1,482	5	188	141	334	1,816
2001	2,041	1,776	7	3,824	1,123	2,443	226	3,792	7,616
2002	7,326	2,144		9,470	5,873	403	52	6,328	15,798
2003	11,551	4,405	85	16,041	4,078	2,652	1,007	7,737	23,778
2004	6,996	4,257	13	11,266	8,454	2,577	1,748	12,779	24,045
2005	10,678	3,258	41	13,977	8,901	4,960	2,596	16,457	30,434
2006	14,313	10,440	28	24,781	11,804	1,107	922	13,833	38,614

Table 5. *Chum* ***salmon length frequency samples by A (Jan-May) and B (June-Dec) seasons and by regions (S=south of 56°, M=56° - 58°, N=north of 58°).***

	A season				B season				Grand
Region	S	M	N	Total	S	M	N	Total	Total
1998	471	2	1	474	2,062	524	181	2,767	3,241
1999	15	72		87	160	566	420	1,146	1,233
2000	110	11		121	111	1,727	754	2,592	2,713
2001	529	128		657	2,836	5,553	892	9,281	9,938
2002	152	31	1	184	22,836	2,756	971	26,563	26,747
2003	1,157	430	2	1,589	47,491	9,475	4,291	61,257	62,846
2004	99	104		203	32,369	22,256	10,239	64,864	65,067
2005	76	220	1	297	30,919	18,218	24,534	73,671	73,968
2006	477	196	3	676	26,303	14,584	5,800	46,687	47,363

Figures

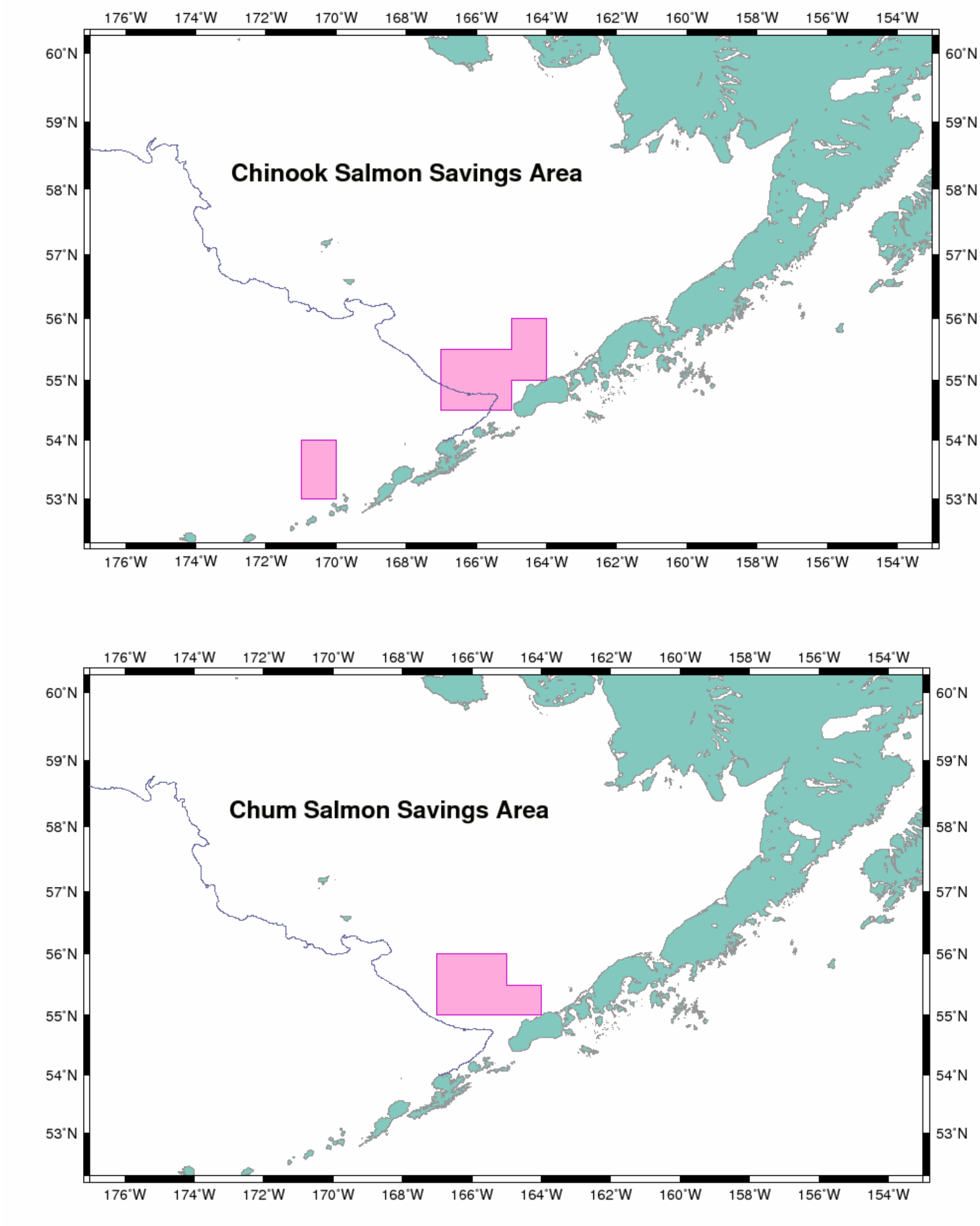


Figure 1 NMFS regulatory areas for Chinook salmon (top) and chum salmon (bottom) established in 1996.

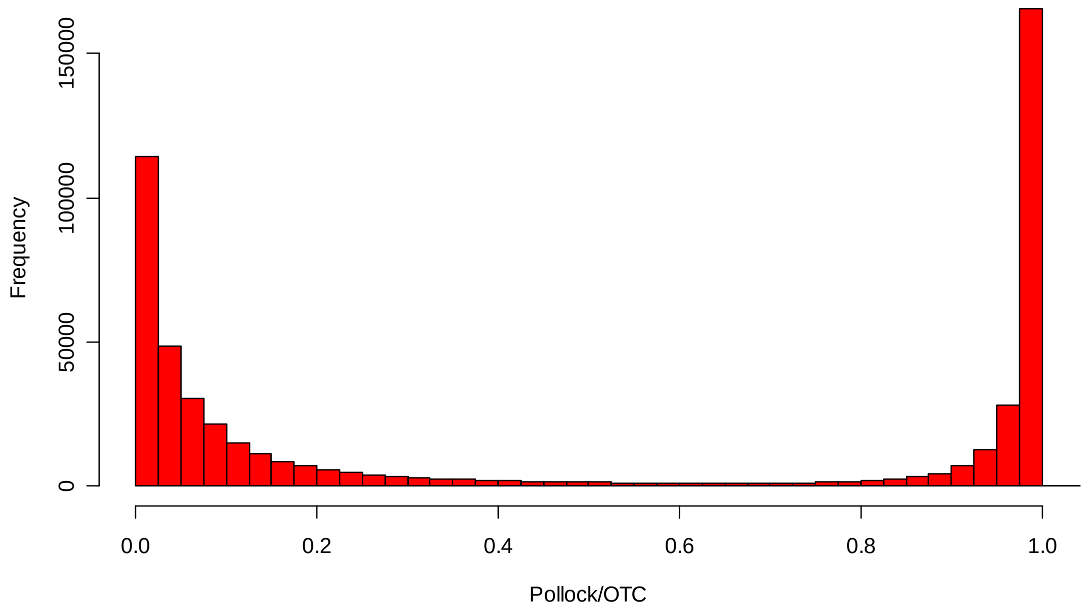


Figure 2 Frequency of NMFS observer data trawl hauls of pollock catch relative to the total weight of the haul (1990-2006). Hauls with pollock as >80% of the catch (by weight) were evaluated in this study.

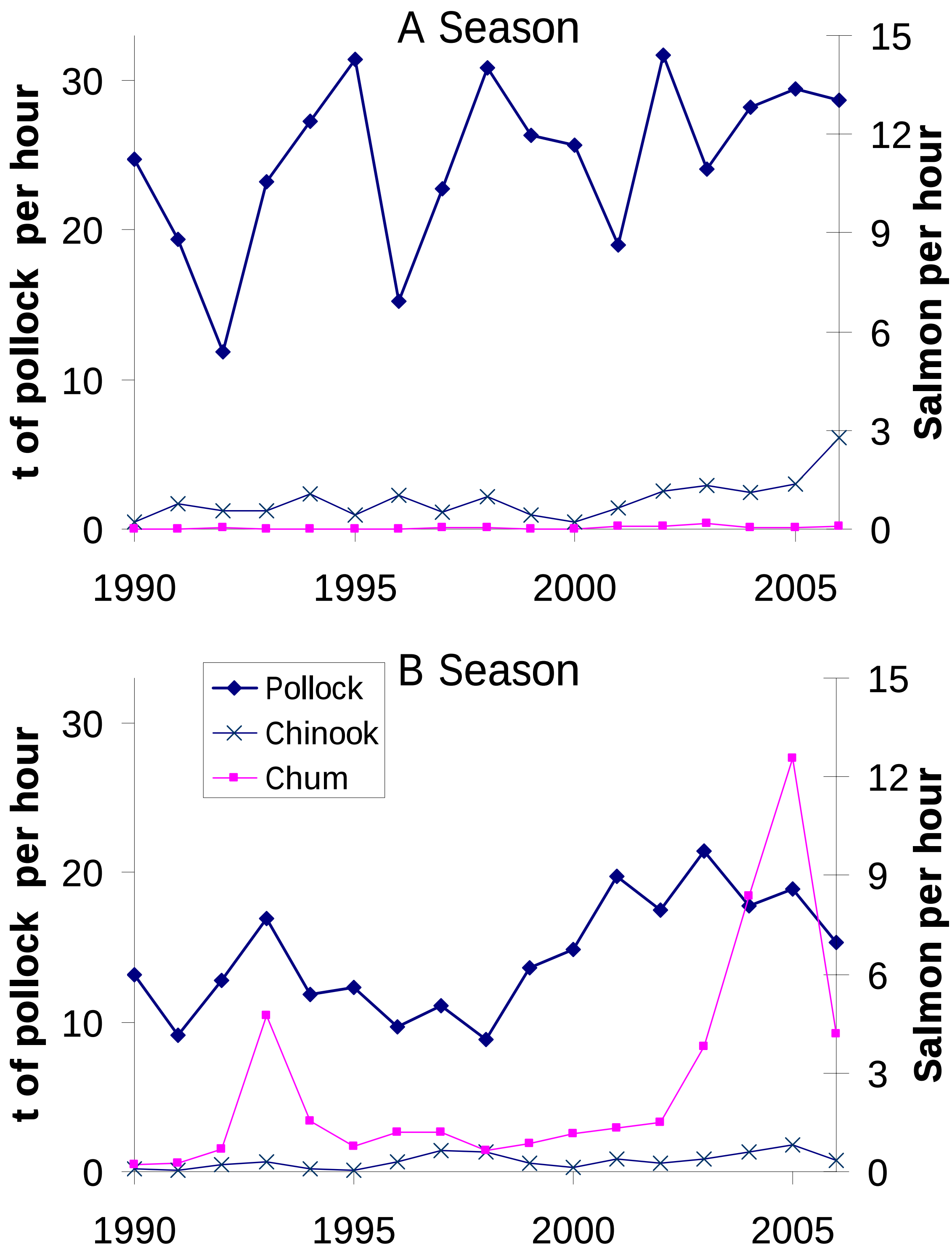
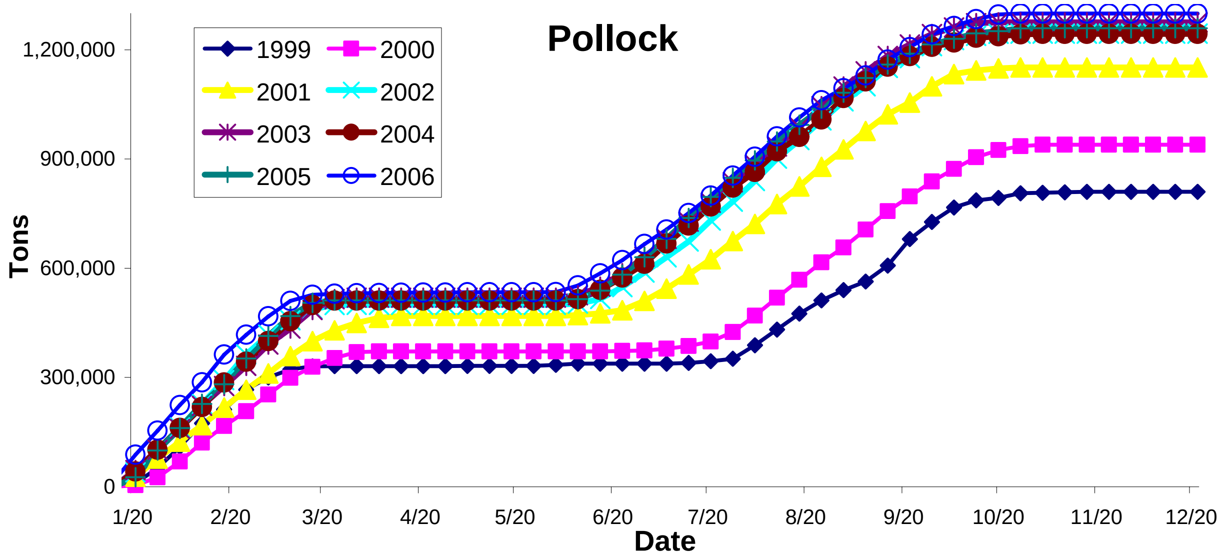


Figure 3 Catch rate (t per hour) of pollock and salmon (number per hour) by A (Jan-May) and B (June-Dec) seasons, 1990-2006 based on NMFS observer data.



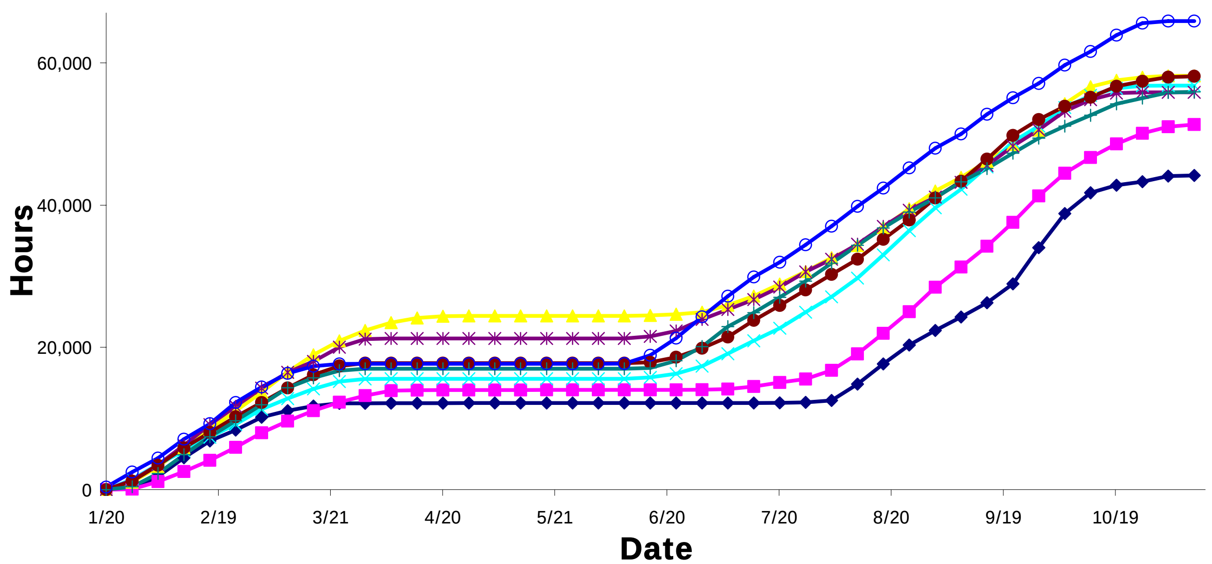
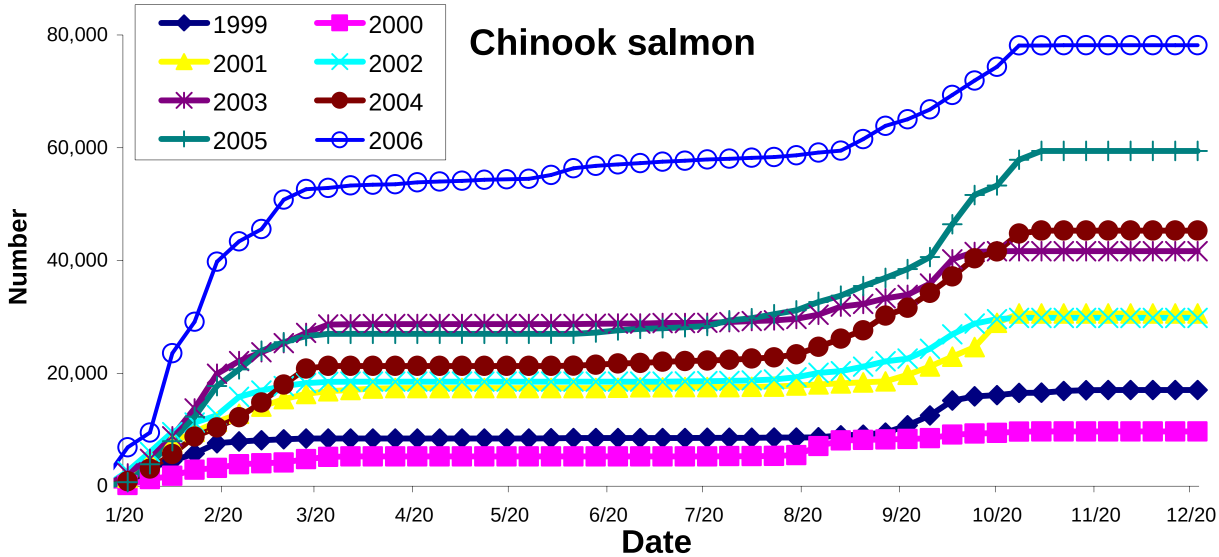


Figure 4 Cumulative annual pollock catches (top) and observed hours fished (bottom) by week, 1999-2006 based on raw NMFS observer data.



