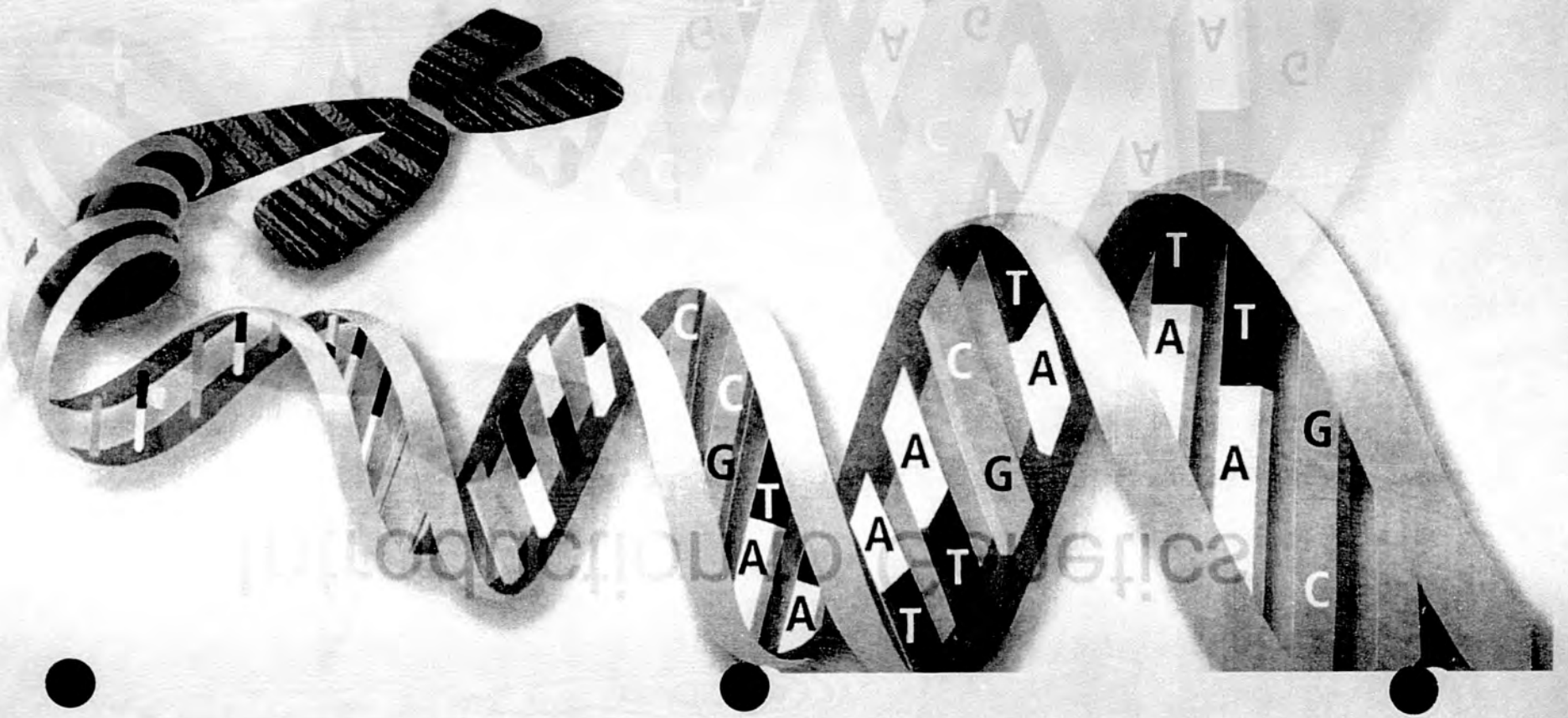
SCOMM

156:4

Introduction to Genetics

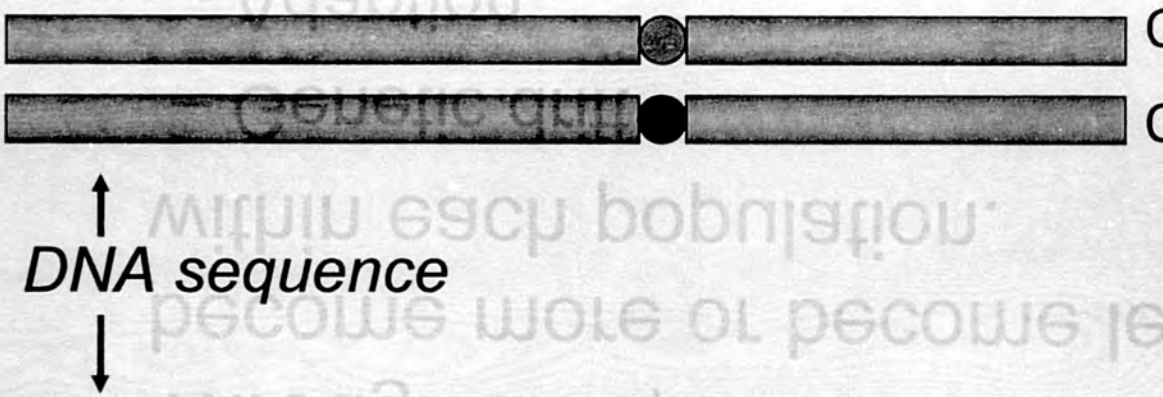
Bill Templin
Gene Conservation Laboratory
Alaska Department of Fish and Game

1) All fish have two sets of chromosomes – one inherited from each parent.
2) Each chromosome is made up of a string of nucleotides (A,G,T,C's).
3) Every fish has slightly different strings.
4) A site where two different nucleotides occur is called a single-nucleotide polymorphism (SNP).

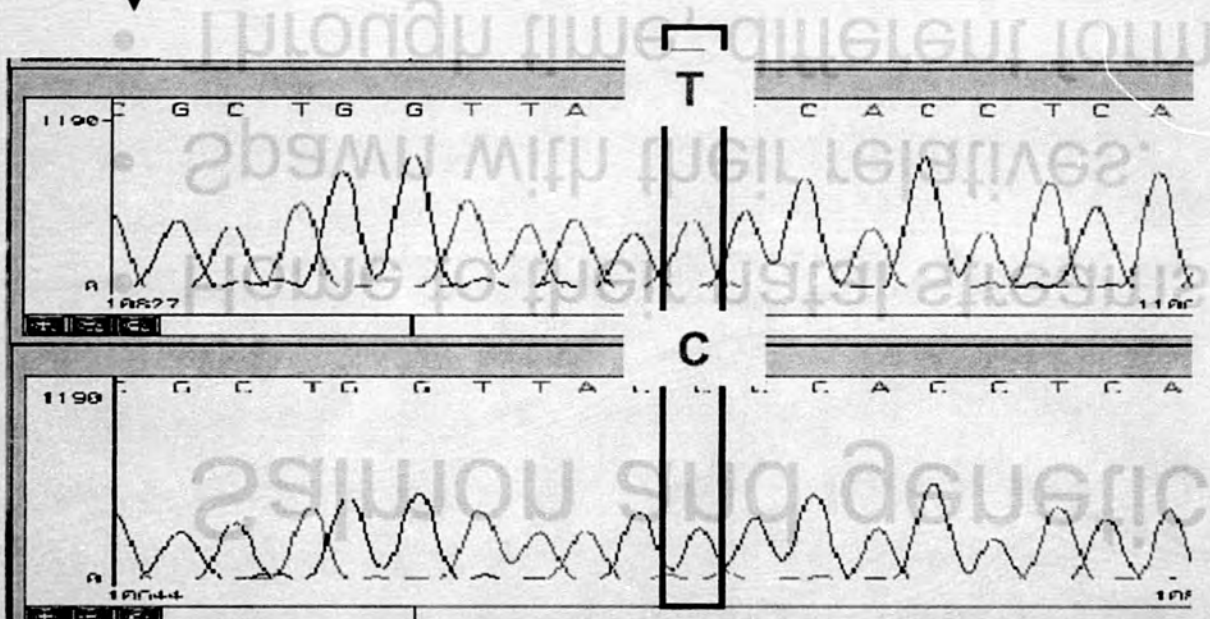


Single Nucleotide Polymorphism (SNP)

DNA base change at a single base



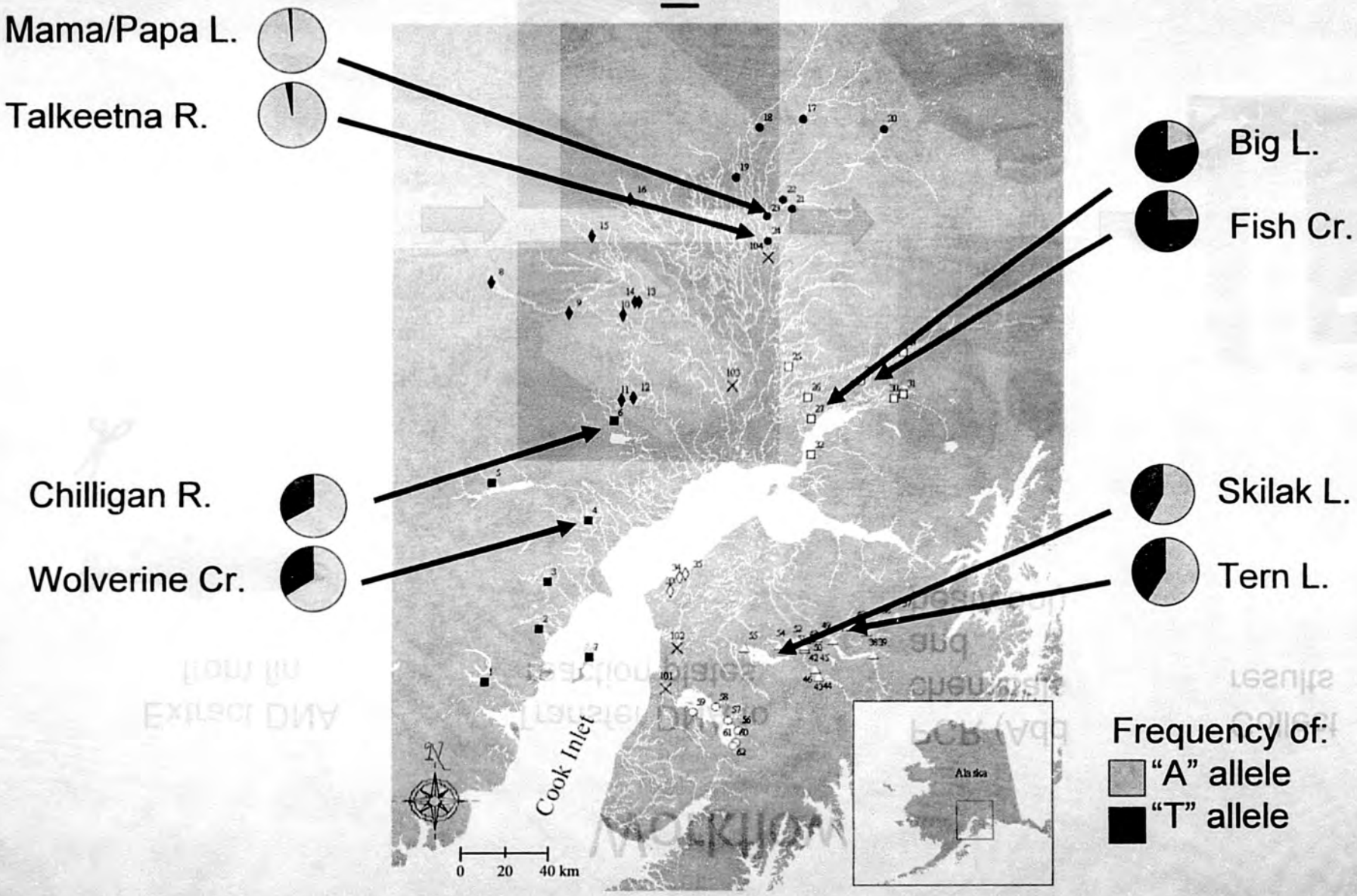
DNA sequence



Salmon and genetic structure

- Home to their natal streams.
- Spawn with their relatives.
- Through time, different forms of each SNP become more or become less common within each population.
  - Genetic drift
  - Adaption

Variation among populations for one SNP "*One_E2-65*"



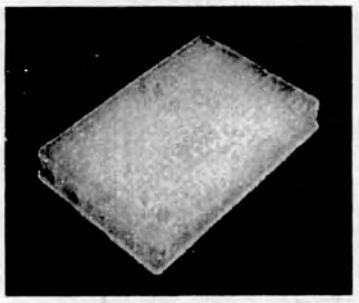
Workflow

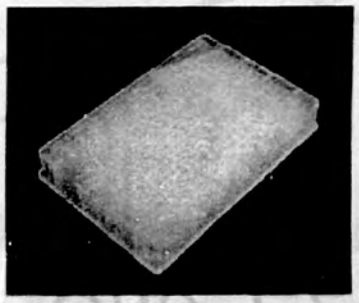
Extract DNA from fin

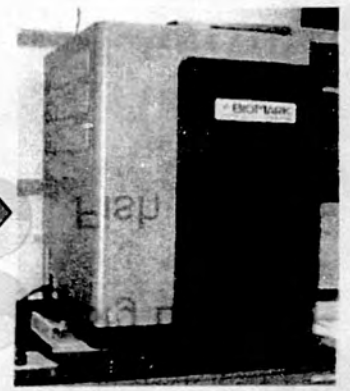
Transfer DNA to reaction plates

PCR (Add chemicals and heat/cool)

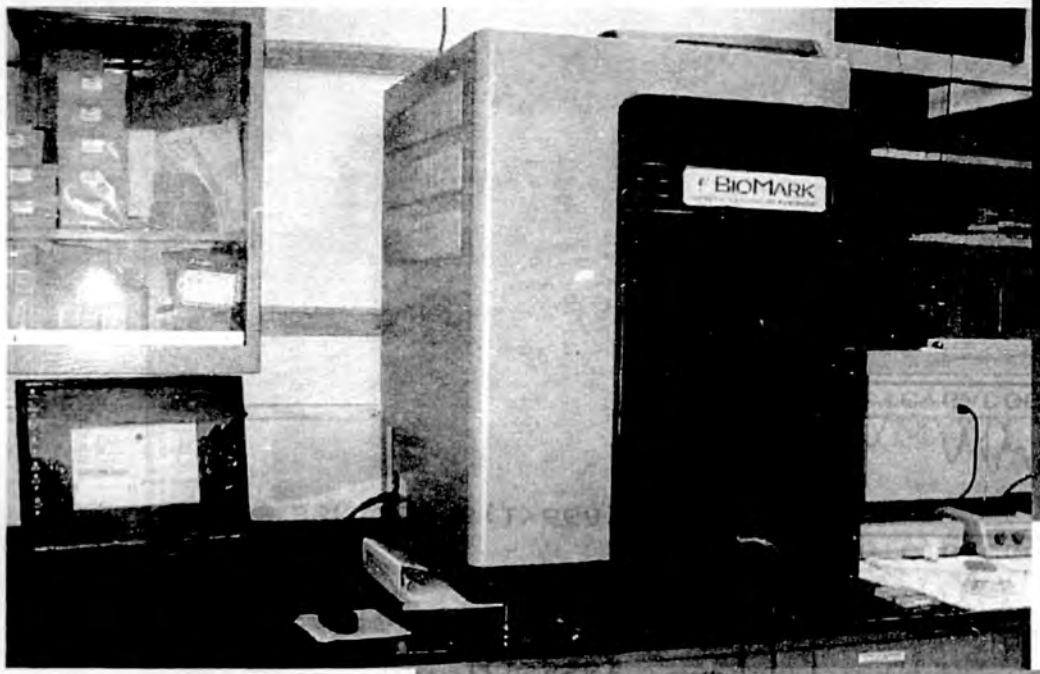
Collect results

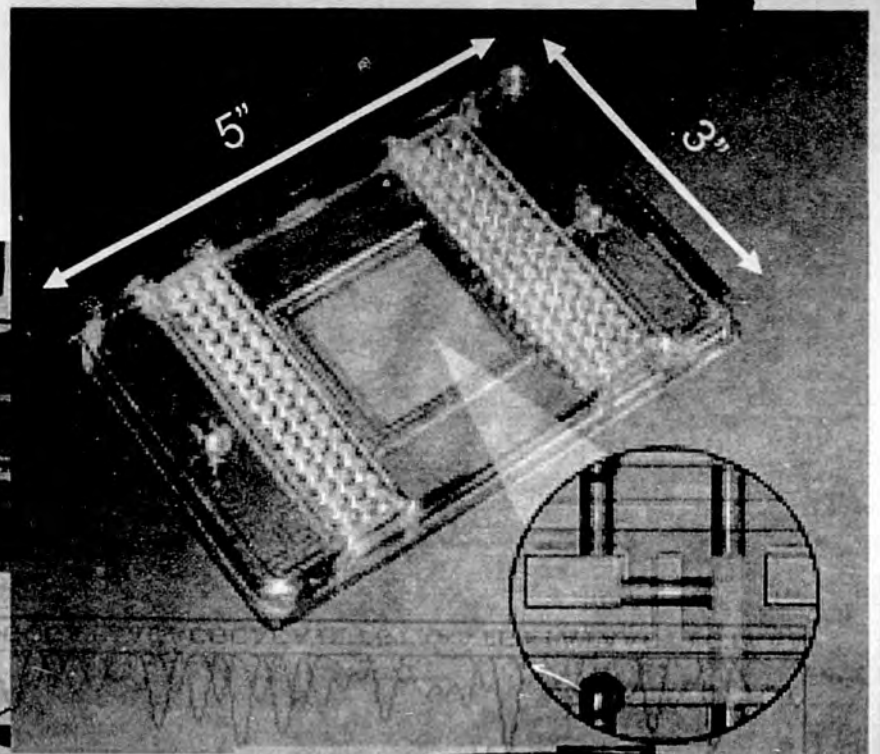


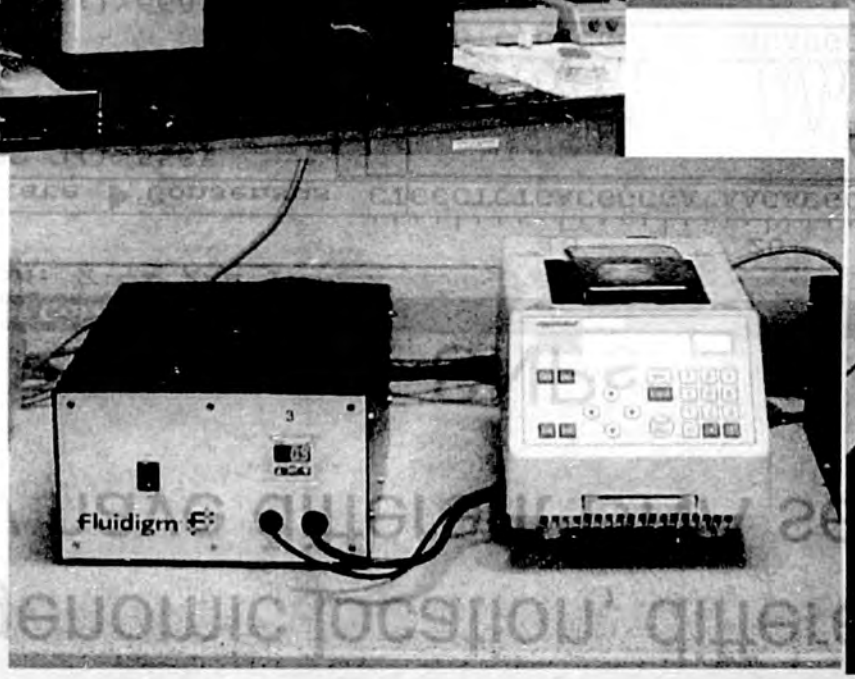




Microfluidics:
low error, high throughput

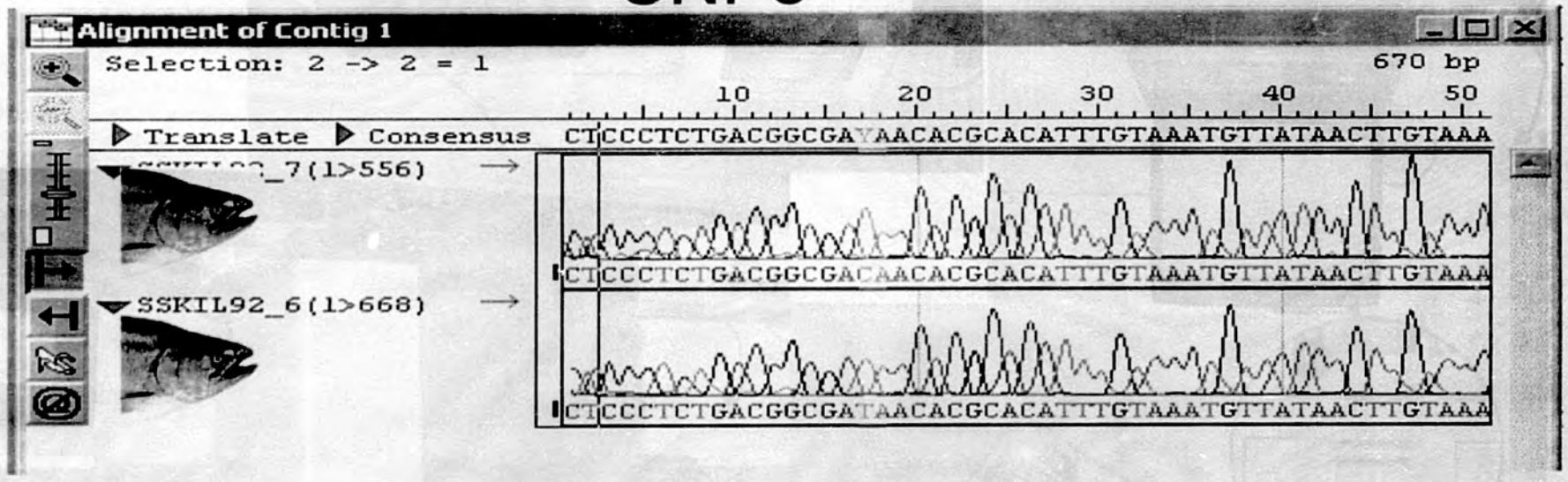




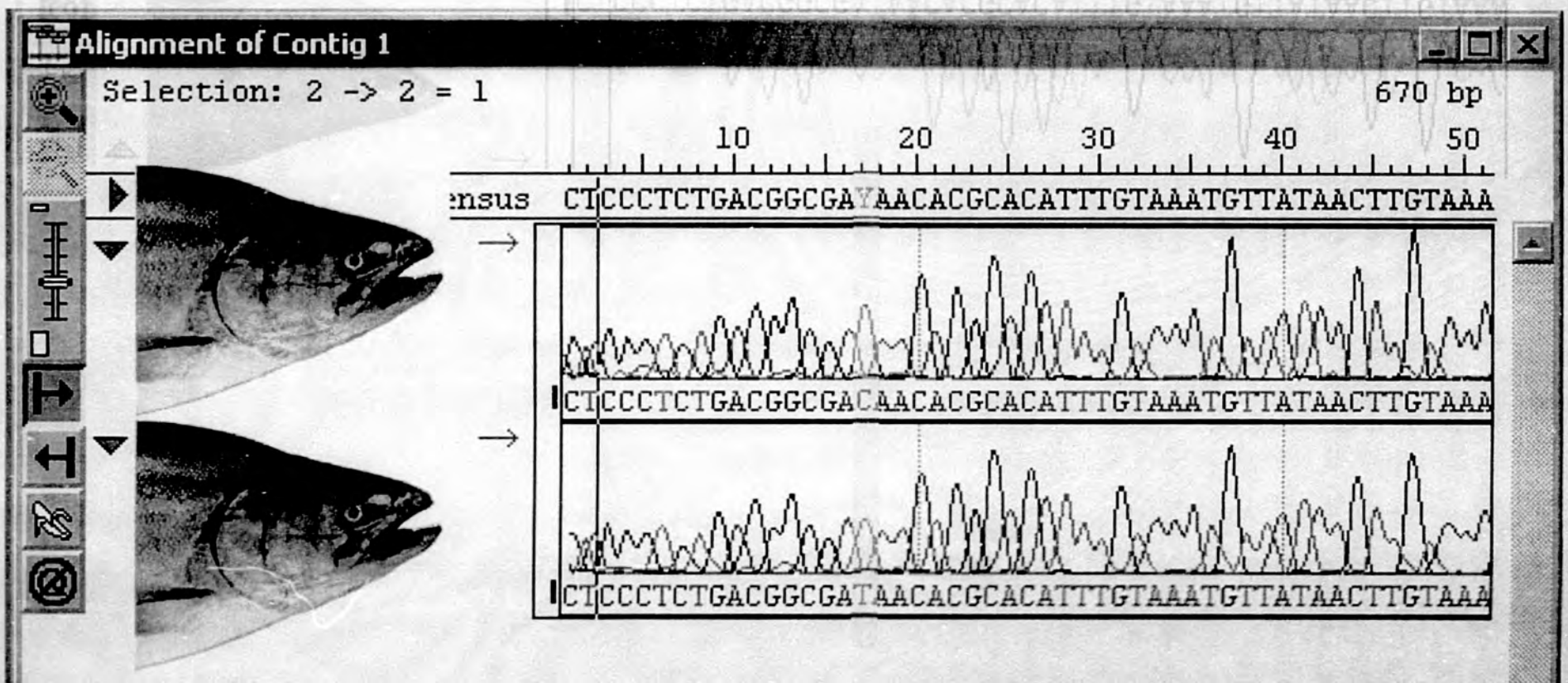


At any genomic location, different individuals may have different DNA sequences.

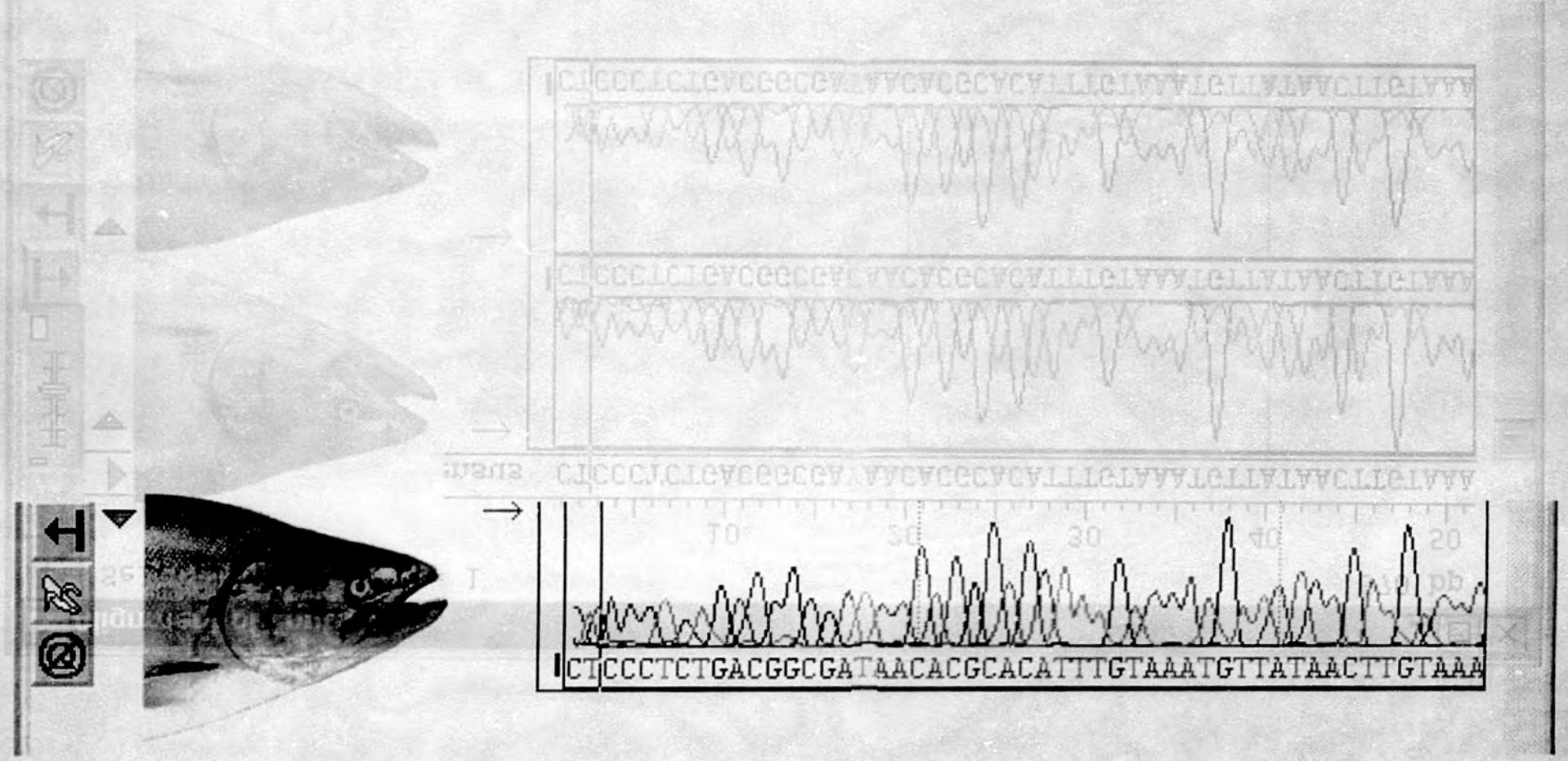
SNPs



5’-nuclease assay



5’-nuclease assay



5’-nuclease assay

CTCCCTCTGACGGCGATAACACGCACATTTGTAAATGTTATAACTTG

5'-nuclease assay

Taq-man

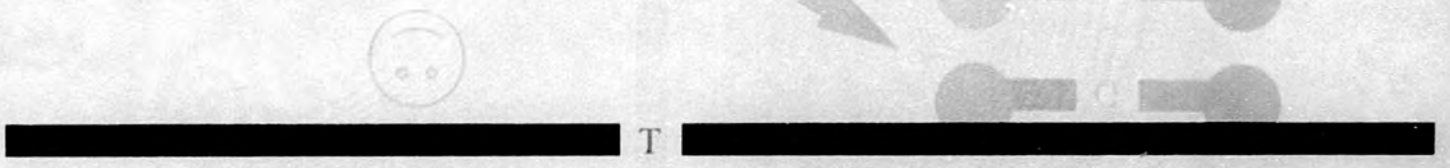
probe

5'-nuclease assay

Taq-man

probe

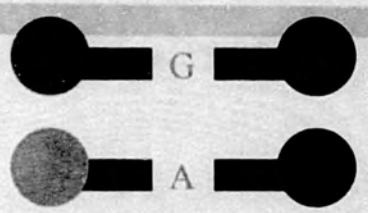
DNA polymerase



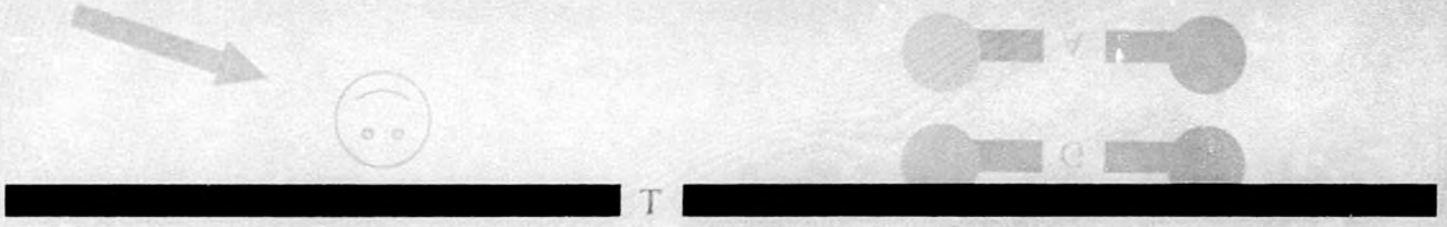
5'-nuclease assay

Taq-man

probe



Fluorescent tag



5'-nuclease assay

Taq-man

probe

Quencher
(prevents fluorescence)

T

5’-nuclease assay

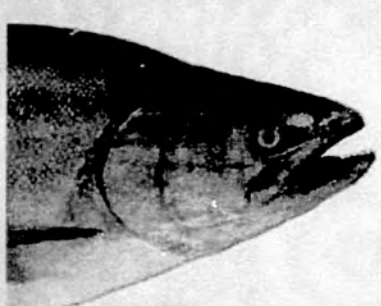
Taq-man

probe

T

5'-nuclease assay

Taq-man probe

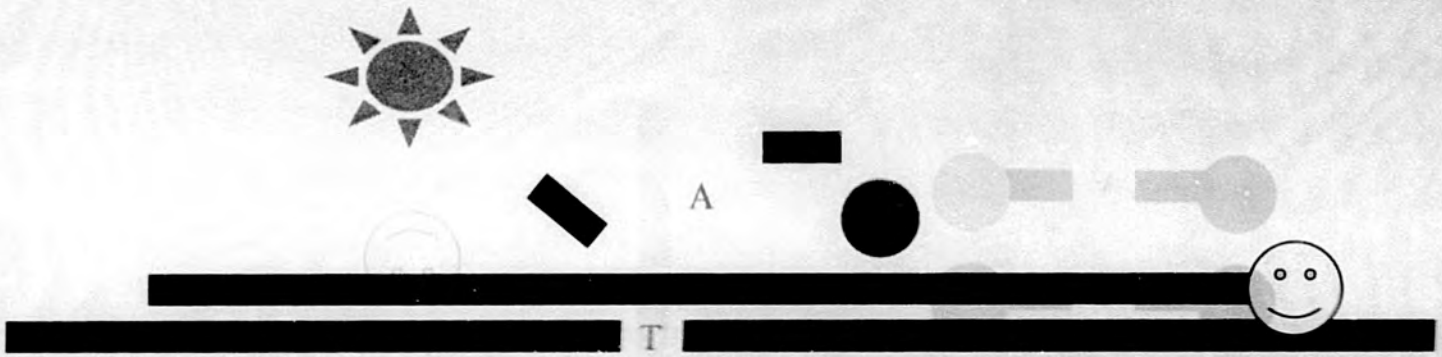


5'-nuclease assay

Taq-man probe

5’-nuclease assay

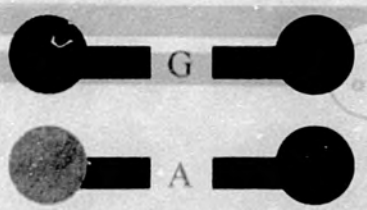
Taq-man probe

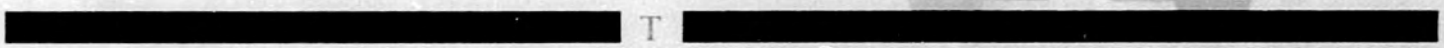


5'-nuclease assay

Taq-man

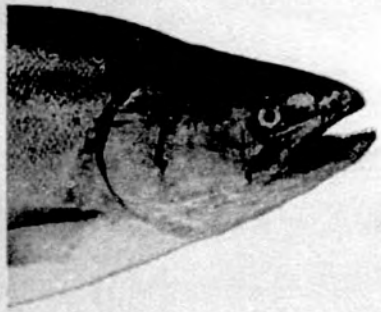
probe





5'-nuclease assay

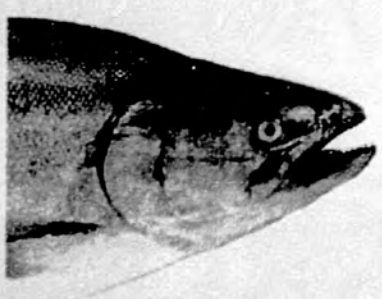
Taq-man probe



5'-nuclease assay

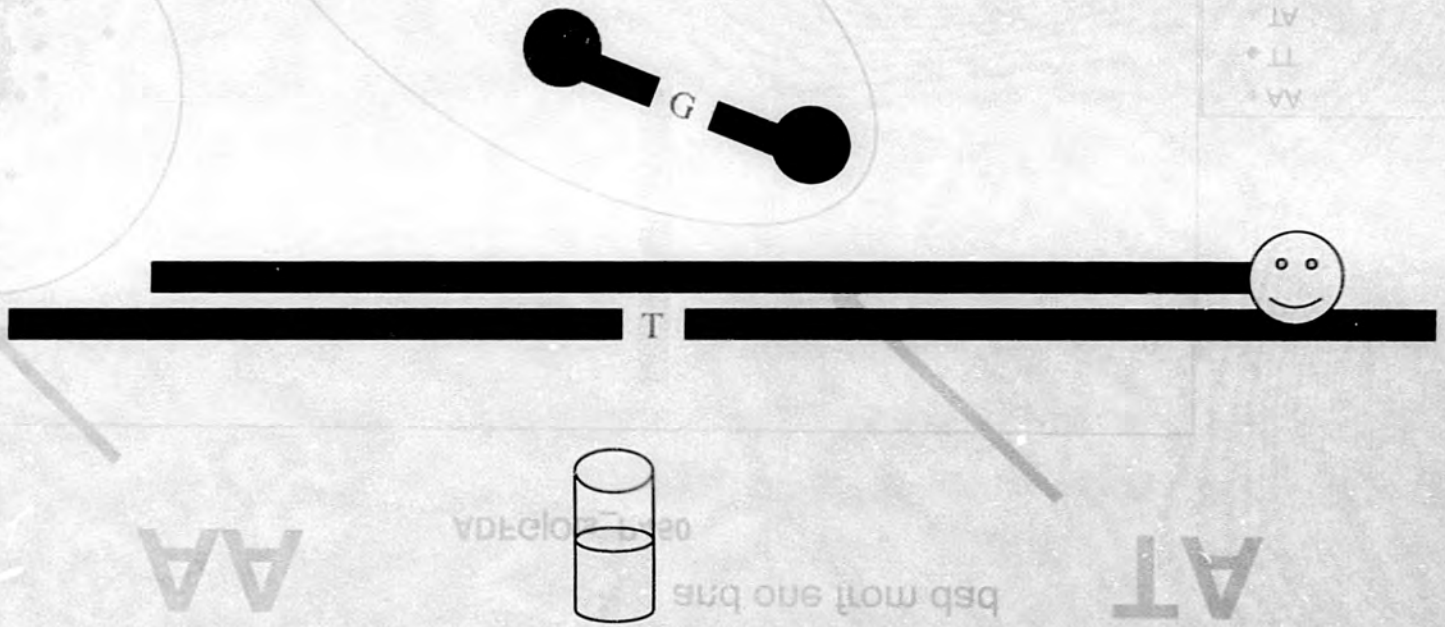
Taq-man

probe



5’-nuclease assay

Taq-man probe

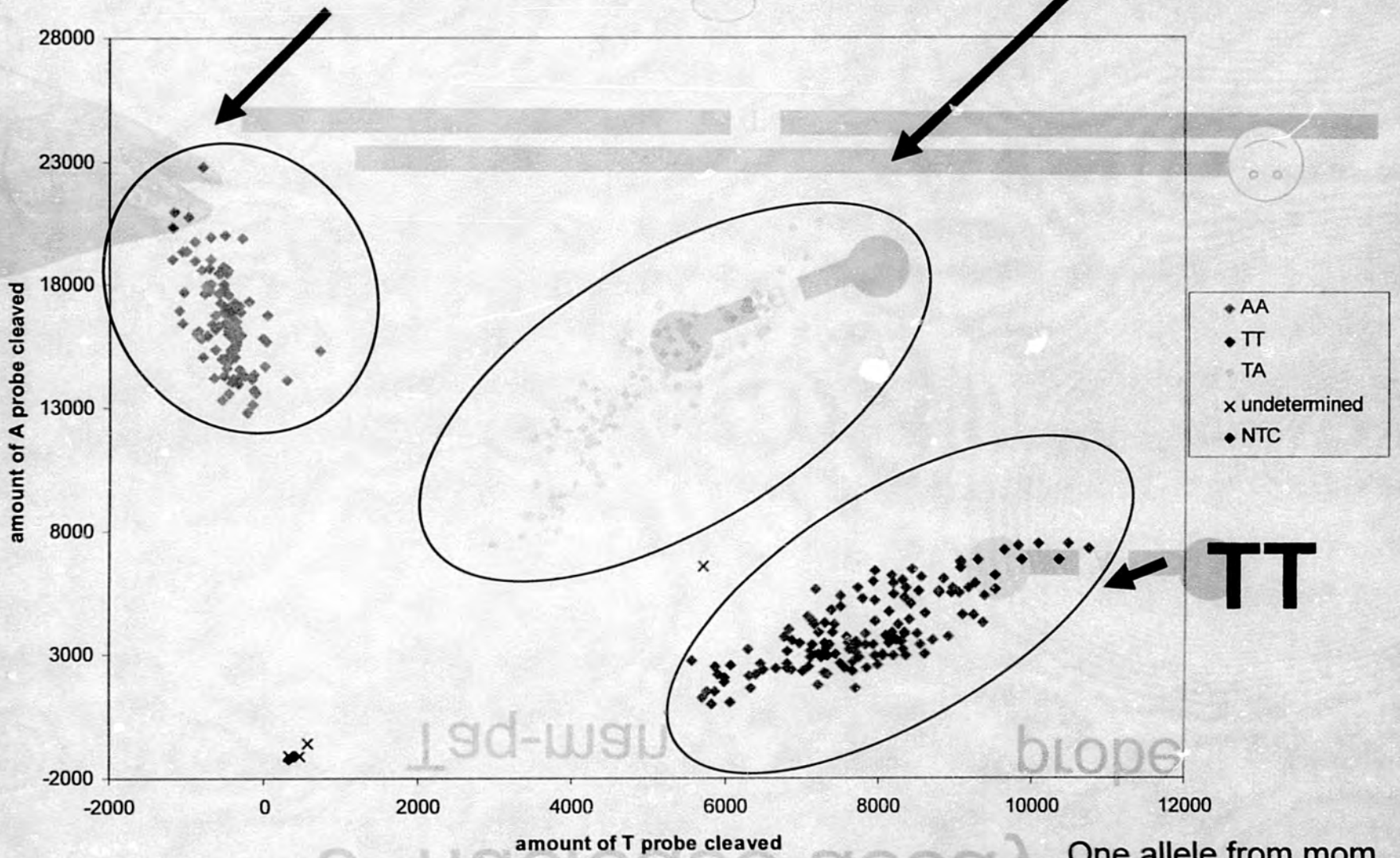


One allele from mom and one from dad

AA

One allele from mom and one from dad

TA

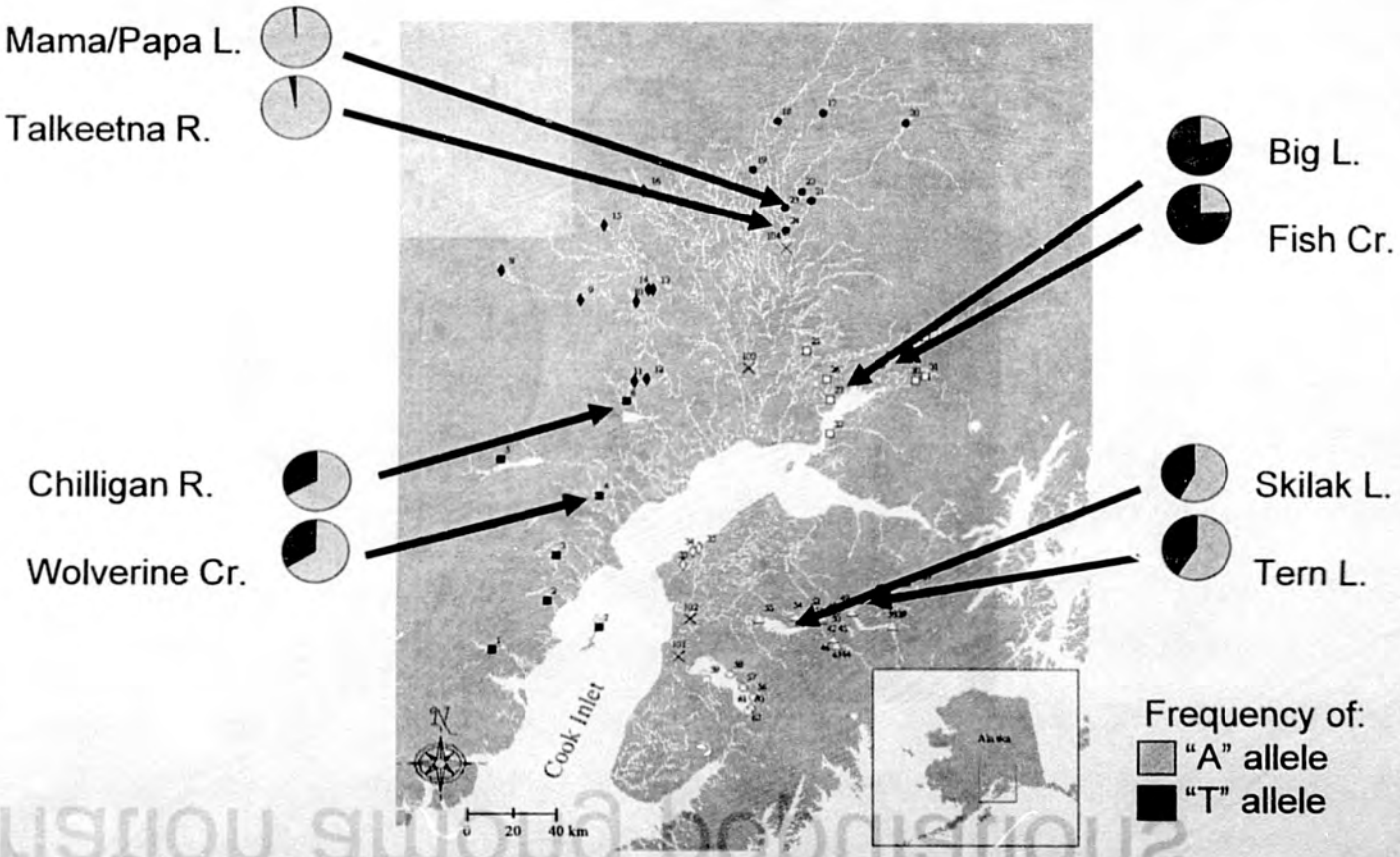


TT

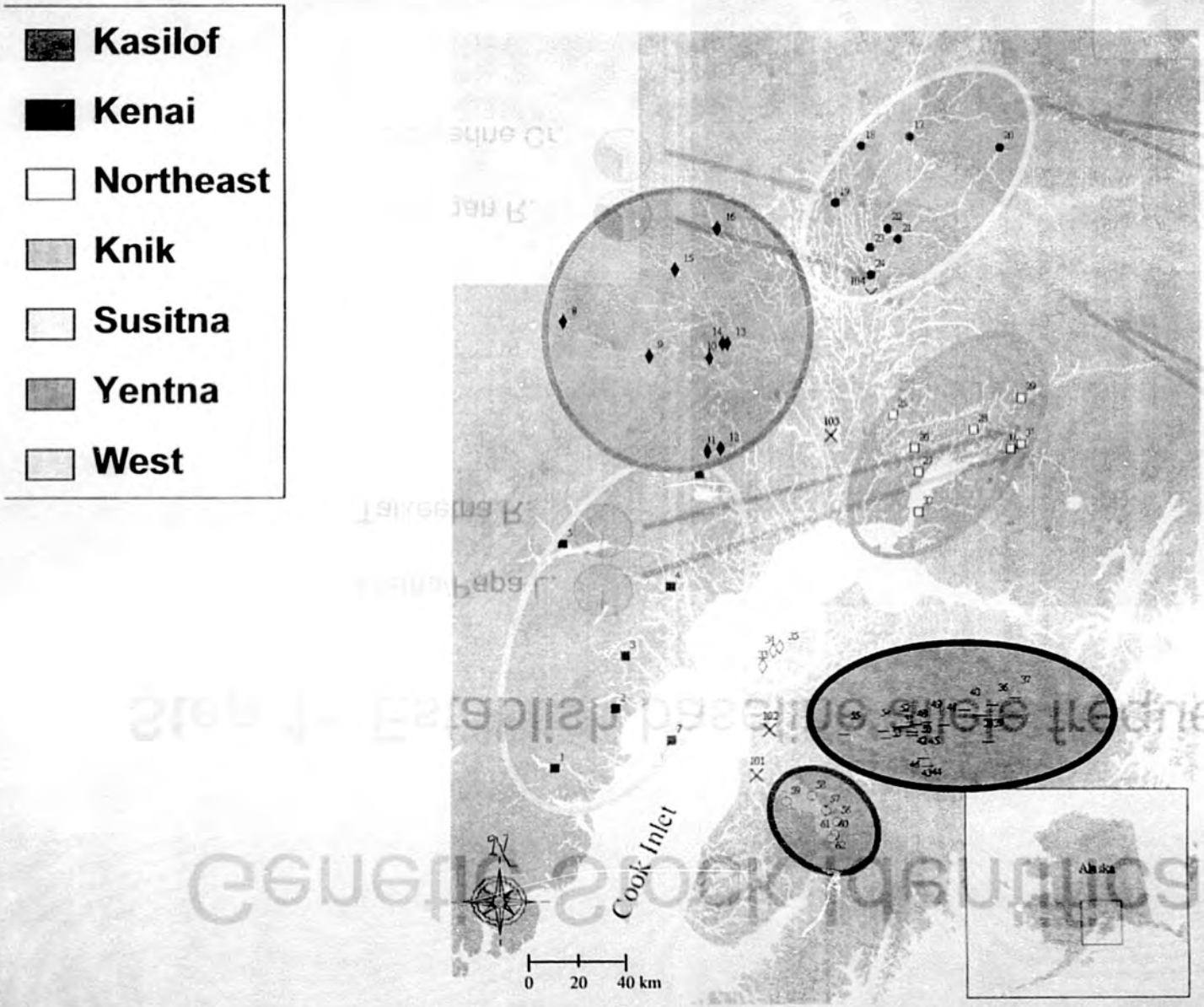
One allele from mom and one from dad

Genetic Stock Identification

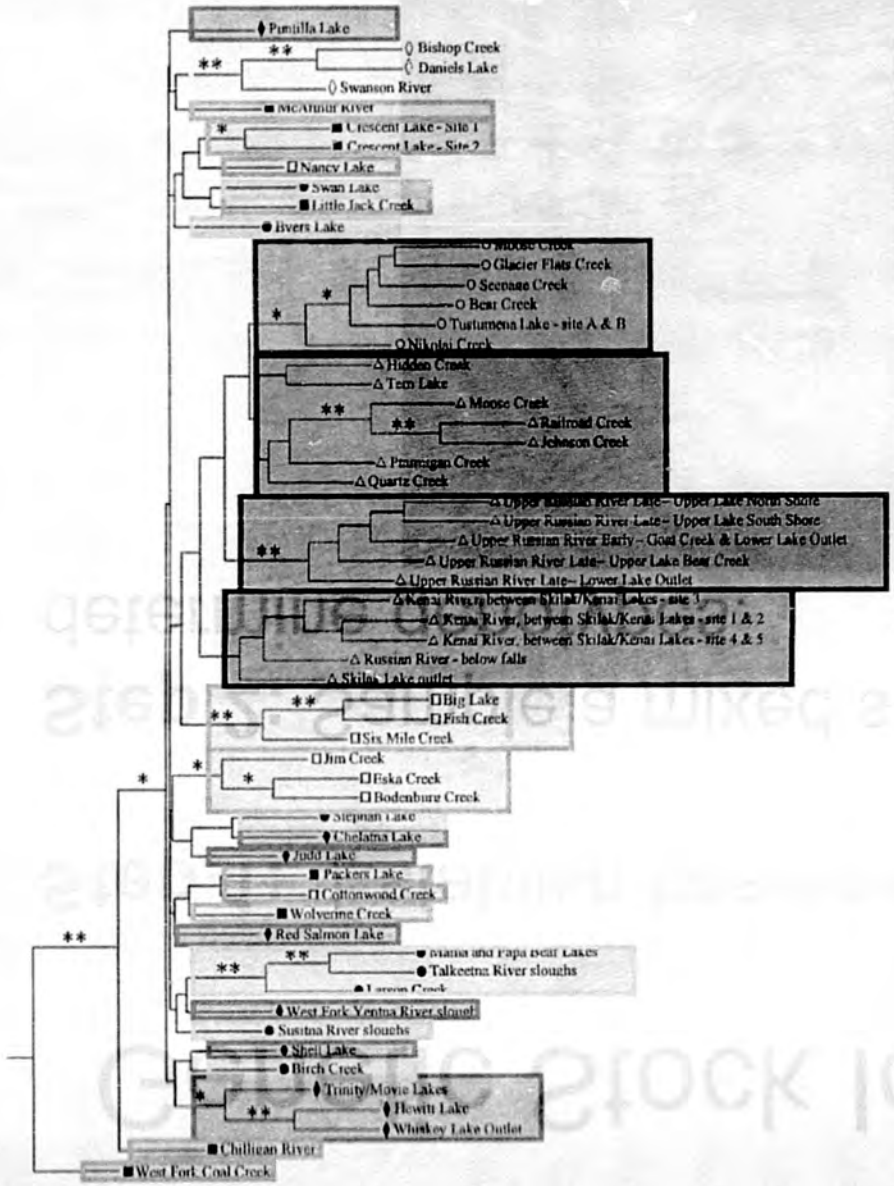
Step 1: Establish baseline allele frequencies.



Variation among populations



N-J tree on Nei distances



- Kasilof
- Kenai
- Northeast
- Knik
- Susitna
- Yentna
- West

Genetic Stock Identification

Step 1: Establish baseline allele frequencies.

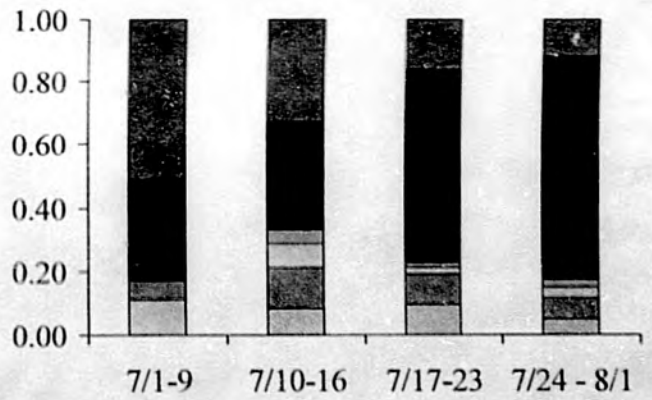
Step 2: Sample a mixed stock fishery and determine genotypes.

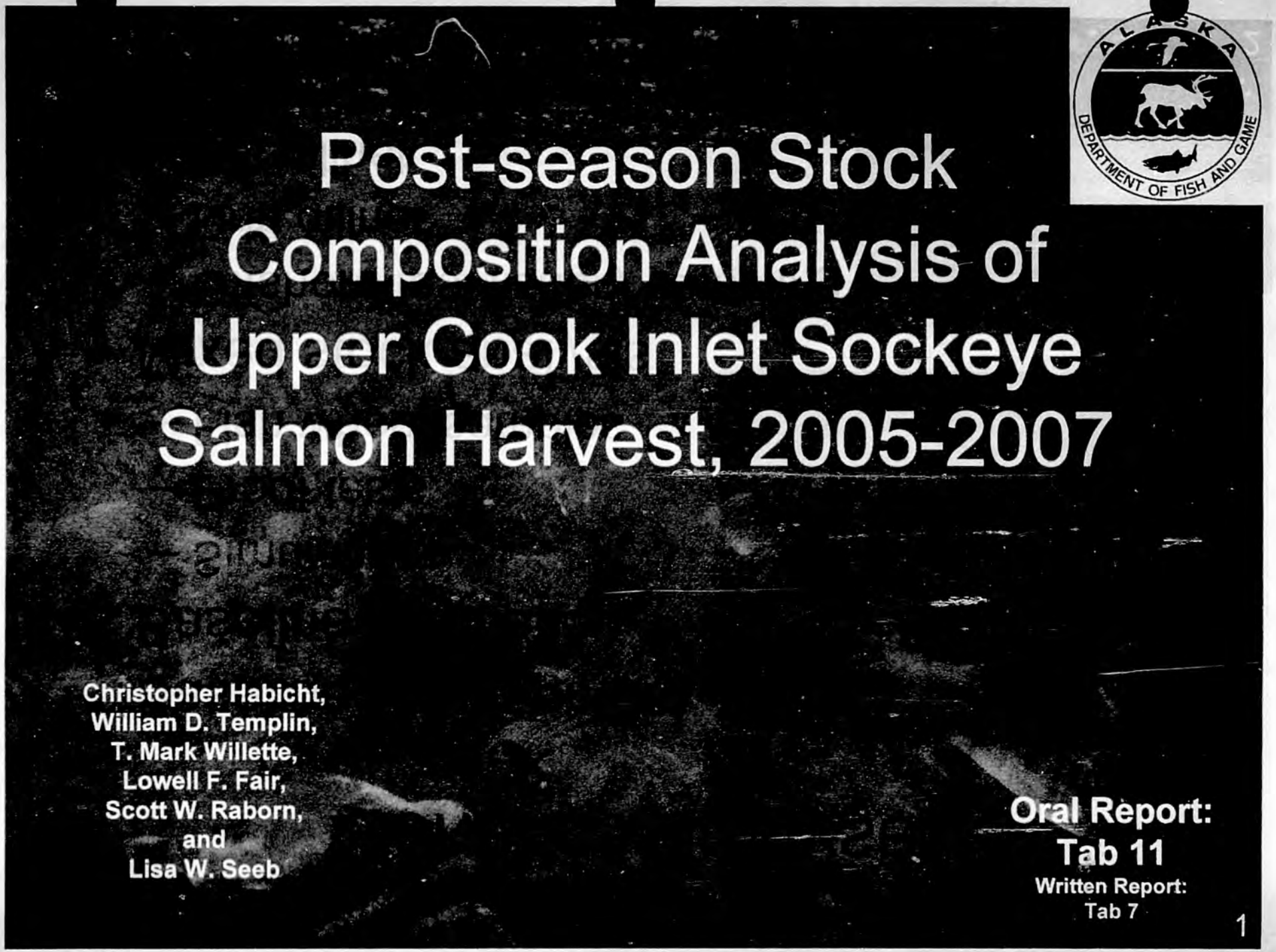
Genetic Stock Identification

Step 1: Establish baseline allele frequencies.

Step 2: Sample a mixed stock fishery and determine genotypes.

Step 3: Estimate stock composition that will best explain the mixture genotypes (fishery).





Post-season Stock Composition Analysis of Upper Cook Inlet Sockeye Salmon Harvest, 2005-2007

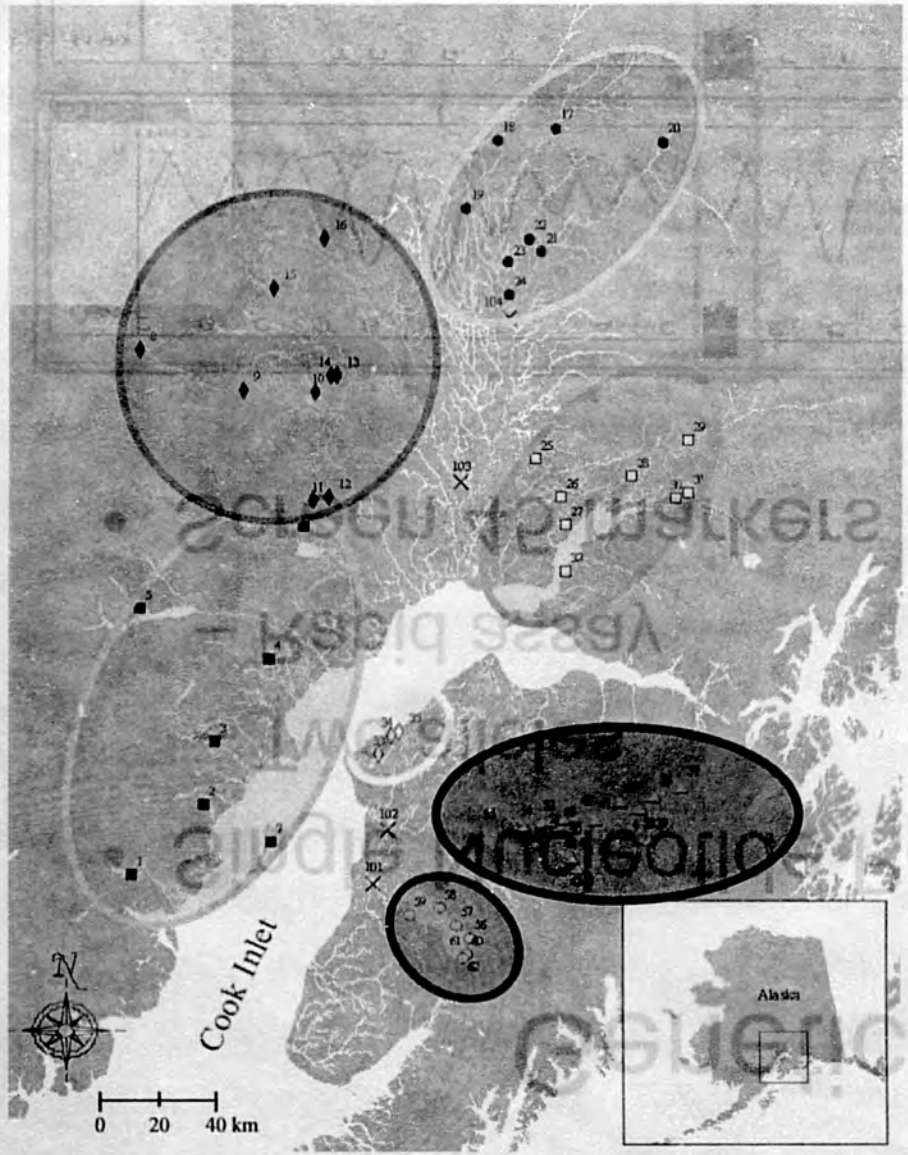
Christopher Habicht,
William D. Templin,
T. Mark Willette,
Lowell F. Fair,
Scott W. Raborn,
and
Lisa W. Seeb

Oral Report:
Tab 11
Written Report:
Tab 7

Genetics analyses

- Baseline development
- Baseline evaluation
  - Simulations
  - Proof tests
  - Fish wheel samples
- Mixed stock analysis
  - Offshore test fishery sampling
  - Drift gillnet
  - Set gillnet

Baseline collections – 7 reporting groups

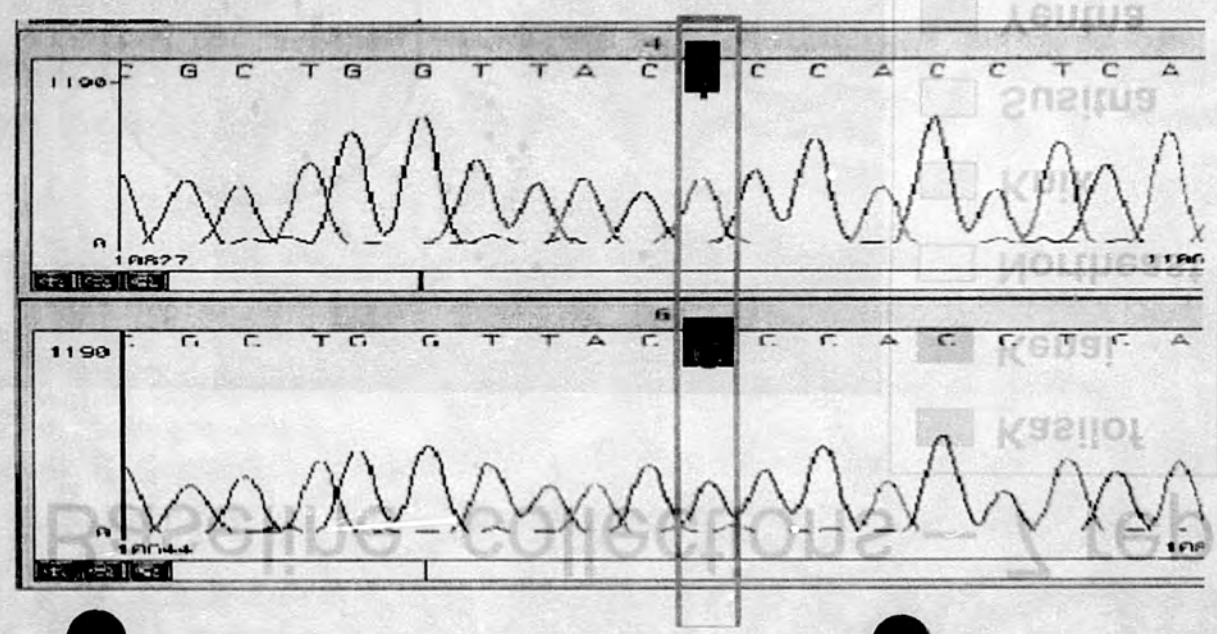


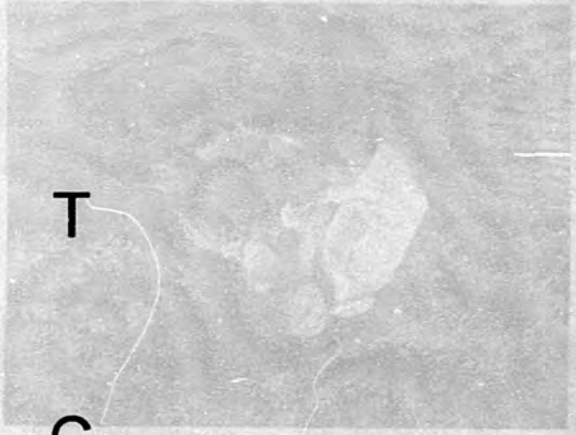
- Kasilof
- Kenai
- Northeast
- Knik
- Susitna
- Yentna
- West

- 1992 to 2006
- 68 collections
- 62 locations

Genetic markers

- Single Nucleotide Polymorphisms (SNPs)
  - Two alleles
  - Rapid assay
- Screen 45 markers

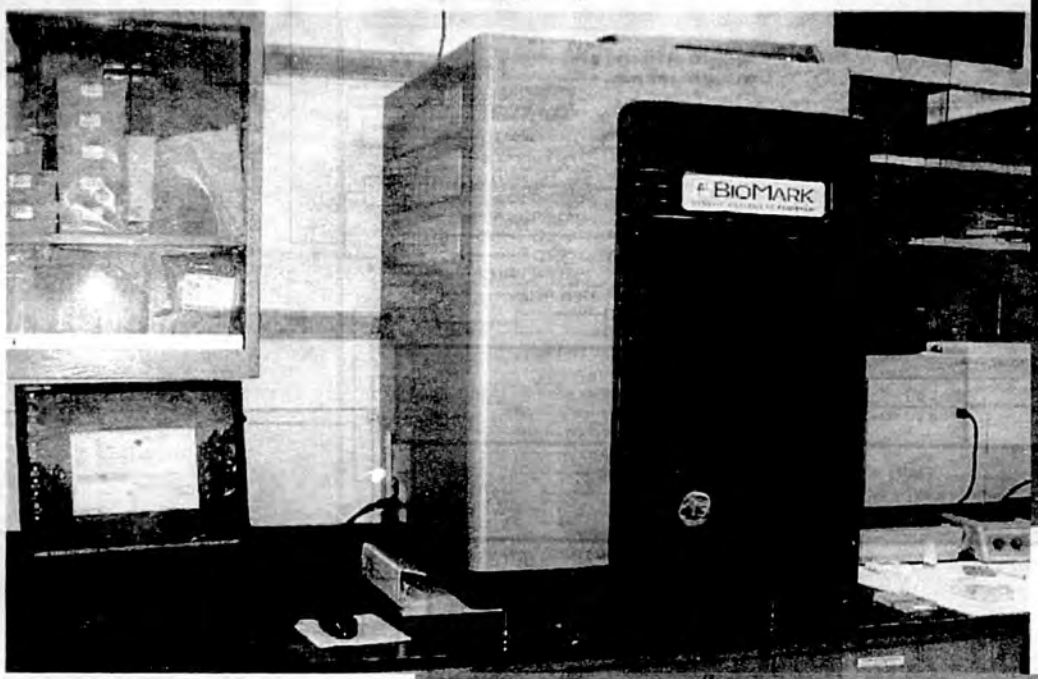


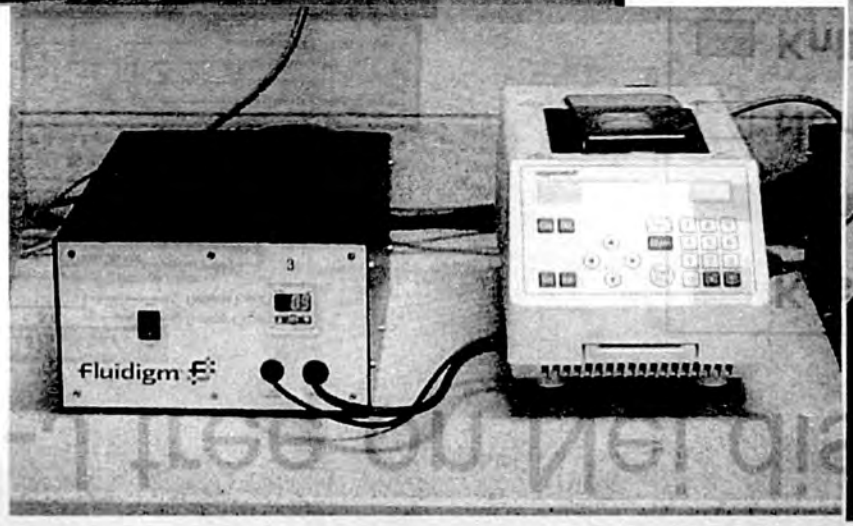


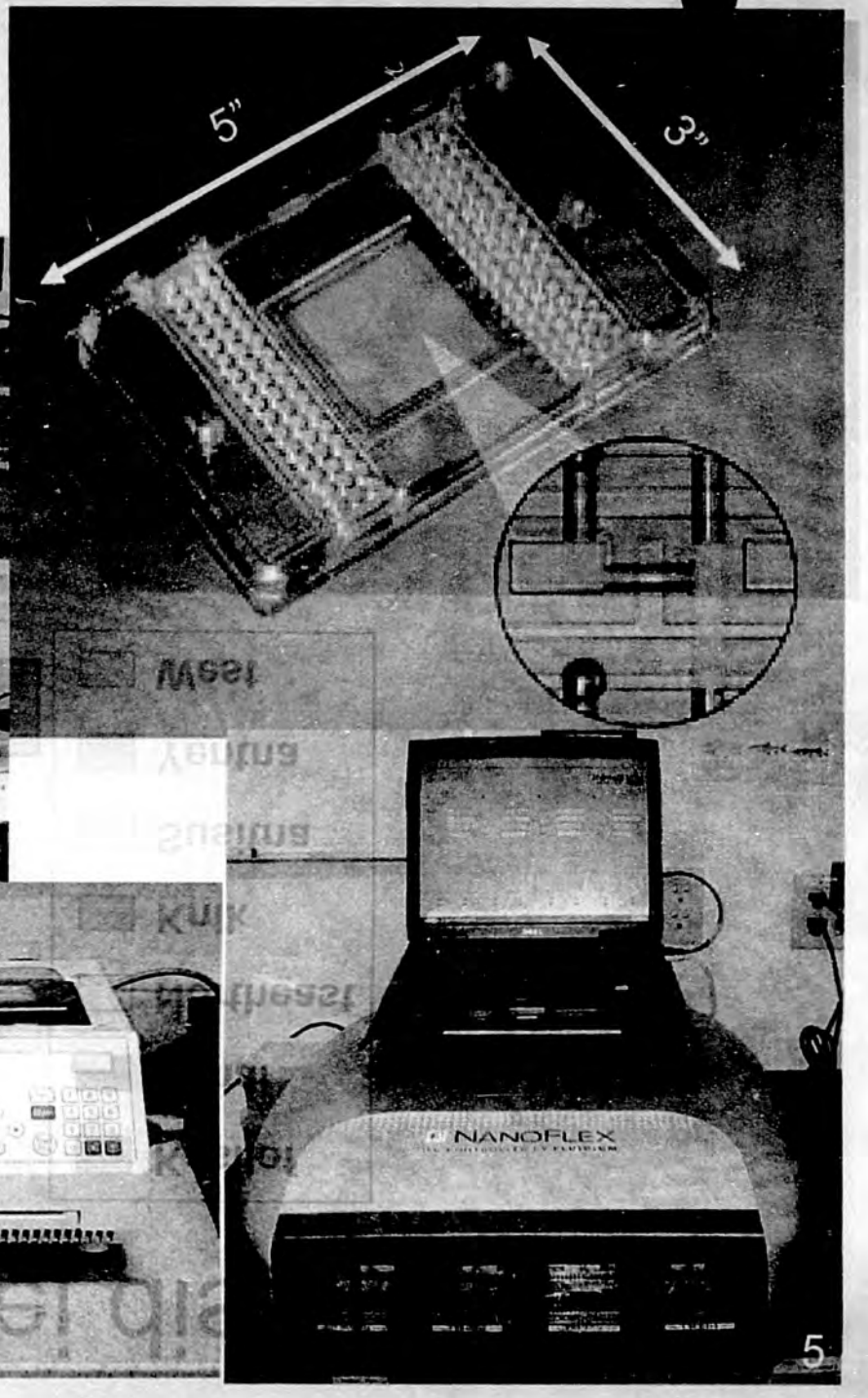
T

C

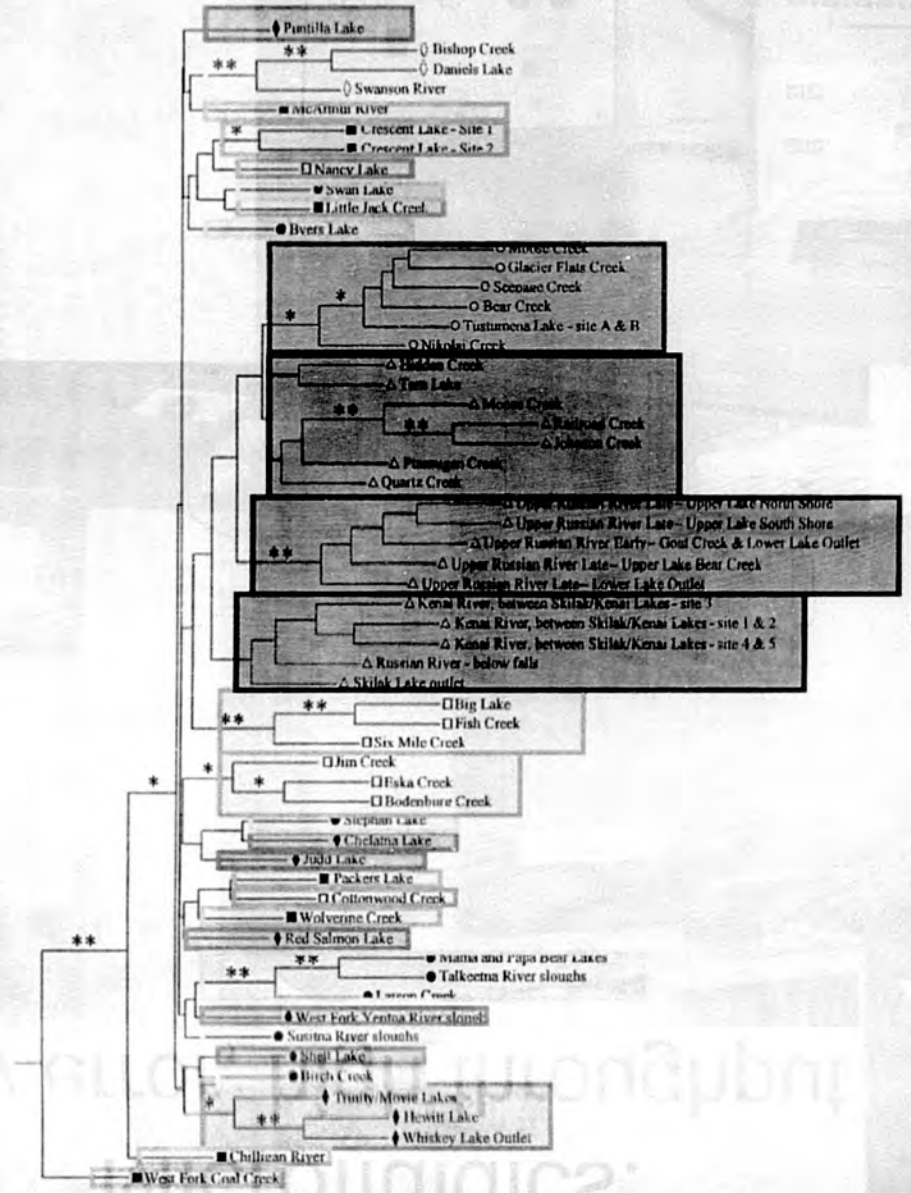
Microfluidics:
low error, high throughput