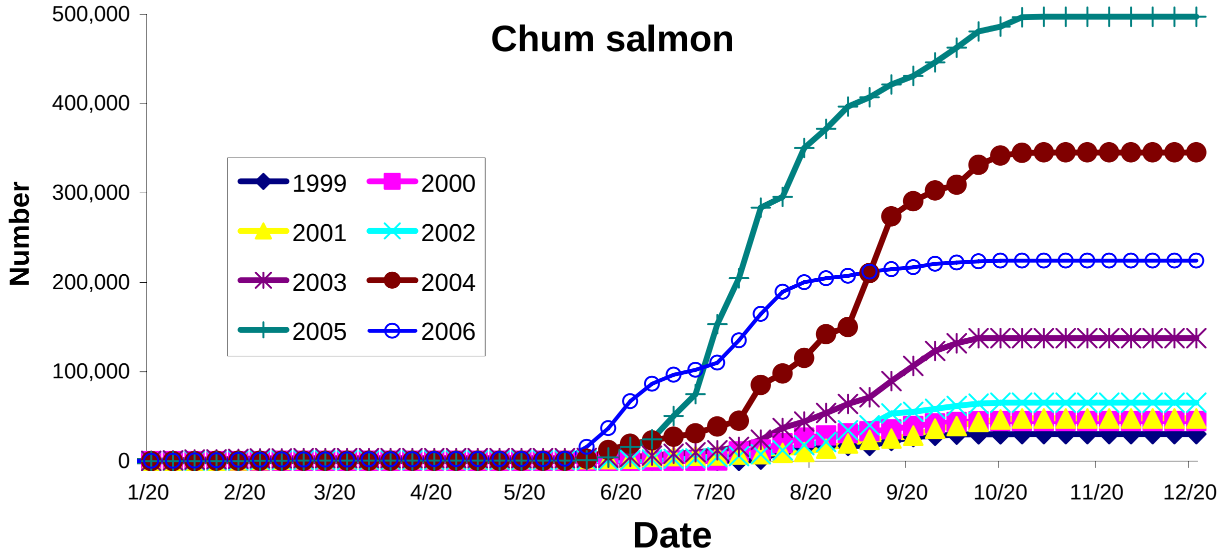


Figure 5 Cumulative catch of Chinook and chum salmon over date, 1999-2006 based on NMFS observer data.

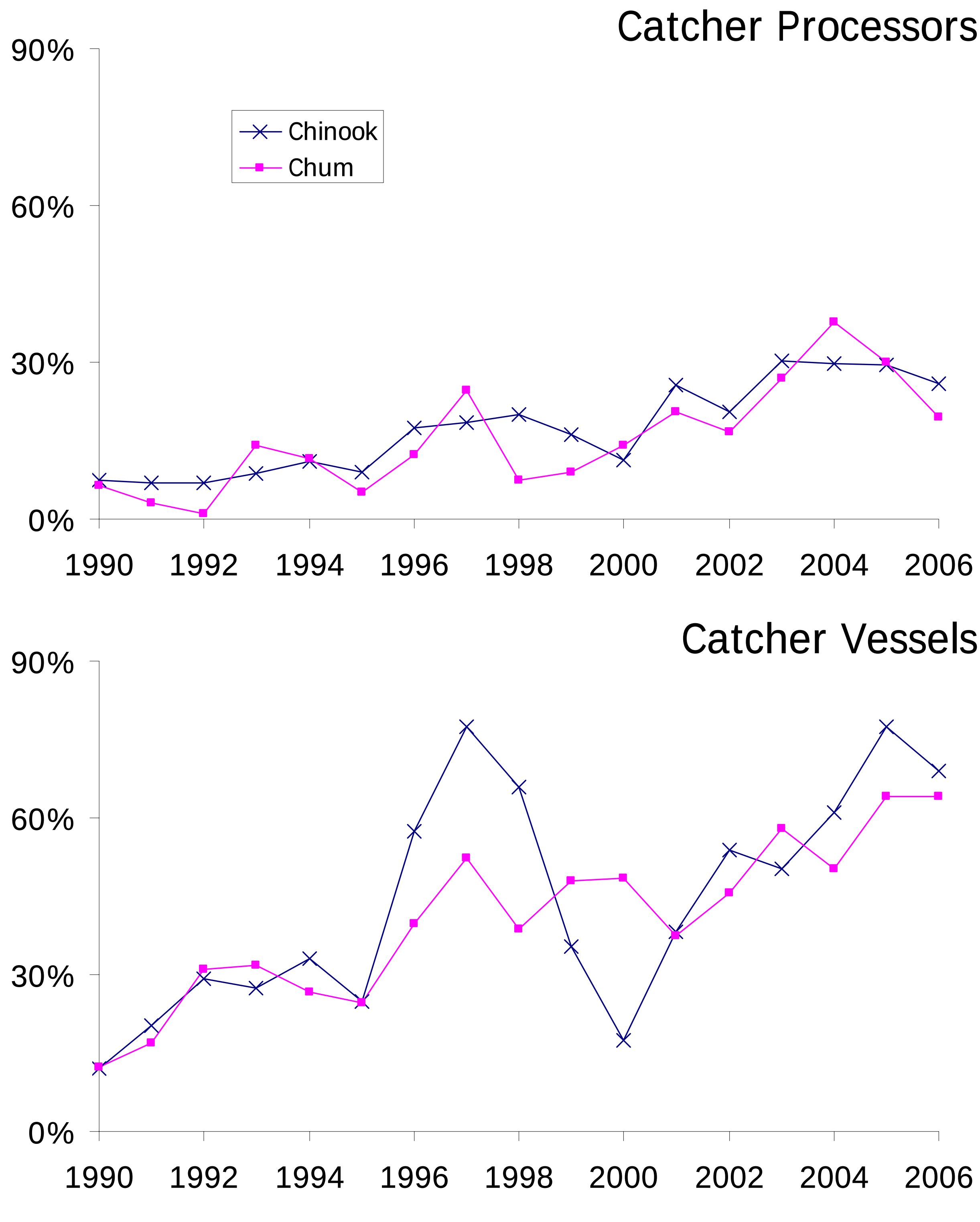


Figure 6 Incidence of salmon in pollock tows for at-sea catcher-processors (top panel) and shore-based catcher vessels (bottom panel) based on NMFS observer data, 1990-2006.

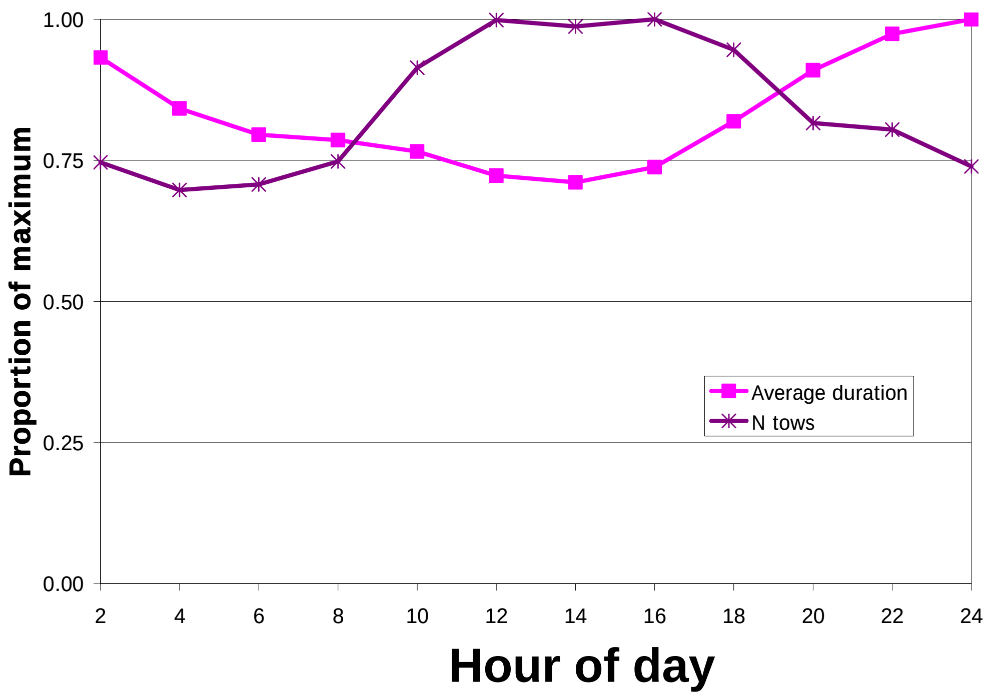


Figure 7 The patterns of pollock tow duration and frequency of tows (relative to their daily maxima) varies by hour of the day. This indicates that on average, there about 75% are fewer tows during the evening and that the tows that do occur, tend to be longer

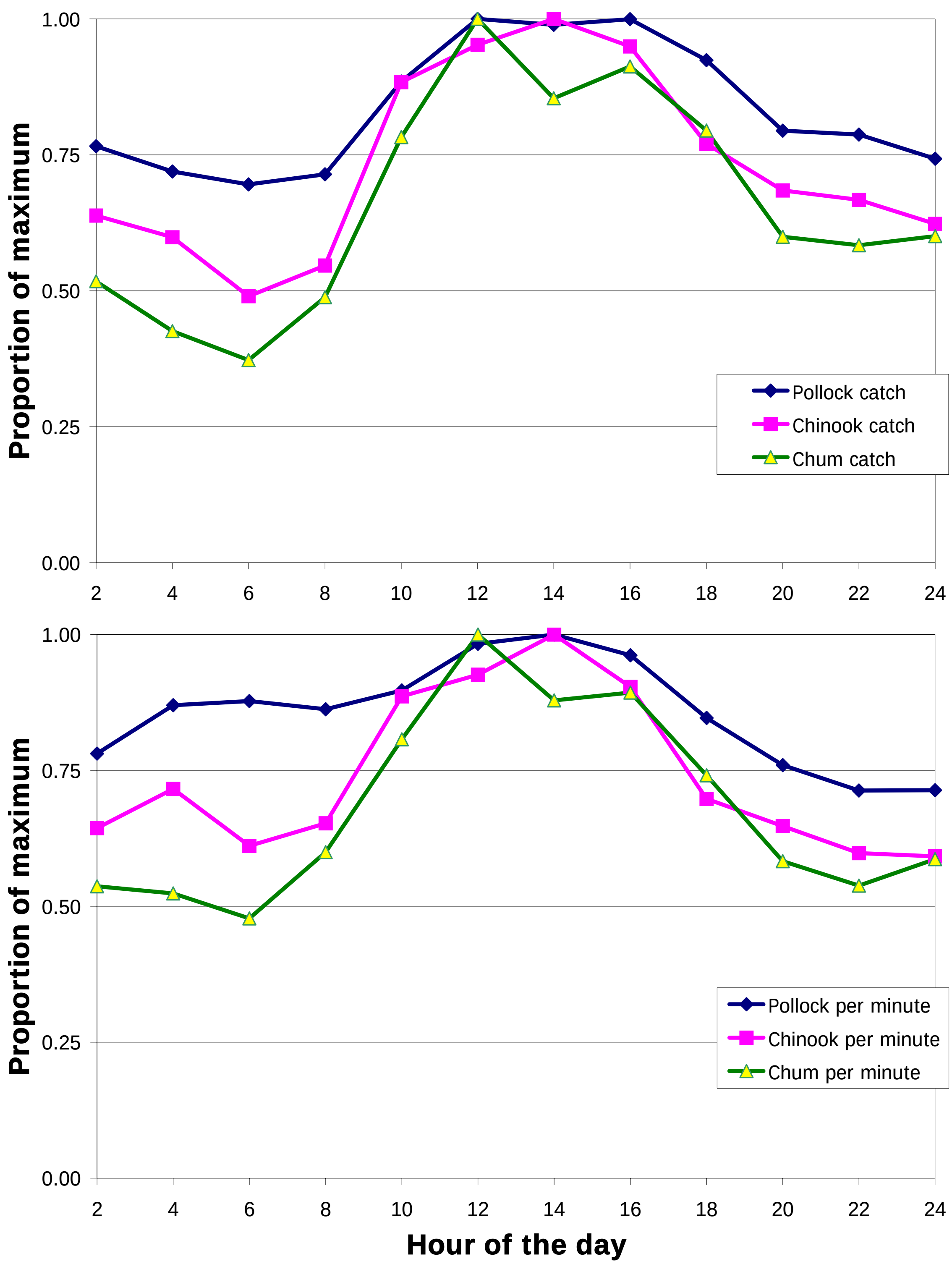


Figure 8 The patterns of pollock and salmon catch (top) and catch per minute (bottom) relative to their daily maxima based on NMFS observer data (1990-2006).

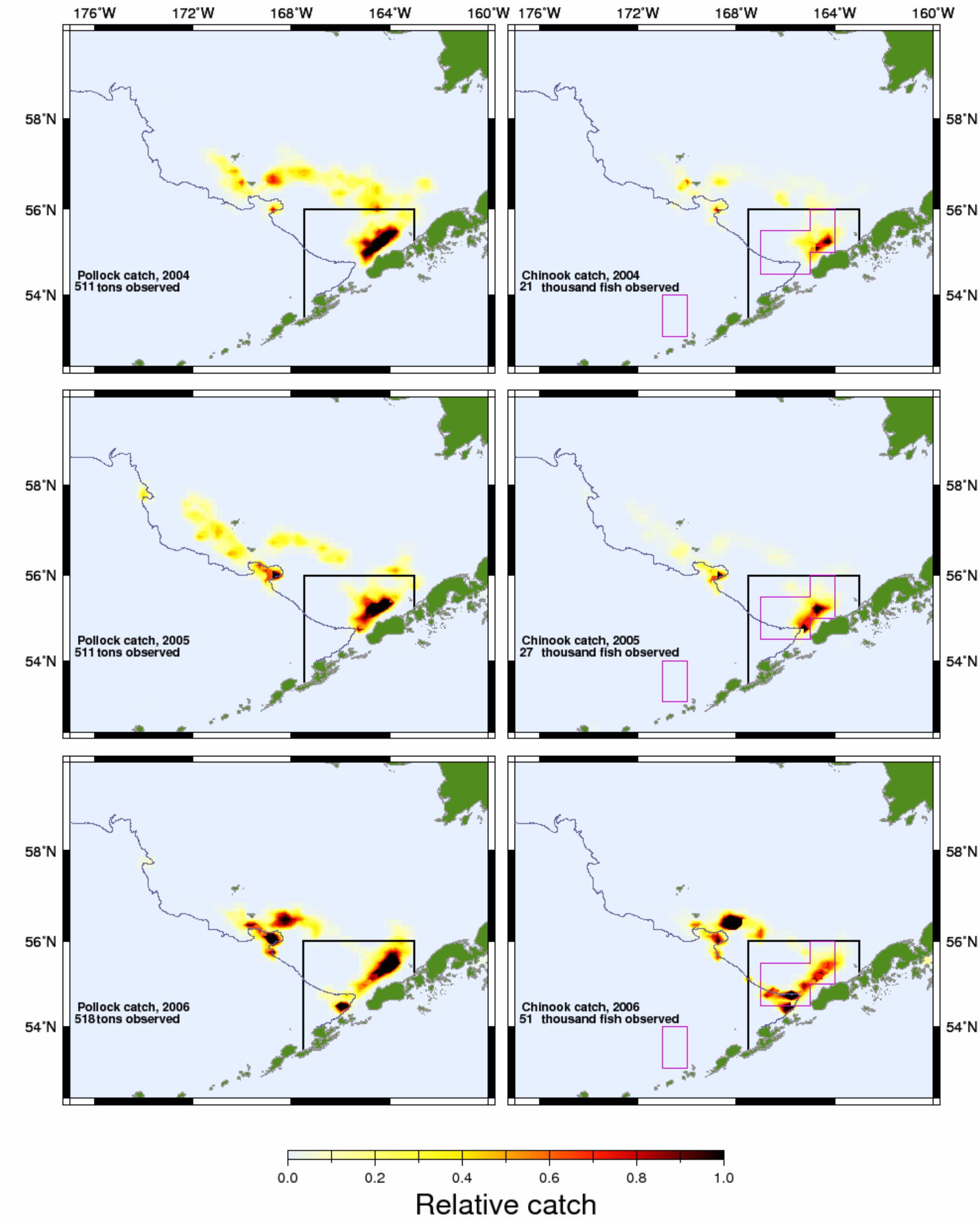


Figure 9 The patterns of pollock (left panels) and Chinook salmon catch (right panels) during the A-season (Jan-May), 2003-2006 based on NMFS observer data.