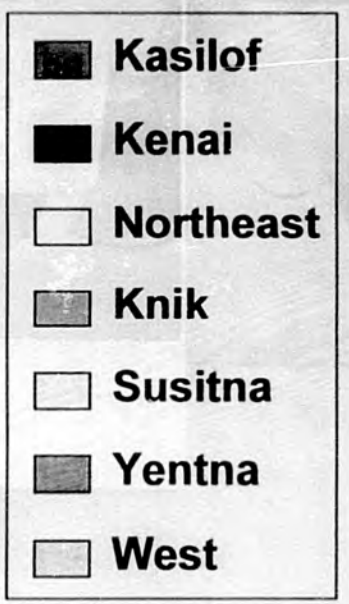




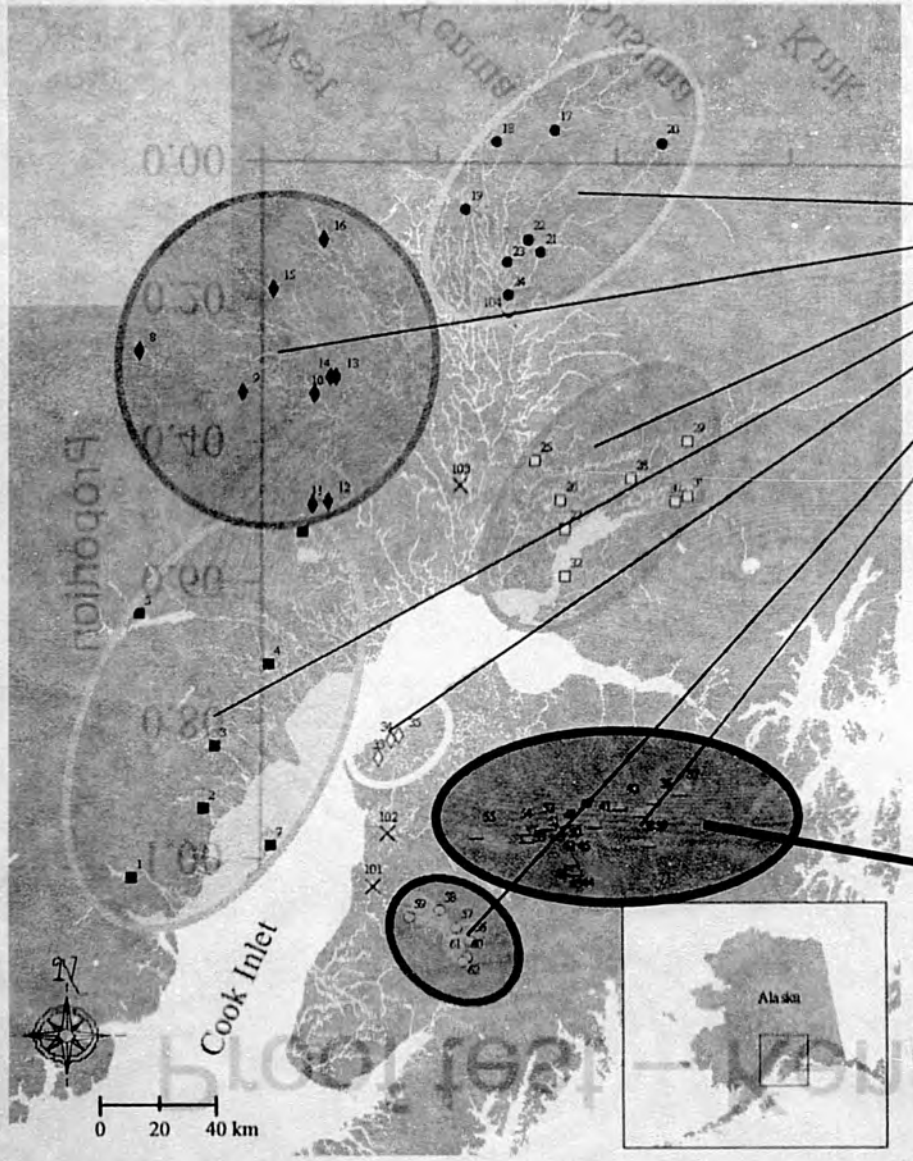


N-J tree on Nei distances





Proof tests - methods



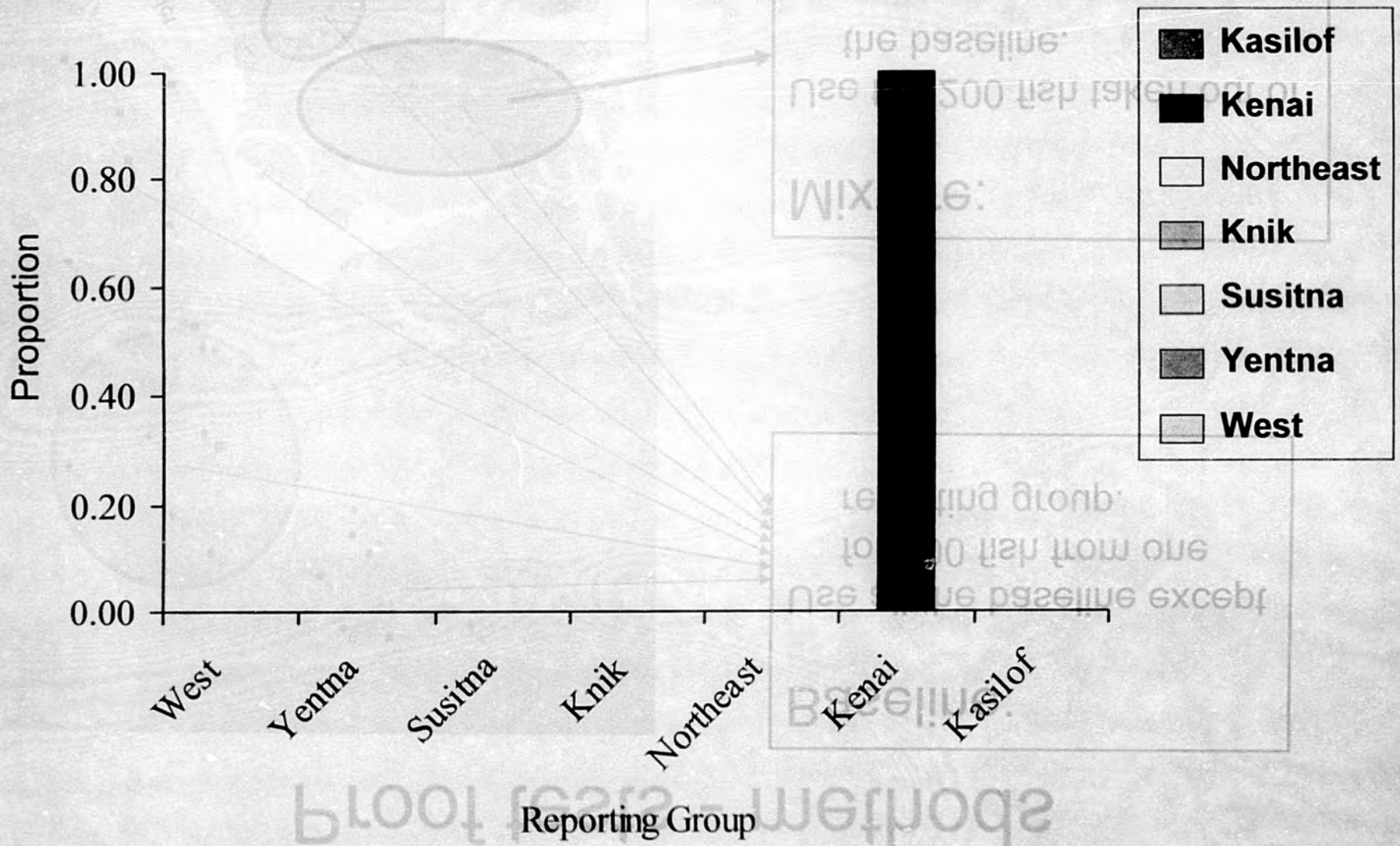
Baseline:

Use all the baseline except for 200 fish from one reporting group.

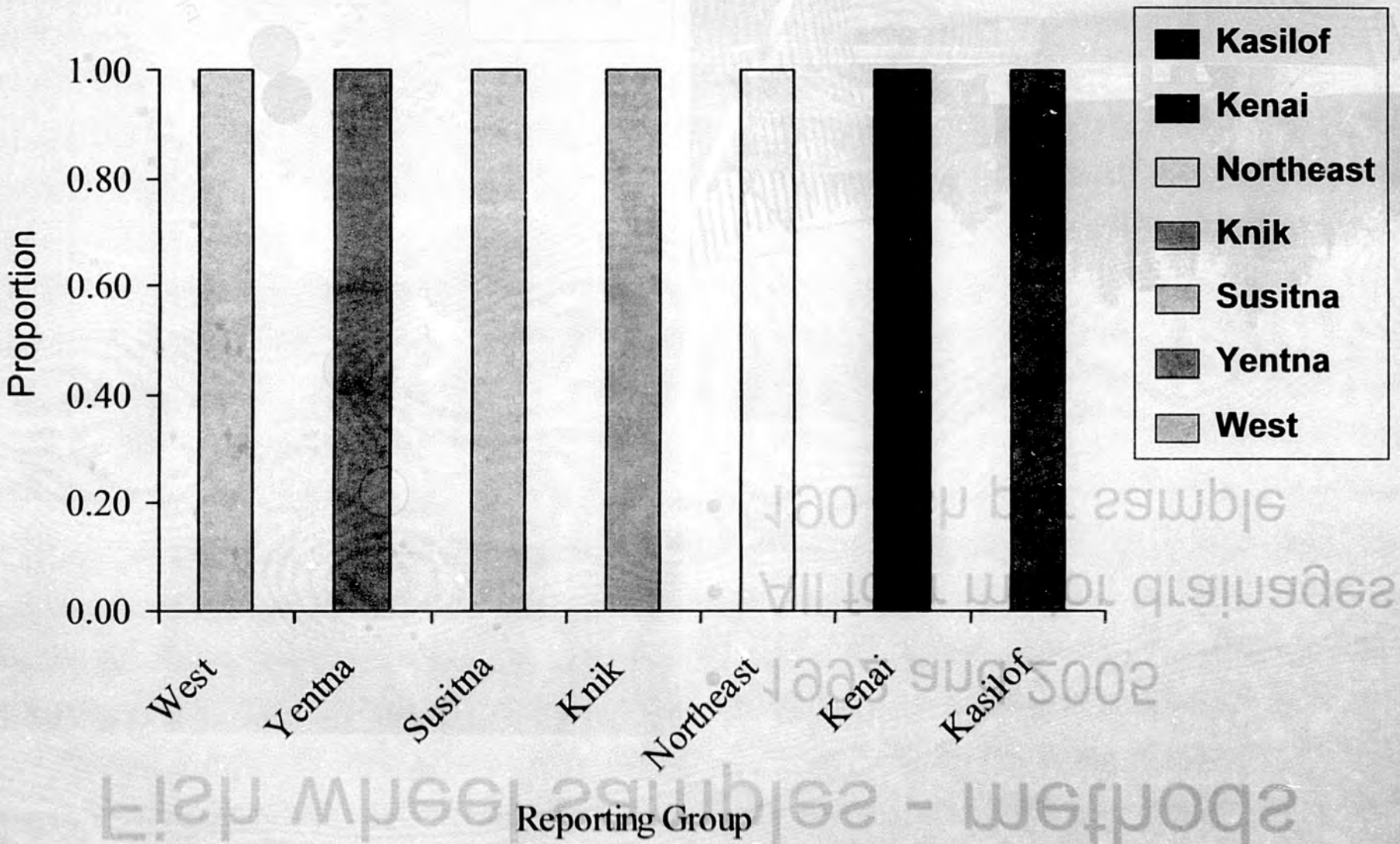
Mixture:

Use the 200 fish taken out of the baseline.

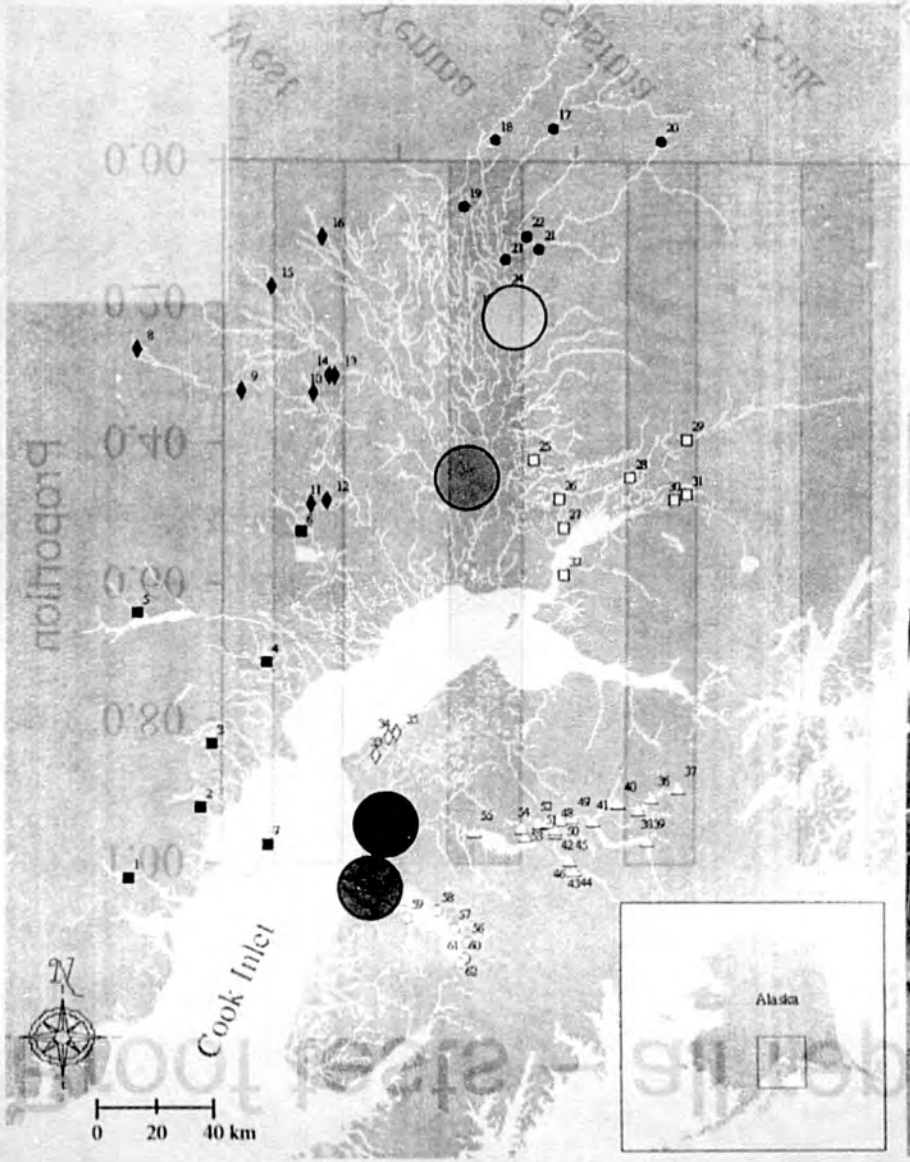
Proof test – Kenai reporting group



Proof tests – all reporting groups good

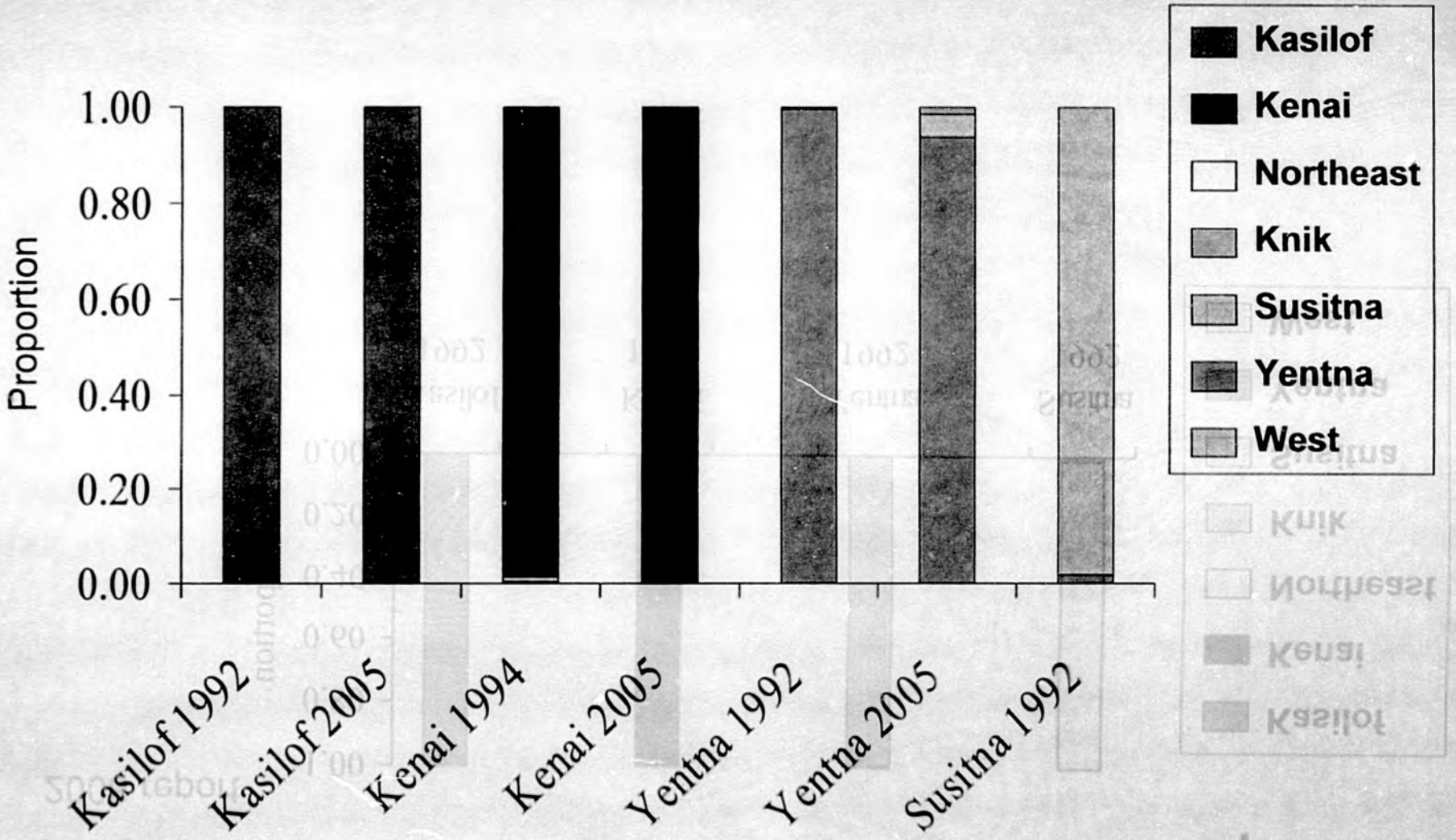


Fish wheel samples - methods



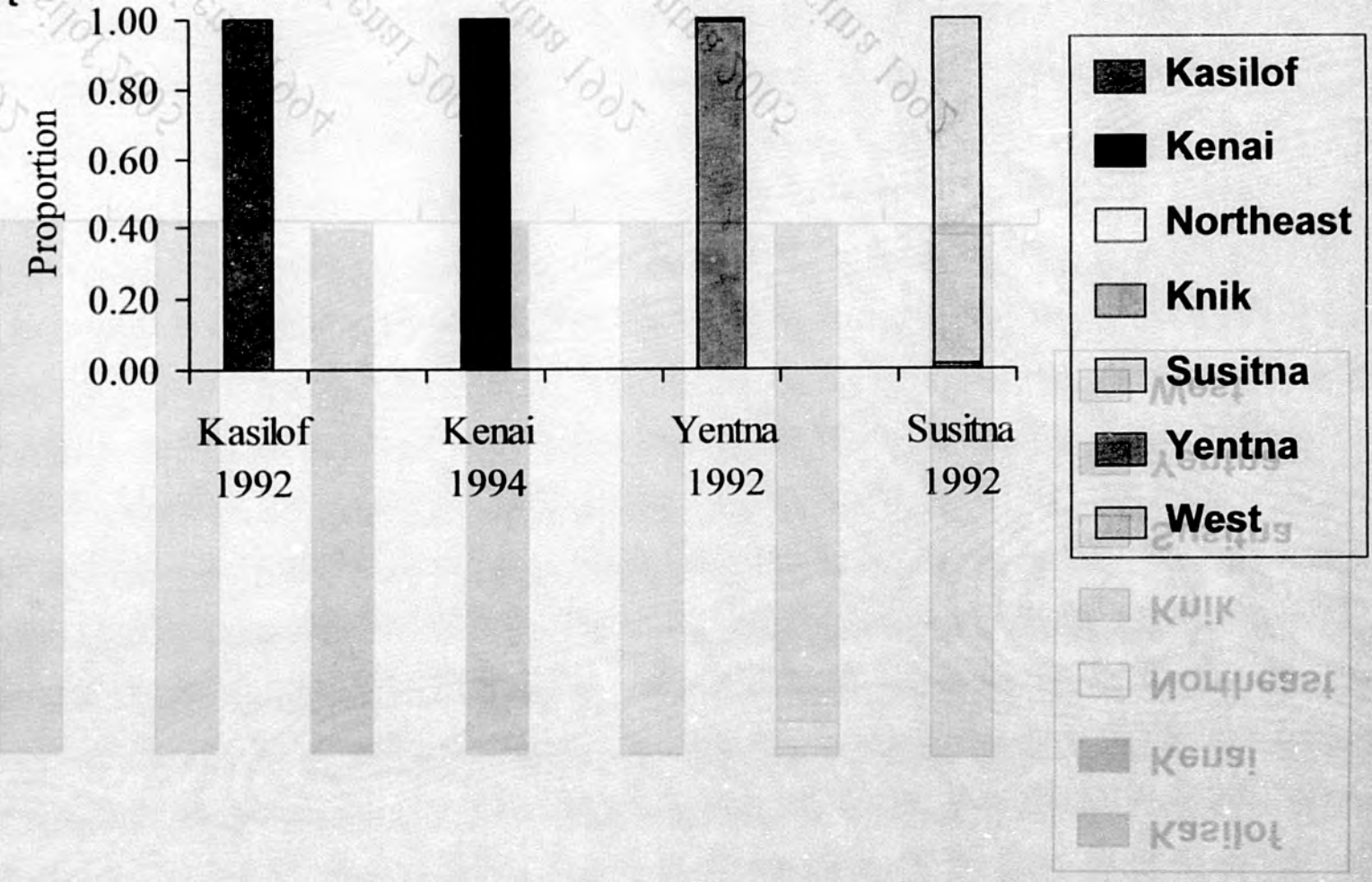
- 1992 and 2005
- All four major drainages
- 190 fish per sample

Fish wheel results – baseline near-saturation



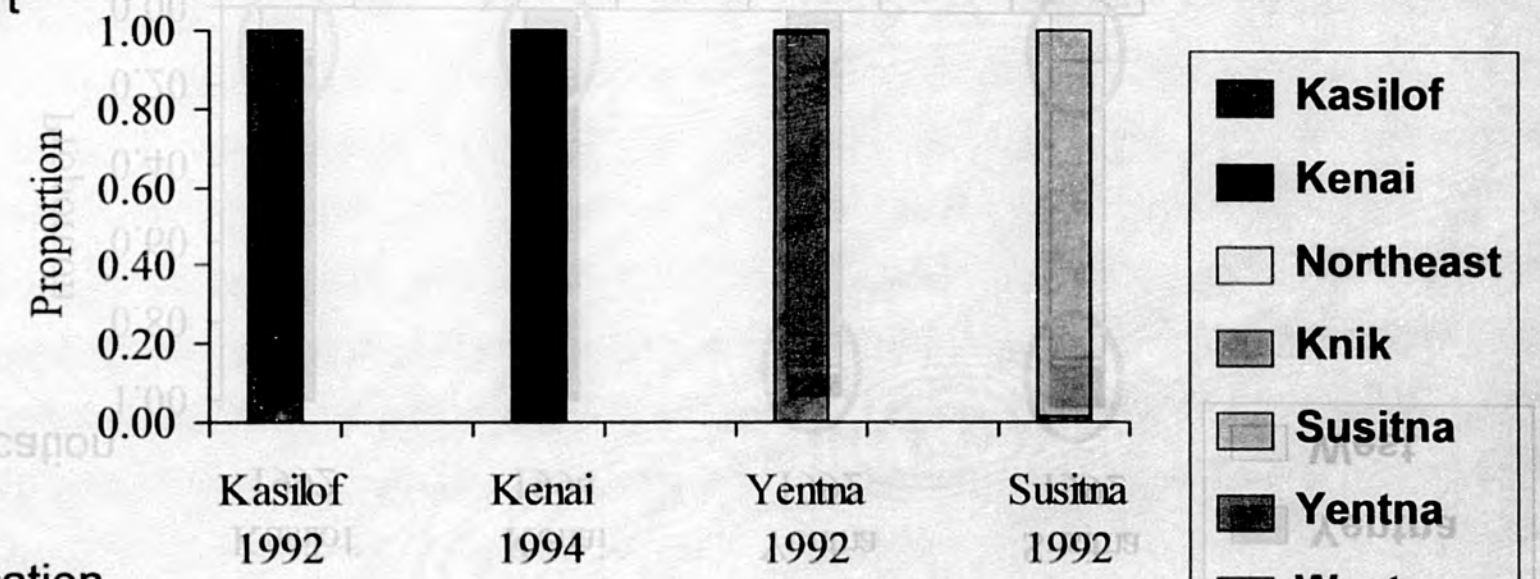
Fish wheel results – 1990's samples

2008 report

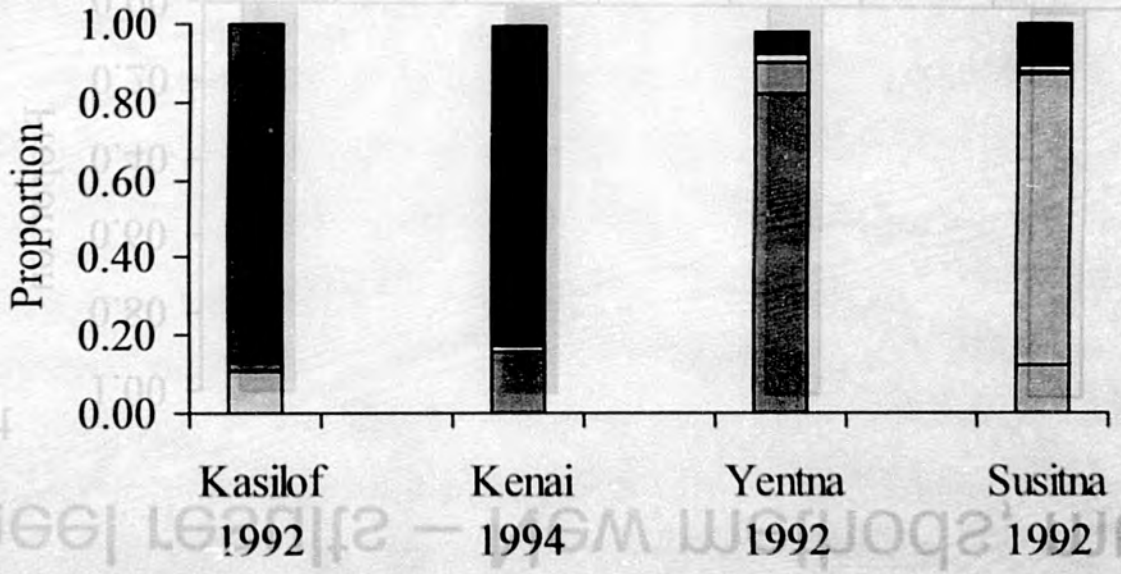


Fish wheel results – New methods, much better

2008 report

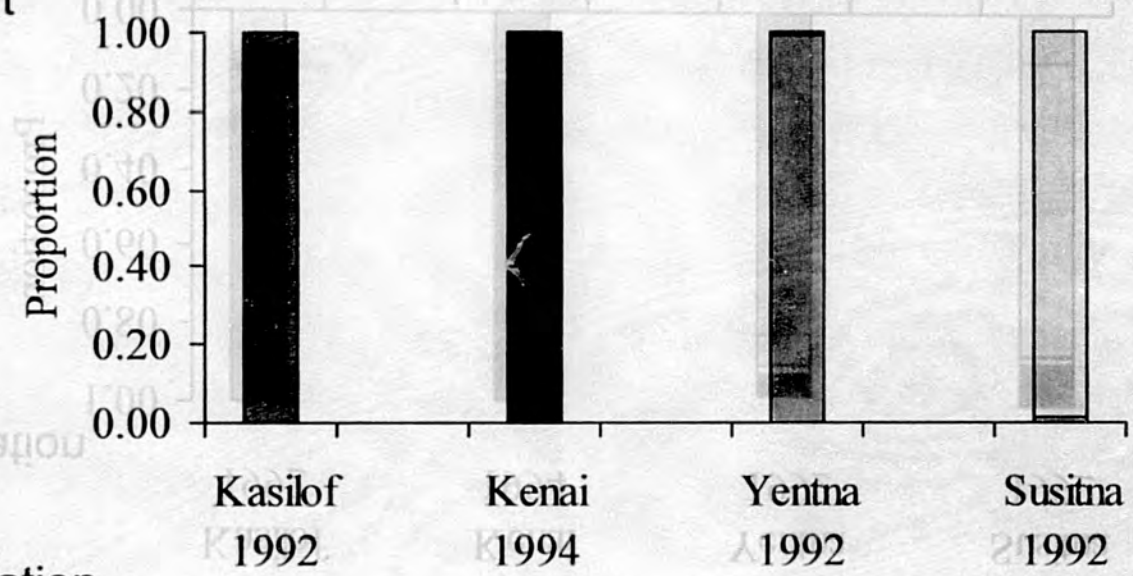


2000 publication

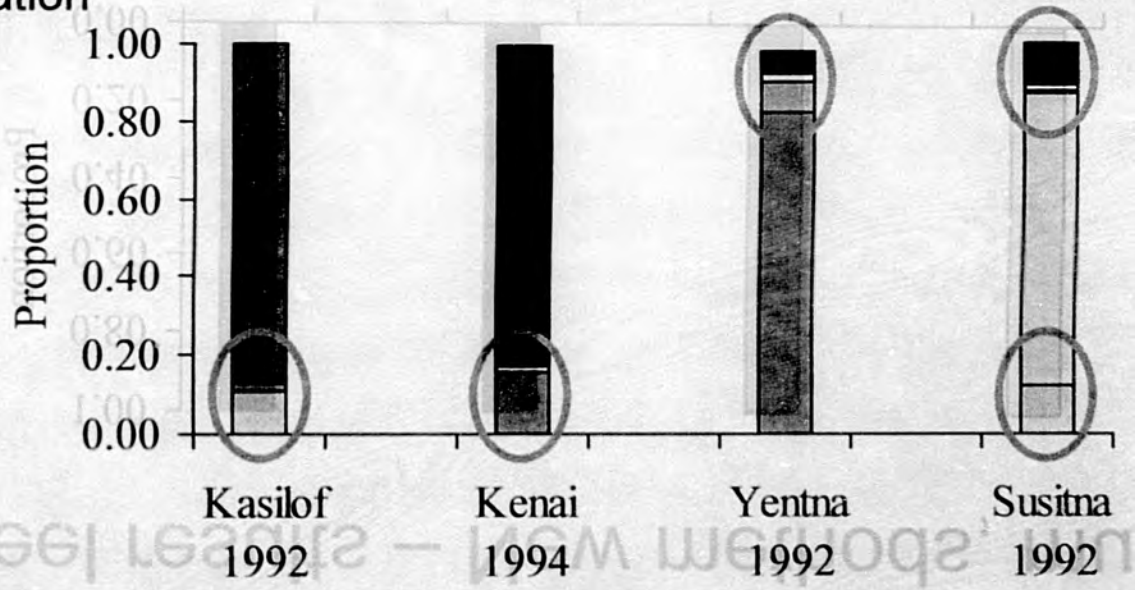


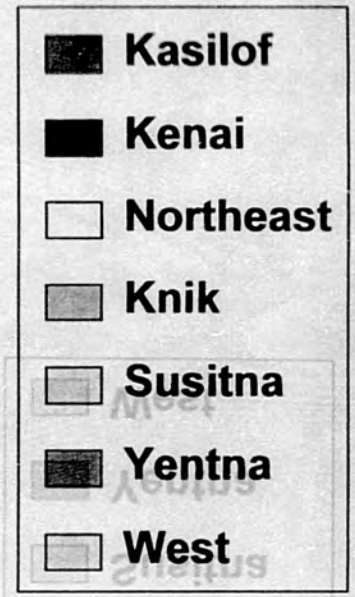
Fish wheel results – New methods, much better

2008 report



2000 publication





Two sources of statistical error

- Genetic error
  - Uncertainty due to use of genetics as a mark.
  - Proof tests and fish wheels indicate these are small.

- Sampling error
  - Uncertainty due to sampling of the harvest.
  - Estimate +- 5% of the true value with sample size of 400 fish, 90% of the time (+- 7% with 200 fish).
  - Samples need to represent the harvest.

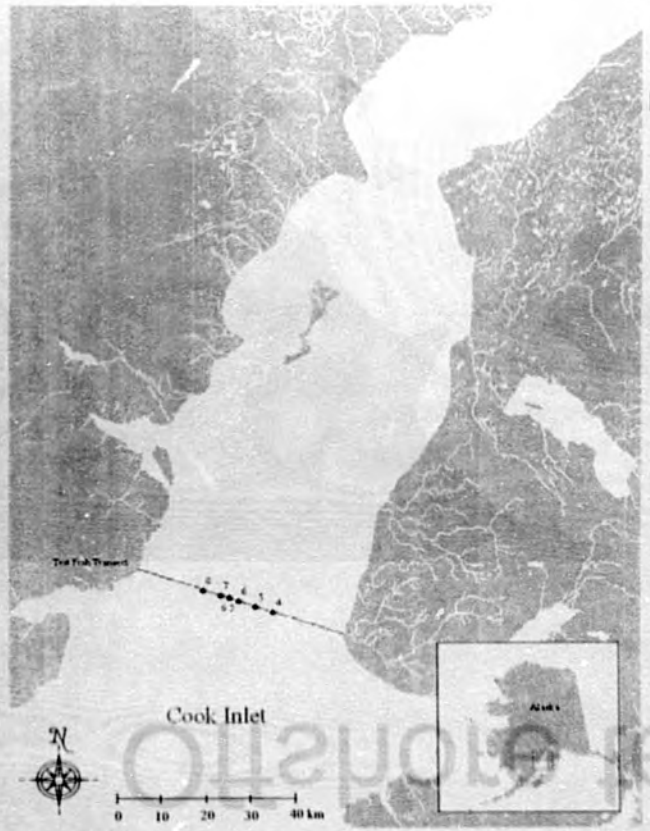
Sampling mixtures

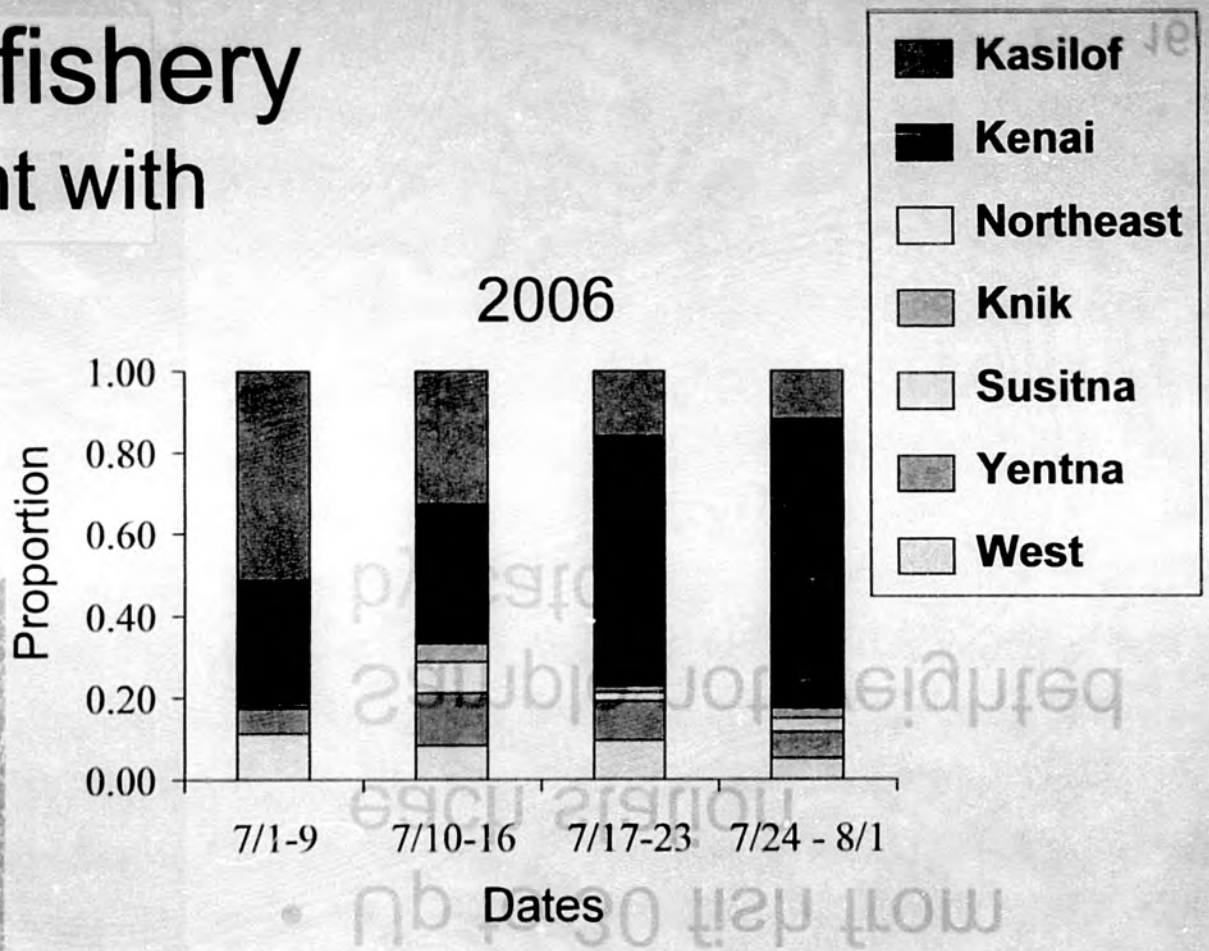
Offshore test fishery - methods

- 2006 and 2007
- Up to 30 fish from each station
- Sample not weighted by catch

Offshore test fishery

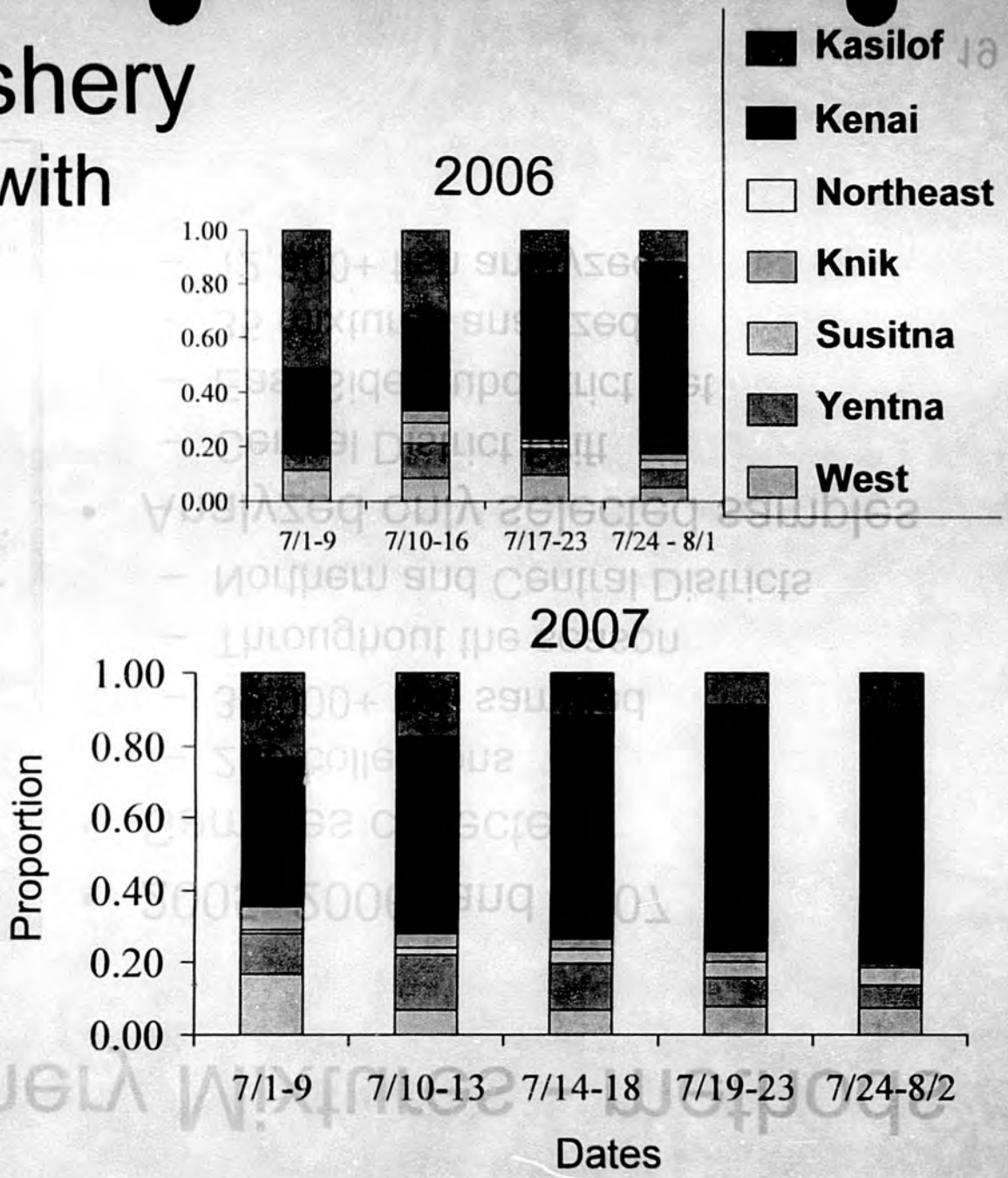
Pattern consistent with known run-timing



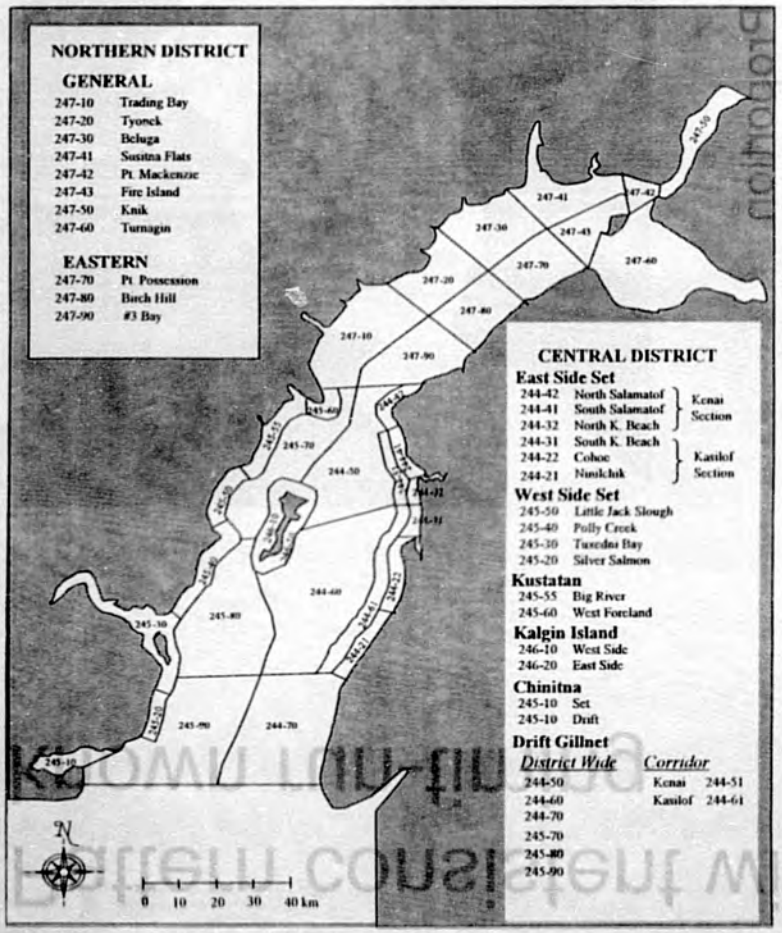


Offshore test fishery

Pattern consistent with known run-timing

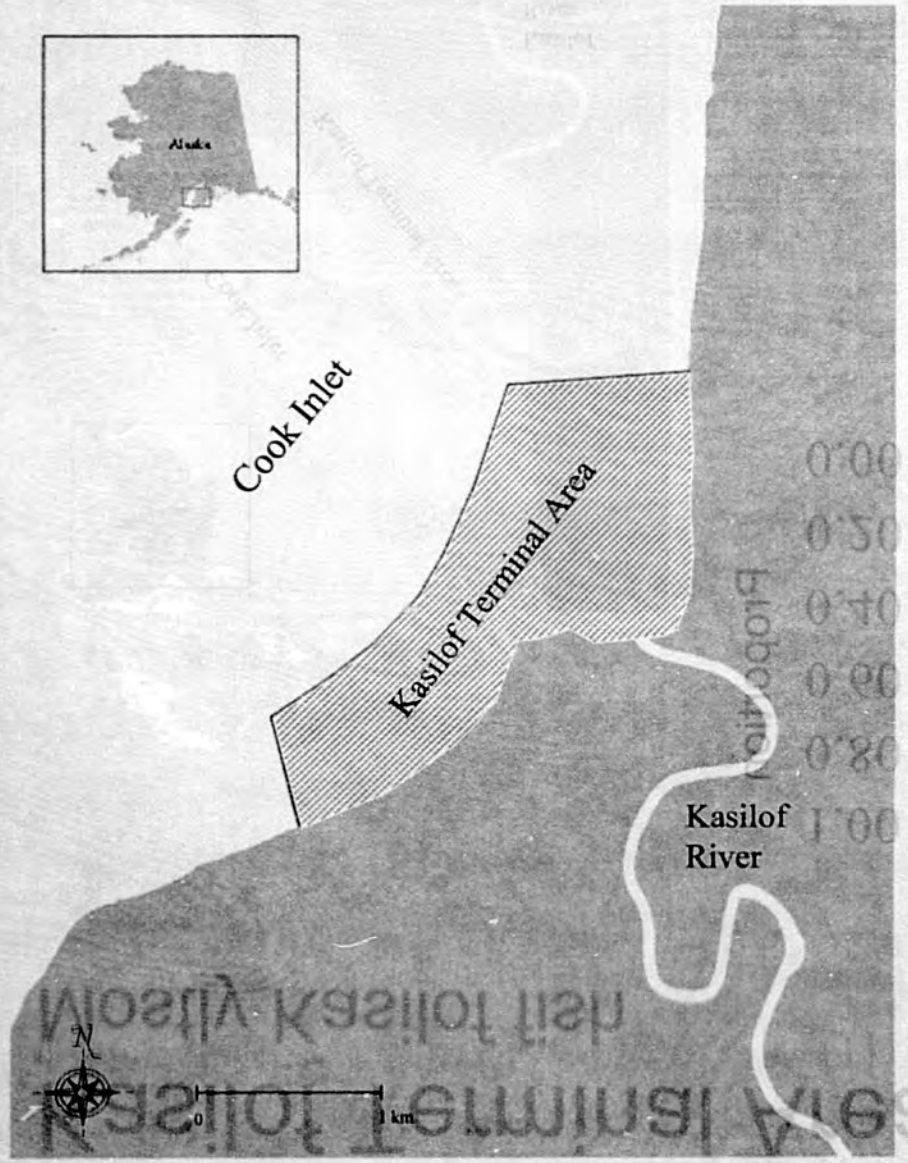


Sampling Fishery Mixtures - methods



- 2005, 2006, and 2007
- Samples collected
  - 230 collections
  - 39,000+ fish sampled
  - Throughout the season
  - Northern and Central Districts
- Analyzed only selected samples
  - Central District Drift
  - East Side Subdistrict Set
  - 35 mixtures analyzed
  - 12,300+ fish analyzed

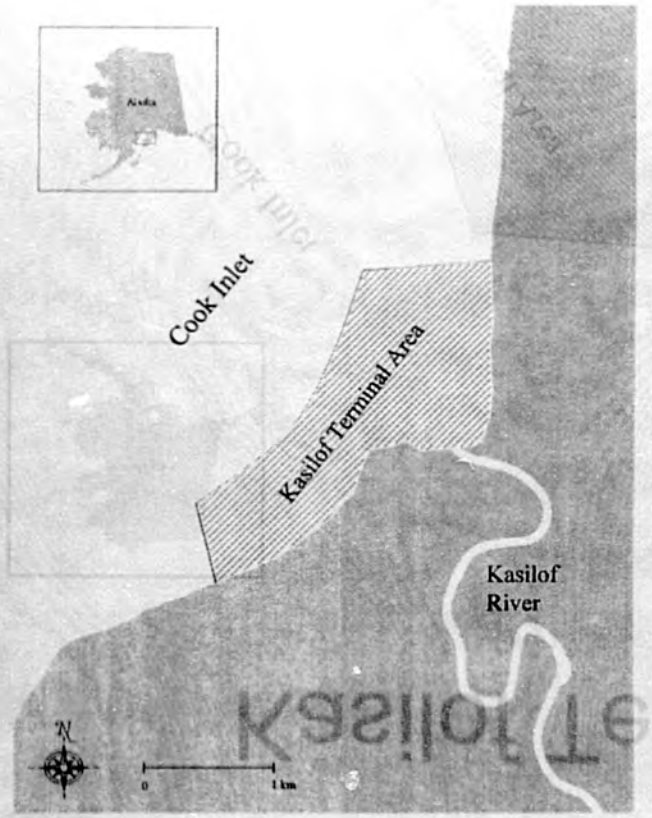
Kasilof Terminal Area - methods

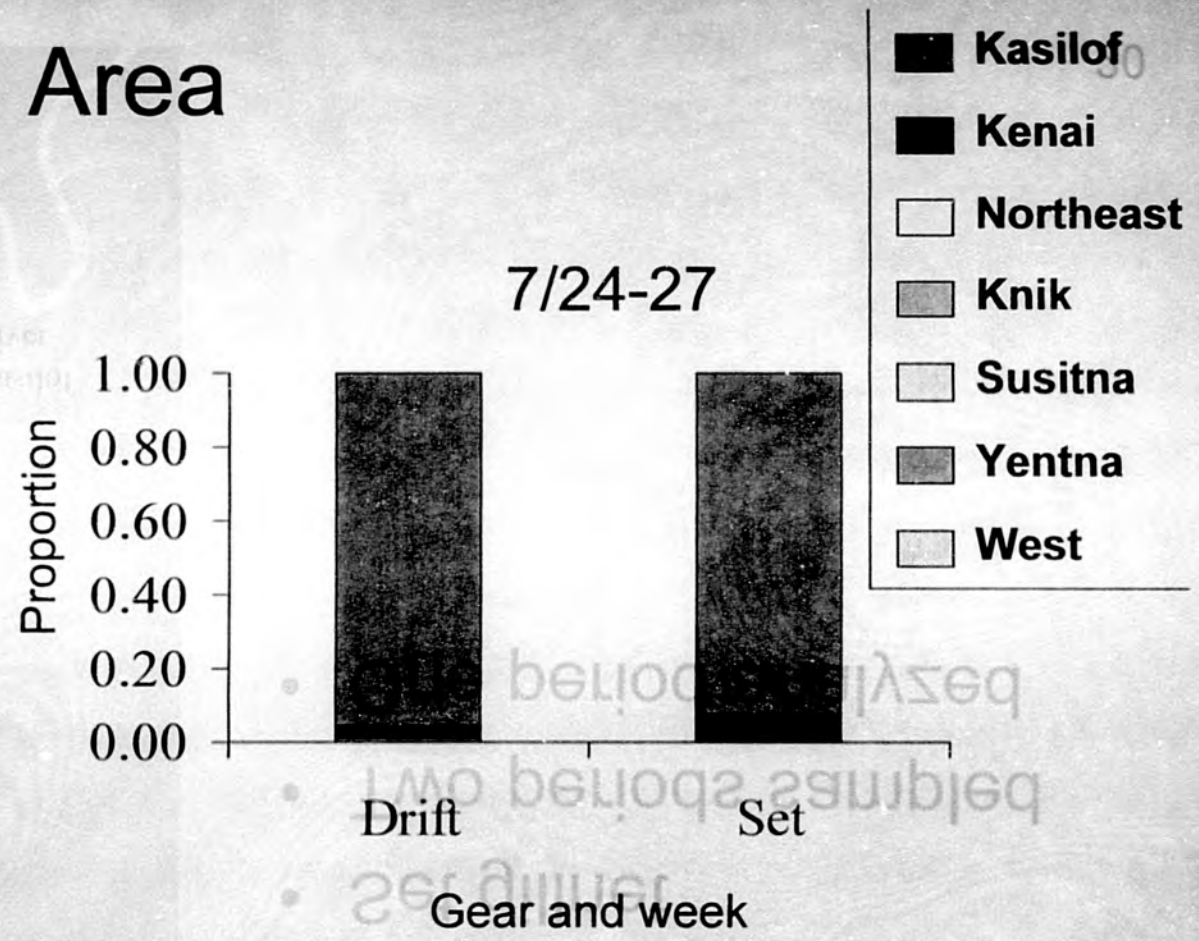


- Only 2006
- Drift gillnet
- Set gillnet
- Two periods sampled
- One period analyzed

Kasilof Terminal Area

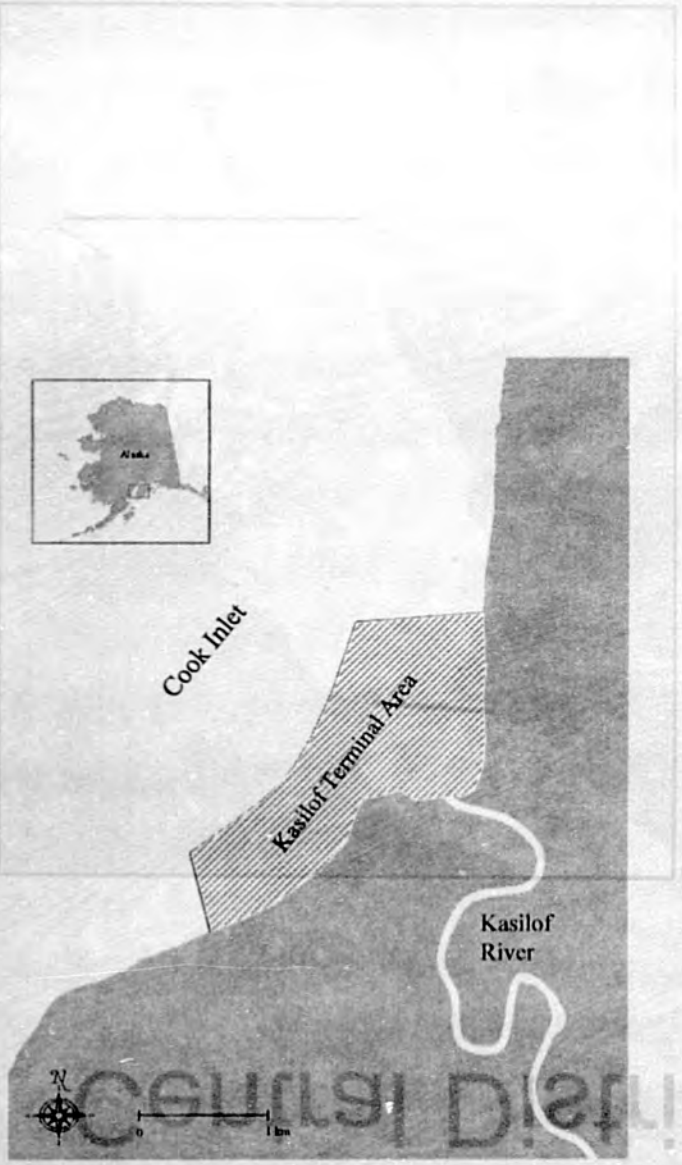
Mostly Kasilof fish

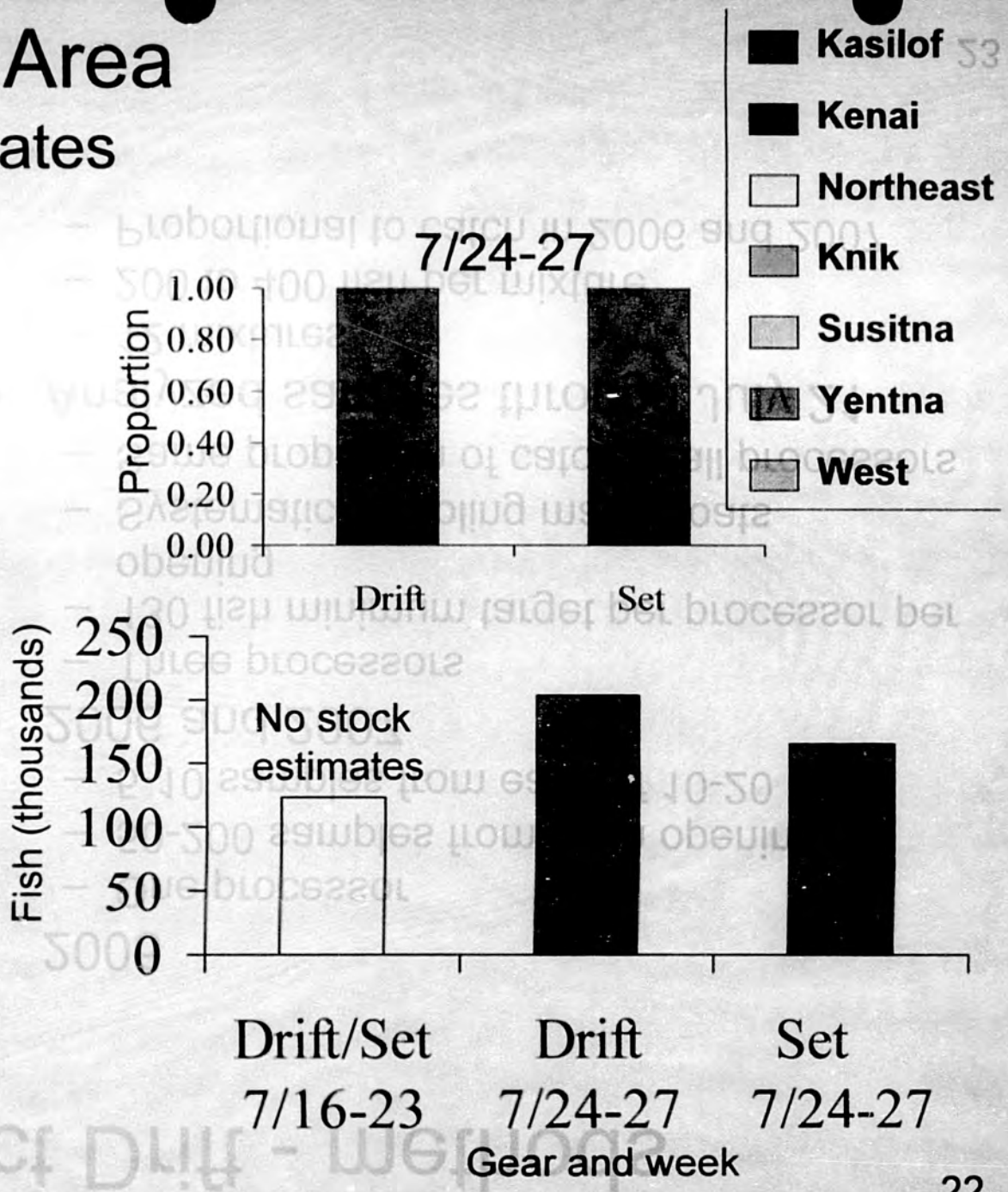




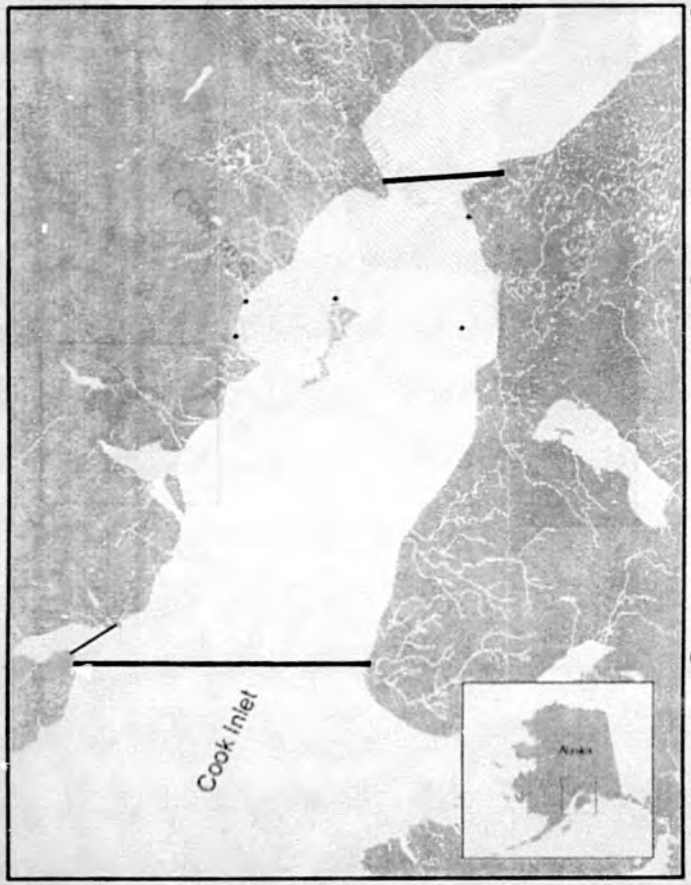
Kasilof Terminal Area

No early period estimates





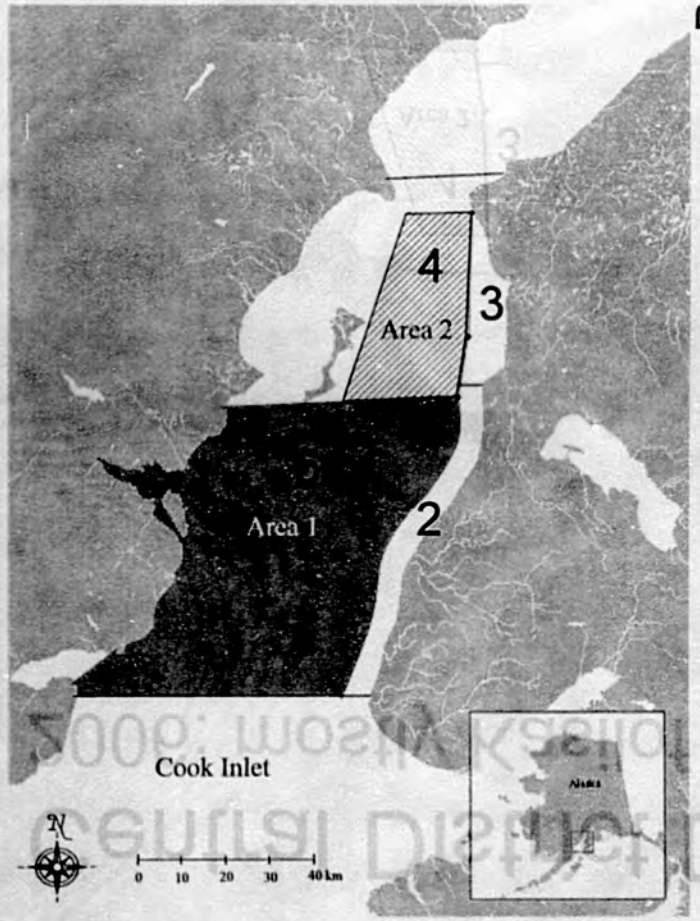
Central District Drift - methods

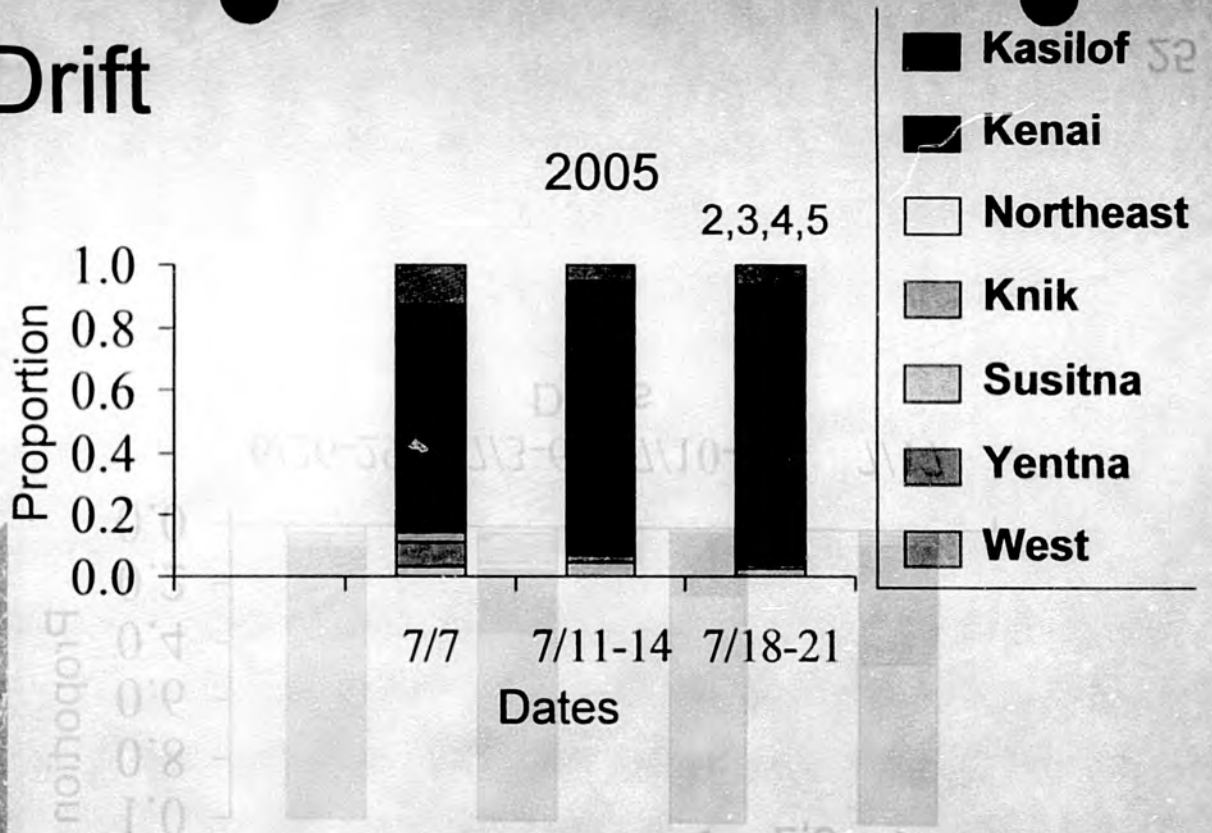


- 2005
  - One processor
  - 50-200 samples from each opening
  - 5-10 samples from each of 10-20 boats
- 2006 and 2007
  - Three processors
  - 130 fish minimum target per processor per opening
  - Systematic sampling many boats
  - Same proportion of catch at all processors
- Analyzed samples through July 21
  - 12 mixtures
  - 200 to 400 fish per mixture
  - Proportional to catch in 2006 and 2007