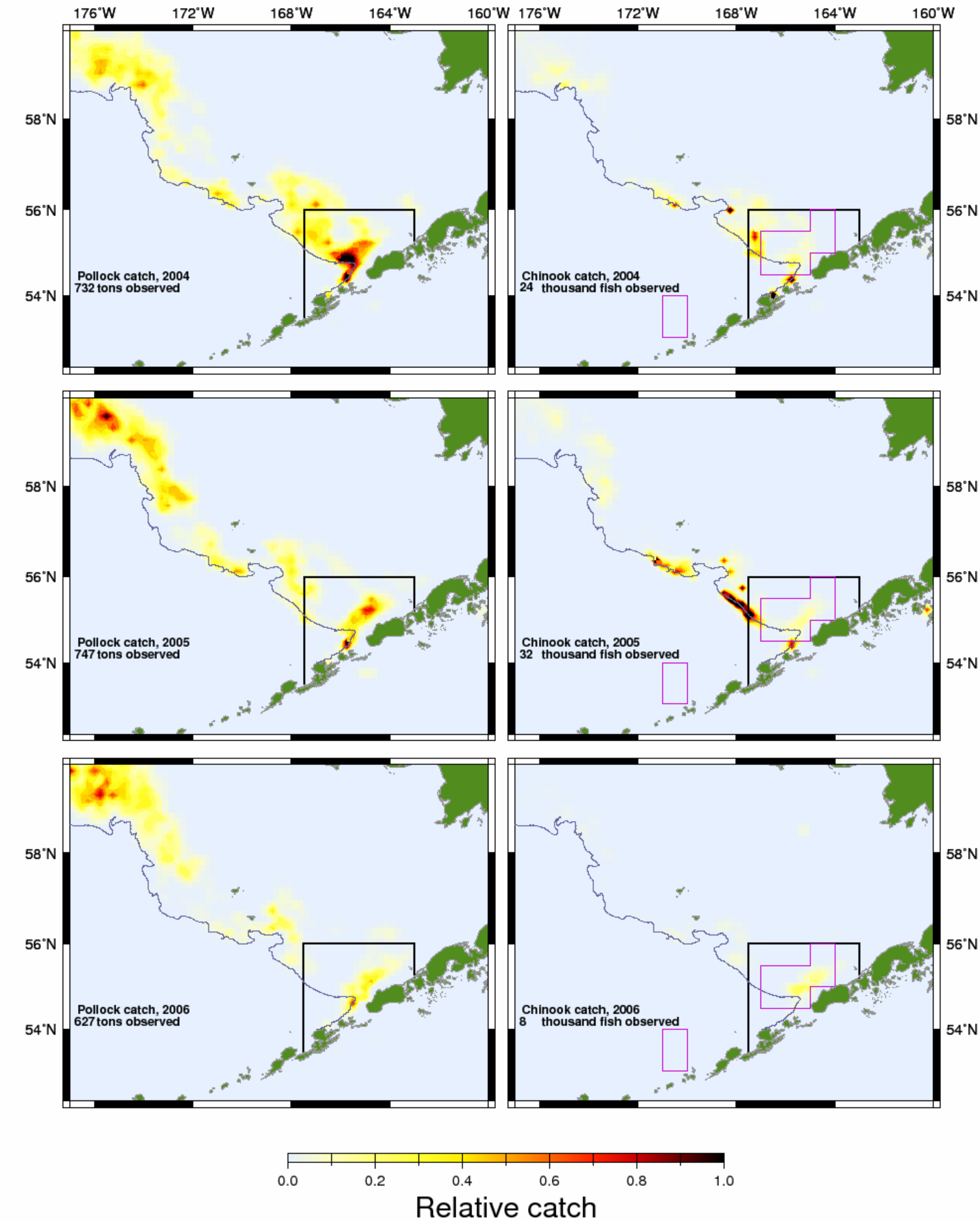


Figure 10 The patterns of pollock (left panels) and Chinook salmon catch (right panels) during the B-season (Jun-Dec), 2003-2006 based on NMFS observer data.

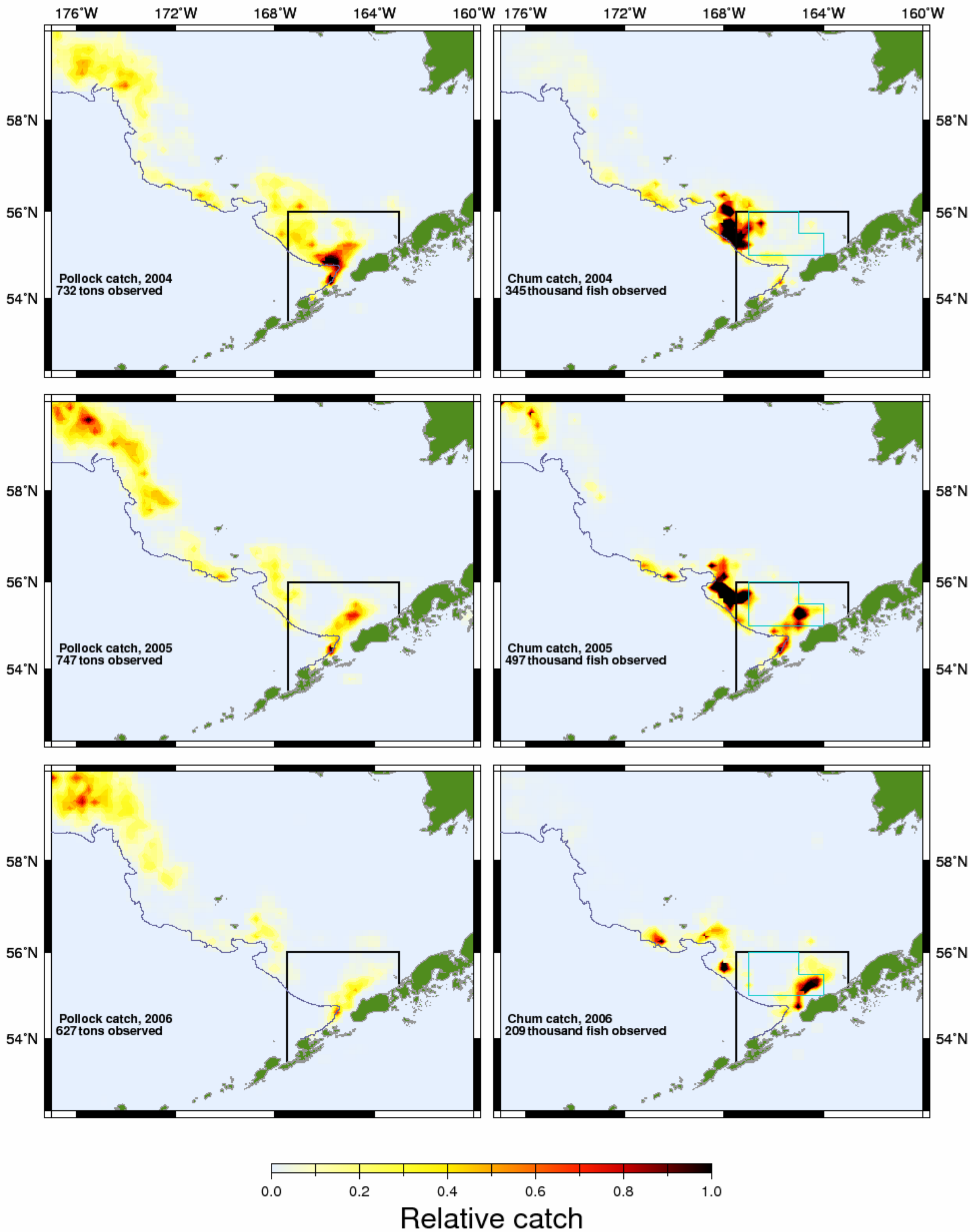


Figure 11 The patterns of pollock (left panels) and chum salmon catch (right panels) during the B-season (Jun-Dec), 2003-2006 based on NMFS observer data.

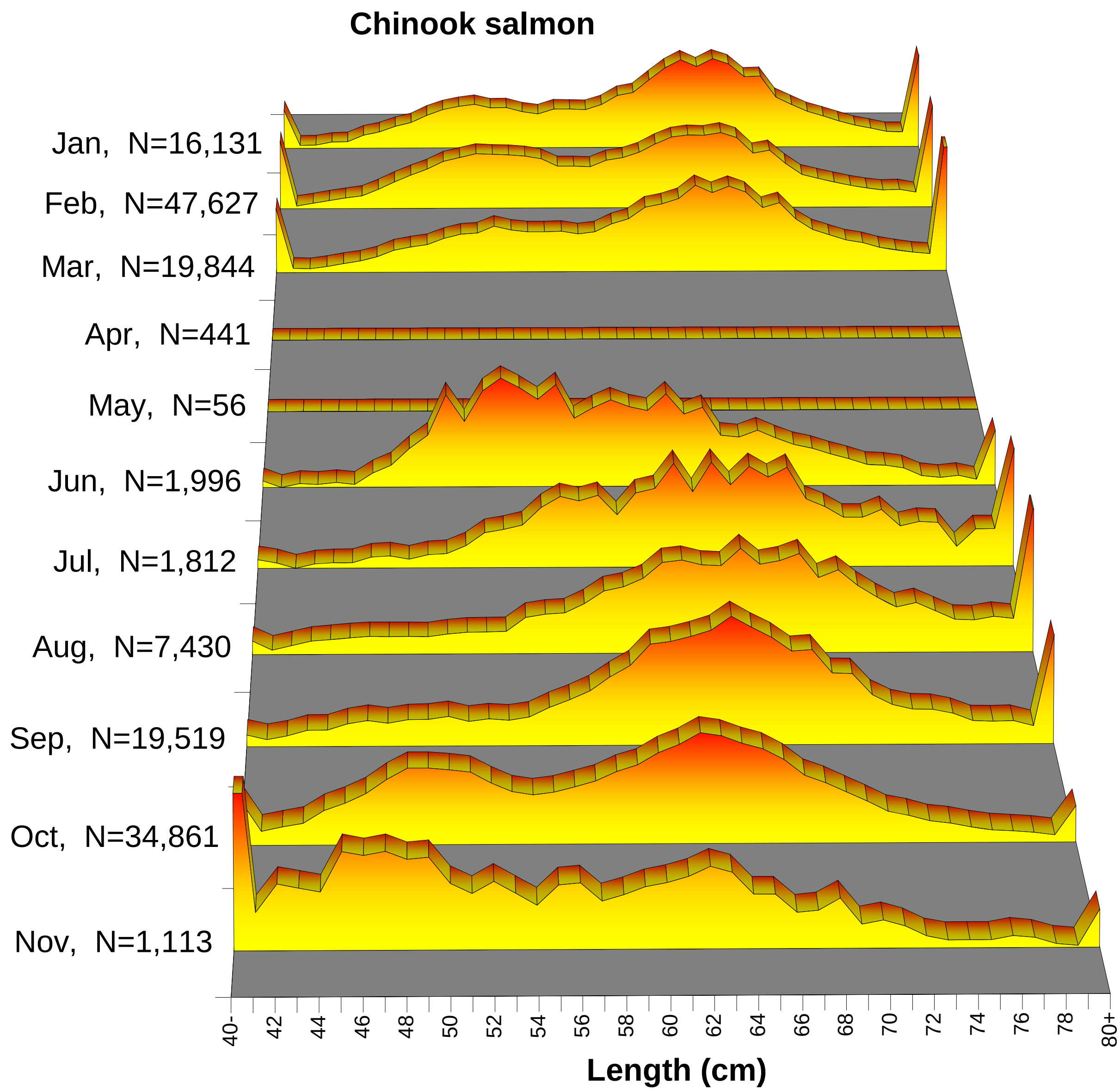


Figure 12 Chinook salmon proportions at length by month as taken in the pollock fishery, 1998-2006 combined. Month and sample sizes are shown in the left axis labels.

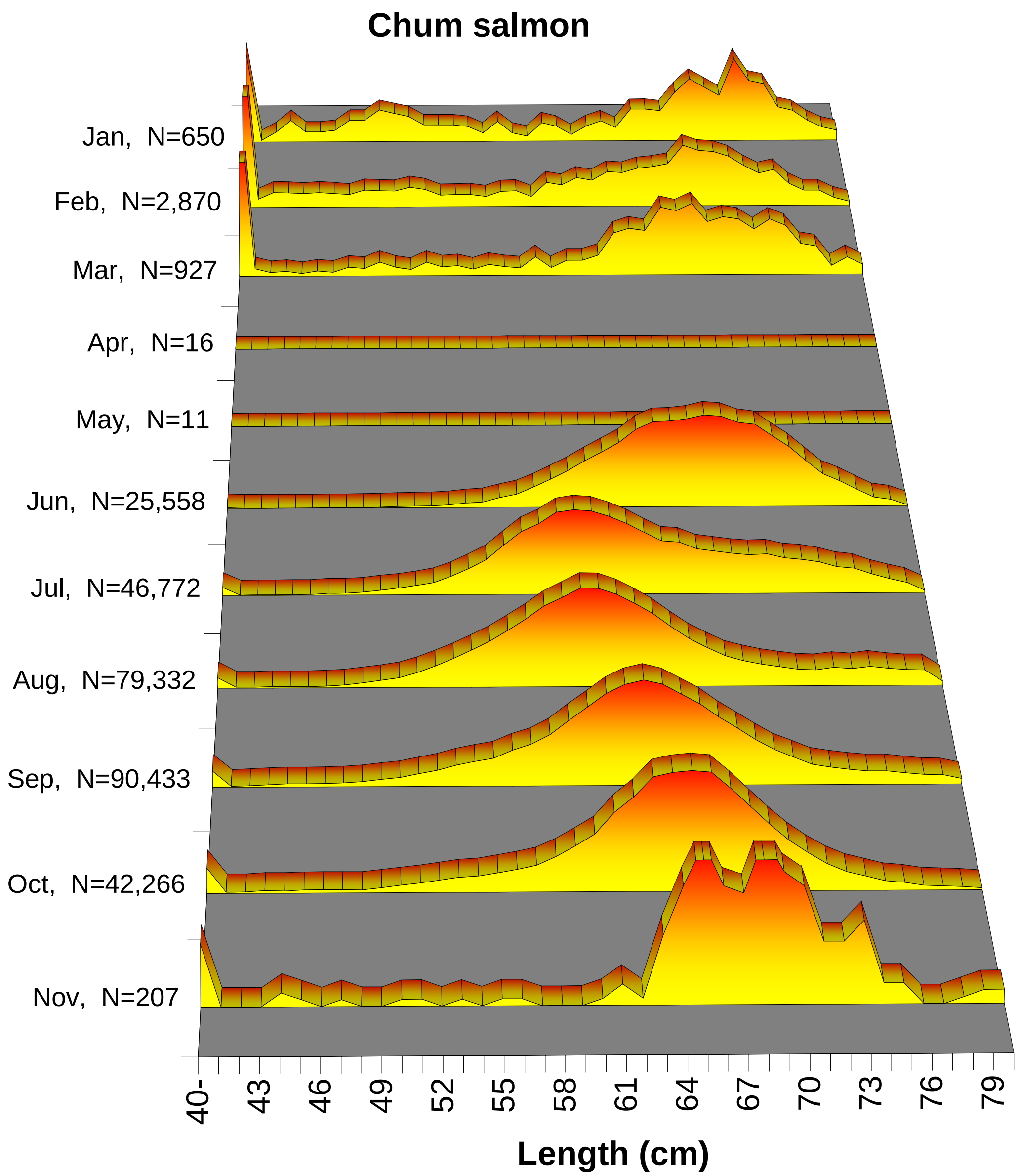


Figure 13 Chum salmon proportions at length by month as taken in the pollock fishery, 1998-2006 combined. Month and sample sizes are shown in the left axis labels.