Central District Drift

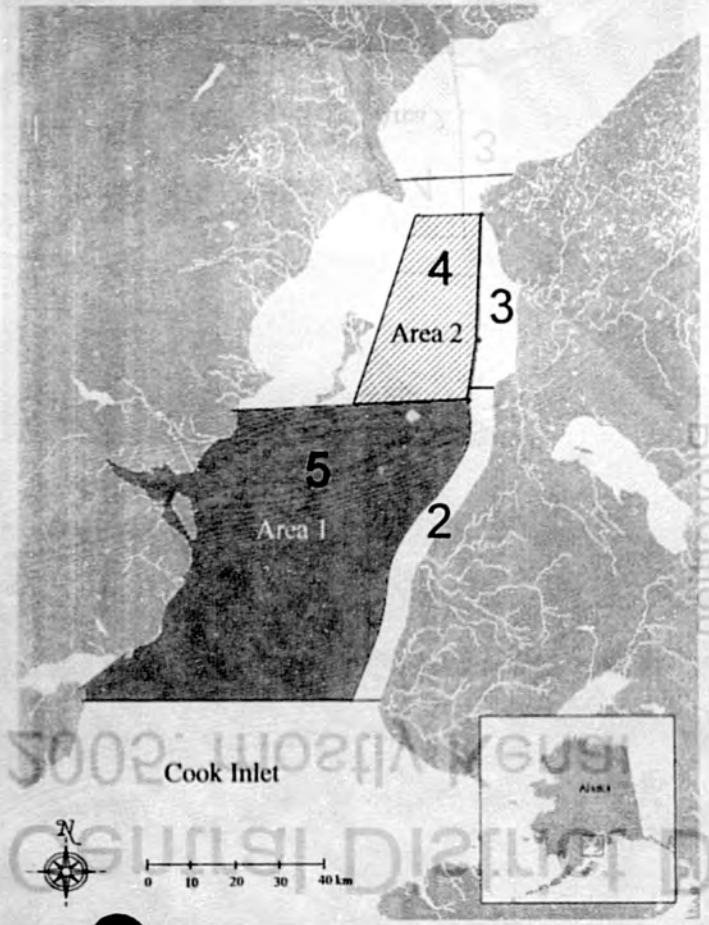
2005: mostly Kenai

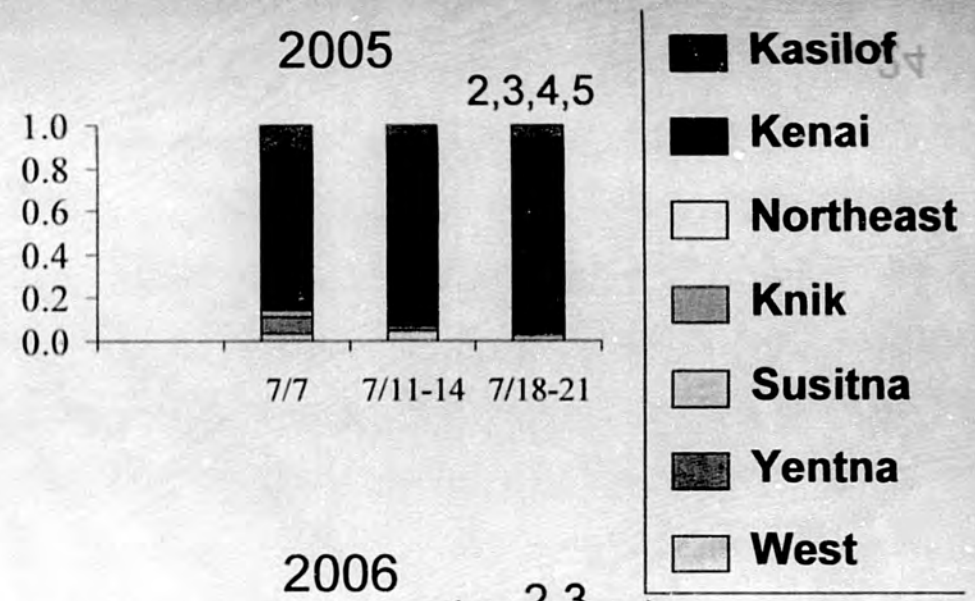


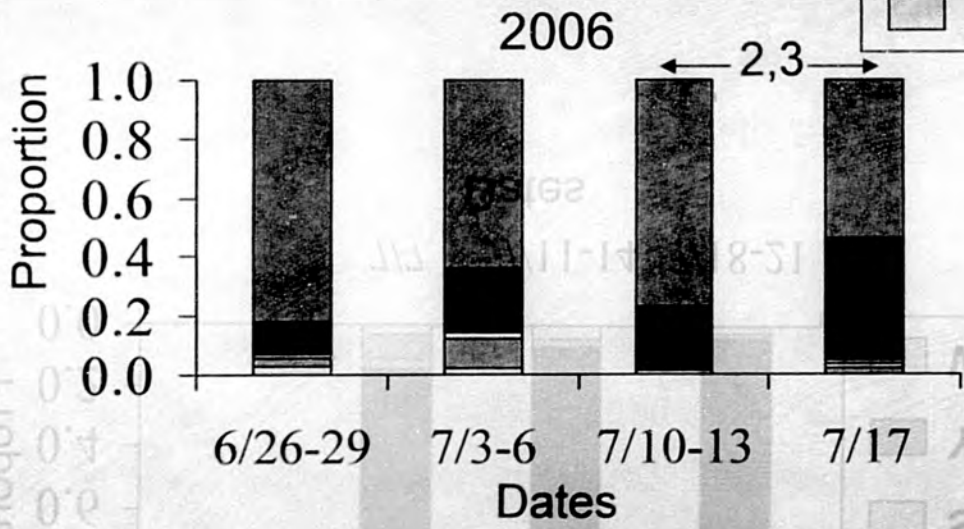


Central District Drift

2006: mostly Kasilof

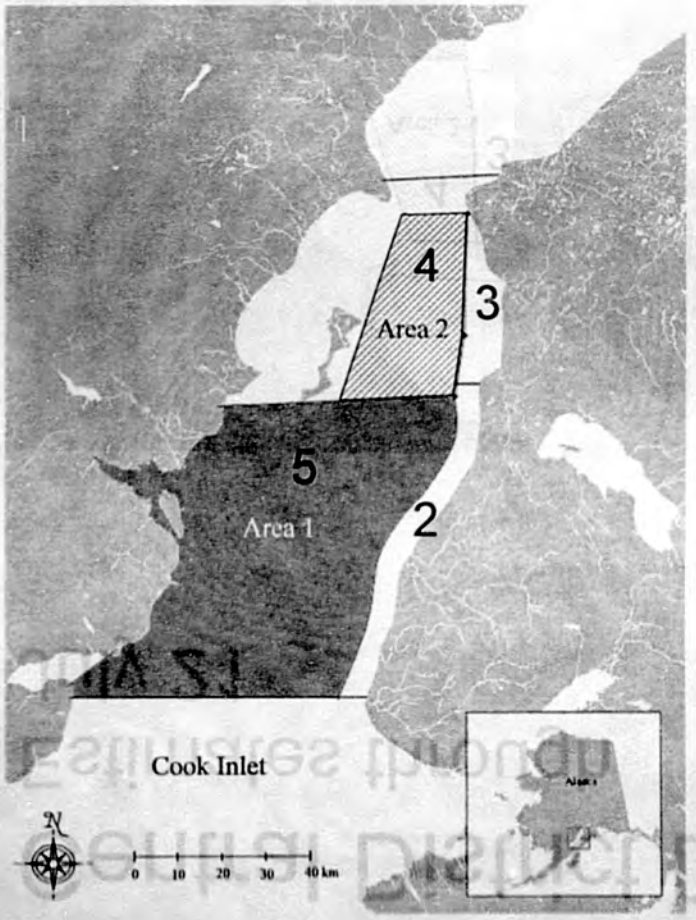


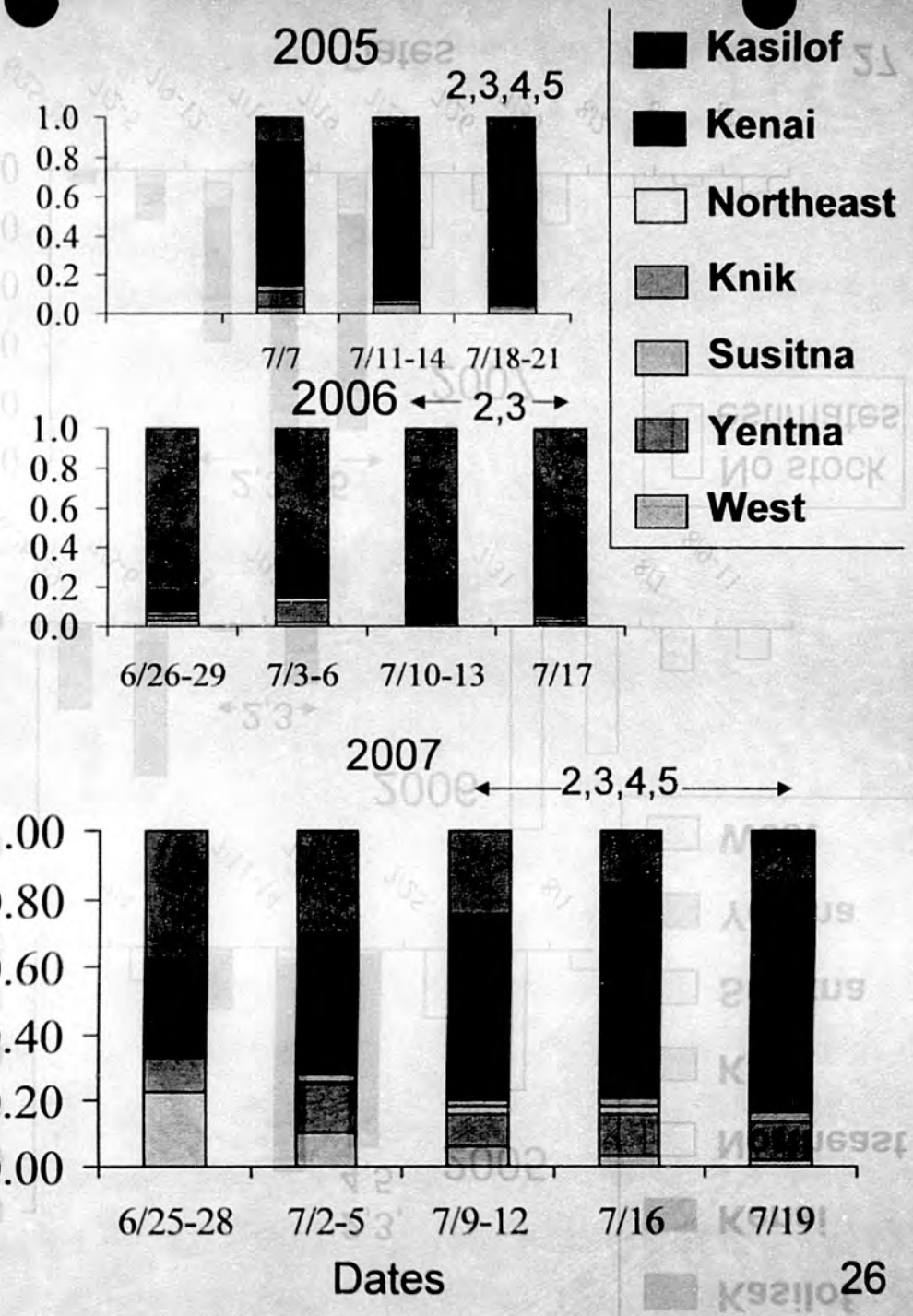




Central District Drift

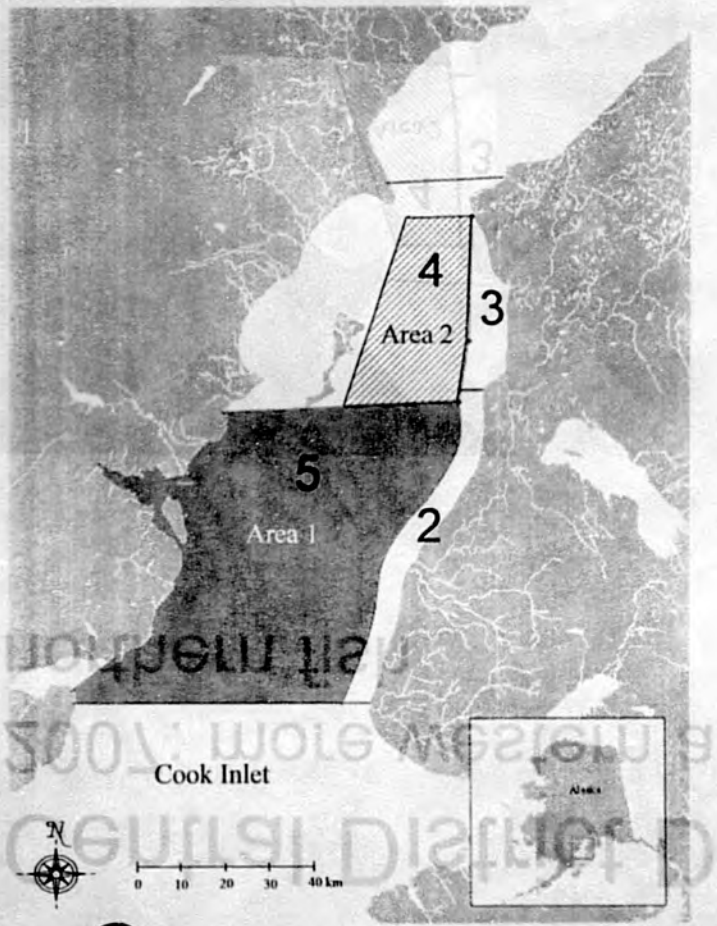
2007: more western and northern fish

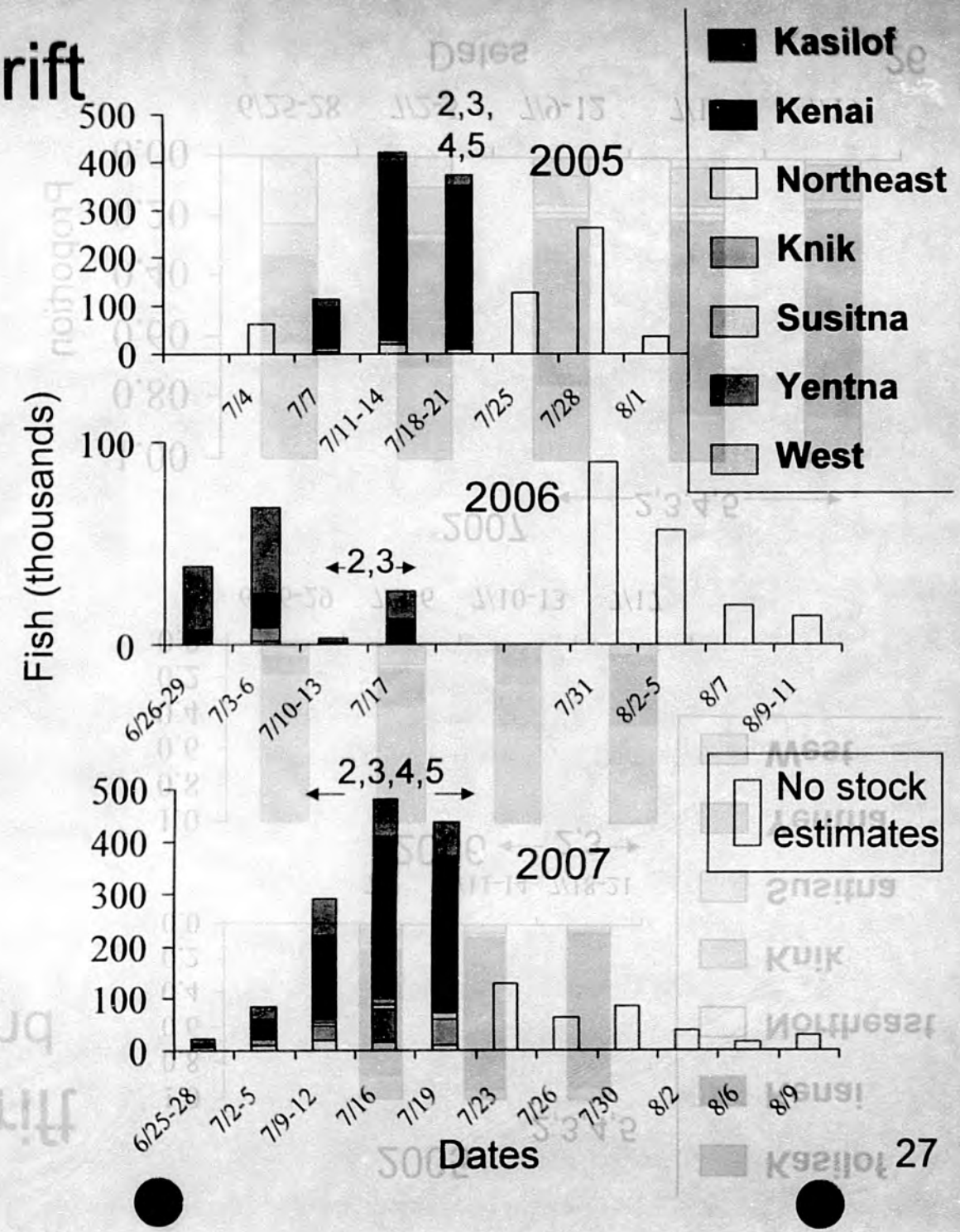




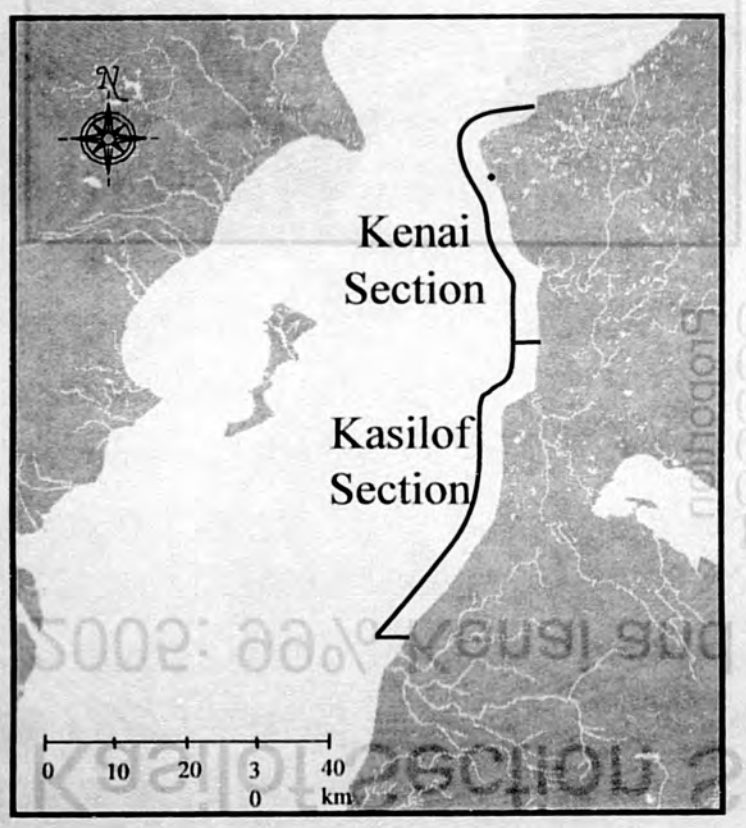
Central District Drift

Estimates through July 21





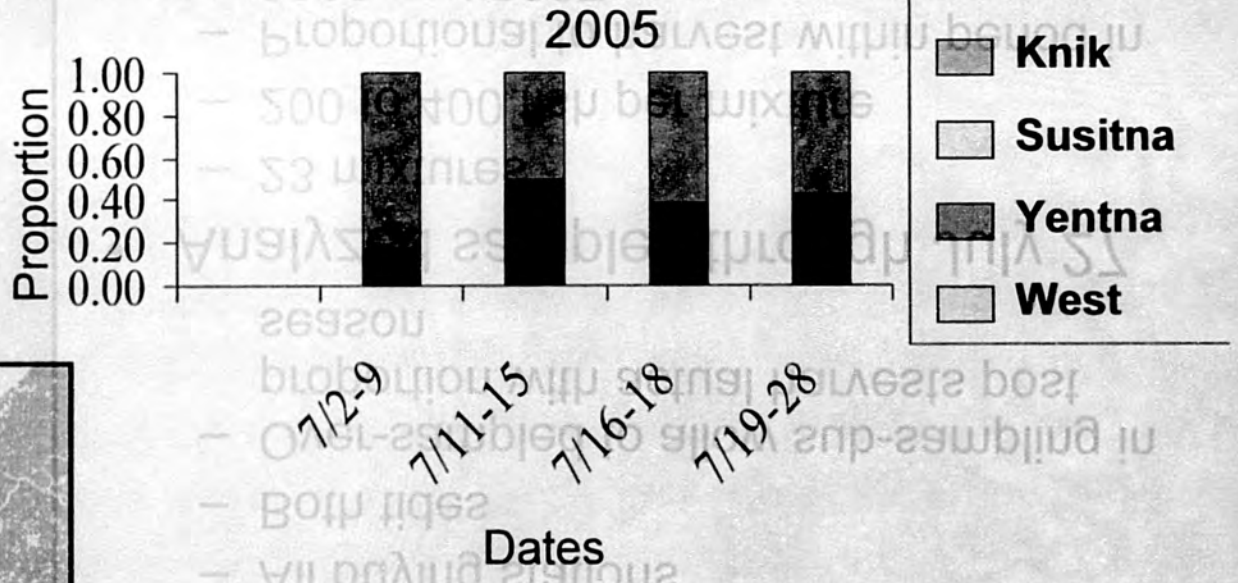
Kenai and Kasilof Section Set - methods

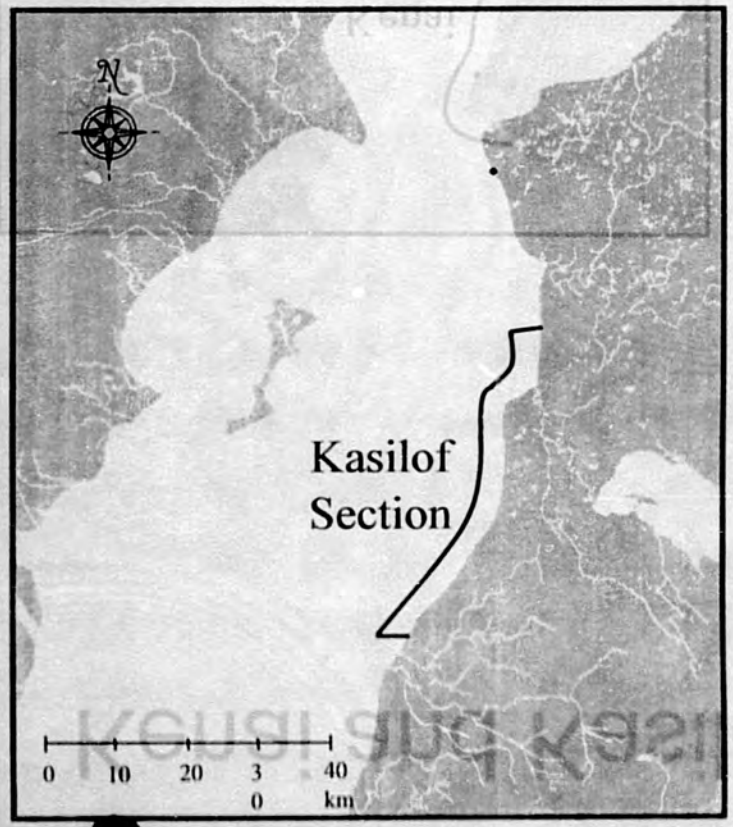


- 2005
  - All buying stations
  - Both tides
  - In proportion to historical averages
- 2006 and 2007
  - All buying stations
  - Both tides
  - Over-sampled to allow sub-sampling in proportion with actual harvests post season
- Analyzed samples through July 27
  - 23 mixtures
  - 200 to 400 fish per mixture
  - Proportional to harvest within period in 2006 and 2007

Kasilof Section Set

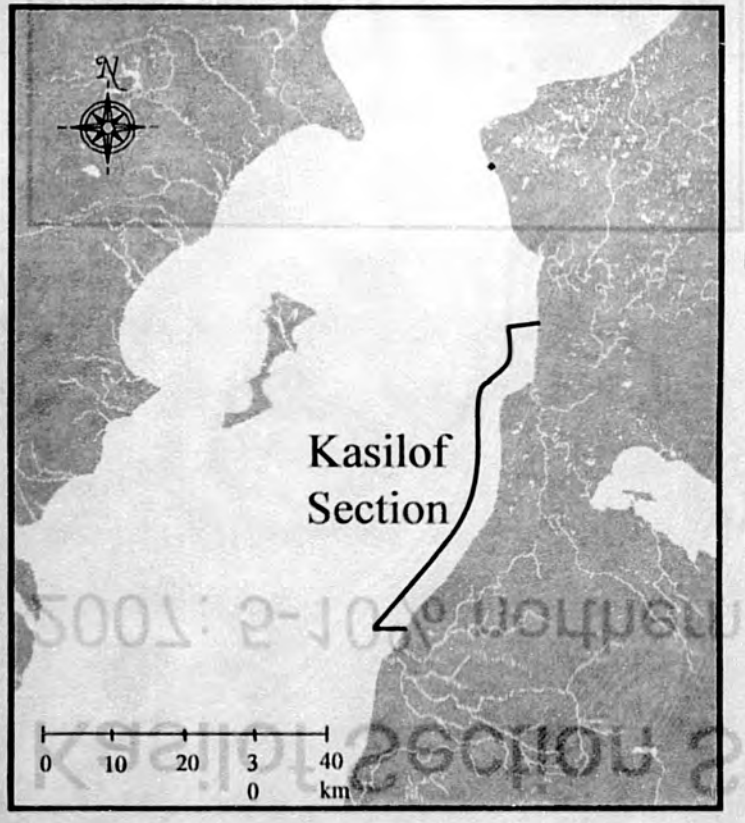
2005: 99% Kenai and Kasilof

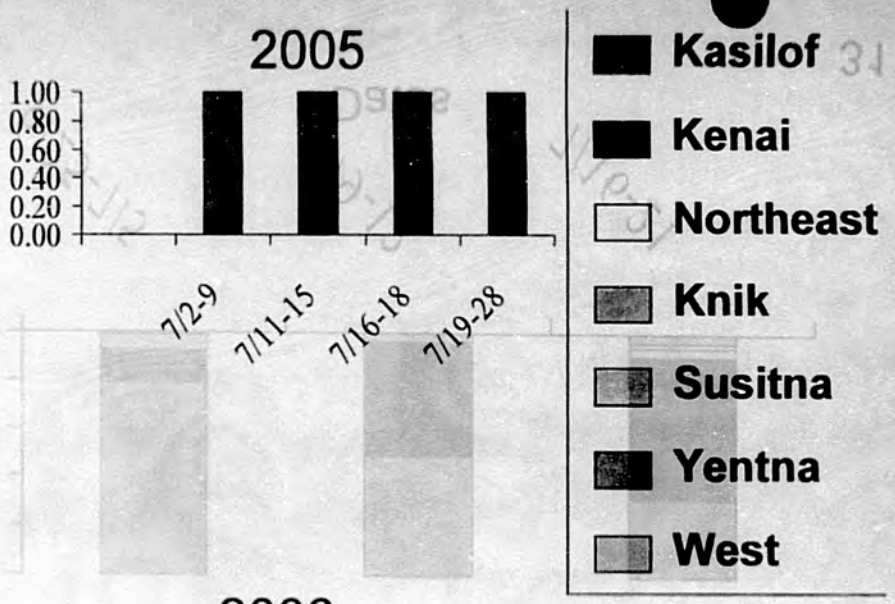


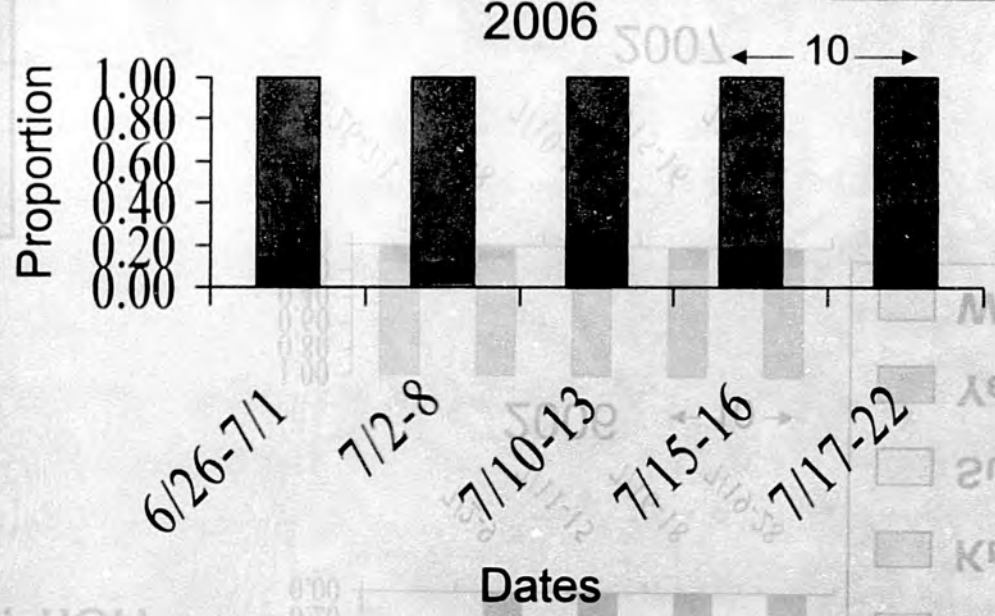


Kasilof Section Set

2006: 99% Kenai and Kasilof

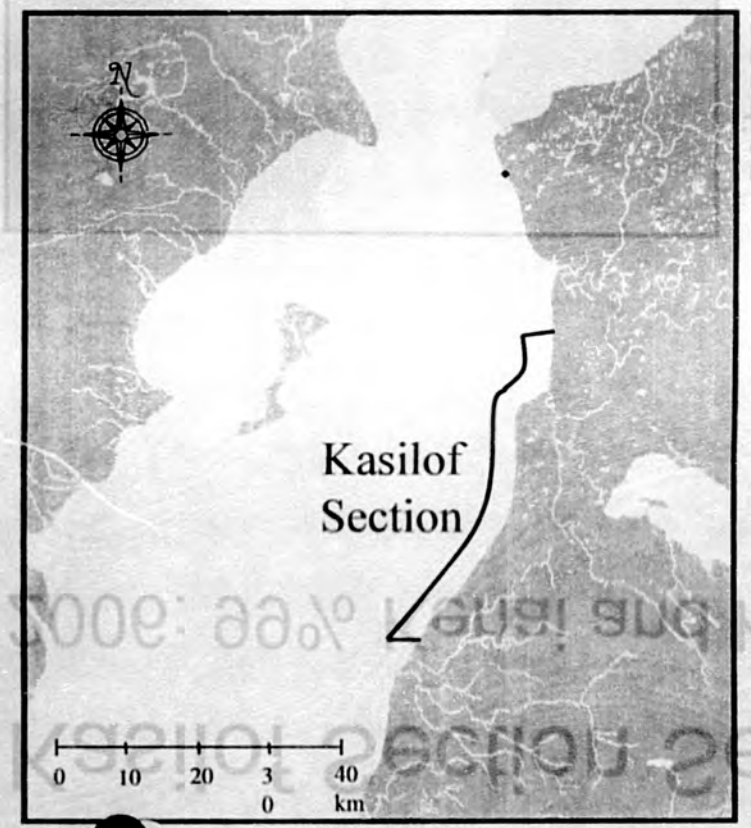


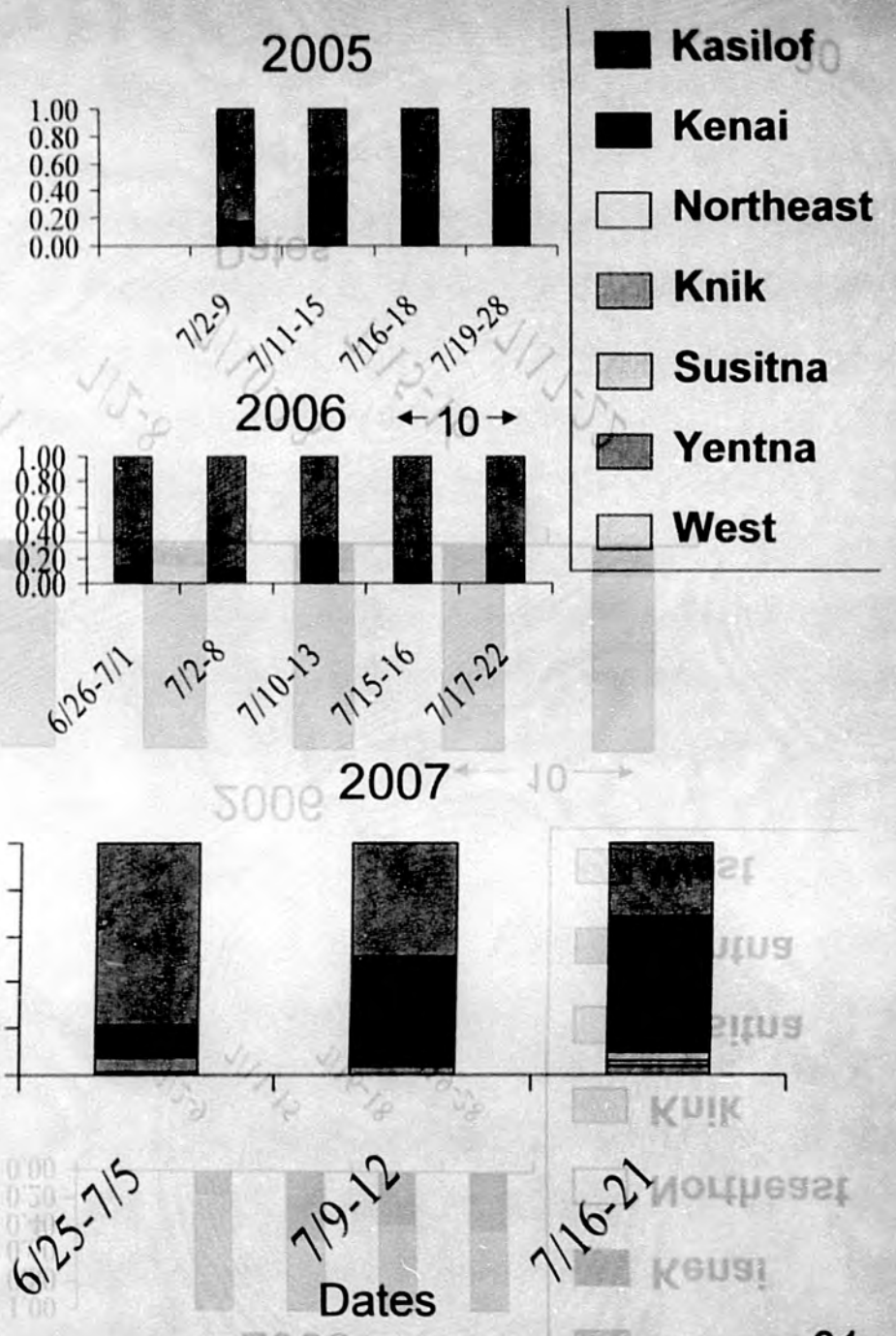




Kasilof Section Set

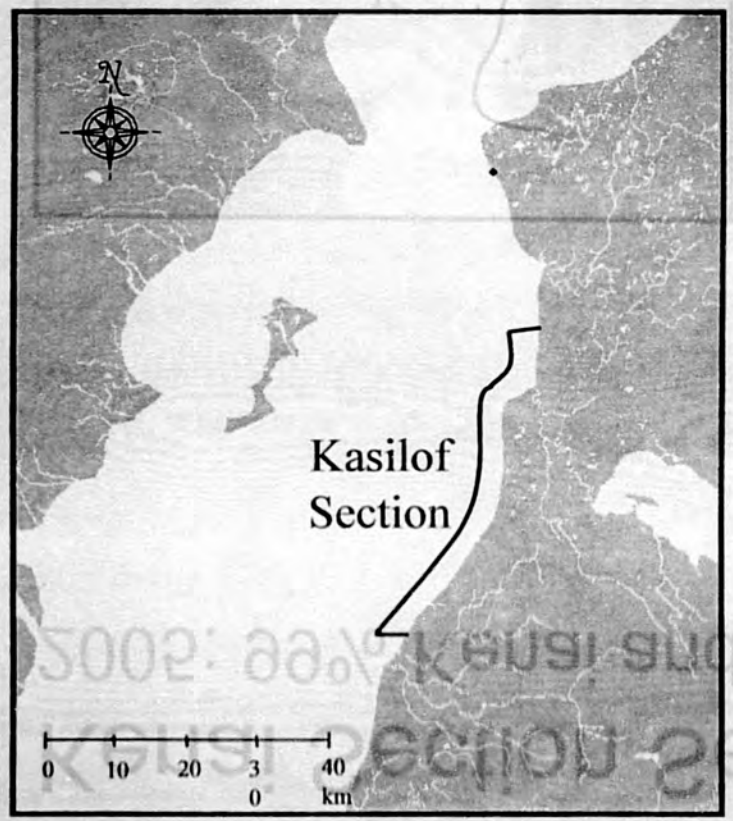
2007: 5-10% northern fish

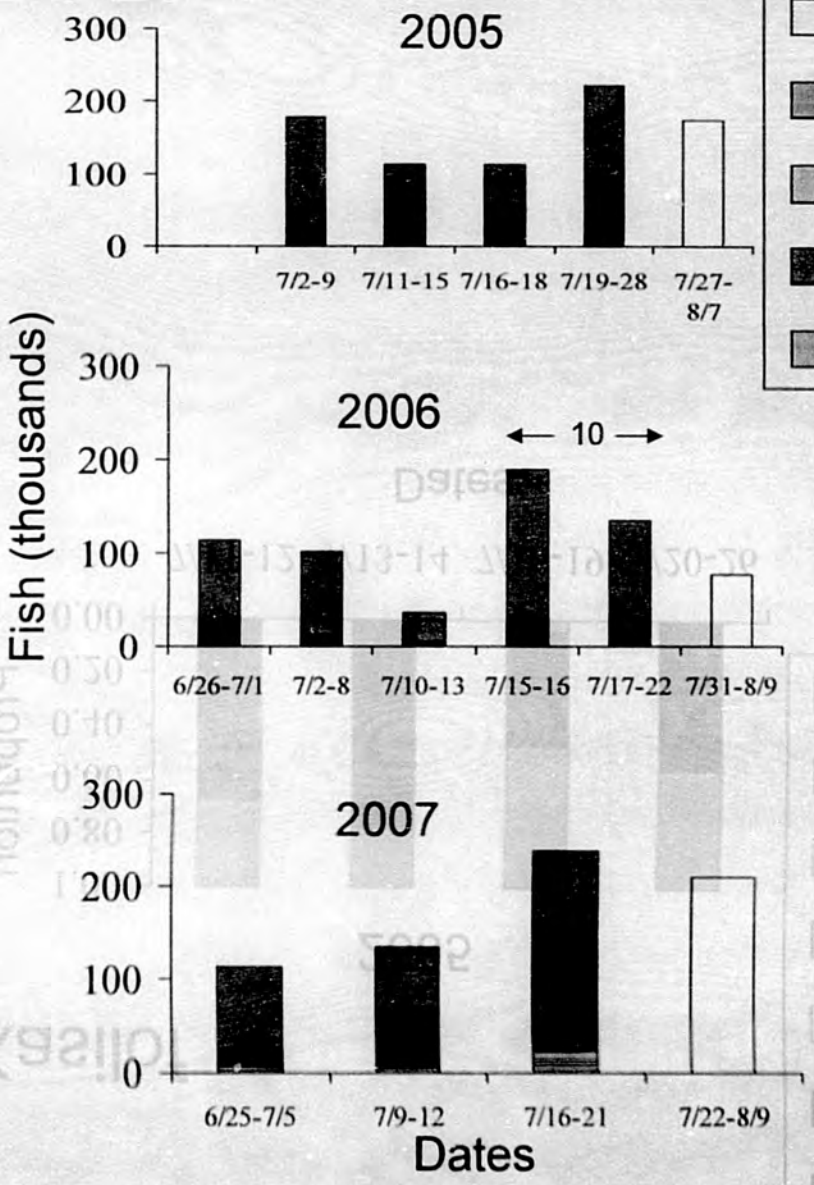




Kasilof Section Set

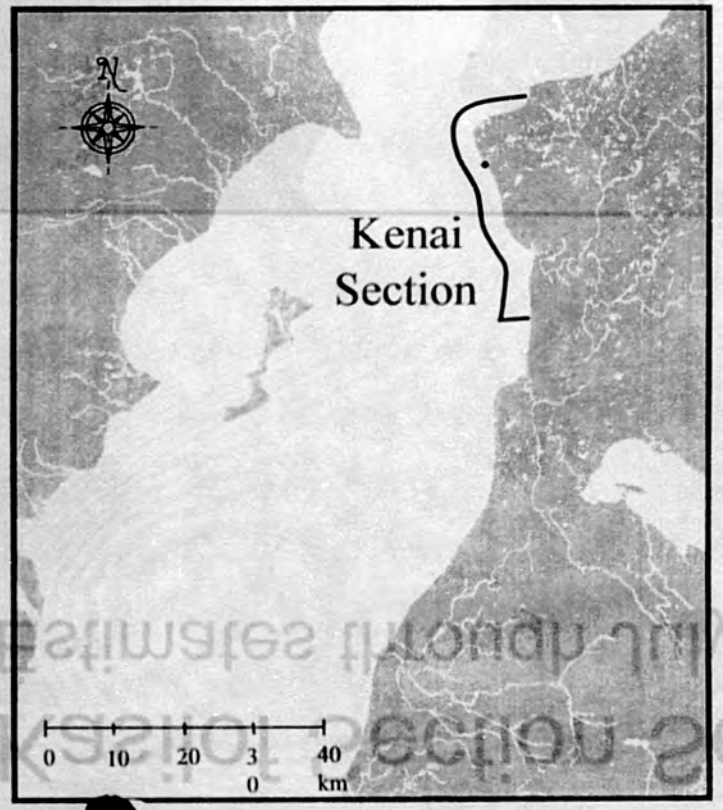
Estimates through July 21/ 28

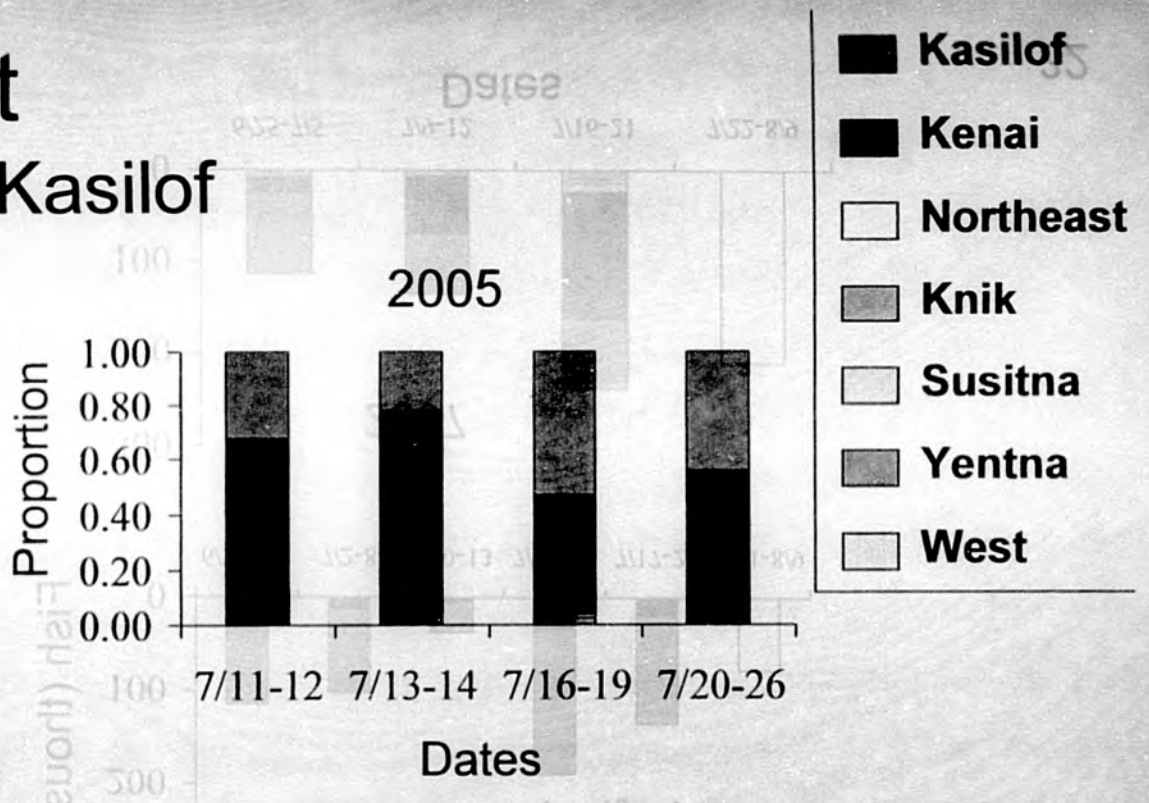




Kenai Section Set

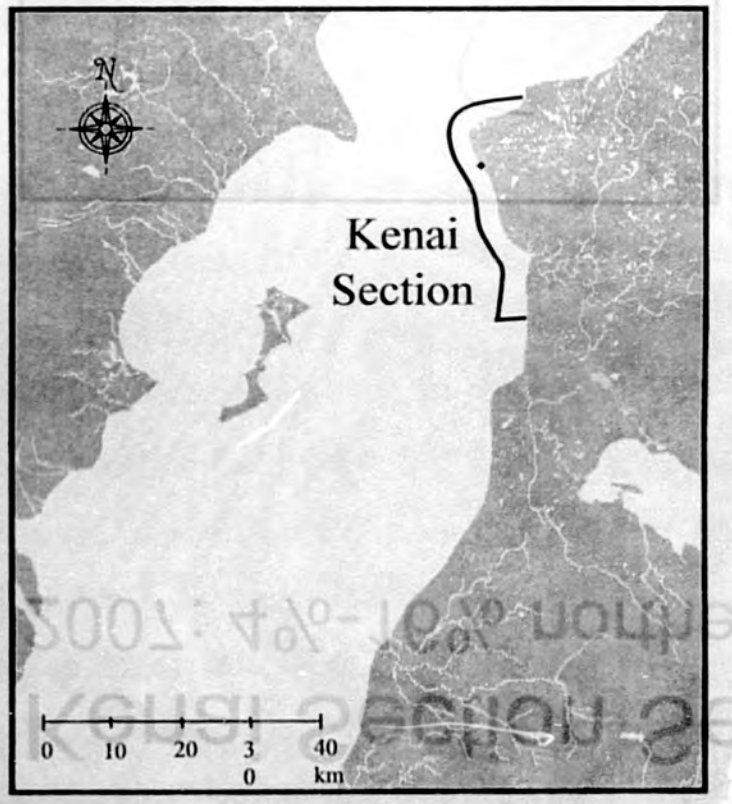
2005: 99% Kenai and Kasilof

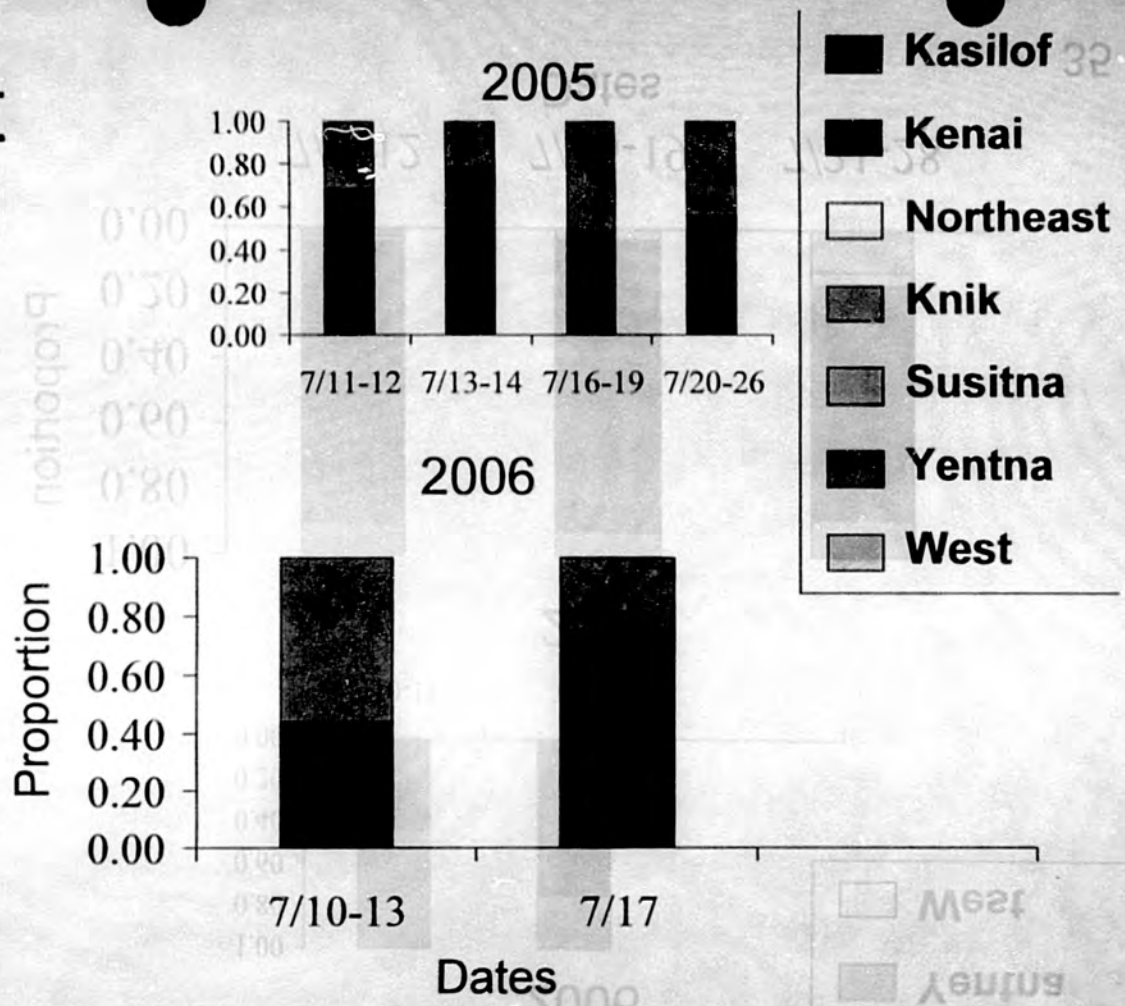




Kenai Section Set

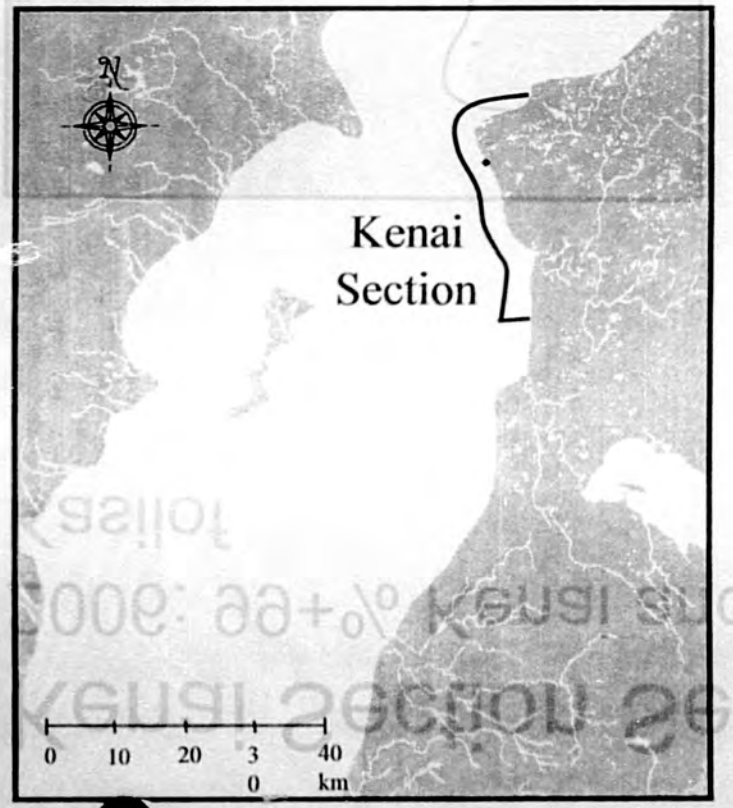
2006: 99+% Kenai and Kasilof

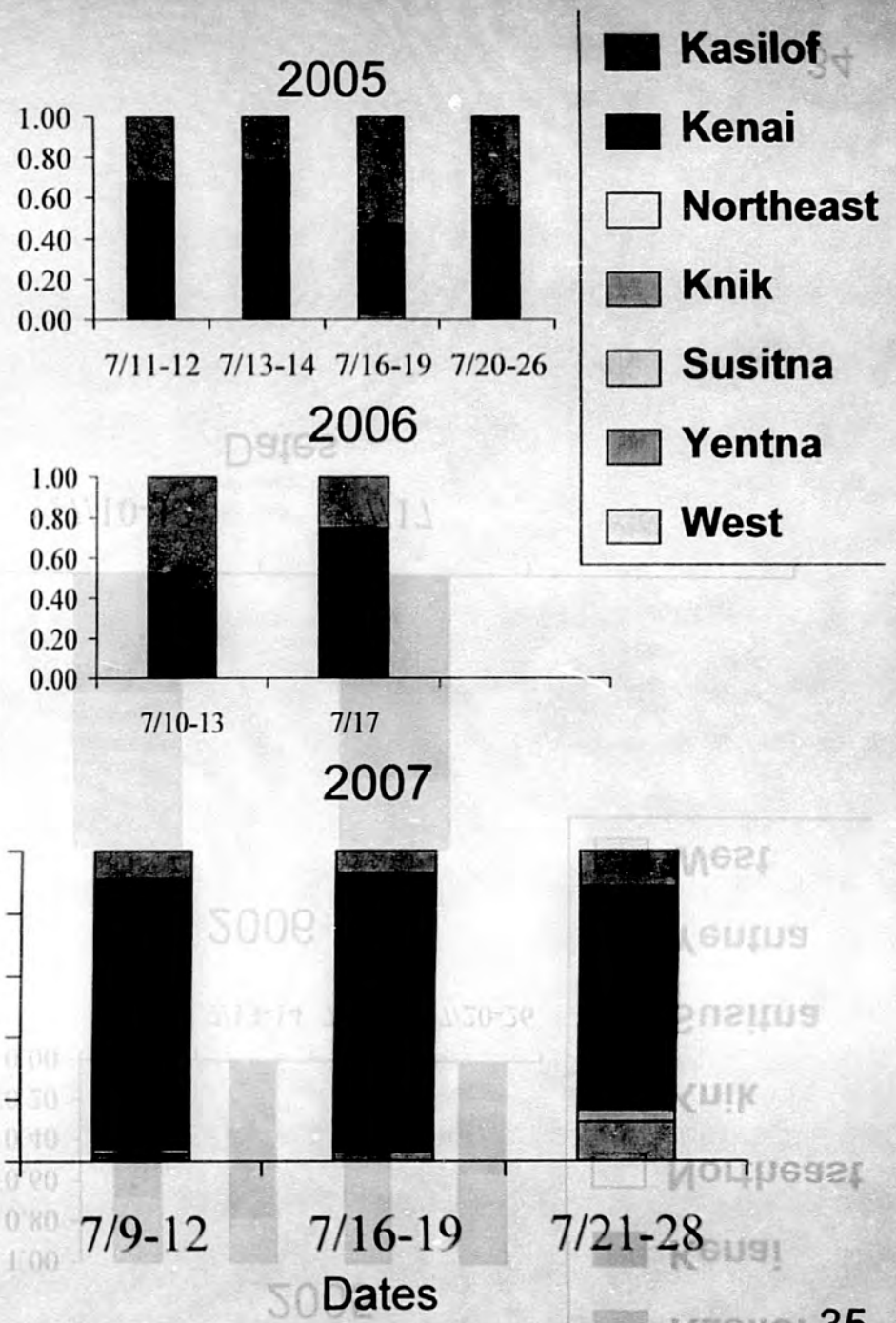




Kenai Section Set

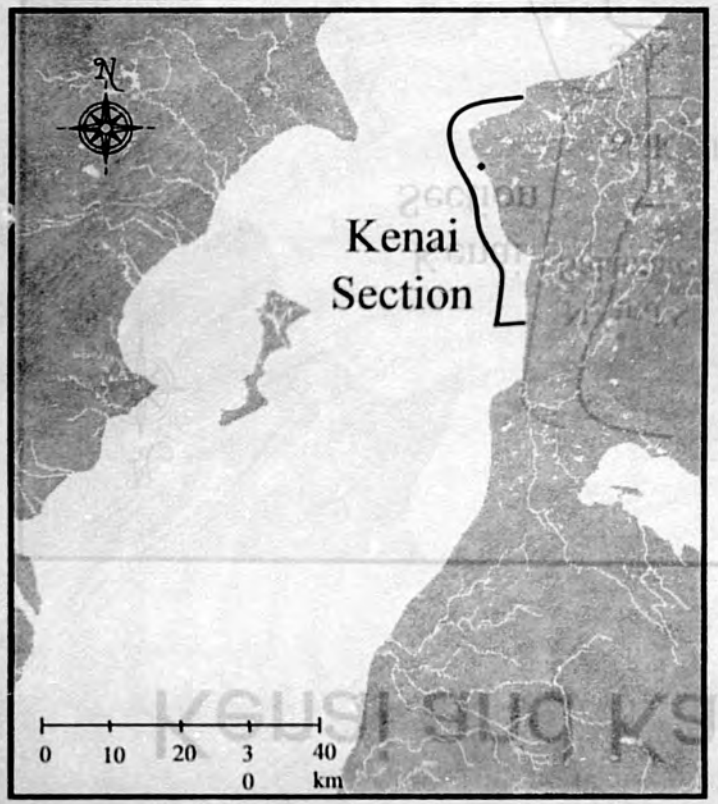
2007: 4%-16% northern fish

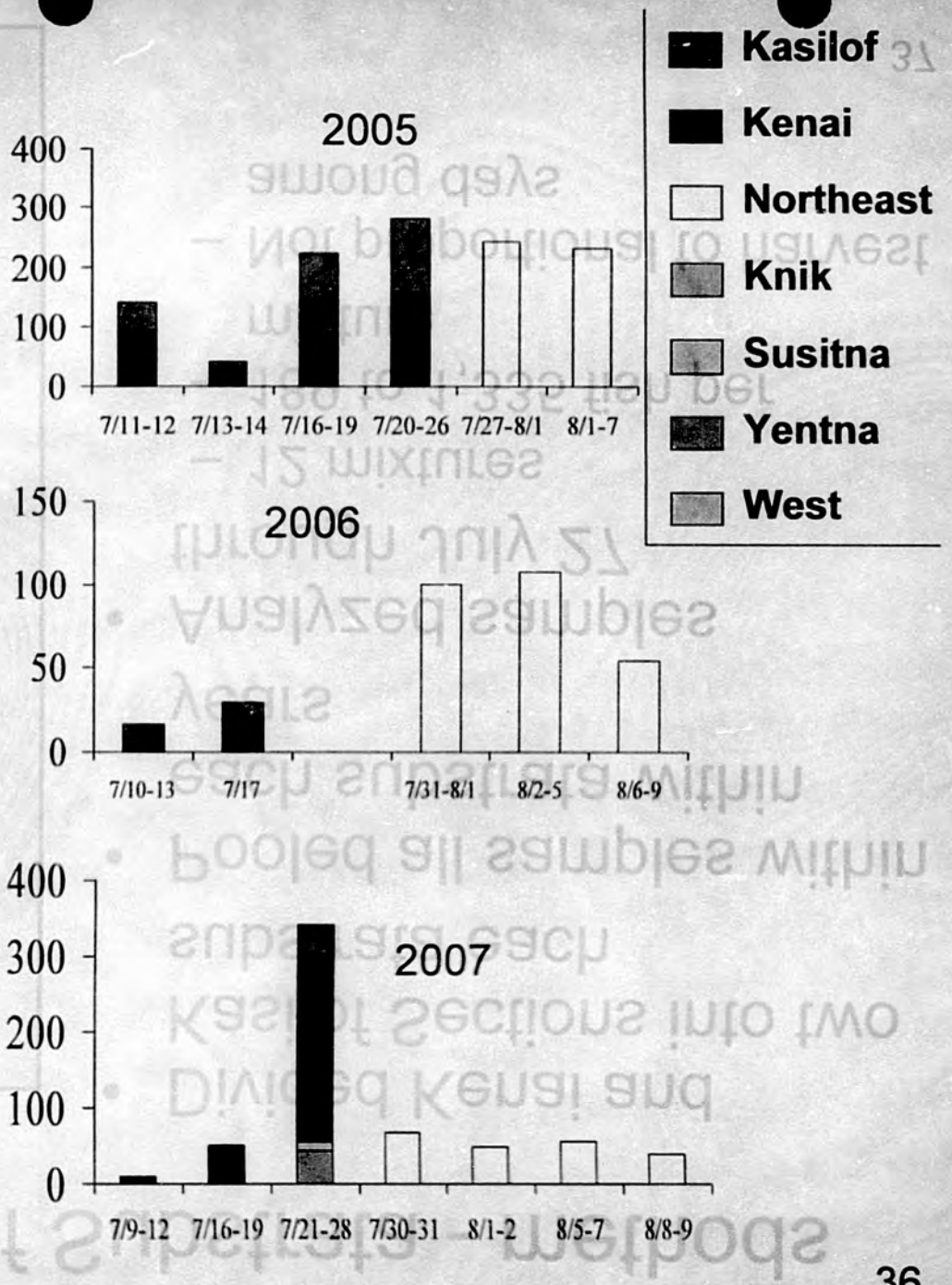




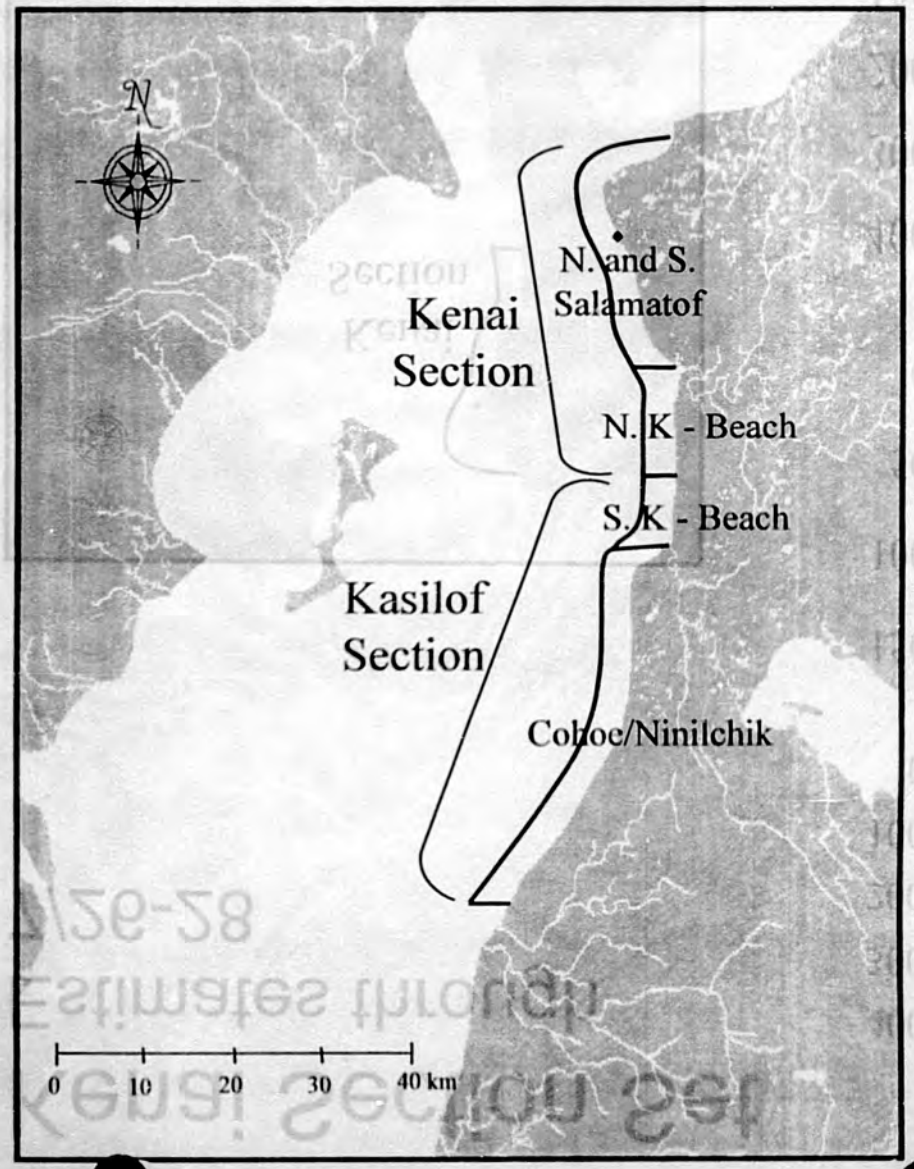
Kenai Section Set

Estimates through 7/26-28





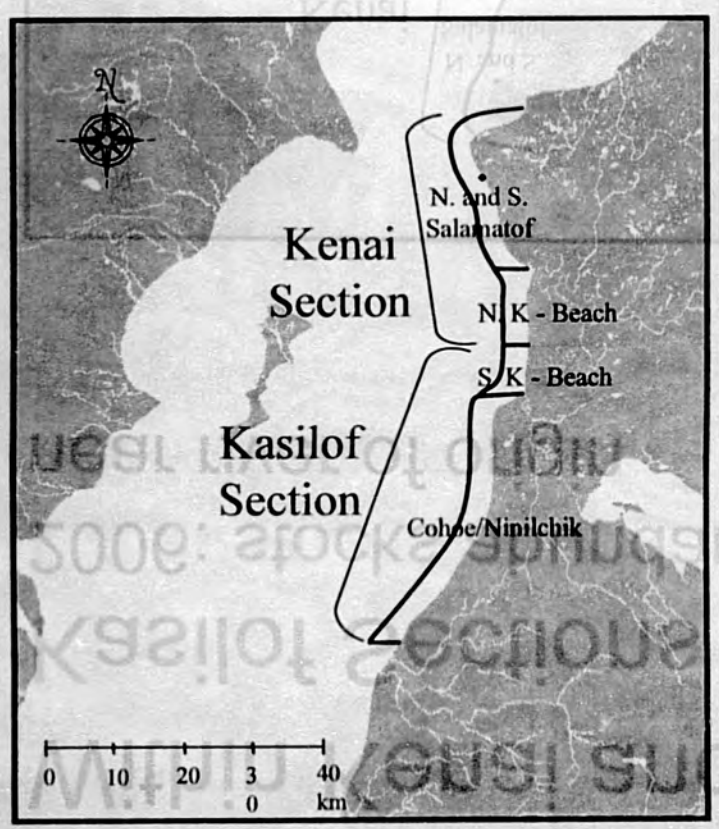
Kenai and Kasilof Substrata - methods

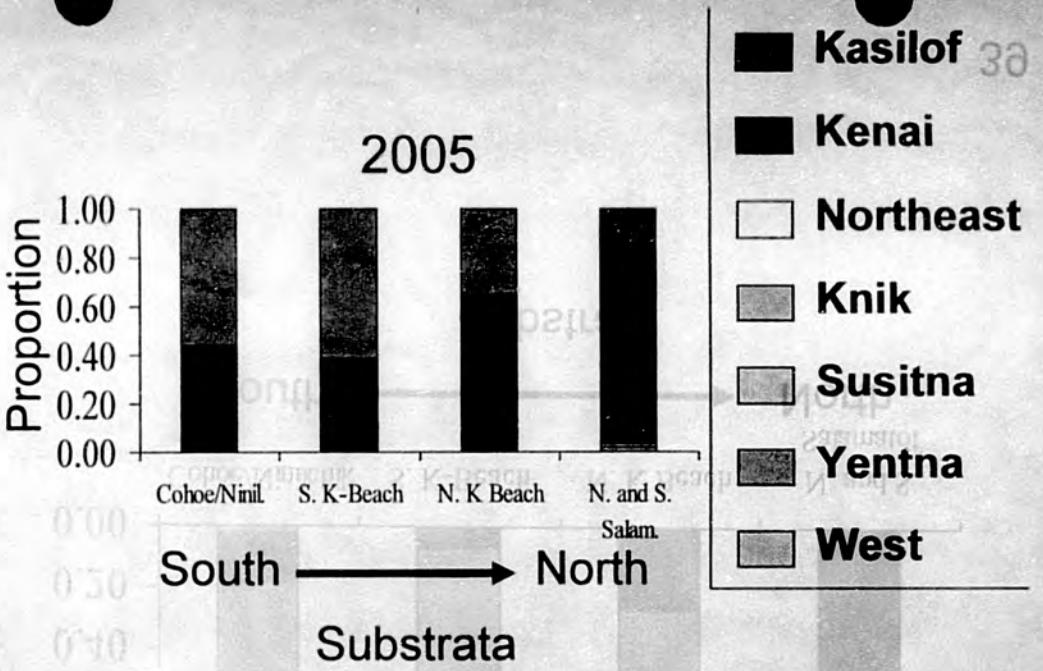


- Divided Kenai and Kasilof Sections into two substrata each
- Pooled all samples within each substrata within years
- Analyzed samples through July 27
  - 12 mixtures
  - 189 to 1,335 fish per mixture
  - Not proportional to harvest among days

Within Kenai and Kasilof Sections

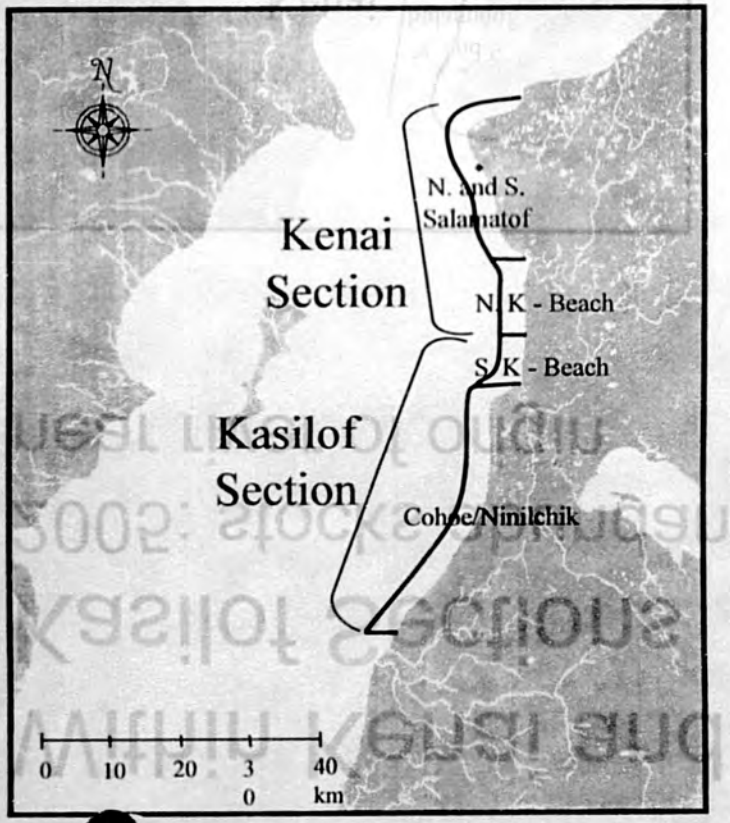
2005: stocks abundant near river of origin

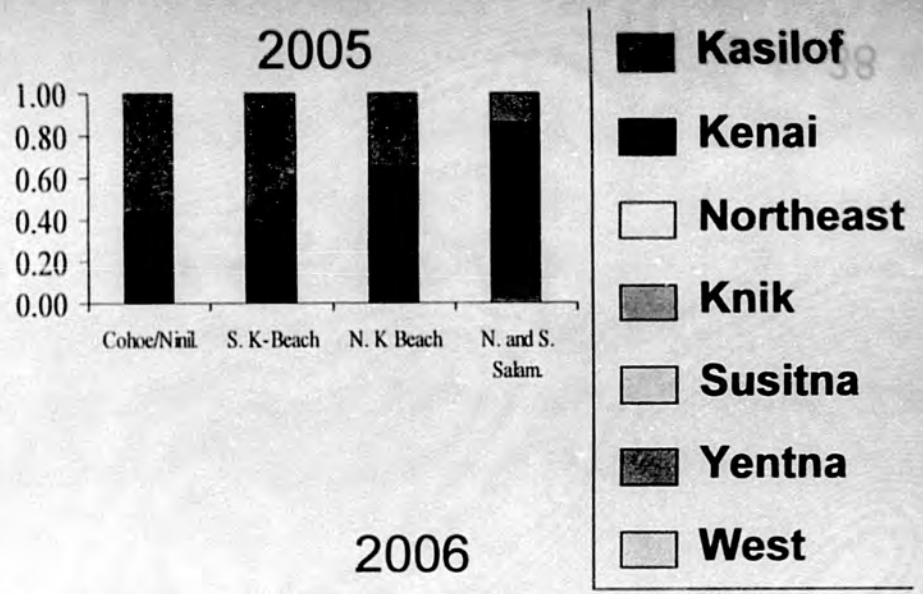


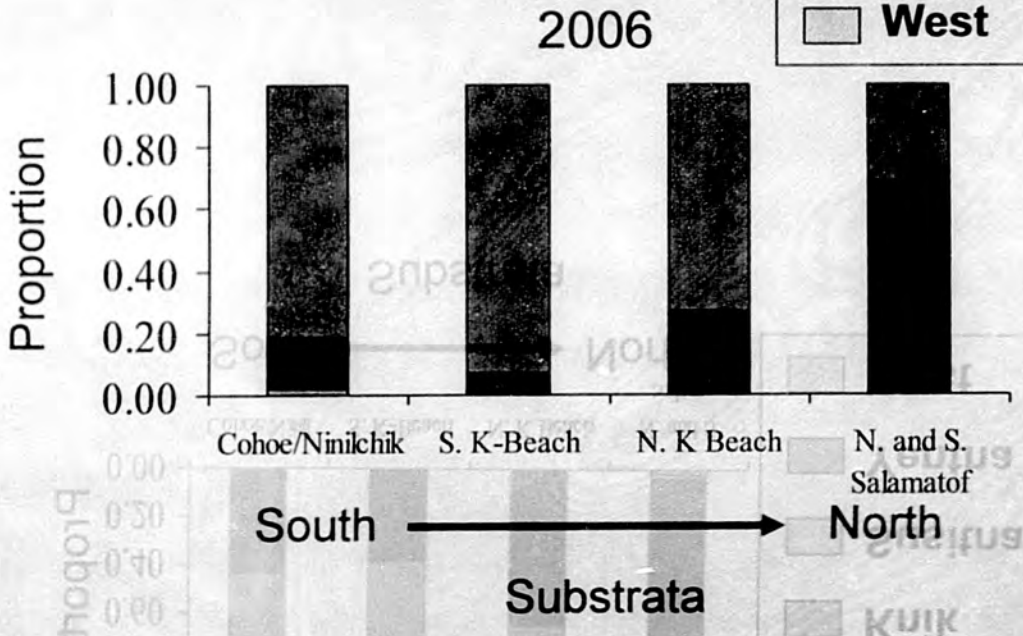


Within Kenai and Kasilof Sections

2006: stocks abundant near river of origin

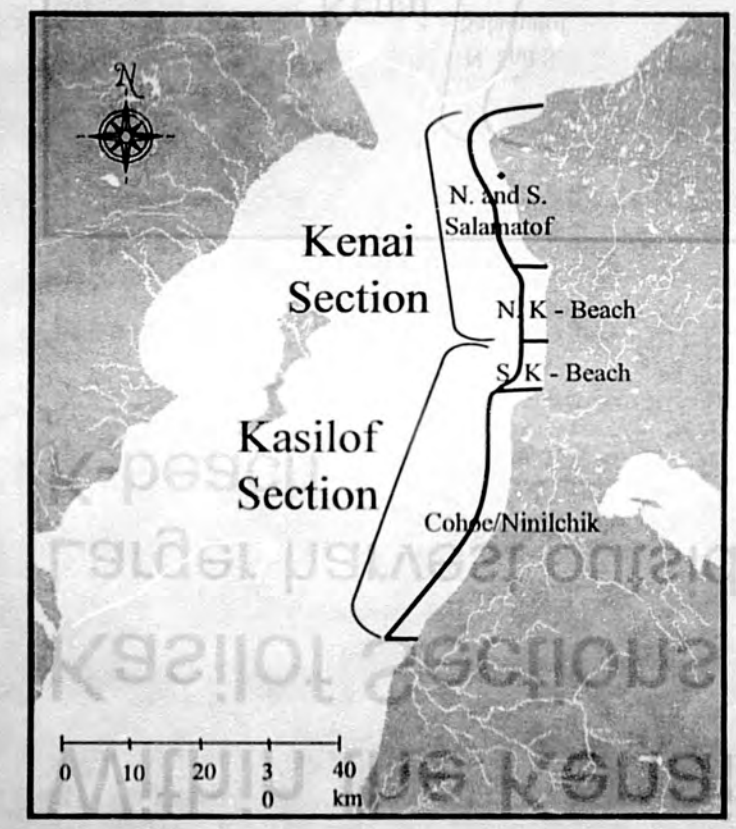


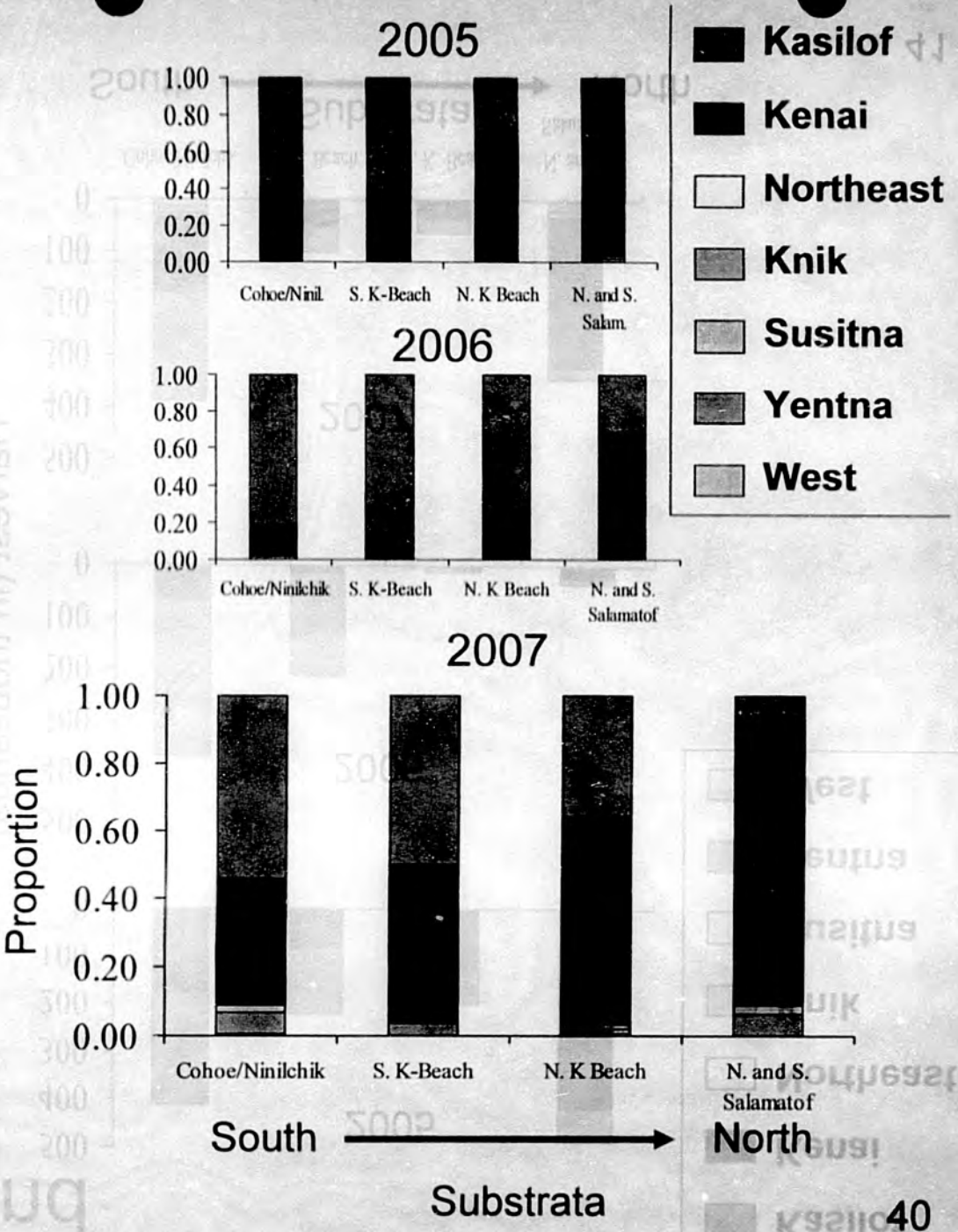




Within Kenai and Kasilof Sections

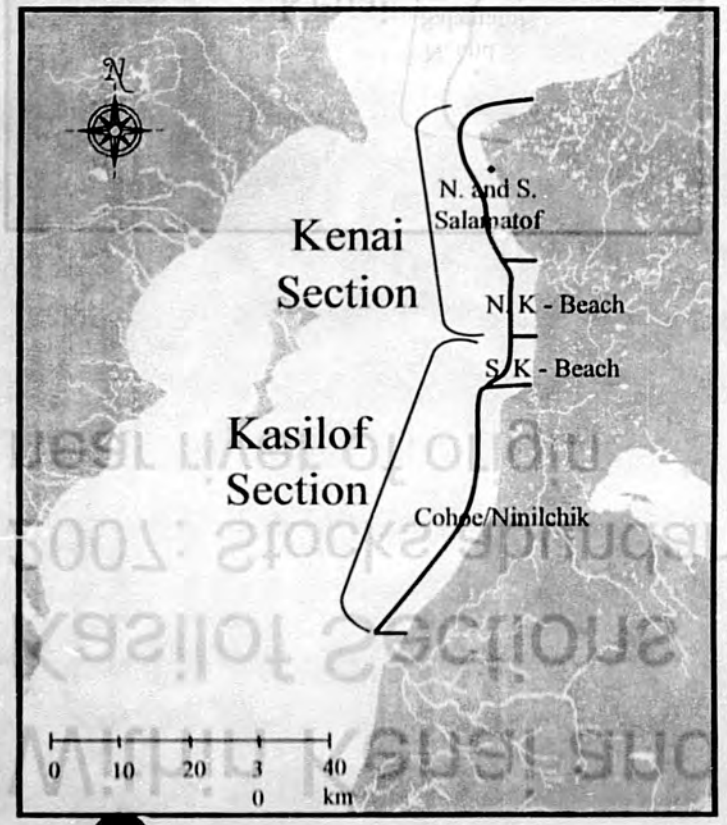
2007: Stocks abundant near river of origin