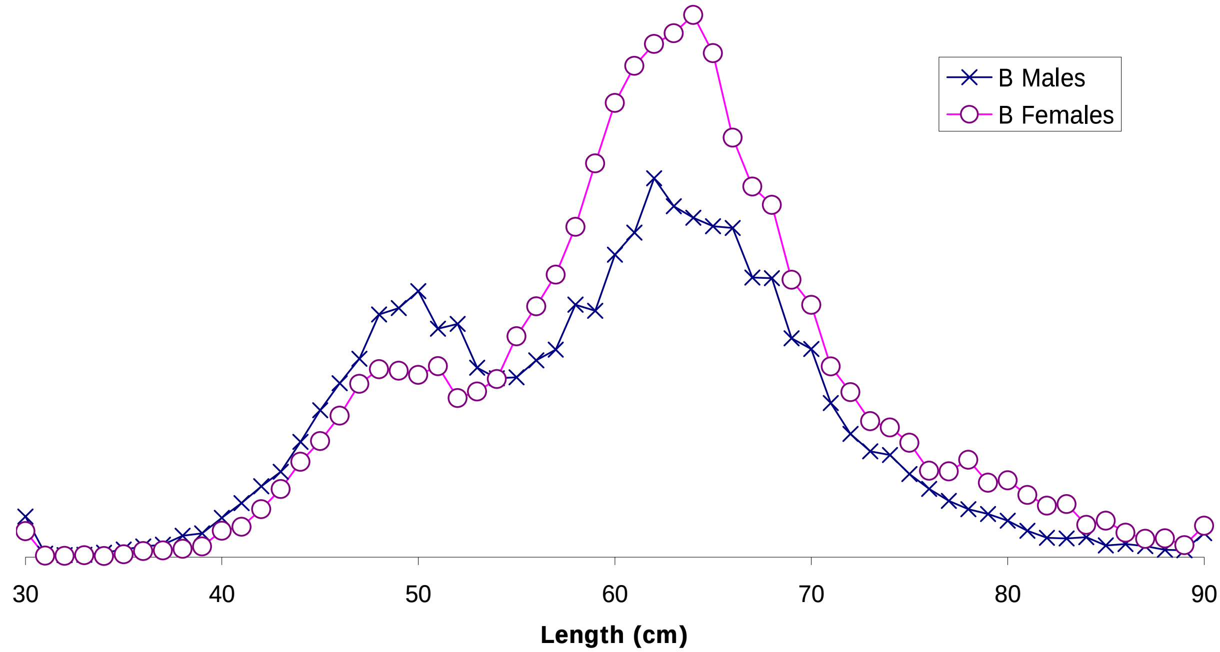


Figure 14 Chinook salmon proportions at length by sex for the A-season (Jan-May, 57% females from 84,099 samples; top panel) and B-season (June-Dec, 55% females from 66,361 samples; bottom panel) as taken in the pollock fishery, 1998-2006 combined.

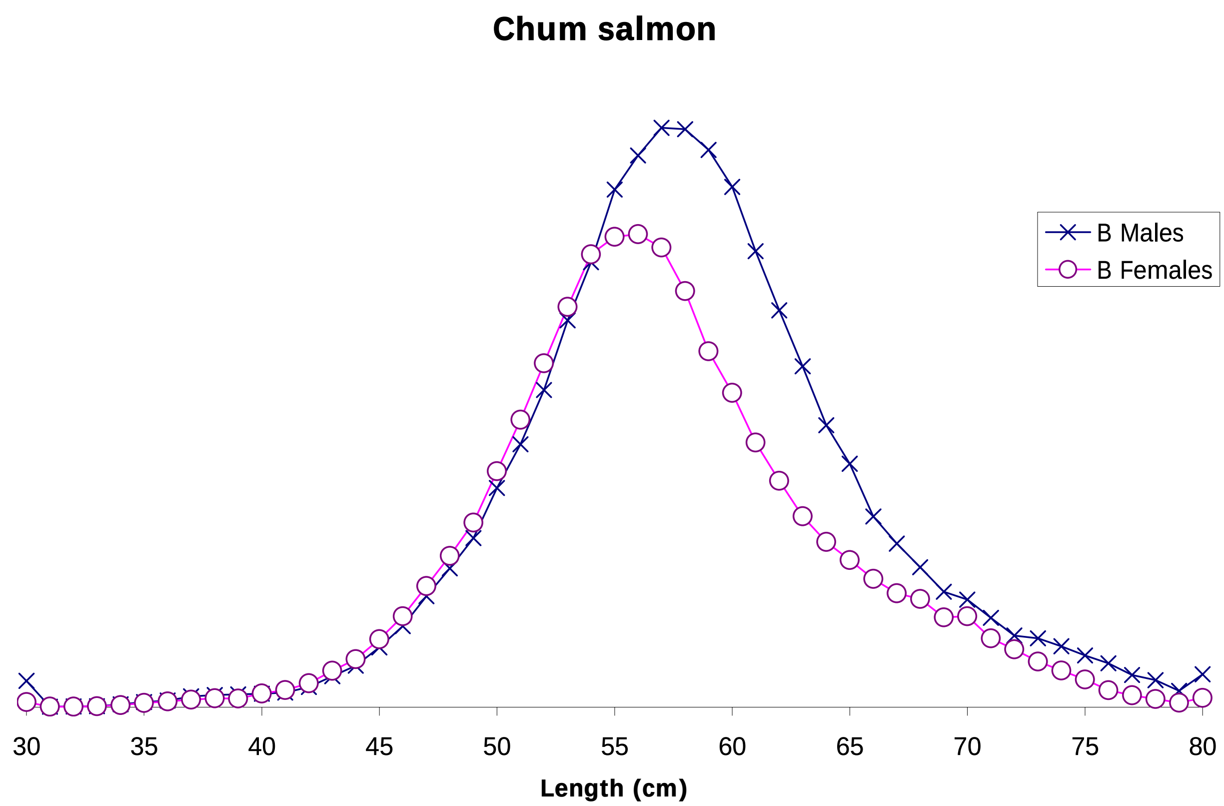


Figure 15 Chum salmon proportions at length by sex for the B-season (June-Dec, 44% females from 287,933 samples) as taken in the pollock fishery, 1998-2006 combined. Chum salmon are much less prevalent (~1% of total chum catch) in A season hence length frequency

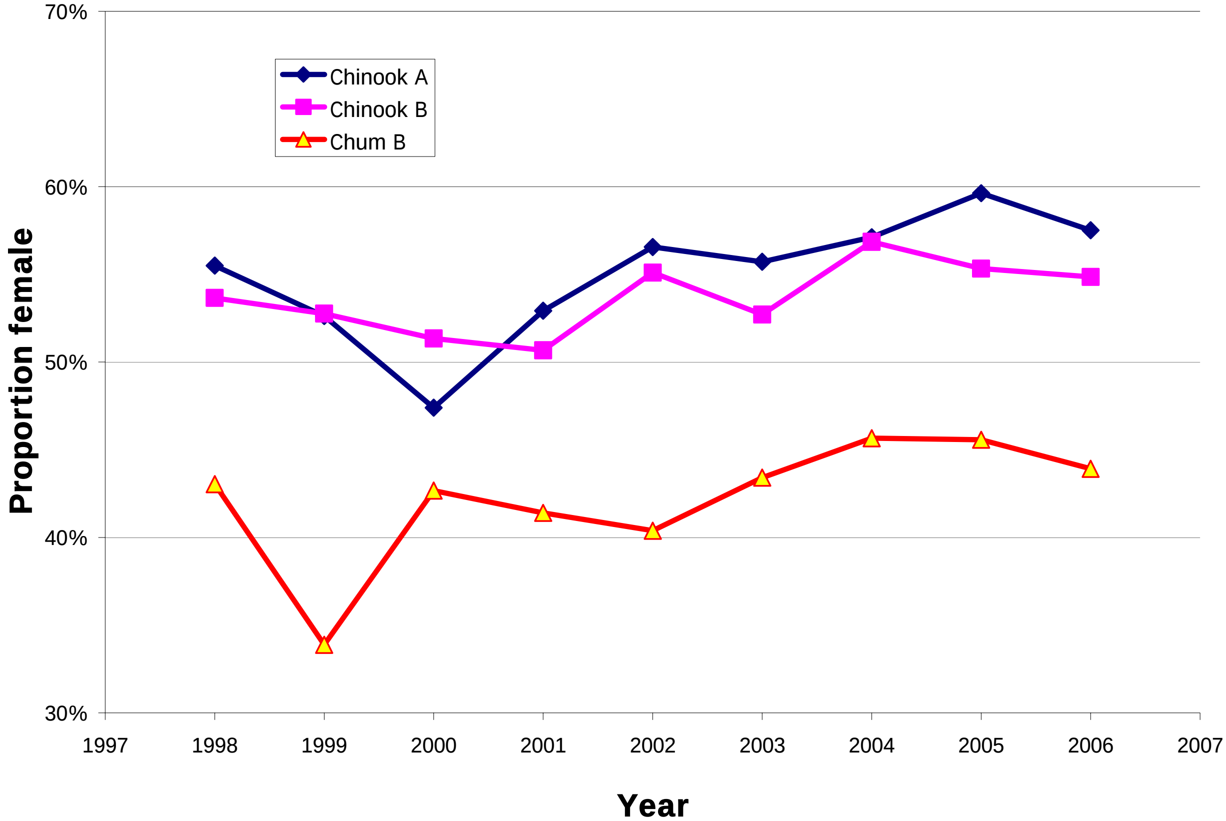


Figure 16 Sex ratios for Chinook and chum salmon over time. A and B-seasons are shown for Chinook since there are significant catches in each of these seasons, chum salmon are primarily taken incidentally during the summer-fall (B) season

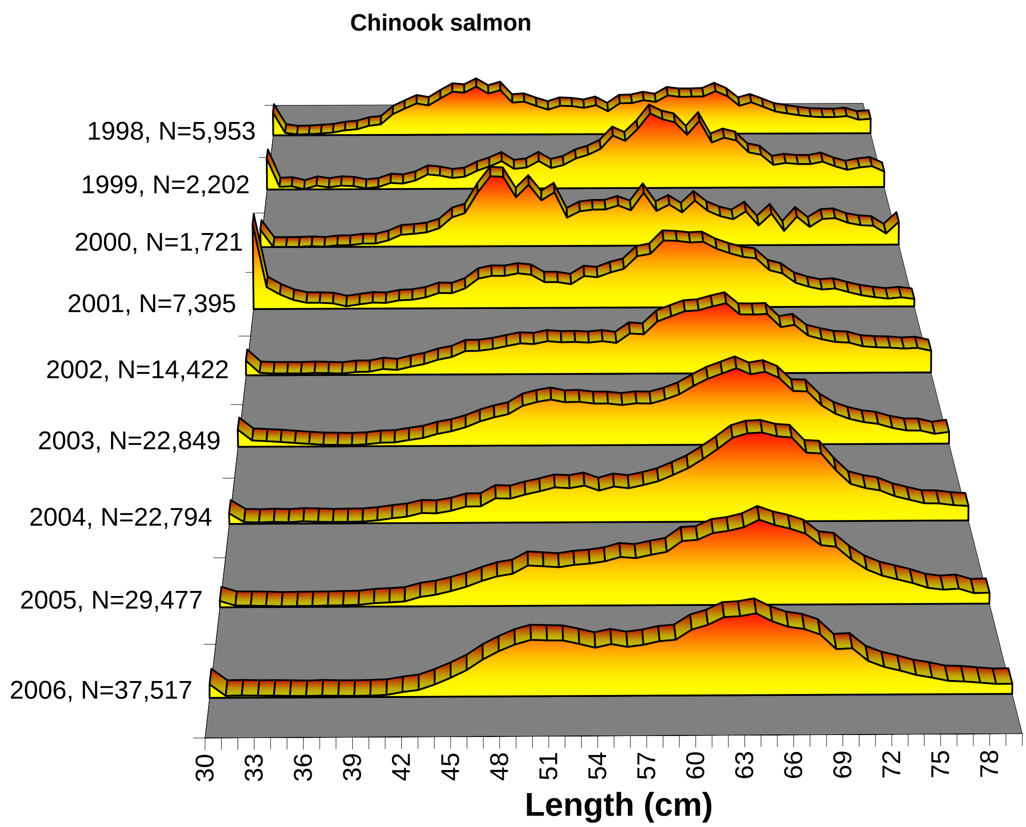


Figure 17 Chinook salmon proportions at length by year as taken in the pollock fishery, 1998-2006. Year and sample sizes are shown in the left axis labels.

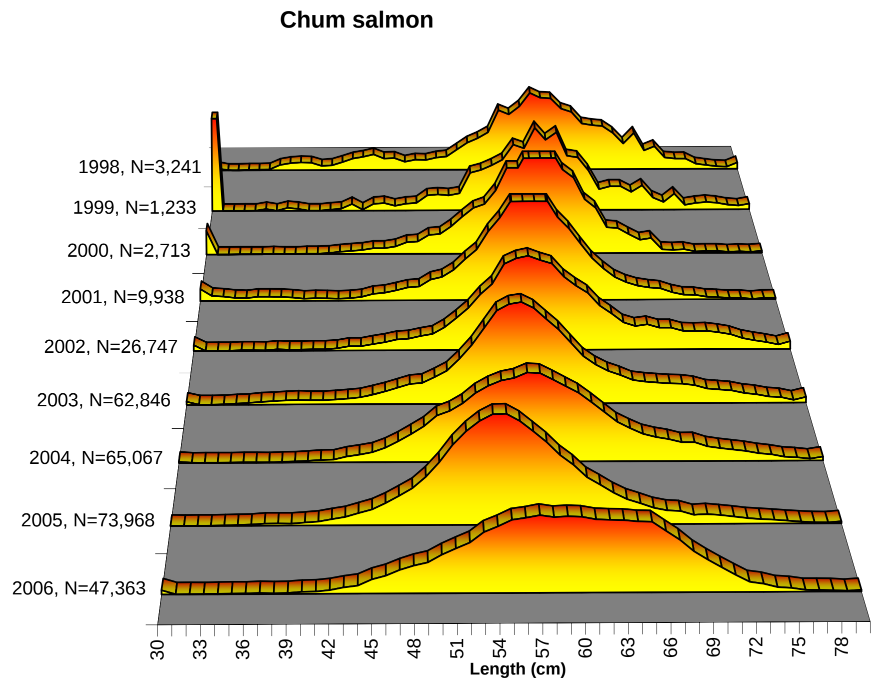


Figure 18 Chum salmon proportions at length by year as taken in the pollock fishery, 1998-2006.

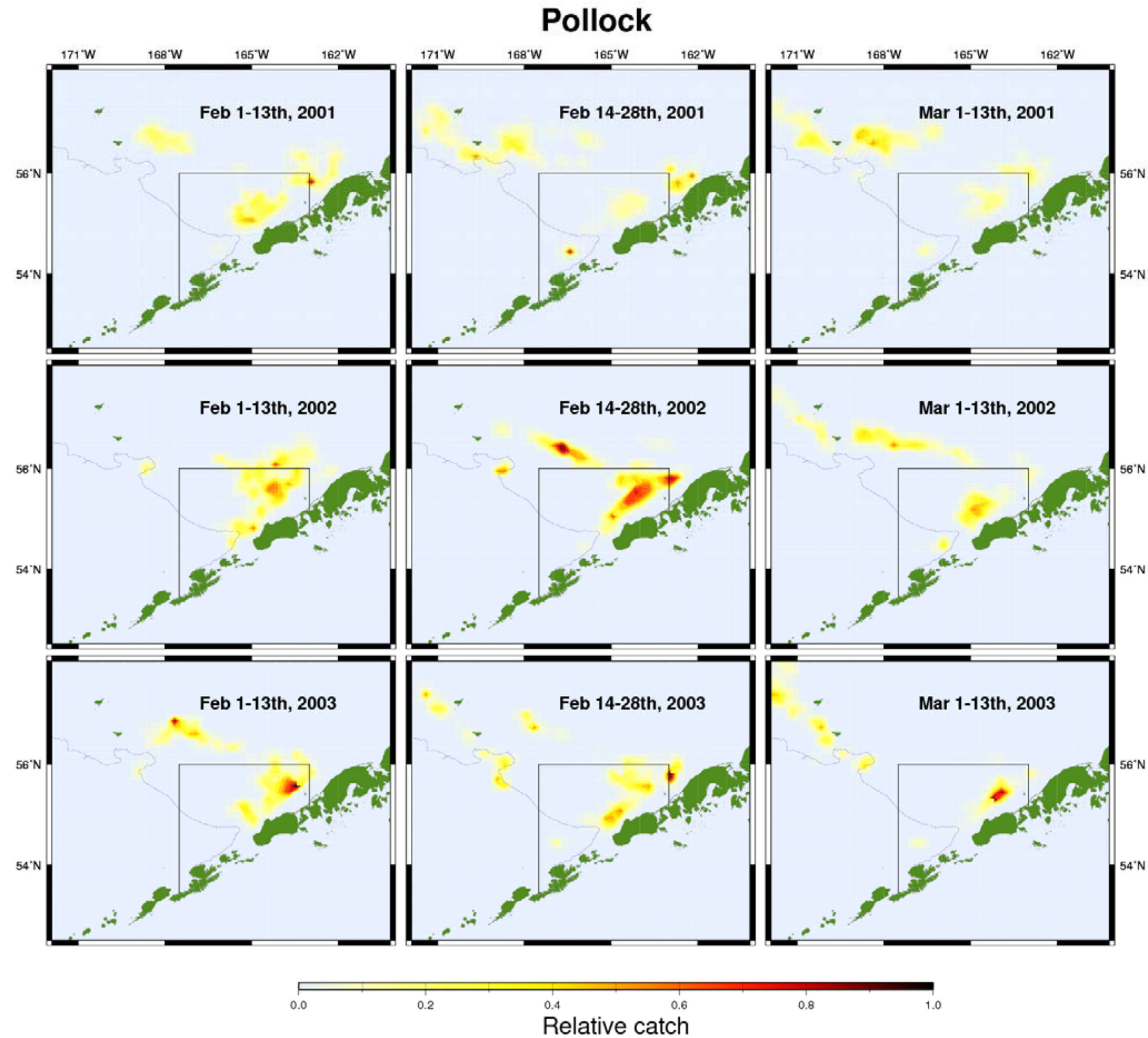


Figure 19 The patterns of pollock catch aggregated bi-weekly during the A-season 2001-2003 based on NMFS observer data.