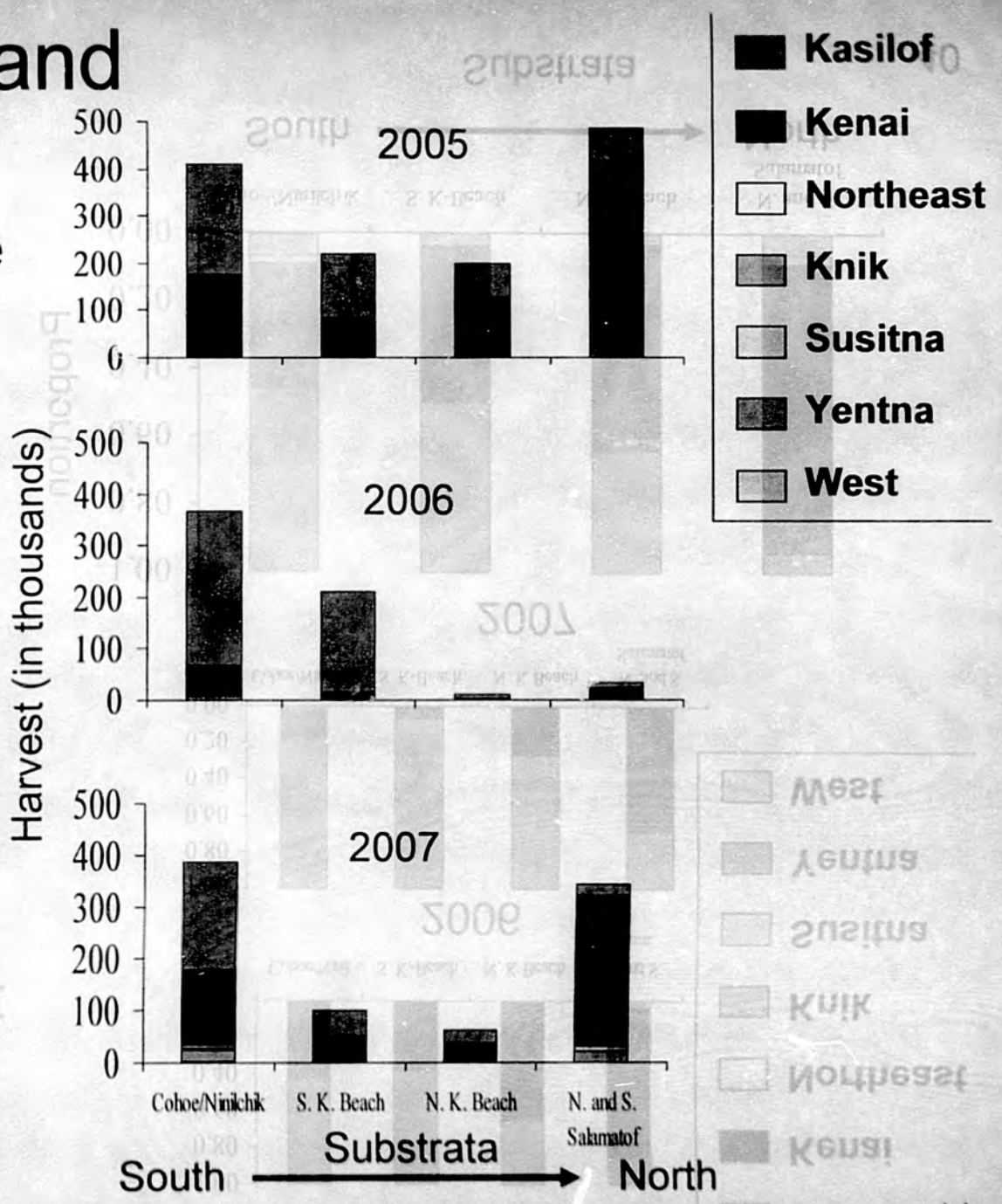




Within the Kenai and Kasilof Sections

Larger harvest outside K-beach



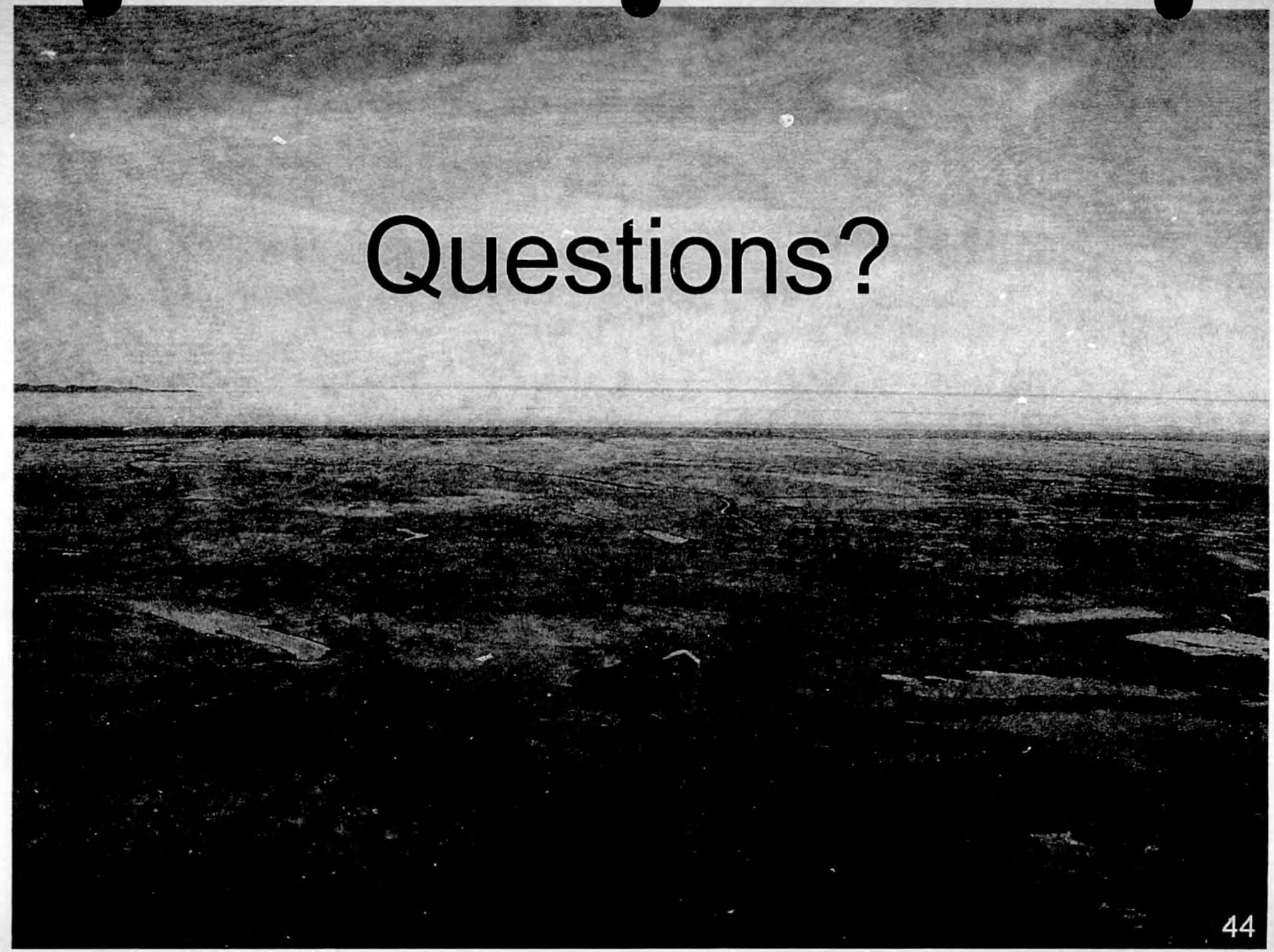


Take-home messages

- High year-to-year variation
  - Additional years needed to understand stock abundance through time and space
- Between-year patterns follow abundance trends
  - Kasilof proportions high in 2006
  - Kenai proportions high in 2005 and 2007
- Within-year patterns follow known migration timing
  - Kasilof proportions high early
  - Kenai proportions high late

Where from here?

- Proposal to Pacific Coast Salmon Recovery Fund
  - Finish out 2005, 2006, and 2007
  - Incorporate into brood tables
- Continue with State General funds
  - 2008 and forward
  - Continued but fewer baseline
- Controlled studies to examine variables under management control?
  - Area
  - Timing


Questions?

Alaska Board of Fisheries
Upper Cook Inlet Committee

Upper Cook Inlet Salmon Management Plans and Issues

March 9, 2007

Upper Cook Inlet Management Plans Issue Paper
Table of Contents

Introduction 3
5 AAC 21.363. Upper Cook Inlet Salmon Management Plan 5
Management Plan: 5
Issue 1: 5
5 AAC 21.353. Central District Drift Gillnet Fishery Management Plan 5
Management Plan: 5
Issue 1: 5
Issue 2: 6
Issue 3: 6
5 AAC 21.356. Cook Inlet Pink Salmon Management Plan. 6
Management Plan: 6
Issue 1: 6
Issue 2: 6
5 AAC 21.358. Northern District Salmon Management Plan. 6
Management Plan: 6
Issue 1: 7
5 AAC 21.360. Kenai River Late-Run Sockeye Salmon Management Plan. 7
Management Plan: 7
Issue 1: 7
Issue 2: 8
Issue 3: 8
Issue 4: 8
Issue 5: 8
Issue 6: 8
5 AAC 21.365. Kasilof River Salmon Management Plan. 8
Management Plan: 8
Issue 1: 9
Issue 2: 9
Issue 3: 9
Issue 4: 10
Issue 5: 10
Issue 6: 10
5 AAC 77.540. Upper Cook Inlet Personal Use Salmon Fishery Management Plan. 10
Management Plan: 10
Issue 1: 10
Issue 2: 10
Other issues and regulations that were raised: 10

Introduction

The fishery management plans for salmon in Upper Cook Inlet (UCI) are, arguably, the most complex in the State. This complexity has evolved over the years as the Board of Fisheries has struggled to balance the allocation needs and desires of the various user groups. Over half of the State population resides within the UCI watershed. In most years, UCI is second only to Bristol Bay in terms of average commercial sockeye salmon harvests in the State, and also produces significant runs of chinook salmon, with the notable Kenai River known around the world as a premier sport fishing destination for monster kings. These factors and more, arguably, also combine to make the allocative tension in UCI the highest in the State's fisheries.

At the Board of Fisheries worksession in October 2006, the Board received numerous Agenda Change Requests (ACRs), mostly from commercial fishery interests, that asked the Board to re-evaluate many aspects of the UCI salmon fishery management plans. While the Board declined to accept the ACRs, it created a committee of three Board members (Nelson, Campbell, and Heyano) to begin a comprehensive review of the management plans in preparation for the regular, in-cycle meeting for UCI during the winter of 2007/2008. With input from the Alaska Department of Fish and Game, the committee prepared an initial "issues paper" on the UCI management plans. This initial draft was made available to the public for written comment and was not intended to be all-encompassing in the issues it presented, just merely a kick start of the discussion and to solicit the additional comments that were sure to come from the various users. The committee received 12 written comments, which have been incorporated into this re-draft of the issues paper, which the committee now presents to the full Board.

Based on the comments received, the committee strived to include as many additional issues as possible, not wanting to necessarily "screen" anything at this time. The committee also wishes to state that inclusion of any issue into this document does not necessarily imply an endorsement by the committee, or the full Board. This document is also not intended to be an all-encompassing issues paper. There are most likely other issues that may be brought forward through the proposal process. Even with the additional comments that the Committee incorporated, readers may wish to refer to the individual comments for further justification. For the sake of completeness, the Committee wishes to incorporate, by reference, all the timely comments that were received on the initial draft. Copies of these comments have been posted on the Board of Fisheries website at:

http://www.boards.adfg.state.ak.us/fishinfo/uciissues.php

The comments that the committee received addressed the complexity of the management plans, the competing nature of their intent and goals (or the lack of guidance in balancing those competing goals), and aspects of allocation across the user groups and the region. Some comments addressed the management plans in a general nature, stressing organization, purpose, and simplicity; other comments went into great specificity regarding aspects of each regulatory management plan.

Other comments referenced previous requests for Board action, particularly the ACRs that were submitted at the worksession, and also requested that the Board return the management plans to the more simple and flexible plans that existed prior to 1995 (Comment #5, Central Peninsula Fish and Game Advisory Committee).

Many comments focused on the management plans as being overly-prescriptive and "tying the hands of managers", limiting their ability to react in-season and allow commercial harvest opportunity on available surpluses of fish. They argued that the plans have resulted in serial over-escapement of sockeye into the Kenai and Kasilof Rivers that meant, at best, lost harvest and income for the commercial fishermen and, at worst, biologically jeopardized the future yield potential of these systems (Comment #9, Jeff Beaudoin). While some comments took issue with the actual numbers that are the escapement and/or in-

river goals, many comments generally stated that the management plans should be liberalized to allow the department to better manage for those goals. This theme recurred throughout many of the comments on the management plans.

Other comments expressed concern about low sockeye escapements to the Sustina drainage, particularly to the Yentna River which has failed to meet the lower end of its escapement goal in many recent years. It was argued that the intensive commercial fishery effort that focused on the abundant Kenai River sockeye salmon also caught significant numbers of Yentna sockeye. Some other comments raised questions about other (non-fishery) possible causes for low sockeye productivity in the Susitna drainage.

Yet other comments arose in defense of the current management plans. They argued that the plans' complexities are simply the result of years of work and the balancing of the needs of various users and goals. They stated that changes to increase commercial fisheries "flexibility" will only exacerbate current in-river fishery and chinook escapement problems. They also stated that the plans have largely been successful, providing for above-average commercial harvests in many recent years as well as strong in-river returns for sport and personal-use harvest opportunity and spawning escapement. (Comment #6, Kenai River Sportfishing Association)

Some comments mentioned the need for clear purpose/goal statements within each of the management plans, and that this may help to clarify priorities when the purposes and goals of each plan may be in conflict with one another. They also spoke of the need for a better organizational structure for all the plans.

5 AAC 21.363. Upper Cook Inlet Salmon Management Plan

Management Plan:

Sometimes referred to as the "Umbrella Plan", this plan provides general management principles for all UCI salmon plans, rather than specific management directives. Many of the comments that the committee received focused on section (e) that the Board inserted in 2005:

(e) It is the intent of the Board that, while in most circumstances, the Department will adhere to the management plans in this chapter, nothing in the management plans in intended to override the commissioner's emergency order authority under AS 16.05.060 should significant new information arise that, in the commissioners judgment, warrants departure from the provisions in the management plans.

Issue 1:

Paragraph (e) provides no guidance as how this should be interpreted and has created conflict with the Department and the public (Comment #2, Kenai Area Fishermen's Coalition). Another comment suggested that some guidance should be provided regarding "significant new information" (Comment #10, Kenai Peninsula Fishermen's Association)

5 AAC 21.353. Central District Drift Gillnet Fishery Management Plan

Management Plan:

The department shall manage the Central District commercial drift gillnet fishery as follows:
Weekly fishing period are Monday and Thursday from 7:00 am to 7:00 pm, except that these fishing periods may be modified by emergency order.

The fishing season will open the third Monday in June or June 19, whichever is later, and from July 9 through July 15, (i) fishing during the two regular fishing periods is restricted to the Kenai and Kasilof Sections and Drift Gillnet Area 1; (ii) at run strengths greater than 2,000,000 sockeye salmon to the Kenai River, the commissioner may, by emergency order, open one additional 12-hour fishing period in the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Area 1.

From July 16 through July 31, (i) at run strengths of less than 2,000,000 sockeye salmon to the Kenai River, fishing during the two regular 12-hour fishing periods is restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Area 1; (ii) at run strengths of 2,000,000 to 4,000,000 sockeye salmon to the Kenai River, fishing during the two regular 12-hour fishing periods is restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Areas 1 and 2; (iii) at run strengths greater than 4,000,000 sockeye salmon to the Kenai River, there will be no mandatory restrictions during regular fishing periods.

Issue 1:

In medium to larger sockeye salmon runs, the drift gillnet fishery is a necessary tool to harvest salmon in excess of escapements. However, in recent years, restrictions to the drift gillnet fishery have been taken in an attempt to achieve the Yentna River escapement goal. The Yenta River EG has been exceeded once, within the range twice, and below the range 5 times since 1999 while the Kasilof and Kenai River goals have often been exceeded. (Issue from initial Committee draft)

The committee also received comments that management for "weak stocks" (Yentna sockeye) is wasteful. (Comment #3, Homer Fish and Game Advisory Committee)

Some comments suggested that additional caution should be taken in the early part of the season, when more Yentna sockeye are likely to be present. They also suggested that perhaps July 20 or 25 should be used as the date when the management plan shifts based on the in-season Kenai River run strength assessment. (Comment #7, Alaska Outdoor Council and Comment #8, Matanuska Valley Fish and Game Advisory Committee)

Another comment suggested a "conservation corridor" for northern sockeye stocks be created in the Central District from July 9 through July 25. (Comment #8, Matanuska Valley Fish and Game Advisory Committee)

Issue 2:

The preseason forecast, which determines the amount of fishing time and window closures for the start of the commercial fishing season, has not been correct since these plans were implemented. Since 1999 the department forecast of Kenai run strength has not been in the same tier when the total return is completed. Management actions can be opposite of what is actually necessary. (Issue from initial Committee draft)

Other comments the committee received indicated that management based on pre-season predictions may be unrealistic (Comment #3, Homer Fish and Game Advisory Committee)

Issue 3:

The management plan contains an apparent overlight, with no direction regarding commercial fishing time from August 1 through August 10. (Comment #6, Kenai River Sportfishing Association)

5 AAC 21.356. Cook Inlet Pink Salmon Management Plan.

Management Plan:

This plan directs the Department to manage the Cook Inlet pink salmon stocks primarily for commercial uses to provide an economic yield from the harvest of these salmon resources based on abundance. The Department shall also manage the commercial pink salon fishery to minimize the harvest of Northern District and Kenai River coho salmon stocks.

Issue 1:

The plan addresses only the drift fleet, while the Central District eastside setnet fleet was historically the major harvester of Kenai River pink salmon. (Comment #2, Kenai area Fishermen's Coalition)

Issue 2:

The timing of the management plan is outside the migratory run timing for Susitna River pink salmon stocks. (Comment #2, Kenai area Fishermen's Coalition)

5 AAC 21.358. Northern District Salmon Management Plan.

Management Plan:

The purposes of this management plan are to: 1) minimize the harvest of coho salmon bound for the Northern District of upper Cook Inlet and; 2) to provide the department direction for management of salmon stocks. The department shall manage the chum, pink, and sockeye salmon stocks primarily for

commercial uses to provide commercial fisherman with an economic yield from the harvest of these salmon resources based on abundance.

Issue 1:

In 14 of the last 15 seasons the Northern District set gillnet fishery has been closed for one or more periods, and the drift gillnet fishery has been restricted in an attempt to meet the Yentna River escapement goal. While these restrictions have been taken to meet the Yentna River escapement goal, both the Kasilof and Kenai River goals have often been exceeded. Under 5 AAC 21.358(b) it states "Achievement of the lower end of the Yentna River optimal escapement goal shall take priority over not exceeding the upper end of the Kenai River escapement goal. When the sockeye salmon returns to the Kenai River are four million or greater, the optimal escapement goal is 75,000 to 180,000 sockeye salmon in the Yentna River". It is unclear as to which goal in the Kenai the plan is referencing. (Issue from initial Committee draft)

The committee received comments that the Kenai management should take precedence over Yentna escapement as long as sustainability is maintained. (Comment #4, Homer Fish and Game Advisory Committee)

5 AAC 21.360. Kenai River Late-Run Sockeye Salmon Management Plan.

Management Plan:

The department shall manage the Kenai River late-run sockeye salmon stocks primarily for commercial uses based on abundance. The department shall also manage the commercial fisheries to minimize the harvest of Northern District coho, late-run Kenai River king, and Kenai River coho salmon stocks to provide personal use, sport, and guided sport fishermen with a reasonable opportunity to harvest salmon resources. The Kenai River late-run sockeye salmon commercial, sport, and personal use fisheries shall be managed to (1) meet an optimum escapement goal (OEG) range of 500,000 - 1,000,000 late-run sockeye salmon; (2) achieve inriver goals as established by the board and measured at the Kenai River sonar counter located at river mile 19; and (3) distribute the escapement of sockeye salmon evenly with the OEG range, in proportion to the size of the run.

Issue 1:

The BOF has adopted escapement goals, windows, and established fishing time restrictions. It is unclear which is the higher priority; allowable fishing time or managing within the escapement goals. It is also unclear which goal the board is referring to when managing for escapement goals, the OEG listed under 5 AAC 21.360(b)(1) or the inriver goals listed under 5 AAC 21.360(2) As mentioned earlier, the amount of fishing time allowed by current regulations and the inriver goal at the sonar site (at mile 19) is determined by the preseason run projection until approximately July 25. This can create problems because since 1999, the end of season total run estimate has never matched the management tier based on the preseason run projection. (Issue from initial Committee draft)

Comments on this issue stated that the Kenai sockeye run should be managed within it's escapement goals with wide emergency order authority for the Department and no regulations that mandate closures, windows, tiers, etc. (Comment #4, Homer Fish and Game Advisory Committee)

Many other comments spoke of the confusion between the OEG and the in river goals and suggested clarification.

Issue 2:

The bag and possession limit is set in the management plan at three sockeye salmon. When bag and possession limits are set in management plans, the department cannot use its emergency order authority to increase or decease limits unless allowed by the management plan. This plan only allows a bag and possession limit increase to six sockeye salmon. The issue is the department does not have the flexibility to decrease limits rather than closing the fishery or increasing the possession limit to increase harvest. (Issue from initial Committee draft)

Issue 3:

It is unclear if the sport and personal use fisheries are also required to take action to meet all three of the criteria listed under (b) of 5 AAC 21.360. (Issue from initial Committee draft)

Issue 4:

Paragraph (a) states "...The Department shall manage the commercial fisheries to minimize the harvest of Northern District coho, late-run Kenai River king, and Kenai River coho salmon stocks to provide personal use, sport, and guided sport fishermen with a reasonable opportunity to harvest salmon resources". The term "reasonable opportunity" is vague and the Board should consider a better definition of this term. (Comment #2, Kenai Area Fishermen's Coalition)

Issue 5:

Clarify priorities relative to 5 AAC 21.359 (a) which directs that the department shall manage the late-run Kenai River chinook run primarily for sport and guided sport uses. Despite this direction, management of commercial sockeye fisheries typically results in a de facto 50% or greater allocation to the commercial fishery. How should adjustments to existing plans that diminish this directive be addressed? (Comment #6, Kenai River Sportfishing Association)

Issue 6:

The current OEG range and in-river goal range need to be recalibrated and reflect updated in-river sockeye fisheries harvest levels. Kenai goals are based on sustainable spawning escapement goals backed down to the sonar based on assumptions for in-river harvest in sport and personal use fisheries. However, in-river harvest has been significantly greater than previously assumed, particularly when large number of sockeye are available in the river. As a result, even when the sonar goals have been exceeded, escapement targets have often been met. (Comment #6, Kenai River Sportfishing Association)

Another comment suggested that the Kenai River late-run sockeye escapement goals are too high given concerns about the productivity of Kenai and Skilak Lakes and that the goals should be reduced to avoid jeopardizing future returns. (Comment #10, Kenai Peninsula Fishermen's Association)

5 AAC 21.365. Kasilof River Salmon Management Plan.

Management Plan:

This management plan governs the harvest of Kasilof River salmon excess to spawning escapement needs. It is the intent of the Board of Fisheries that Kasilof River salmon be harvested in the fisheries that have historically harvested them, including the methods, means, times, and locations of those fisheries.

Openings in the areas historically fished must be consistent with escapement objectives for upper Cook Inlet salmon and with the Upper Cook Inlet Salmon Management Plan (5 AAC 21.363).

Issue 1:

The Kasilof River biological escapement goal has been exceeded 6 of seven years since 1999 while the OEG has been exceeded 4 of 5 years (OEG established in spring of 2002). The current management plans allotted fishing time prior to July 9 is not sufficient to harvest excess fish. The 48 hour window has also been problematic as during that period of time, large passage rates have occurred. These two factors have kept the department from being able to manage for the escapement goal. (Issue from initial Committee draft)

One comment suggested that the current Kasilof River sockeye salmon escapement goal and OEG may be too low. Large escapements into the Kasilof, rather than reducing run size have instead produced above replacement resulting in even larger returns. (Comment #6, Kenai River Sportfishing Association)

Issue 2:

Because of the increased frequency of exceeding the escapement goal, the department has begun to use the Kasilof River Special Harvest Area (KRSHA) much more aggressively to harvest excess fish to stay within the current Optimal Escapement Goal of 150,000 to 300,000 sockeye salmon. From 1986 until 2004 the KRSHA was not used. The current use of the KRSHA is the only tool available to attempt to keep the escapement within the goal during closed windows and when all available fishing time in 5 AAC 21.360 has been utilized. It also is in conflict with the BOF intent to harvest salmon in fisheries that have historically harvested them including the methods, means, times, and locations of those fisheries. (Issue from initial Committee draft)

A public comment stated that the KRSHA is a valuable tool to utilize when the Kenai or other stocks must be protected, but there is a significant surplus of Kasilof fish, and stated that the while it may not be the prefect solution, the KRSHA should have been used more often in recent years. (Comment #1, Gary Hollier)

Another comment mentioned that various fishery restrictions such as windows and limitations on E.O. authority have led to the necessity of the KRSHA, which has increased the harvest of Kenai and Kasilof kings, while still not catching enough Kasilof reds. (Comment #4, Homer Fish and Game Advisory Committee)

A comment also mentioned that the KRSHA has resulted in poor quality of salmon harvested, intense user conflicts, displacement of historic users and that the Kasilof River plan should be de-coupled from the Kenai River Late-Run Sockeye Management Plan. (Comment #9, Jeff Beaudoin and Comment #10, Kenai Peninsula Fishermen's Association)

Issue 3:

Beginning July 8, the set gillnet fishery in the Kasilof Section is managed as specified in 5 AAC 21.360(c); in addition to the provisions of 5 AAC 21.360(c), the commissioner may, by emergency order, limit fishing during the regular weekly periods and any extra fishing periods to those waters within one-half mile of shore, if the set gillnet fishery in the Kenai and East Forelands Sections are not open for the fishing period. July 8 may be too early to manage the Kasilof stock based on the run strength of the Kenai River. (Issue from initial Committee draft)

Issue 4:

After July 15, if the department determines that the Kenai River late-run sockeye salmon run strength is projected to be less than two million fish and the 300,000 optimal escapement goal for the Kasilof River sockeye salmon may be exceeded, an additional 24-hours per week in the Kasilof Section within one-half mile of shore as allowed by regulation. This additional time may not be sufficient to harvest surplus Kasilof sockeye. (Issue from initial Committee draft)

A public comment (#1, Gary Hollier) expressed concern that additional time in the Kasilof section may keep the Kenai from achieving its minimum goals.

Issue 5:

The current opening date of June 25 (or as early as June 20 if 50,000 sockeye are in the Kasilof River) may be too late to prevent lost commercial harvest opportunity and escapements above the upper end of the goals. While the comment related to the Kasilof section, the actual regulation that governs the starting date is found at 5 AAC 21.310. Fishing Seasons. (Comment #1, Gary Hollier)

Issue 6:

Commercial fisheries at or near the mouth of the Kasilof River in late-June and through much of July have drastically reduced what was historically a productive and popular in-river chinook salmon sport fishery. Also, the harvest of significant numbers of Kenai chinook in Kasilof sockeye setnet fisheries contribute to the disproportionate harvest share of Kenai chinook in the commercial setnet fishery relative to their sport fishery priority identified in the Kenai River Late-run King Salmon Management Plan. (Comment #6, Kenai River Sportfishing Association)

5 AAC 77.540. Upper Cook Inlet Personal Use Salmon Fishery Management Plan.

Management Plan:

This management plan governs the harvest of salmon in Upper Cook Inlet for personal use. This plan establishes seasons, areas, harvest levels, reporting requirements, harvest permits, and allowable gear types.

Issue 1:

The department cannot use its emergency order authority to extend the personal use fishing season beyond what is stated in the management plan. The current season regulatory closure of July 31 for the Kenai River dip net fishery does not allow flexibility to harvest fish in a late run year. It is also unclear if the department can use its emergency order authority to increase or decrease time and area of the personal use fishery in response to abundance. (Issue from initial Committee draft)

Issue 2:

The Department lacks the authority to make inseason adjustments to bag and possession limits in the personal use fishery. (Comment #6, Kenai River Sportfishing Association)

Other issues and regulations that were raised:

Kenai River Chinook Salmon (Early Run):

Current slot limit affecting harvest of early-run chinook salmon in the Kenai River may unnecessarily restrict harvest opportunity in the sport fishery given that the escapement goal range has been reduced. (Comment #6, Kenai River Sportfishing Association)

Kenai River Chinook Salmon:
Current restrictions on the harvest of jack salmon do not allow for a harvest of this size and age class proportional to abundance and is therefore limiting harvest opportunity. Comment #6, Kenai River Sportfishing Association)

5 AAC 39.222. Policy for the Management of Sustainable Salmon Fisheries
Several comments referenced the SSFP in the context of managing the fisheries for their escapement goals, and suggested that management plans that consistently allow for goals to be exceeded are in violation of the policy.

Another comment suggested that the Kasilof River should be found as a stock of concern due to its inability to meet its escapement goals (exceeding) based on the SSFP. (Comment #3, Jeff Beaudoin)

5 AAC 39.223 Policy for Statewide Salmon Escapement Goals
Several comments suggested that a review and justification of current escapement goals was warranted. While many of these comments focused particularly on the Board-established OEG's, some comments suggested that some or all escapement goals undergo a thorough review (BEG, SEG, OEG). (Comment #2, Kenai Area Fishermen's Coalition, Comment #8, Kenai River Sportfishing Association, Comment #10, Kenai Peninsula Fishermen's Association)

RC 14

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES

MEMORANDUM

TO: John Hilsinger
Director
Division of Commercial Fisheries
Headquarters – Anchorage
and
Charlie Swanton
Director
Sport Fish Division
Headquarters – Juneau

DATE: September 25, 2007

PHONE: (907) 267-2376 (LFF)
PHONE: (907) 267-2124 (JJH)
FAX: (907) 267-2442 (LFF)
FAX: (907) 267-2401 (JJH)

SUBJECT: Upper Cook Inlet stocks of concern recommendation

THRU: Jeff Regnart
Regional Supervisor
Division of Commercial Fisheries
Region II – Anchorage

FROM: Lowell F. Fair
Regional Research Coordinator
Division of Commercial Fisheries
Region II – Anchorage
and
James J. Hasbrouck
Regional Supervisor
Sport Fish Division
Region II – Anchorage

The Sustainable Salmon Fisheries Policy (SSFP; 5 AAC 39.222) directs the department to provide the Alaska Board of Fisheries (BOF), at regular meetings, with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation. In the Upper Cook Inlet (UCI) Management Area no stocks have been identified as such. However, this memorandum does provide the department's assessment of the Yentna River sockeye salmon run, which has had difficulty in recent years in reaching its SEG range.

Yentna River sockeye salmon

Stock Assessment

The Susitna River sockeye salmon run is thought to be a large contributor to major sockeye salmon runs in Upper Cook Inlet. During 1976-2001, estimated total UCI sockeye salmon runs ranged from 1.8-12.1 million, while estimated Susitna River sockeye salmon runs ranged from 280 thousand to 773 thousand, and averaged 492 thousand (Tobias and Willette 2001). Management of the Susitna River sockeye salmon run is based upon sonar estimates on the Yentna River, which is thought to be a major producer of sockeye salmon in the Susitna drainage and an indicator of run strength in the mainstem Susitna River. Technical challenges currently preclude operation of sonar on the lower main-stem Susitna River. Since 1981, based upon sonar estimates, the number of Yentna River spawners has ranged from approximately 37 thousand to 181 thousand sockeye salmon.

How well the sonar indexes total escapement has not been verified. The Yentna River is a large, dynamic glacial river that is difficult to assess using sonar, mid-river sections are not ensonified, and significant runs of other salmon species occur where fishwheels must be used to apportion the total sonar count by species. Any one of these issues will create biases in the estimation of species-specific escapement. Whether any of these biases are significant, or if they vary seasonally or annually, is unknown.