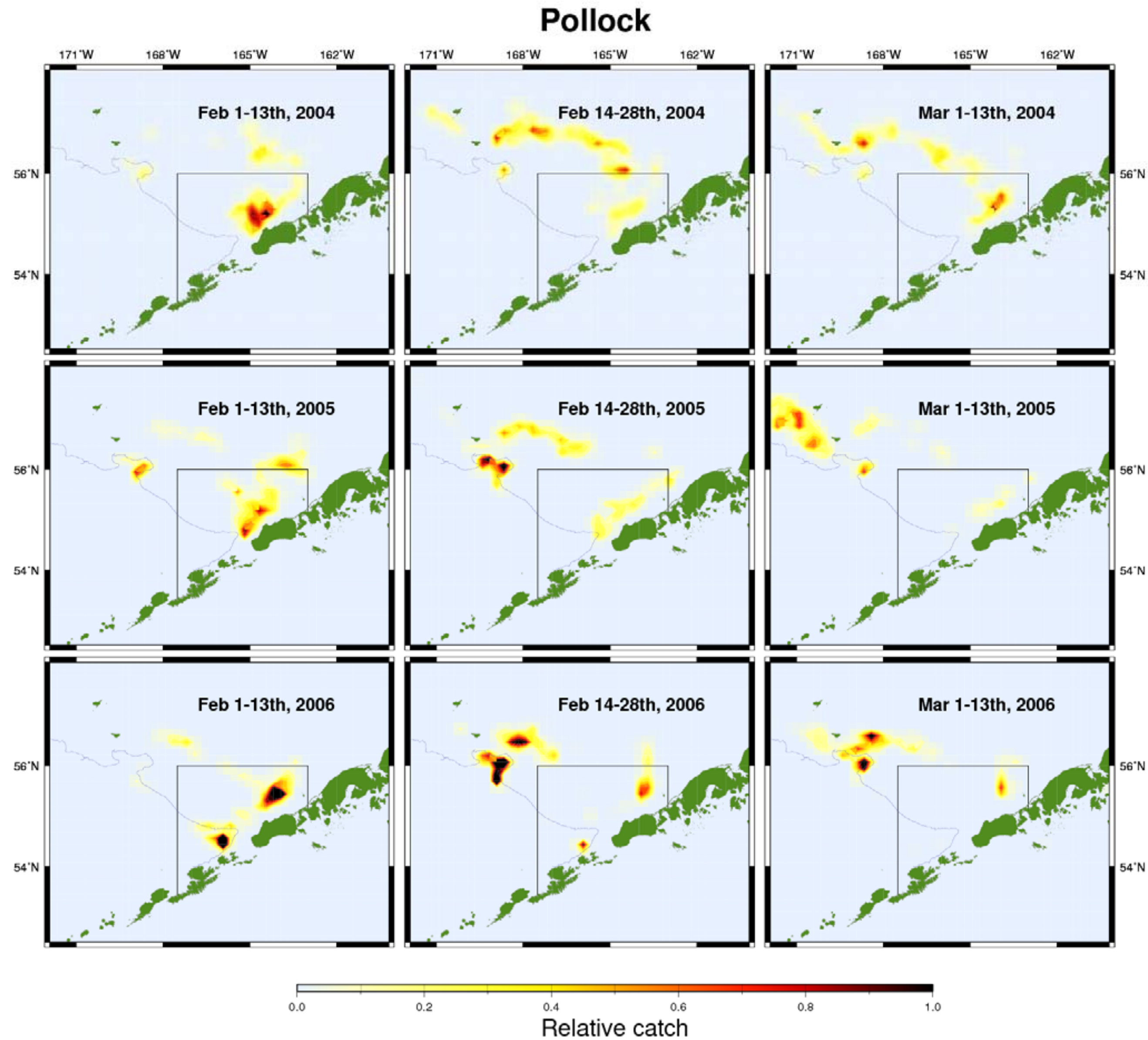


Figure 20 The patterns of pollock catch aggregated bi-weekly during the A-season 2004-2006 based on NMFS observer data

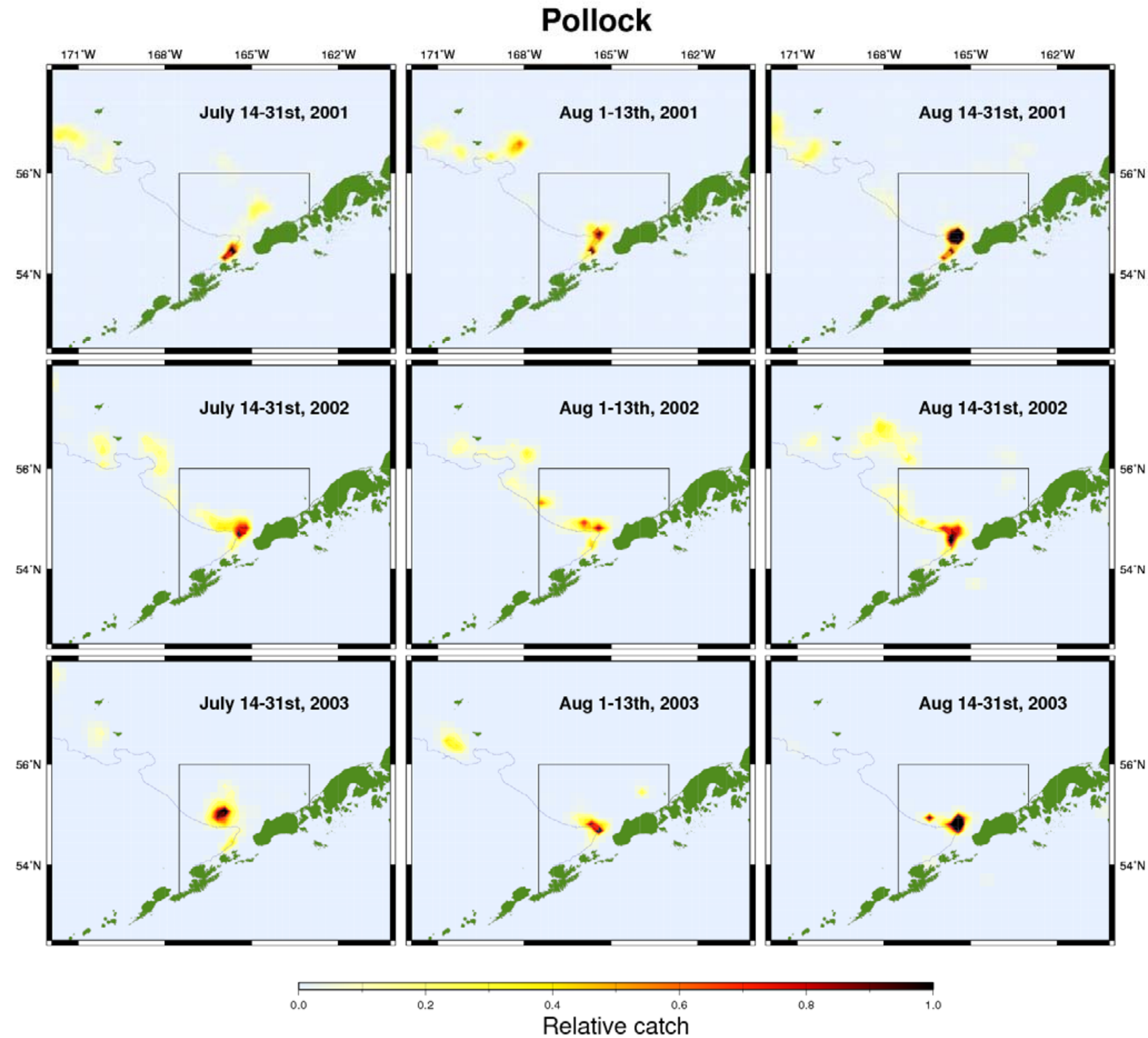


Figure 21 The patterns of pollock catch aggregated bi-weekly during the B-season (July and August) 2001-2003 based on NMFS observer data

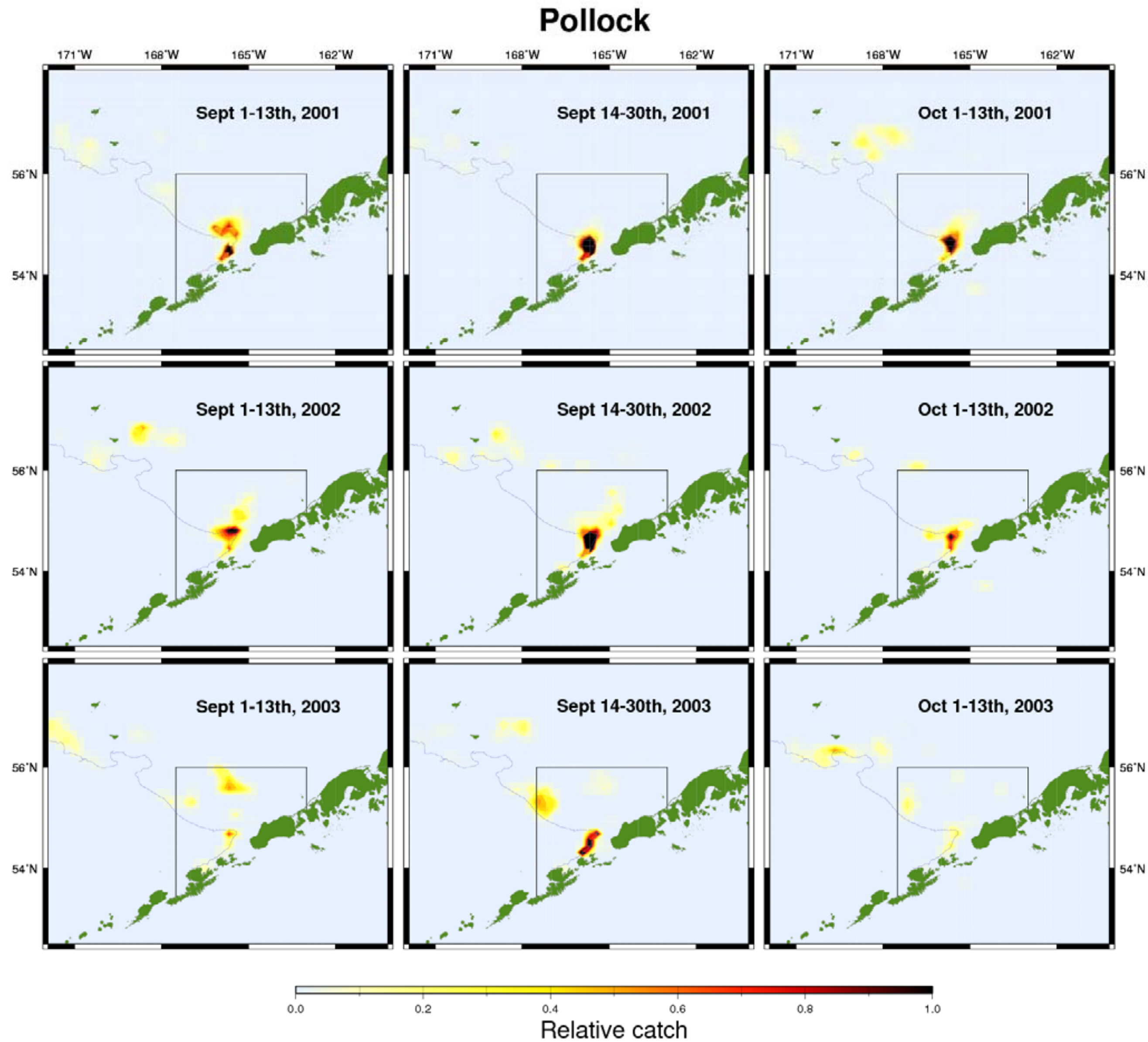


Figure 22The patterns of pollock catch aggregated bi-weekly during the B-season (September and October) 2001-2003 based on NMFS observer data

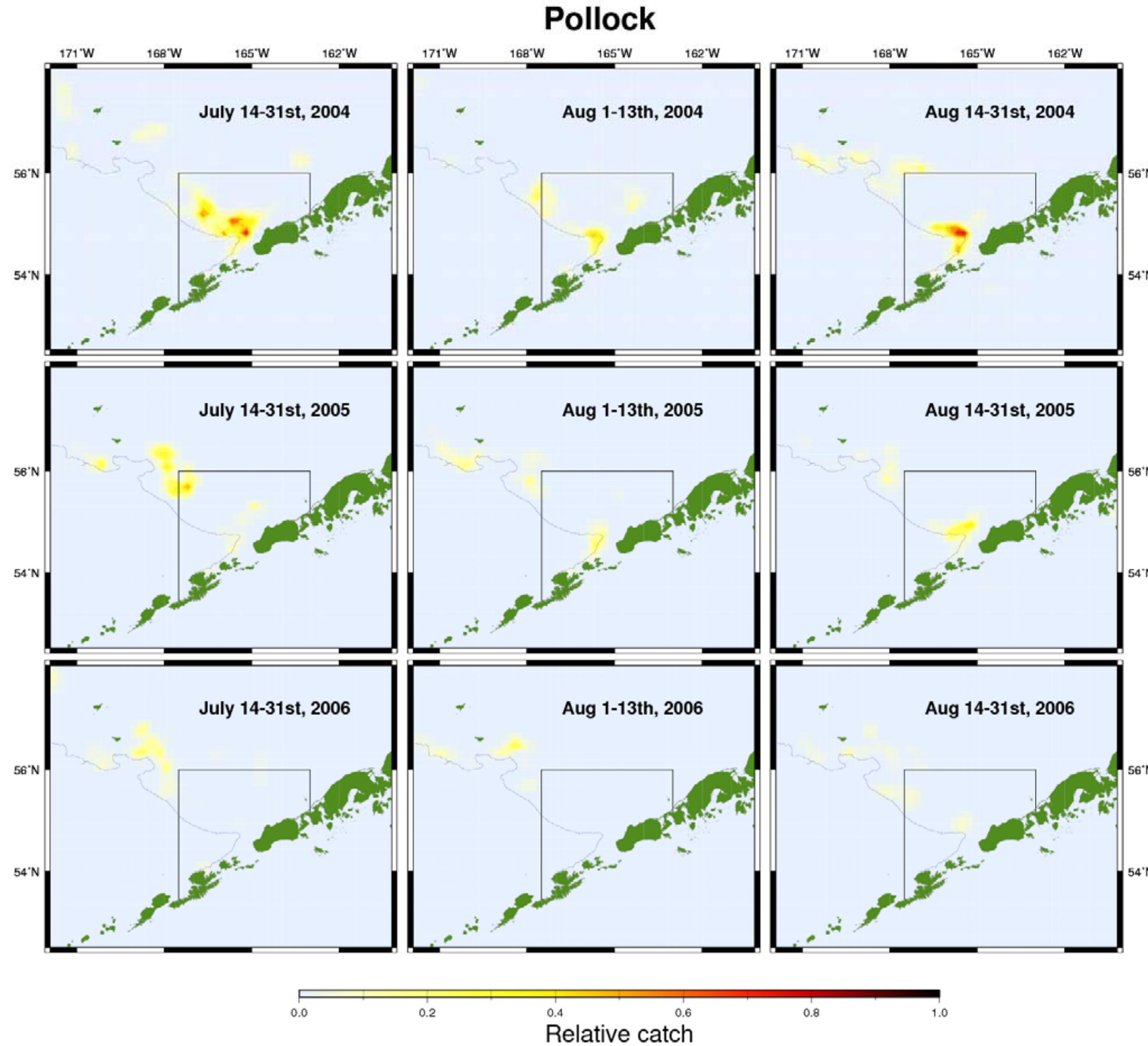


Figure 23 The patterns of pollock catch aggregated bi-weekly during the B-season (July and August) 2004-2006 based on NMFS observer data

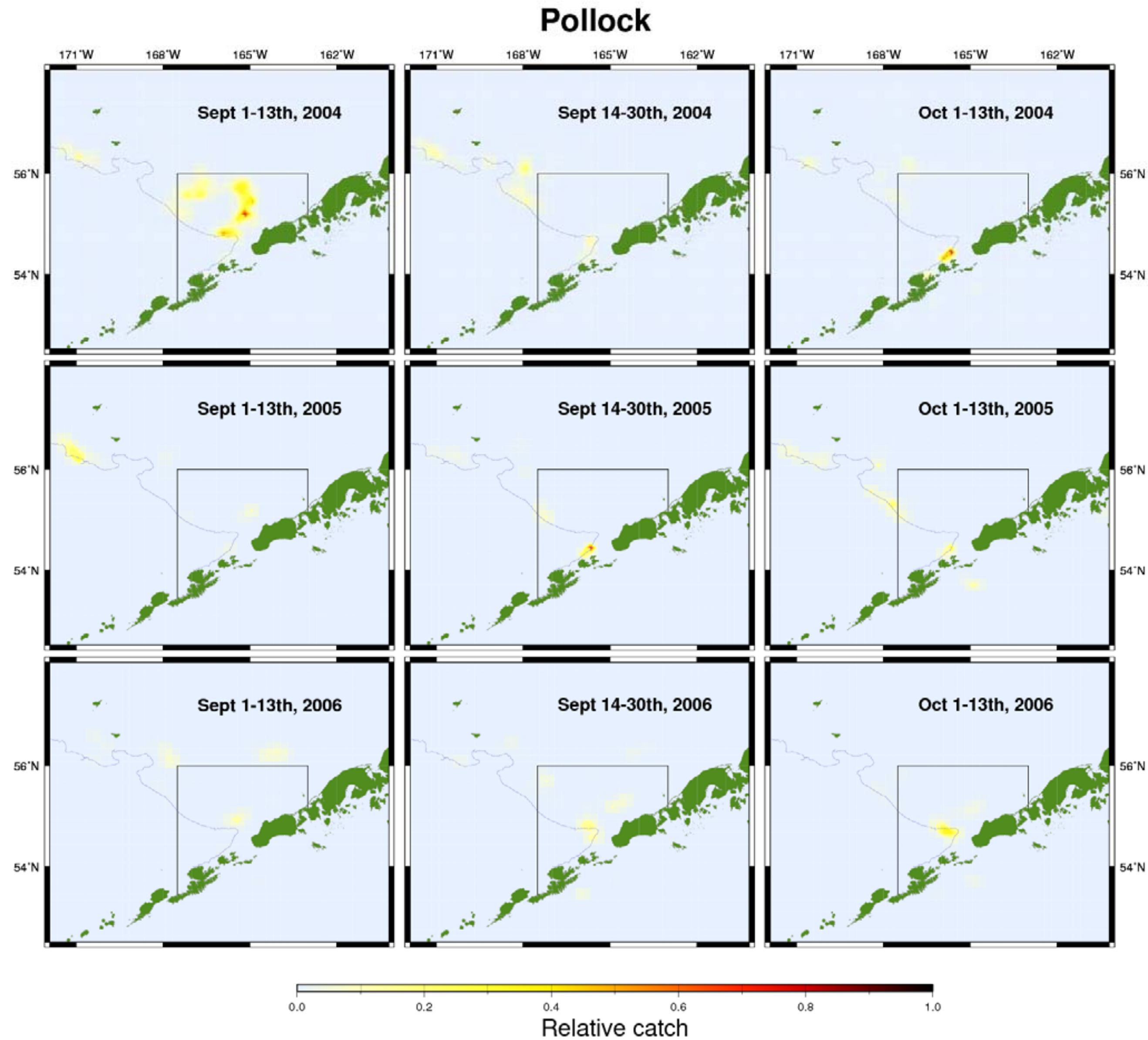


Figure 24 The patterns of pollock catch aggregated bi-weekly during the B-season (September and October) 2004-2006 based on NMFS observer data

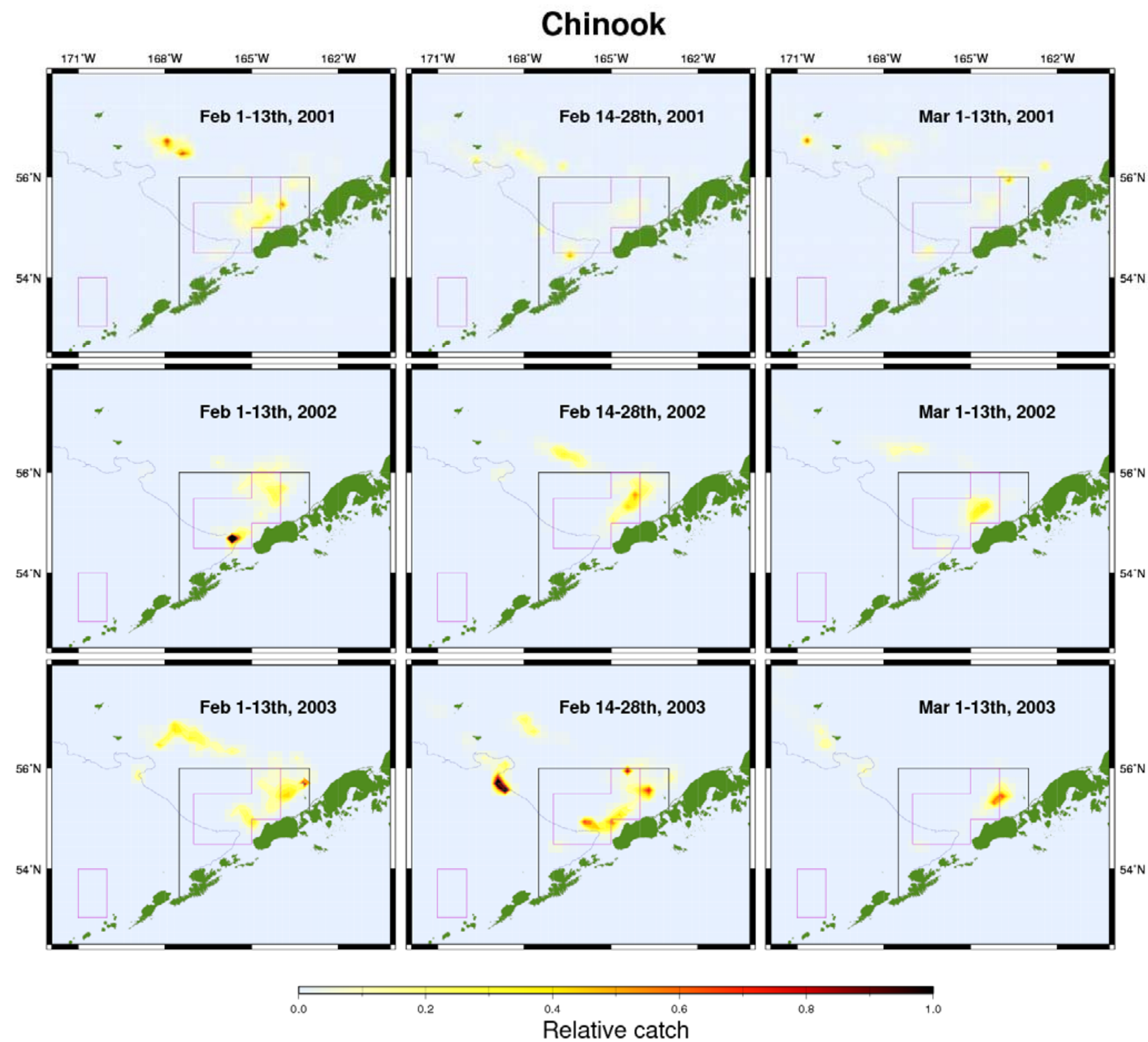


Figure 25 The patterns of Chinook catch aggregated bi-weekly during the A-season 2001-2003 based on NMFS observer data

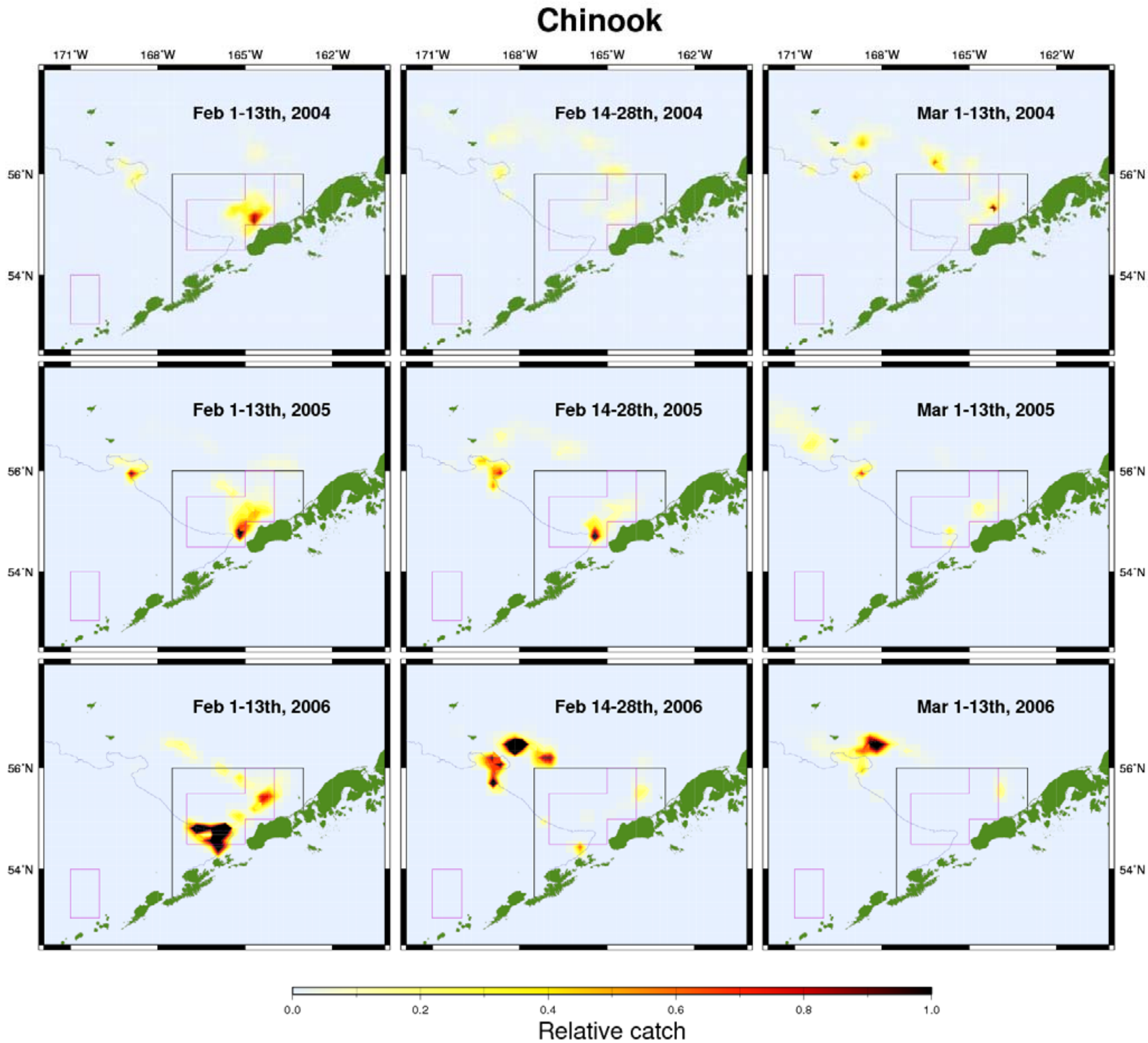


Figure 26 The patterns of Chinook catch aggregated bi-weekly during the A-season 2004-2006 based on NMFS observer data

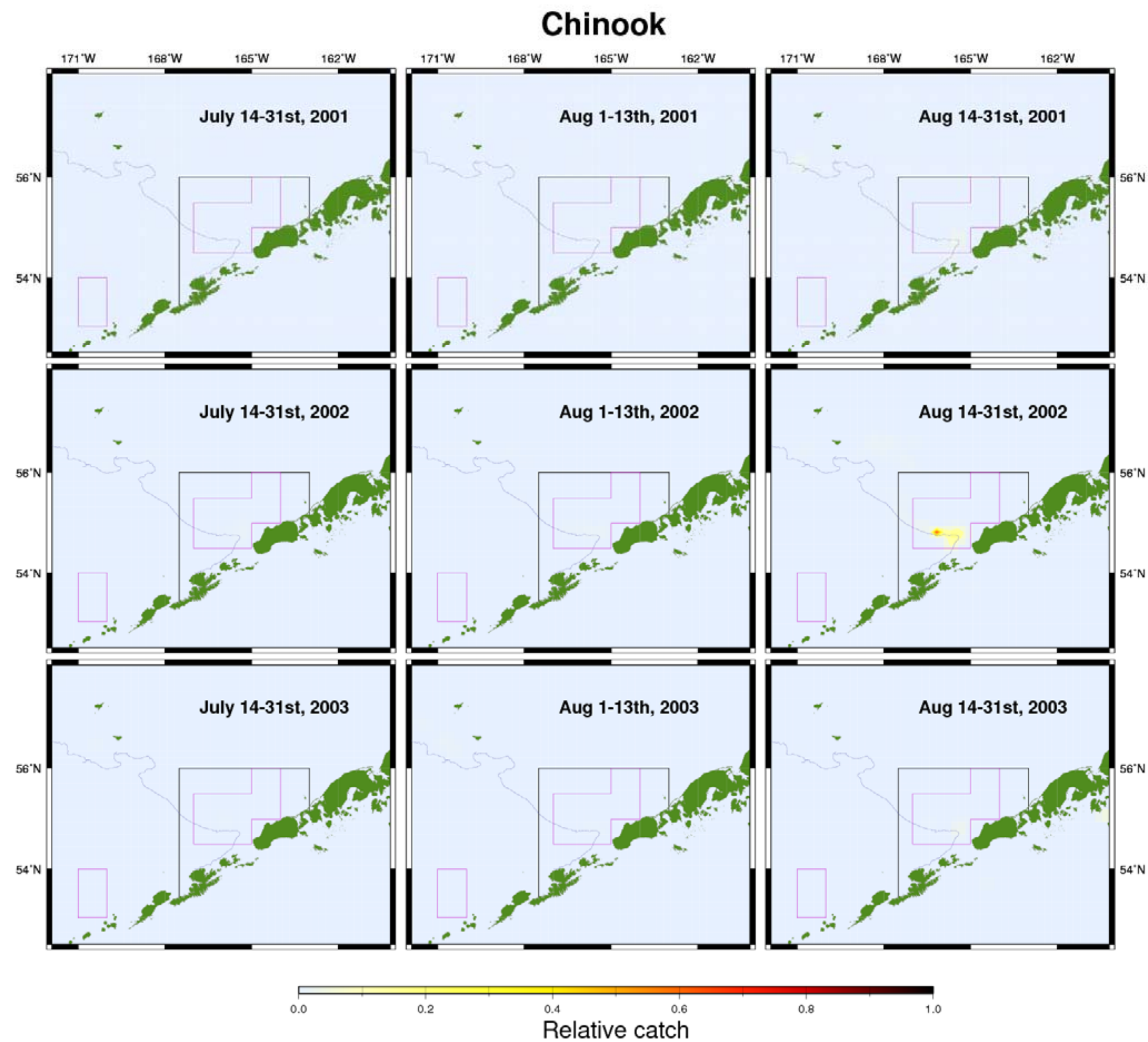


Figure 27 The patterns of Chinook catch aggregated bi-weekly during the B-season (July and August) 2001-2003 based on NMFS observer data

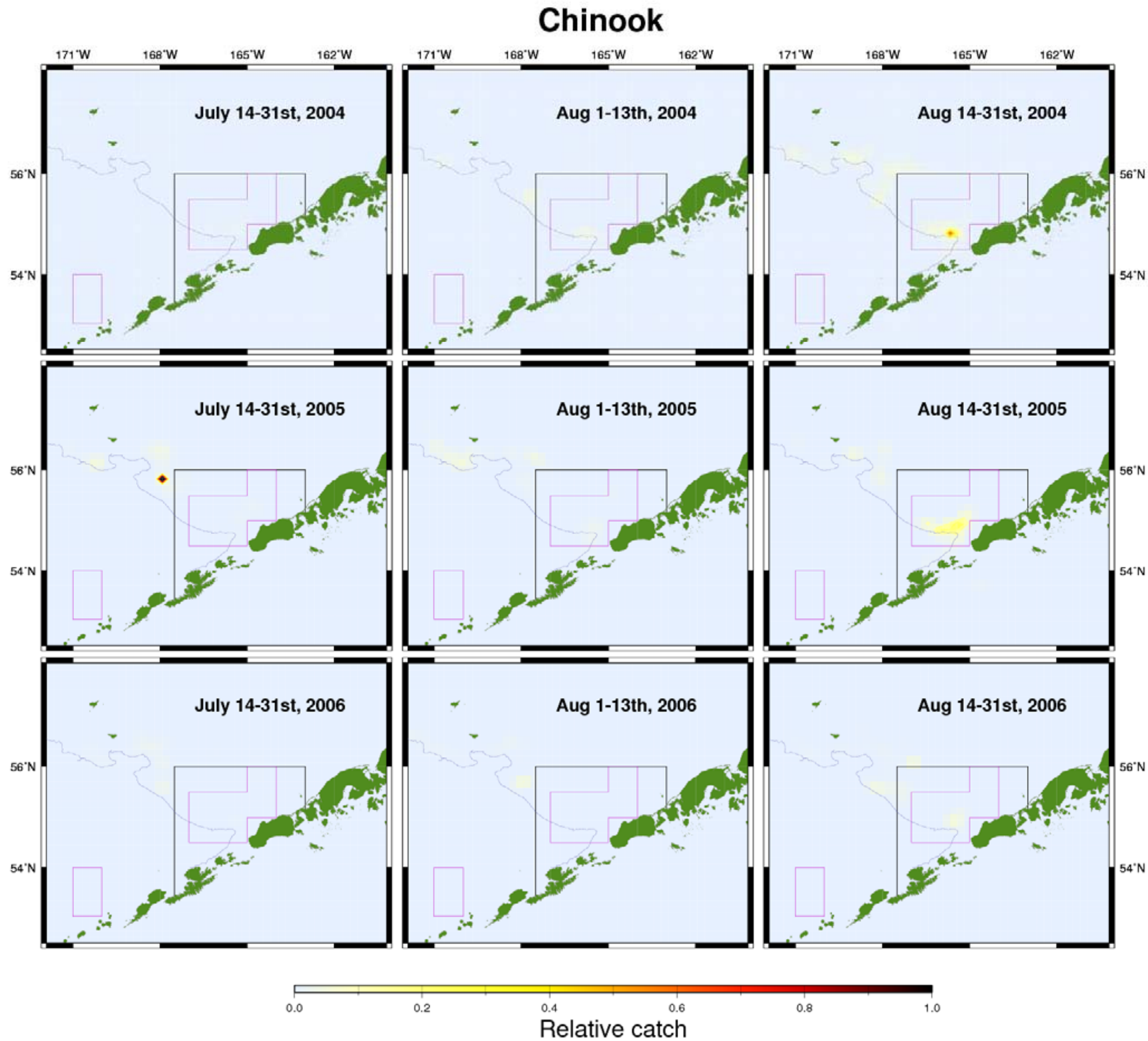


Figure 28 The patterns of Chinook catch aggregated bi-weekly during the B-season (July and August) 2004-2006 based on NMFS observer data

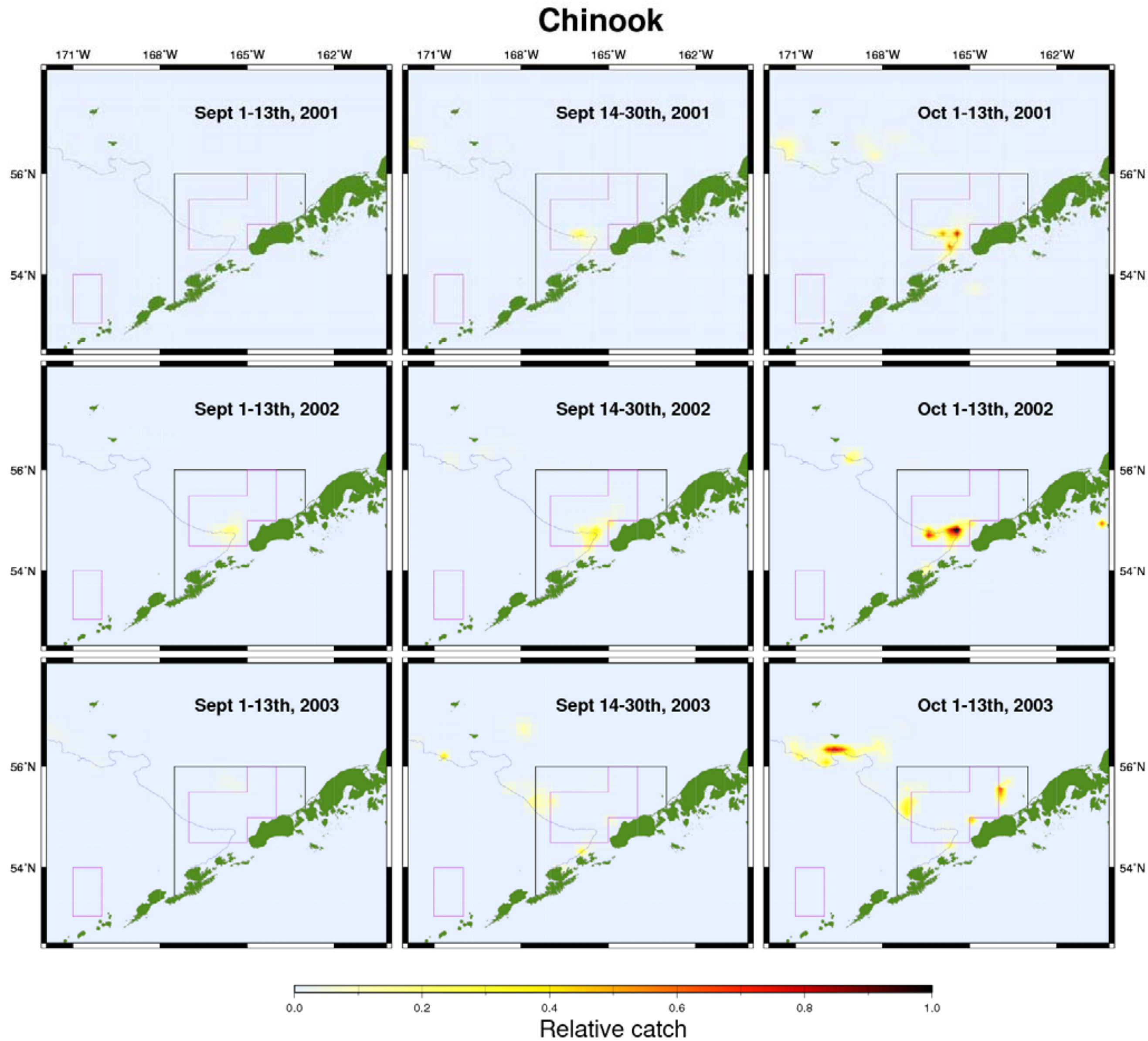


Figure 29 The patterns of Chinook catch aggregated bi-weekly during the B-season (September and October) 2001-2003 based on NMFS observer data

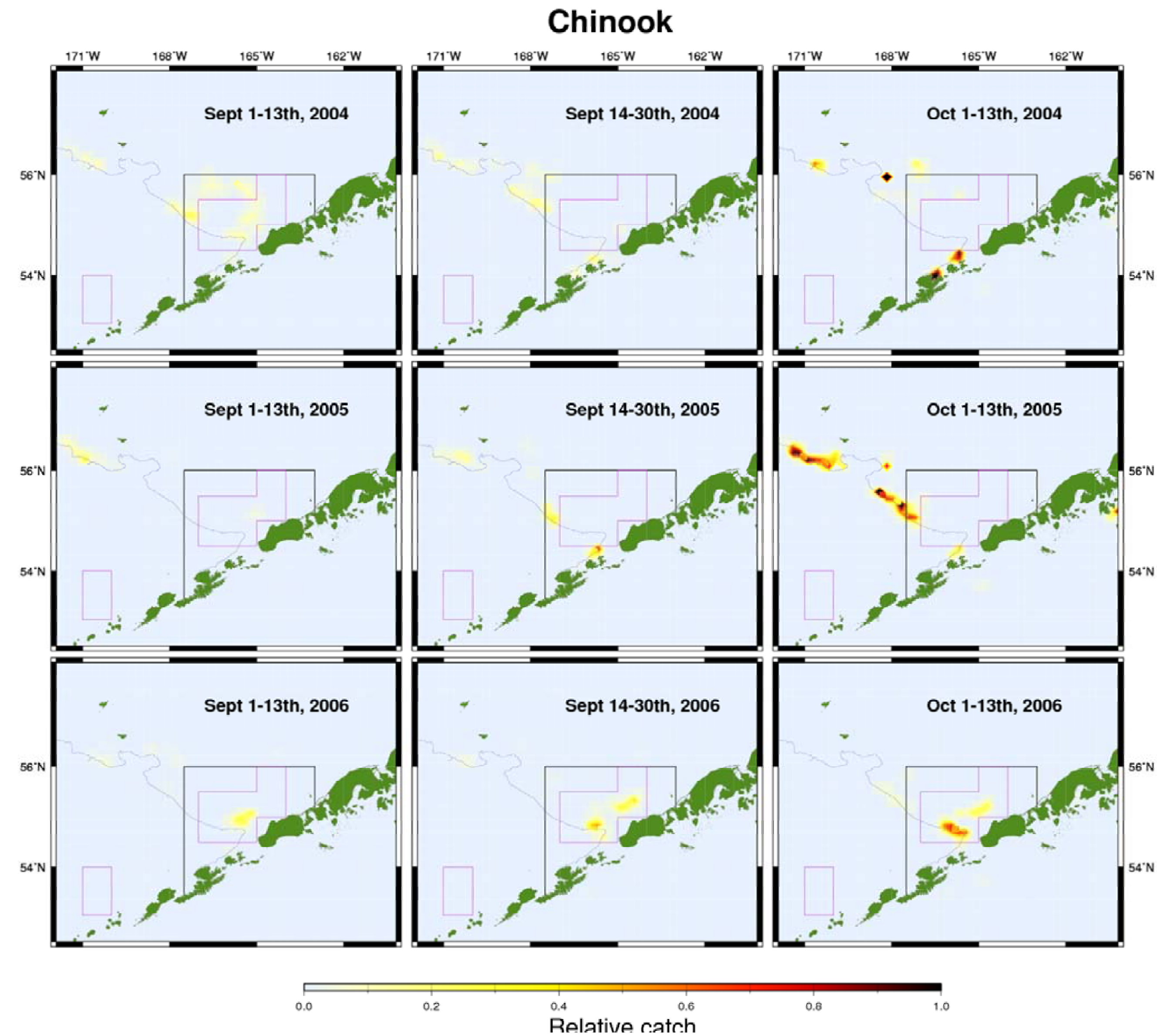


Figure 30 The patterns of Chinook catch aggregated bi-weekly during the B-season (September and October) 2004-2006 based on NMFS observer data

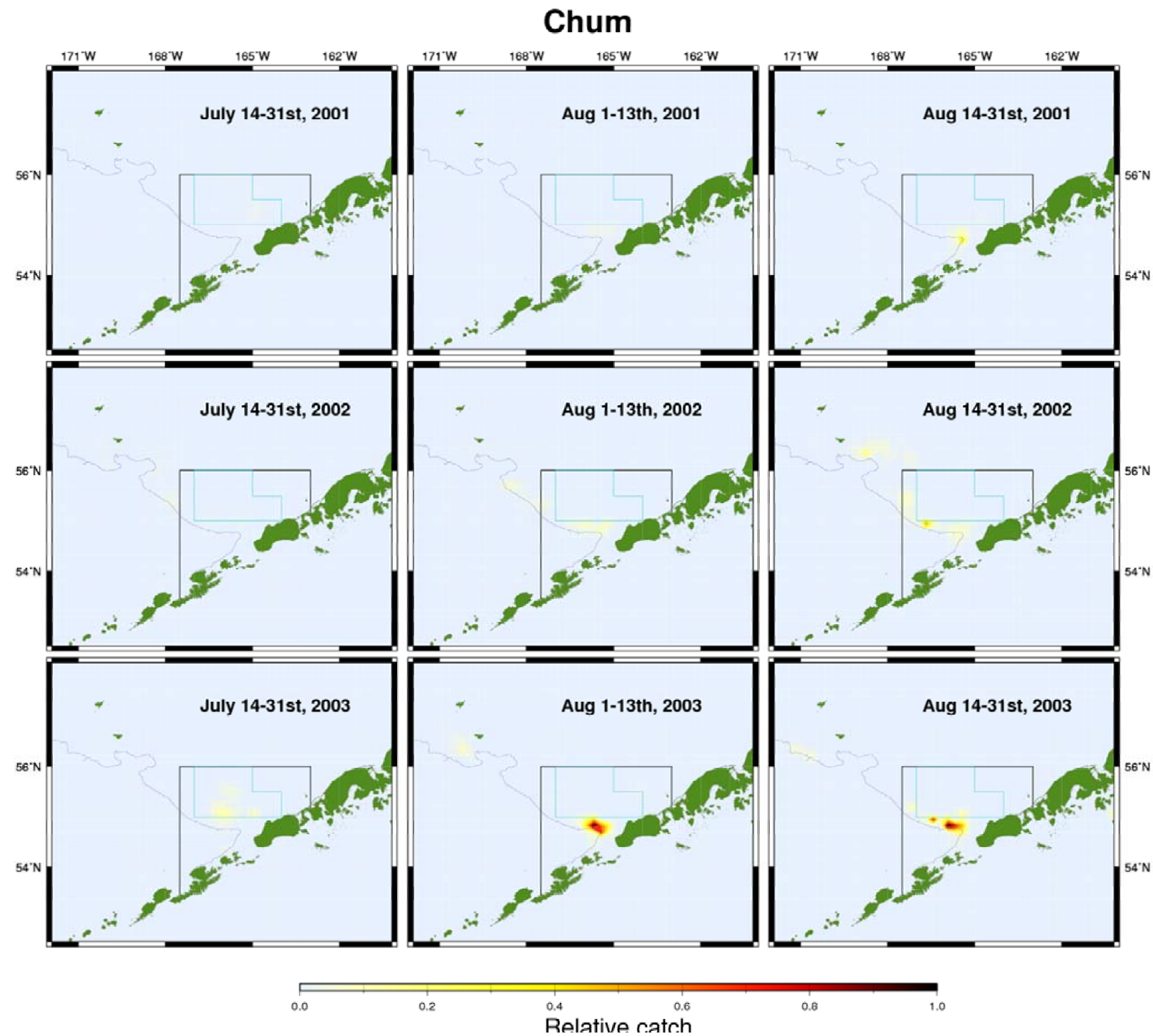


Figure 31 The patterns of chum salmon catch aggregated bi-weekly during the B-season (July and August) 2001-2003 based on NMFS observer data

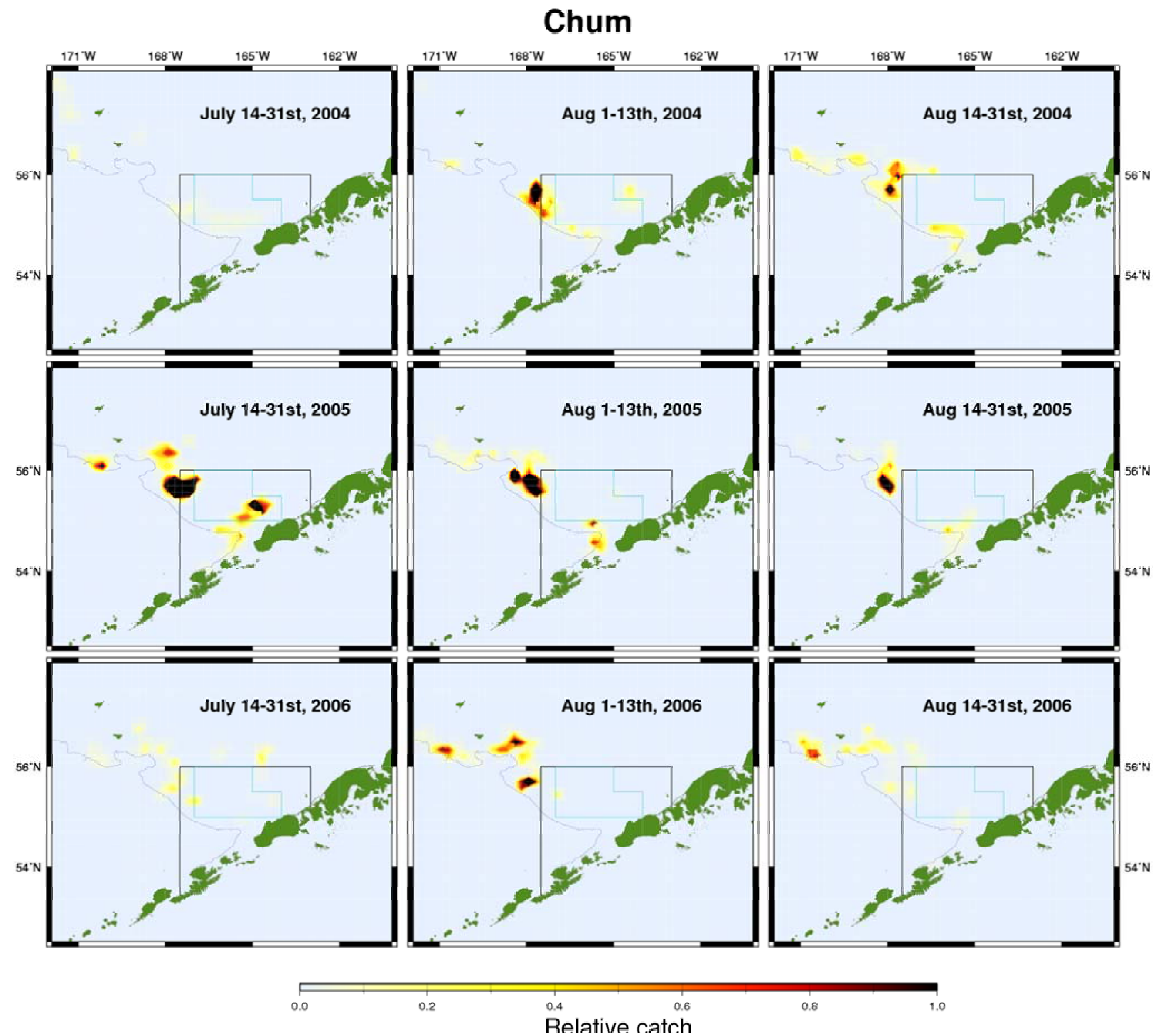


Figure 32 The patterns of chum salmon catch aggregated bi-weekly during the B-season (July and August) 2004-2006 based on NMFS observer data

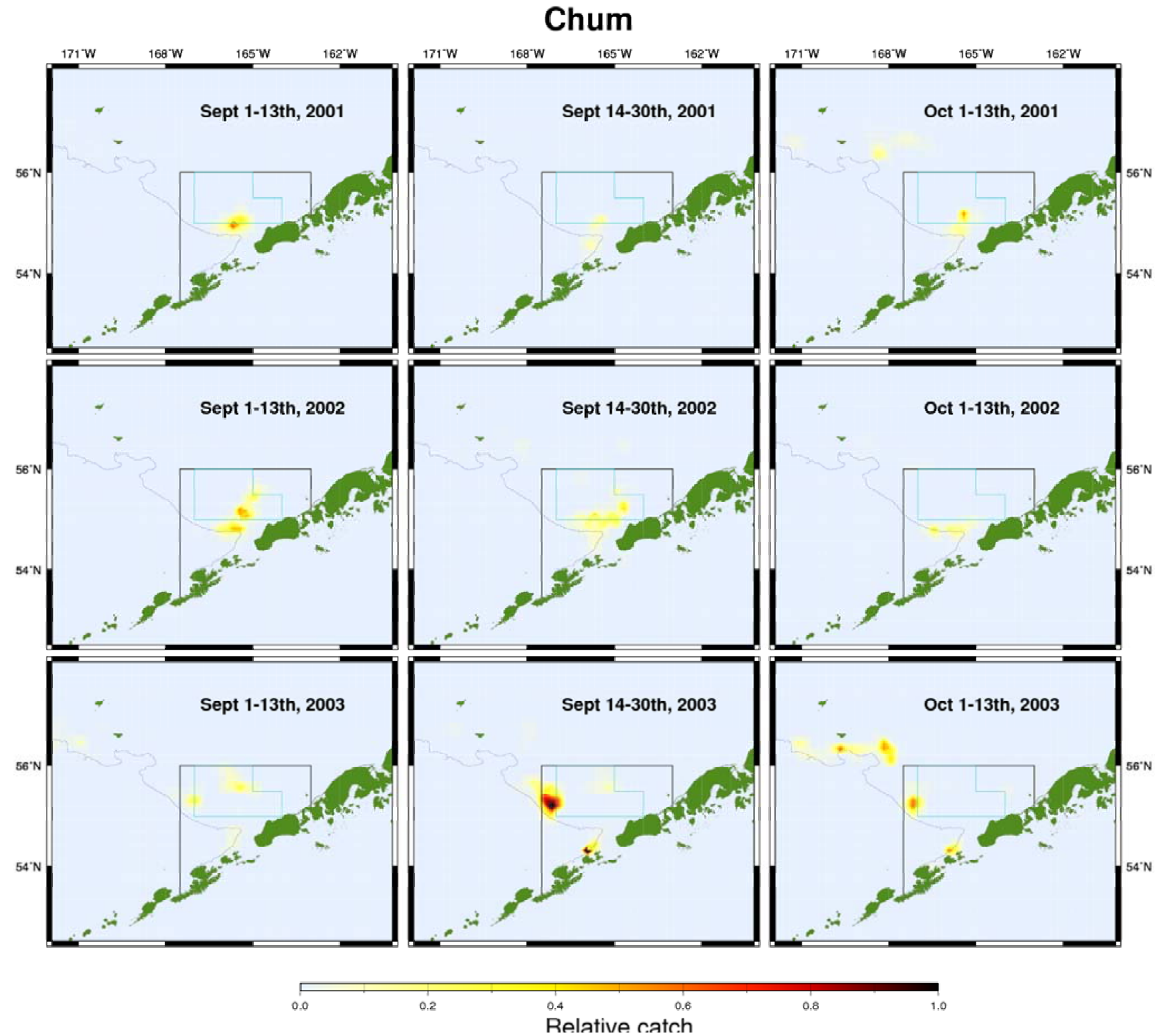


Figure 33 The patterns of chum salmon catch aggregated bi-weekly during the B-season (September and October) 2001-2003 based on NMFS observer data

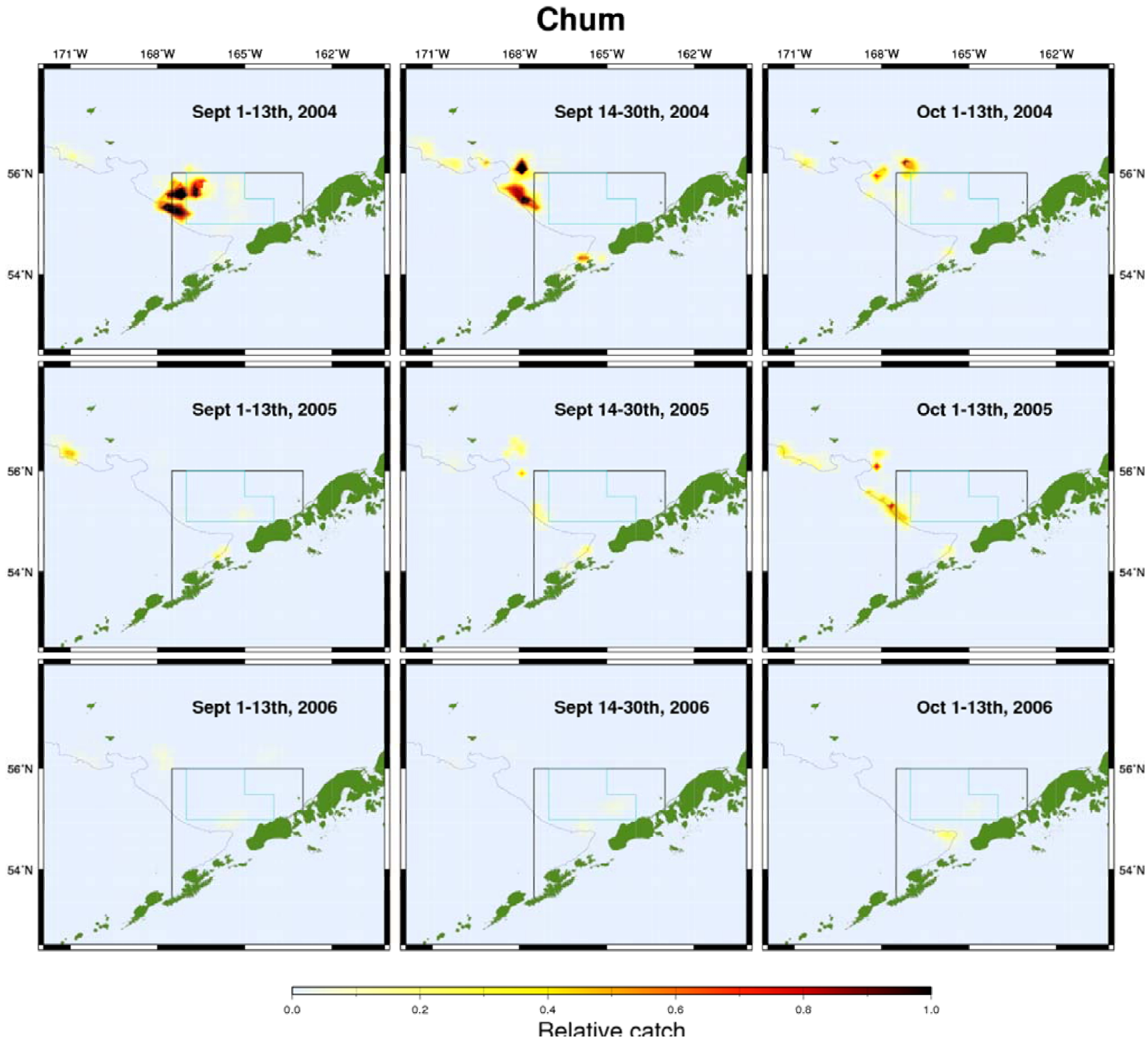


Figure 34 The patterns of chum salmon catch aggregated bi-weekly during the B-season (September and August) 2004-2006 based on NMFS observer data

Attachment 1

Information Bulletin 06-10
Sustainable Fisheries Division
907-586-7228

February 14, 2006
10:00 a.m.

NMFS Prohibits Directed Fishing for Non-CDQ Pollock in the Chinook Salmon Savings Areas of the Bering Sea and Aleutian Islands Management Area

The National Marine Fisheries Service (NMFS) is prohibiting directed fishing for non-Community Development Quota (CDQ) pollock with trawl gear in the Chinook Salmon Savings Areas of the Bering Sea and Aleutian Islands management area (BSAI) effective 12 noon, Alaska local time (Alt.), February 15, 2006, through 12 noon, A.l.t., April 15, 2006, and from 12 noon, A.l.t., September 1, 2006, through 12 midnight, A.l.t., December 31, 2006, according to Robert D. Mecum, Acting Administrator, Alaska Region, NMFS.

This action is necessary to prevent exceeding the 2006 non-CDQ limit of chinook salmon caught by vessels using trawl gear while directed fishing for non-CDQ pollock in the BSAI and is issued pursuant to 50 CFR 679.21(e)(7)(viii).

After the effective date of this closure the maximum retainable amounts at 50 CFR 679.20(e) and (f) apply at any time during a trip.

The Chinook Salmon Savings Areas are areas defined as the following portions of the BSAI:

(1) The area defined by straight lines connecting the following coordinates in the order listed:
54 degrees 00' N. lat., 171 degrees 00' W. long.
54 degrees 00' N. lat., 170 degrees 00' W. long.
53 degrees 00' N. lat., 170 degrees 00' W. long.
53 degrees 00' N. lat., 171 degrees 00' W. long.
54 degrees 00' N. lat., 171 degrees 00' W. long.

(2) The area defined by straight lines connecting the following coordinates in the order listed:
56 degrees 00' N. lat., 165 degrees 00' W. long.
56 degrees 00' N. lat., 164 degrees 00' W. long.
55 degrees 00' N. lat., 164 degrees 00' W. long.
55 degrees 00' N. lat., 165 degrees 00' W. long.
54 degrees 30' N. lat., 165 degrees 00' W. long.
54 degrees 30' N. lat., 167 degrees 00' W. long.
55 degrees 30' N. lat., 167 degrees 00' W. long.
55 degrees 30' N. lat., 165 degrees 00' W. long.
56 degrees 00' N. lat., 165 degrees 00' W. long.

This information bulletin only provides notice of a regulatory change. For the purposes of complying with the regulatory change, you are advised to see the actual text in the Code of Federal Regulations.

Attachment 2

SSC minutes April 2006 on Salmon Bycatch Workshop

D-1 (c,d) Progress Report on BSAI salmon bycatch amendment and Salmon Research Workshop

Diana Stram (NPFMC staff) provided an overview of the problem statement and suite of alternatives for amendment package 84B. Public testimony was received by Karl Haflinger (SeaState), Jennifer Hooper (Association of Village Council Presidents), Mike Smith (Tanana Chiefs Conference), and Becca Robbins (Yukon River Drainage Fisheries Association).

Analysis and refinement of the current salmon savings areas may be necessary in the event pollock vessels either surrender or lose their exemption and return to fishing under the regulatory salmon bycatch program. There is a need for development of more effective alternatives to the voluntary rolling hot spot system (VRHS). Amendment packages B-1 and B-2 are intended to provide those additional alternatives. Amendment package B-1 would be to establish new regulatory salmon savings systems that take into account the most recent available salmon bycatch data. Amendment package B-2 would be to develop a regulatory individual vessel salmon bycatch accountability program.

Salmon Workshop

The SSC conducted a salmon research workshop intended to aid in the discussion and development of bycatch management alternatives, such as biomass-based caps, updated salmon savings areas, and analysis of the current system under VRHS. Jim Ianelli (AFSC) provided a report on salmon bycatch patterns in the Bering Sea pollock fishery. Jim Murphy (AFSC) presented BASIS survey results on distribution and abundance of salmon in the Bering Sea. Richard Wilmot (AFSC) presented information on the stock origins of salmon caught in the Bering Sea groundfish fishery. Jim and Lisa Seeb (ADF&G) presented work on development of standardized DNA baselines for identifying mixtures of salmon stocks. Tony Gharrett (UAF) reported on genetic methods for determining salmon stock origins. Gene Sandone and Dan Bergstrom (ADF&G) presented information on Chinook and chum salmon stock status in the AYK region. Lastly, Alan Haynie (AFSC) presented information on incentives for bycatch avoidance. Summaries of the workshop presentations will be posted on the NPFMC website by Council staff.

SSC Discussion

The ensuing SSC discussion focused on attempting to address the following questions:
1) How to craft biomass-based caps?
2) What are innovative ideas for salmon savings systems and how to craft them to be more responsive to changing conditions?
3) What are appropriate milestones and standards for effective bycatch reduction?

Given the recent bycatch rates and presentations at the workshop, it is clear that the current state of knowledge is in flux so the Council should anticipate that additional changes may be required as research projects are completed.

How should we craft biomass based caps?
The SSC notes that developing a basis to establish biomass-based caps will be difficult and perhaps years away. Improved escapement enumeration and identification of salmon to stock of origin are required. Progress is being made in these areas.

To establish an abundance index, time trends of average run size from regions that correspond to the origins of salmon in the bycatch would be needed. This would allow analysts to assess whether increases in the encounter rate of salmon in the pollock fishery are a function of population trends. If an index of this type could be developed, then bycatch caps could include adjustments for the status of salmon runs likely to be contributing to bycatch.

In addition to run size indicators by stock, it may be possible to utilize the BASIS survey to infer future returns of Alaskan origin salmon in the EBS. If the survey is used in this manner, NMFS should attempt to standardize the start date and station grid used for the BASIS survey to reduce the potential for missing out-migrations of salmon in some years. Such projections would need to adjust for natural mortality rate and migration. NMFS should also review the station spacing to assess whether the station allocation is appropriate for a comparative analysis of distribution and abundance of chum and Chinook salmon.

The information on the stock origin by age was informative, and the SSC recommends that the data collected from the EBS shelf be re-evaluated to assess the potential impact of age on the composition of home stream origin. The analysis of the home stream origin of salmon appeared to reveal that the regional contribution to the sample changed with age. This suggested that older salmon might have a different regional breakdown than younger salmon. This makes sense on two grounds: (1) younger salmon may not be fully mixed with the adult population, and (2) adult salmon from different regions may occupy different parts of the Bering Sea and sub-arctic Pacific thus, at older age groups we would see different regional contributions to the sample. Perhaps there are other explanations for the result. The bottom line is that there appears to be an age effect on regional partitions of home stream of origin. If this is the case, then the samples from the Bering Sea need to be re-examined to evaluate whether this effect could be impacting our samples.

Genetic analyses indicate that salmon from a broad geographic range of stocks contribute to salmon bycatch in pollock fisheries. Future cap calculations should reflect the likelihood that the origin of salmon captured as bycatch varies with season and location over the EBS shelf and slope. The SSC commends the collaboration of state, federal and academic geneticists and encourages these scientists to continue to work together to develop SNPs and microsatellite markers to assess home stream origin of salmon captured as bycatch. It is also recommended that geneticists work together with the industry on a sampling plan that will provide a reasonable representation of the annual bycatch. Given the apparent dependence of home stream origin on age, and the potential for shifts in the spatial distribution of pollock fishing, this study should include multiple years of sampling. The investigators should also determine the desired sample size necessary to assess home stream origin of schools encountered by commercial groundfish fisheries.

The SSC recommends devoting research to oceanographic factors influencing the spatial and temporal distribution and concentration of salmon. This includes an investigation of prey distributions relative to spatial distribution of salmon over the EBS shelf.

Other research should be devoted to examining vessels with a history of low bycatch rates. Factors such as gear configuration, deployment procedures or other fishing methods might be important determinants of salmon bycatch rates. If such factors can be associated with “clean” fishing then those might be more broadly applied to the fleet.

Dr. Ianelli recommended that a robust cap linked to an index of the catch rate in the pollock fishery could be considered. The SSC also considered the possibility of using in-season bycatch rates to establish in-season caps. Several problems with this approach were noted including: the lack of evidence that bycatch rates are an indicator of abundance and the possibility that the bycatch rate could be intentionally influenced to inflate the cap. The SSC noted that bycatch rates may vary with changes in abundance or density or both.

Given the current state of knowledge and potential difficulties in achieving research results in the near-term, the SSC discussed the possibility of setting an interim precautionary – arbitrary cap. The SSC concluded that setting an arbitrary cap was not a scientific issue but something that the Council would need to negotiate among the interested parties.

Innovative ideas for a salmon savings area

The SSC noted that the existing rolling hotspot approach is a logical way to attempt to control bycatch at the current time. A problem with the current situation is that the base rate continues to change. **Incentives should be considered to get fishers to move back into closed areas after they are reopened to collect post-closure bycatch rates in those areas.** It was noted that both bycatch rate of salmon and catch rate of pollock decrease at night but the drop in salmon bycatch is greater than the drop in pollock catch. However, it is not clear that a shift to night-time fishing is practical.

Historical salmon spatial bycatch patterns should be analyzed to determine if there are coherent shifts that might allow for periodic adjustment of closure areas. The Council may wish to consider techniques, including whether shifts in the A and B fishing season apportionments can yield additional salmon savings.

Individual vessel accountability programs

The SSC briefly discussed individual bycatch quotas. One idea put forward, given the lack of data, would be to put the fleet in competition to reduce salmon bycatch by posting a bond that would be distributed back to a portion of the fleet with the lowest bycatch rates of the end of the season (and perhaps affected Alaska communities). Any individual vessel accountability strategy would put a focus on getting good counts of salmon in the catch, which might put additional pressure on observers. Any vessel accountability program would also require a mechanism to limit catch and the identification of a target cap.

SSC Comments on Workshop

The SSC appreciates the efforts of the Council staff to organize the workshop, and extends thanks to all the presenters for providing us with the most up to date information on their research efforts. It is clear that the combined efforts of the several research programs are leading us towards a much better understanding of the origins of salmon taken as bycatch and their distribution in the Bering Sea.