Currently, the Yentna River sockeye salmon escapement goal, 90,000 to 160,000 fish, is a sustainable escapement goal (SEG) that was adopted in 2002 (Bue and Hasbrouck *Unpublished*). An SEG is a level of escapement that is known to provide for sustained yield over a 5 to 10 year period and is used in situations where a biological escapement goal (BEG) cannot be estimated due to a concern about the spawner-return data (lack of age composition estimates and/or concern with stock-specific catch allocation) or there is a lack of information on stock productivity. In 2005, the Alaska Board of Fisheries defined an optimal escapement goal of 75,000-180,000 fish in the Yentna River that applies when the run of Kenai River sockeye salmon exceeds 4 million fish (5AAC21.358).

In January 2007, an interdivisional salmon escapement goal review team, including staff from the Division of Commercial Fisheries and Sport Fish Division, was formed to comprehensively review the existing salmon escapement goals in the Upper Cook Inlet Management Area based on the SSFP and the Policy for Statewide Salmon Escapement Goals (5 AAC 39.223). While this review is ongoing, the recommendation of the escapement goal review team is that the

current Yentna River sockeye salmon escapement goal should remain unchanged. Results of this escapement goal review will be available in a written report published by December 1, 2007.

Regulatory History

At this time, five of the last seven years of sonar escapement estimates of sockeye salmon into the Yentna River have fallen below the lower end of the SEG (Figure 1). This issue has been addressed in the immediate term by placing restrictions on fisheries that harvest this stock. For the last seven seasons the Northern District set gillnet fishery has been closed for one or more periods, except in 2000.

The drift gillnet fishery has also been restricted each year since 2001 for one or more periods in an attempt to meet the Yentna River sockeye salmon escapement goal. Additionally, in 2005, the department implemented a more conservative fishing schedule with the drift fleet than was allowed in regulation to conserve Northern District fish, including Yentna River sockeye salmon stocks. Restrictions to the drift fleet included: 1) closing areas where Yentna River sockeye salmon were thought to be; and 2) not exercising a third commercial opening that was allowed by the Central District Drift Gillnet Fishery Management Plan (5 AAC 21.353). In addition the Northern District set gillnet fishery was closed for five regular fishing periods from July 21 through August 4. Actions taken in the drift fishery may not be observed or realized until 10 to 14 days later and actions taken in the Northern District may not be realized for 7 to 10 days. Once the effects of the first actions are observed it is generally too late to take further corrective actions. The subsistence fishery in the Yentna River has not been restricted.

The sport fishery was also restricted in each of the last four seasons by closing the fishery to retention of sockeye salmon.

Stock of Concern Recommendation

Given the recent pattern of low sockeye salmon escapements to the Susitna River drainage, the department is working to resolve two uncertainties regarding this stock. The first uncertainty is our understanding of stock structure, and the harvest of these stocks in the mixed stock fishery. An ongoing comprehensive study includes processing genetic material to develop a DNA genetic baseline. Sockeye salmon caught in the drift and set gill net fisheries of Upper Cook Inlet will continue to be sampled and DNA analysis conducted to determine river of origin. The second uncertainty concerns the overall sockeye salmon escapement into the Susitna River. We currently have a sonar assessment project on the Yentna River to estimate escapement but it is uncertain how well the sonar indexes escapement in the Yentna River and what contribution escapement in the Yentna River makes to the overall Susitna River sockeye salmon escapement.

The ADF&G, with participation from Cook Inlet Aquaculture Association, is estimating adult sockeye salmon abundance within the entire Susitna River during 2006, 2007, and 2008. A mark-recapture and radio telemetry study will provide an estimate of sockeye salmon escapement in the Susitna River drainage (Yentna River and mainstem Susitna River) to compare with the existing Yentna River sonar and allow the identification of potential spawning areas in the drainage. Such abundance estimates will allow: 1) estimation of the total annual run of Susitna River sockeye salmon, when abundance estimates and genetics-based harvest allocation

estimates are combined, 2) evaluation of the accuracy of the Yentna River sonar estimate, and 3) the proportion of Yentna River sockeye salmon in the entire Susitna River sockeye salmon escapement. The uncertainties in the Yentna River sonar estimate and contribution of Yentna River sockeye salmon to the entire Susitna River escapement has questioned our assumptions of Susitna River drainage sockeye salmon productivity used in managing this mixed-stock fishery.

Additionally, the department is evaluating the current sockeye salmon escapement assessment tool, a Bendix single beam sonar system, with a more advanced and proven hydroacoustic system known as DIDSON. The transition from Bendix sonar to DIDSON is occurring throughout the Cook Inlet management area. The first full season comparison between the two sonar systems for the Yentna River began in 2006.

In summary, the department does not believe the sustainability of the Yentna River sockeye salmon stock, as defined by the *Sustainable Salmon Fisheries Policy* (5 AAC 39.222), is jeopardized despite the failure to reach escapement goals in five of the last seven years. As defined in this policy, sustained yield means an average annual yield that results from a level of salmon escapement that can be maintained on a continuing basis; a wide range of average annual yield levels is sustainable; a wide range of annual escapement levels can produce sustained yields. However, the department is treating the persistently low escapements of sockeye salmon to the Yentna River as a serious issue. This issue has been addressed in the short term by placing restrictions on fisheries that harvest this stock, and in the longer term by a suite of research programs intended to: 1) answer key questions regarding the productivity of the stock and 2) improve our knowledge of where and how many sockeye salmon from this stock are harvested through genetic studies.

Partial and preliminary information from these studies will be available to the Board at the next regular Cook Inlet cycle meeting in February 2008. However, the majority of the findings and conclusions from these studies will not be available until the 2010-2011 Cook Inlet Board meeting. This information will help determine if stock specific fishing strategies may be developed for Upper Cook Inlet, as well as guide the implementation of any such fishing strategies to better assure achievement of the Yentna River sockeye salmon escapement goal.

Literature Cited

Bue, B. G., and J. J. Hasbrouck. *Unpublished.* Escapement goal review of salmon stocks of Upper Cook Inlet.. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Tobias, T., and T.M. Willette. 2001. An estimate of total return of sockeye salmon to upper Cook Inlet, Alaska 1976-2001. Alaska Department of Fish and Game, Susitna River Aquatic Studies Program, Anchorage, Alaska. Regional Information Report No. 2A01-06.

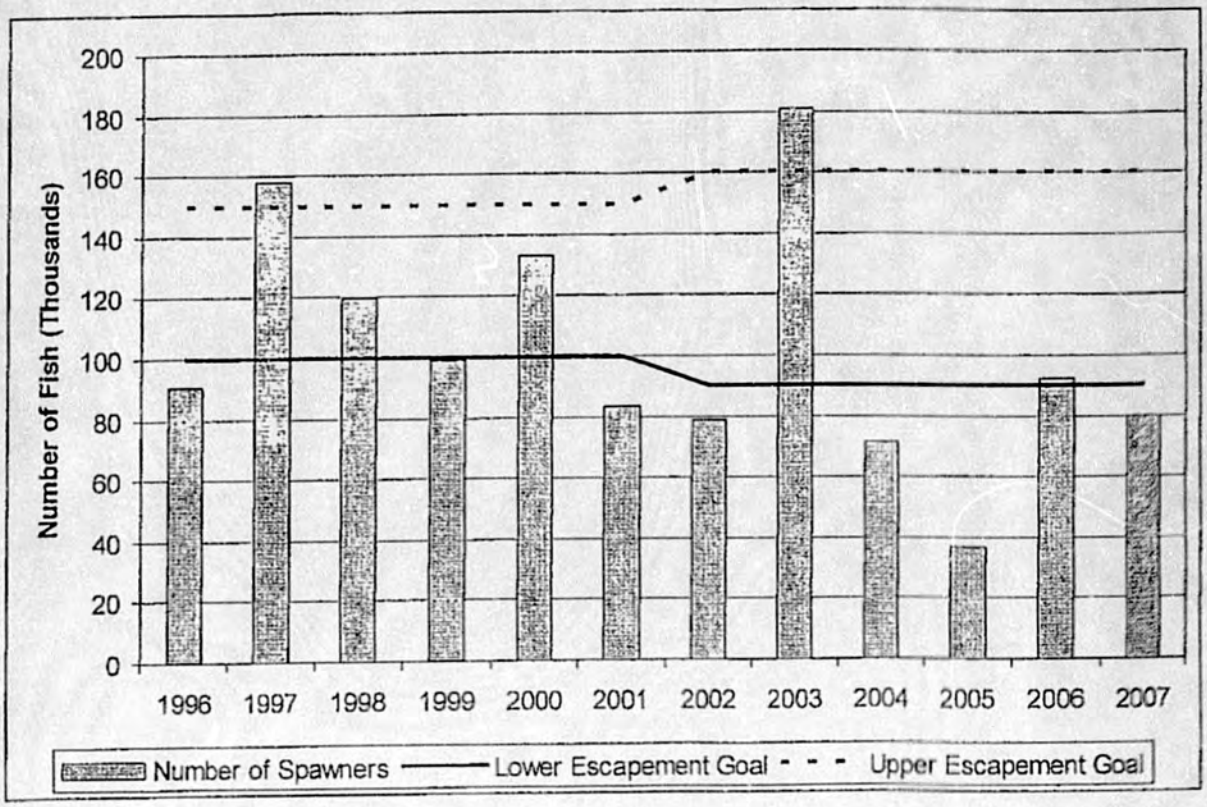


Figure 1. Yentna River sockeye salmon escapement goal range and number of spawners, 1996-2007.

RC 8

STATE OF ALASKA

SARAH PALIN, GOVERNOR

DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES
DIVISION OF SPORT FISH

333 Raspberry Road
Anchorage, AK 99518
PHONE: (907) 267-2100
FAX: (907) 267-2442

MEMORANDUM

TO: Mel Morris, Chairman - Alaska Board of Fisheries

FROM: John Hilsinger
Director
Division of Commercial Fisheries
And
Charles O. Swanton
Director
Division of Sport Fish

DATE: January 24, 2008

SUBJECT: Upper Cook Inlet potential management options

At the Alaska Board of Fisheries (BOF) work session in October 2006, the board received numerous Agenda Change Requests (ACRs) that asked the board to re-evaluate many aspects of the Upper Cook Inlet (UCI) salmon fishery management plans. While the board declined to accept the ACR's, they created a committee of three board members to begin a comprehensive review of the management plans in preparation for the regular, in-cycle meeting for UCI during the winter of 2007/2008. With input from the Alaska Department of Fish and Game, the committee prepared an initial "issues paper" on the UCI management plans. This initial draft was made available to the public for written comment and was intended to stimulate discussion and to solicit additional comments from the public (i.e., various users). The committee received 12 written comments from the public which were incorporated into the issues paper. This paper was presented to the full Board by the committee during the March 2007 BOF meeting.

Based on comments from the public, the committee worked toward including as many issues as possible, not wanting to necessarily "screen" anything at the time. The committee also stated that an inclusion of any issue into the document did not necessarily imply an endorsement by the committee or the full BOF. This document was not intended to be an all-encompassing issues paper, and it was assumed that other issues would be brought forward through the BOF proposal process.

Although numerous issues concerning UCI management were identified, possible options addressing these issues were not listed. This memo outlines potential options from the department addressing some of the major issues.

5 AAC 21.363. Upper Cook Inlet Salmon Management Plan

Issue 1: In the various management plans, the BOF has adopted optimal escapement goals (OEG), inriver run goals, and established fishing time restrictions or other management actions that are often in conflict with each other. In general, this management plan does not provide direction to or describe management actions to the department.

Option: Eliminate this umbrella management plan.

5 AAC 21.353. Central District Drift Gillnet Fishery Management Plan

Issue 1: In medium to larger sockeye salmon runs (over 3 million to the Kenai River), the drift gillnet fishery is a necessary tool to harvest salmon in excess of the various goals (inriver run goals and biological, sustainable, or optimal escapement goals) in the Kenai and Kasilof rivers. However, in recent years, restrictions to the drift gillnet fishery have been implemented in an attempt to achieve the Yentna River sustainable escapement goal. This goal has been exceeded once, within the range twice, and below the range 6 times since 1999. During that time the Kenai River inriver run goal has been exceeded 5 of 9 years and the Kasilof River biological escapement goal (BEG) has been exceeded 8 of 9 years, and since the Kasilof River OEG (150,000–300,000) was adopted prior to the 2002 season, that goal has been met once and exceeded 5 of 6 years.

At run strengths greater than 2 million sockeye salmon to the Kenai River, one additional 12-hour fishing period in the Kenai and Kasilof Sections of the Upper Subdistrict and in Drift Gillnet Area 1 may be allowed by emergency order (EO) between July 9 and July 15. This additional time is likely never to be used because it is allowed prior to an inseason assessment of run strength to the Kenai or Yentna rivers. Implementing this additional time could be harmful if used in years with low runs to the Susitna River based on the forecast alone because it is generally not accurate for Susitna River sockeye salmon stocks.

Since 1999, the department's forecast of Kenai River run strength has been in the correct tier when compared to postseason total run assessment only in 2007. In early to mid July the department is required to put restrictions in place for the drift fishing fleet that are based on this forecast and the tiers within these management plans. The current regulations read as follows:

Weekly fishing periods are Monday and Thursday from 7:00 am to 7:00 pm, except that these fishing periods may be modified by emergency order.

The fishing season will open the third Monday in June or June 19, whichever is later, and from July 9 through July 15, (i) fishing during the two regular fishing periods is restricted to the Kenai and Kasilof Sections and Drift Gillnet Area 1; (ii) at run strengths greater than 2 million sockeye salmon to the Kenai River, the commissioner may, by emergency order, open one additional 12-hour fishing period in the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Area 1.

From July 16 through July 31, (i) at run strengths of less than 2 million sockeye salmon to the Kenai River, fishing during the two regular 12-hour fishing periods is restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Area 1; (ii) at run strengths of 2 million to 4 million sockeye salmon to the Kenai River, fishing during the two regular 12-hour fishing

periods is restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Areas 1 and 2; (iii) at run strengths greater than 4 million sockeye salmon to the Kenai River, there will be no mandatory restrictions during regular fishing periods.

Option: Reconsider the current regulated fishing time/area such that a more flexible management scenario is in place to harvest stocks based on run strength. Since many of these restrictions and other limitations were put in regulation, the number of EOs issued has doubled. Reducing or eliminating the mandatory drift restrictions prior to and after July 16, and eliminating the additional third period between July 9 and 15 in Drift Area Number 1, could provide flexibility and greatly simplify these plans. The department could then use EO authority to manage for escapement goals. Management actions taken in the drift gillnet fishery would remain dependent on meeting the Yentna River sockeye salmon sustainable escapement goal, as measured by the Yentna River sonar project.

Drift Gillnet Area 1 & Area 2 Descriptions

AREA 2 DESCRIPTION	COORDINATES
A. Southwest Corner	60° 20.43' N. lat., 151 ° 54.83' W. long.
B. Northwest Corner	60° 41.08' N. lat., 151 ° 39.00' W. long.
C. Northeast Corner	60° 41.08' N. lat., 151 ° 24.00' W. long.
D. Blanchard Line Corridor Boundary	60° 27.10' N. lat., 151 ° 25.70' W. long.
E. Southeast Corner	60° 20.43' N. lat., 151 ° 28.00' W. long.

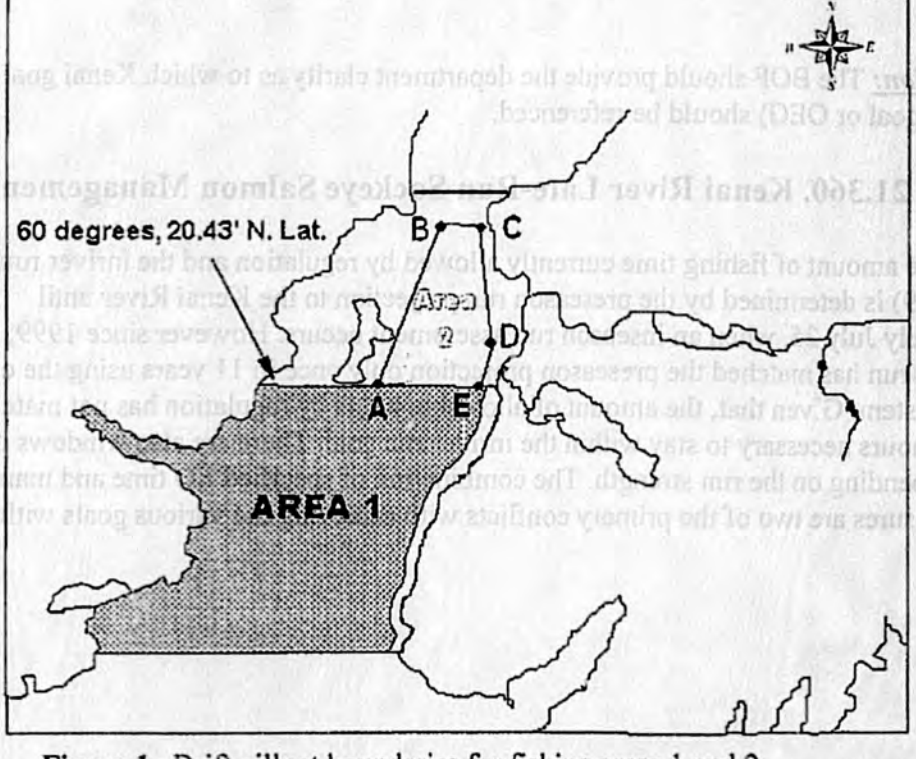


Figure 1.–Drift gillnet boundaries for fishing areas 1 and 2.

5 AAC 21.358. Northern District Salmon Management Plan

For the last 17 seasons, the Northern District set gillnet fishery has been closed for one or more periods, and the drift gillnet fishery has been restricted each year for one or more periods in an attempt to meet the Yentna River sustainable escapement goal. While these restrictions have taken place in an effort to meet the Yentna River sustainable escapement goal, the Kenai River inriver run goal has been exceeded 5 out of 9 years and the Kasilof River BEG has been exceeded 8 out of 9 years, and since the OEG (150,000–300,000) was adopted prior to the 2002 season, that goal has been met once and exceeded 5 of 6 years. The Yentna River sonar appears to be undercounting, by possibly a significant amount, and may be a poor indicator of abundance. The department needs to develop an alternative assessment to manage Northern District sockeye salmon fisheries and gain a better understanding of production and exploitation of Susitna River sockeye salmon stocks.

Since 1999 (8 years)	Yentna R.	Kenai R. (OEG)	Kenai R. (IRG)	Kasilof R. (BEG)	Kasilof R. (OEG Est. 2002)
Below	6	2	0	0	0
Within	2	4	4	1	1
Exceeded	1	3	5	8	5

Issue 1: 5 AAC 21.358(b) states "Achievement of the lower end of the Yentna River OEG shall take priority over not exceeding the upper end of the Kenai River escapement goal. When the sockeye salmon returns to the Kenai River are 4 million or greater, the OEG is 75,000 to 180,000 sockeye salmon in the Yentna River". It is unclear as to which goal in the Kenai River the plan is referencing.

> ***Option:*** The BOF should provide the department clarity as to which Kenai goal (inriver run goal or OEG) should be referenced.

5 AAC 21.360. Kenai River Late-Run Sockeye Salmon Management Plan

Issue 1: The amount of fishing time currently allowed by regulation and the inriver run goal (at river mile 19) is determined by the preseason run projection to the Kenai River until approximately July 25, when an inseason run assessment occurs. However since 1999, the end of season total run has matched the preseason projection only once in 11 years using the current three tier system. Given that, the amount of allowable hours by regulation has not matched the amount of hours necessary to stay within the inriver run goal. There are also windows of closure in place depending on the run strength. The combination of specified EO time and mandatory window closures are two of the primary conflicts with achieving the various goals within the plans.

Current UCI Mgmt. Plan (3 Tiers)			
	Kenai River		Actual Run in Same Tier as Forecast?
Year	Forecast	Actual	
1999	1.60	2.60	No
2000	2.50	1.50	No
2001	2.40	1.90	No
2002	1.70	3.10	No
2003	1.96	3.80	No
2004	3.20	5.00	No
2005	3.30	5.60	No
2006	1.85	2.53	No
2007	2.41	2.77	**Yes**
		Correct	**11%**

Run < 2 million	**Run 2–4 million**	**Run > 4 million**
Inriver run goal: 650,000–850,000	Inriver run goal: 750,000–950,000	Inriver run goal: 850,000–1,100,000
24 hours of emergency order authority beyond the two regular periods	51 hours of emergency order authority beyond the two regular periods	84 hours of emergency order authority beyond the two regular periods
NA	24 hour floating window closure	NA
NA	36 hour window closure that has to start between 7pm Thursday and 7am Friday.	36 hour window closure that has to start between 7pm Thursday and 7am Friday.

Option: Based on the difficulty of accurately projecting the Kenai River sockeye salmon run, a possible solution would be to replace the current three tier system with a two tier system. Below is a plan outlining what a possible two-tiered system might resemble. Changing to a two-tier system may require modification of the inriver run goal in order to provide an allocation of fish to the inriver user. Kenai River late-run sockeye salmon sport fish harvests from 1997–2006 have averaged 224,758 fish. An inriver run goal set too low may result in restrictions or closures to the sport and personal use fisheries.

Plan With a 2 Tier system (3 million)			
	Kenai River Run		Actual Run in Same Tier as Forecast?
Year	Forecast	Actual	
1999	1.60	2.60	**Yes**
2000	2.50	1.50	**Yes**
2001	2.40	1.90	**Yes**
2002	1.70	3.10	No
2003	1.96	3.80	No
2004	3.20	5.00	**Yes**
2005	3.30	5.60	**Yes**
2006	1.85	2.53	**Yes**
2007	2.41	2.77	**Yes**
		Correct	**78%**

Run less than 3 million	**Run greater than 3 million**
Option 1: Inriver run goal: 650–850	Option 1: Inriver run goal: 850–1.100
Option 2: Inriver run goal: 750–950	
51 hours of emergency order authority	84 hours of emergency order authority
24 hour floating window	24 hour floating window deleted (as it is in runs greater than 4 million sockeye)
36 hour fixed window	36 hour window that can be fished into if needed to control escapement into the Kenai River

Issue 2: Specify which management objective in the plan is the priority when considering escapement goals (inriver run goal or OEG), window closures, or regulated fishing time via EO.

Option 1: Specify that the Kenai River inriver run goal found in the various tiers is the inseason target and priority for the department. The prescribed window closures and EO hours will be used to achieve the inriver run goal but the inriver run goal will not be compromised by a window closure or a set number of EO hours. It is the inriver run goal for which the department has inseason information and uses that information to make management decisions.

Option 2: Specify that the prescribed window closures found in the various tiers are the priority and that achieving the inriver run goals and potentially exceeding EO fishing hours will not compromise a window closure.

Issue 3: The sport fishing bag and possession limit is set in the management plan at 3 sockeye salmon. When bag and possession limits are set in management plans, the department cannot use EO authority to increase or decease limits unless allowed by the management plan. This plan only allows a bag and possession limit increase to 6 sockeye salmon. Adding the flexibility of reducing the bag limit and possession limit by EO rather than total closure may reduce disruption to the sport fishery during years when the department projects that the inriver run goal will not be met but the OEG could be met if the sport fishing sockeye salmon bag and possession limit is lowered. In addition, when escapement goals are being exceeded, the bag and possession limit is confined to 6 fish. Increasing harvest limits beyond 6 fish may increase the opportunity to harvest fish in excess of the escapement goal.

> ***Option:*** Provide the department EO authority to decrease limits rather than close the fishery and increase the bag and possession limit to increase harvest. Decreasing limits to 1 fish or 2 fish may allow the sport fishery to remain open at a very low level of harvest and effort while still achieving the OEG.

Issue: The language under 5 AAC 21.360 (b) relating to the sport and personal use fisheries is inconsistent with the language in (g) and (h). Under (b) of the management plan, it states that the Kenai River late-run sockeye salmon commercial, sport, and person use fisheries shall be managed to (1) meet an OEG of 500,000–1,000,000 sockeye salmon; (2) achieve inriver run goals; and (3) distribute the escapement of sockeye salmon evenly within the OEG range, in proportion to the size of the run. The plan further states under (g) and (h) which requirements are necessary in order to provide for sport and personal use fisheries. These two subsections essentially limit restrictions on these fisheries to those needed to ensure the lower end of the OEG is met.

> ***Option 1:*** Delete the reference to sport and personal use fisheries under (b) of this section. This would be consistent with how the sport and personal use fishery have been previously managed.

> ***Option 2:*** Modify (g) and (h) of this section to subject the sport and personal use fisheries to the requirement of meeting the inriver run goal instead of the OEG. This may require the personal use fishery and the sport fishery below the sonar site to be restricted or closed depending on how many fish pass the commercial fisheries and enter the river.

5 AAC 21.365. Kasilof River Salmon Management Plan

Issue 1: The Kasilof River BEG has been exceeded 8 of 9 years since 1999 while the OEG has been exceeded 5 of 6 years (OEG established in spring of 2002). Fishing time allotted in the current management plan prior to July 9 is not sufficient to harvest excess fish (two regular scheduled periods plus up to 48 hours of additional EO time). The 48 hour window closure has also been problematic because during that period of time large passage rates have occurred. These two factors have kept the department from being able to manage for the escapement goal. In order to meet the Kasilof River escapement goal, the above limitations also make it necessary

to use the Kasilof River Special Harvest Area (KRSHA) much more aggressively. This is also in conflict with the BOF intent to harvest salmon in fisheries that have historically harvested them including the methods, means, times, and locations of those fisheries.

Option: Reduce the 48 hour window closed to commercial fishing to a minimum of 24 hours and increase the amount of allowable EO fishing time from 48 hours to 63 hours (by 15 hours a week). This would provide the department the ability to manage for the Kasilof River sockeye salmon OEG prior to Kenai River sockeye salmon stocks entering the fishery. This change would make use of the KRSHA less likely.

Issue 2: Beginning July 9, the set gillnet fishery in the Kasilof Section is managed in concert with the Kenai and East Forelands sections. The date of July 9 may be too early to manage the Kasilof River sockeye salmon stock based on Kenai River sockeye salmon run strength.

Option: Begin managing the Kasilof River in concert with the Kenai and East Forelands sections July 15 instead of July 9. This would provide additional time to harvest Kasilof River sockeye salmon prior to the arrival of the majority of the Kenai River sockeye salmon entering the fishery. Additional Kenai River sockeye and king salmon could be harvested in the Kasilof section during this time frame. The regulations in place on June 25 in the Kasilof section would remain in effect until July 15. At that time, the Kasilof and Kenai areas would be managed in concert.

Issue 3: After July 15, if the department determines that the Kenai River late-run sockeye salmon run strength is projected to be less than 2 million fish and the 300,000 upper OEG bound for the Kasilof River sockeye salmon may be exceeded, an additional 24-hours of fishing per week in the Kasilof Section within one-half mile of shore is allowed by regulation. This date and the additional time may not be sufficient to harvest surplus Kasilof sockeye.

Option: Provide an additional 24 hours of fishing within one-half mile in the Kasilof Section after July 8.

STATE OF ALASKA

SARAH PALIN, GOVERNOR

P.O. BOX 115526
Juneau, AK 99811-5526
PHONE: (907) 465-4210 (CF)
PHONE: (907) 465-4180 (SF)

DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES
DIVISION OF SPORT FISH

MEMORANDUM

TO: John Hilsinger
Director
Division of Commercial Fisheries
Headquarters – Anchorage
and
Charlie Swanton
Director
Sport Fish Division
Headquarters – Juneau

DATE: January 30, 2008
PHONE: (907) 267-2376 (LFF)
PHONE: (907) 267-2124 (JJH)
FAX: (907) 267-2442 (LFF)
FAX: (907) 267-2401 (JJH)

THRU: Jeff Regnart
Regional Supervisor
Division of Commercial Fisheries
Region II – Anchorage

FROM: Lowell F. Fair
Regional Research Coordinator
Division of Commercial Fisheries
Region II – Anchorage
and
James J. Hasbrouck
Regional Supervisor
Sport Fish Division
Region II – Anchorage

SUBJECT: Upper Cook Inlet stocks of concern follow-up on Yentna River sockeye salmon

The Sustainable Salmon Fisheries Policy (SSFP; 5 AAC 39.222) directs the department to provide the Alaska Board of Fisheries (BOF), at regular meetings, with reports on the status of salmon stocks to identify any salmon stocks that present a concern related to yield, management, or conservation. For example, a "yield concern" means a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs. In the Upper Cook Inlet (UCI) Management Area no stock has been identified as a stock of concern. However, with the approaching UCI Alaska Board of Fisheries meeting in February and as a follow up to the September 2007 memorandum, we reviewed the department's stock of concern assessment of the Yentna River sockeye salmon run.

Escapement Assessment and Trends

Initial efforts to estimate the number of sockeye salmon spawning and rearing in the Susitna watershed were limited in scope and duration. Various lakes within the drainage were visited sporadically in the 1950s and 1960s by United States Fish and Wildlife Service and Alaska Department of Fish and Game (ADF&G) personnel to collect salmonid juvenile and adult data. Adult spawner counts were primarily the product of aerial surveys (King and Walker 1997). At various times since the early 1970s, weirs monitored sockeye salmon entering selected tributaries (Chelatna Lake, Fish Lakes, Judd Lake, Larson Lake, Shell Creek, and Talachulitna River) to spawn (King and Walker 1997).

Mark–recapture projects were conducted on the Susitna River in 1974 and 1975 as part of an effort to estimate juvenile and adult anadromous fish populations in the upper Susitna River between Devil's Canyon and the confluence of the Susitna and Chulitna rivers. These studies were part of the pre-authorization investigation for the proposed Susitna Hydroelectric Project (Barrett 1974; Friese 1975). The results of these studies indicated that the majority of sockeye salmon in the Susitna River basin were produced in the Yentna and Skwentna river drainages (Namtvedt et al. 1978). Mark–recapture projects were again conducted on the Susitna River during 1982–1985 to estimate the inriver run of sockeye salmon (Barrett et al. 1985; Thompson et al. 1986).

Adult salmon escapements into the Susitna River were monitored with sonar at Susitna Station (river kilometer [rkm] 52) from 1976 to 1980. However, changes in bottom characteristics at that sonar location precluded continuation of the project after 1980. Because no other site suitable for the existing sonar equipment was found in the mainstem of the Susitna River, the project was moved to the Yentna River, the largest tributary in the drainage. From 1981 to the present, the Yentna River daily sonar estimates have been used as an indicator of the sockeye salmon escapement into the Susitna River drainage. The sockeye salmon escapement bound for the Yentna River has been thought to be approximately one half of the total Susitna River sockeye salmon escapement based on a combination of 1981–1985 capture-recapture abundance estimates passing Sunshine (Susitna River rkm 116), and sonar abundance estimates passing Yentna (Yentna River; rkm 7) and Susitna Station (Westerman and Willette 2006).

Currently, the Yentna River sockeye salmon escapement goal, 90,000 to 160,000 fish, is a sustainable escapement goal (SEG) adopted in 2002 (Bue and Hasbrouck *Unpublished*). In 2007, an interdivisional salmon escapement goal team reviewed salmon escapement goals in the UCI Management Area based on the SSFP and the Policy for Statewide Salmon Escapement Goals (5 AAC 39.223). The team recommended that the current Yentna River sockeye salmon escapement goal remain unchanged (Fair et al. 2007).

Based on Bendix sonar estimates since 1981, the number of Yentna River spawners has ranged from approximately 37,000 to 181,000 sockeye salmon. The sonar estimate of sockeye salmon escapement into the Yentna River has not met the goal in 5 of the past 8 years (Table 1). Unfortunately, the accuracy of escapement enumeration based on sonar in the Yentna River has not been verified. The Yentna River is a large, dynamic glacial river that poses difficulties in assessing salmon escapement using sonar, and significant runs of other salmon species occur, requiring fish wheels to be used to apportion the total sonar count by species. Any one of these issues will create biases in the estimation of species-specific escapement. Whether any of these biases are significant, or if they vary seasonally or annually, is unknown. Additionally, a comparison of historical sockeye salmon escapements in the Yentna River and in four major rearing lakes (Chelatna, Shell, Judd, and Larson) suggests that production may have recently declined in the smaller rearing lakes in the watershed.

Yield Assessment

The sustained-yield principal requires an understanding of the relationship between the abundance of spawning fish and the abundance of their offspring that survive to adulthood (known as a brood table) by stock. The number of offspring that survive to adulthood is calculated by adding the number of spawning fish and the number of fish harvested for each parent generation.

Accurately estimating the composition of mixed-stock catch is critical to determining the total run of each stock. Age composition has historically been used to facilitate estimation of stock composition. Stock and age specific catch and escapement data have been the basis for development of long-term brood tables used for both pre-season forecasting and for scientific estimation of escapement goals.

Unfortunately, the allocation methodology used to apportion sockeye salmon catches to component stocks in UCI represents a coarse approximation of the actual catch by stock. Historically, a series of largely untested assumptions have been used to allocate stock composition. ADF&G currently uses age composition estimates from the harvest and escapement, and run timing to allocate the harvest to each stock (Bernard 1983). The current method assumes that the stocks present in a district are equally exploited. This untested assumption could greatly affect the estimated stock compositions. The current method probably underestimates the productivity of some stocks and overestimates the productivity of other stocks. As such, the less abundant stocks such as the Susitna River are prone to the greatest percentage error from the true stock composition of the mixture. To be accurate, the age composition method also requires a representative sampling of the harvest, and accurate estimates of escapement numbers and age composition.

In recent years (2005 to present), ADF&G has developed a genetics program for sockeye salmon in UCI. The primary goal of the program is to develop and apply genetic methods to identify stock composition of mixtures. The first comprehensive baseline using genetic markers in UCI employed microsatellites (Habicht et al. 2007). The need to differentiate among all the stocks led to the development of methods to screen single nucleotide polymorphism (SNP) loci under selection. In a recent study of UCI sockeye salmon genetic diversity, simulations indicated that seven regional groups (Kenai River, Susitna River, Yentna River, West Cook Inlet, Kasilof River, Northeast Cook Inlet, and Knik Arm) could be identified in mixtures at high levels of precision and accuracy (Habicht et al. 2007).

Given the potential errors outlined above for estimating the harvest of Susitna stocks in UCI using catch and escapement age composition information, we are hesitant to estimate the historical yield for Yentna stocks. There are many unsubstantiated assumptions involved in the estimation procedure. Nonetheless, in the context of "stock of concern" we have examined the historical estimates of Yentna River sockeye salmon yield in both the Central and Northern districts.

Conclusions and Recommendations

As explained in the September 2007 memorandum, the recent pattern of low sockeye salmon escapements to the Susitna River drainage has prompted the department to better understand stock productivity, errors in escapement estimation, and harvest in the mixed stock fishery of UCI using genetic markers (Habicht et al. 2007). Sockeye salmon rearing lake investigations are being conducted to estimate embryo-to-smolt survivals in the major lakes in the watershed. Additionally, we are assessing the sockeye salmon escapement into the Susitna River using new and improved methodology. ADF&G, with participation from Cook Inlet Aquaculture Association, is estimating the adult sockeye salmon abundance in the entire Susitna River in 2006, 2007, and 2008 with a mark–recapture and radio telemetry study. Such abundance estimates will allow: (1) estimation of the total annual run of Susitna River sockeye salmon, when abundance estimates and genetics-based harvest allocation estimates are combined, (2) evaluation of the accuracy of the Yentna River sonar estimate, and (3) the proportion of Yentna River sockeye salmon in the entire Susitna River sockeye salmon escapement. Additionally, the department is evaluating the current sockeye salmon escapement assessment tool, a Bendix single beam sonar system, with a more advanced and proven hydroacoustic system known as DIDSON (**D**ual frequency **ID**entification **SON**ar). Preliminary spawning abundance estimates based on mark–recapture and DIDSON studies suggest that traditional Bendix estimates are much lower than the actual escapements. As shown in the table below, the high variability that we have observed between the various methods has added considerably greater uncertainty to our previous assessments.

Various sockeye salmon escapement estimates for the Susitna River drainage, 2006 and 2007.

2006				
System	Mark–Recapture	Weirs[a]	Bendix	DIDSON
Yentna	Unknown	126,000	93,000	160,000
Susitna	107,000 (95% CI 59-165)	60,000		
Sum		186,000		

2007[b]				
System	Mark–Recapture	Weirs	Bendix	DIDSON
Yentna	250,000	97,000	80,000	130,000
Susitna	85,000	60,000		
Sum		157,000		

[a] Weirs monitored escapement at a few select lakes and do not represent total river escapement.

[b] The 2007 estimates are preliminary.

Similar to escapement, an accurate assessment of Susitna/Yentna River catch has been problematic given the available methodology (age composition method) and limited resources for catch sampling. The sources of error in estimating the stock-specific catch in UCI are many, and this is especially true for the less abundant stocks such as Yentna River sockeye salmon, which are susceptible to the greatest relative errors (Bernard 1983). Although genetic markers have given us

the ability to accurately determine stock composition for portions of the past 3 years, this data will not be applied to historical harvests of UCI until the full season analyses have been completed, and we have gained a better understanding of stock vulnerability through time and space.

In the Central District drift fishery, the estimated Yentna River commercial harvest for the most recent 5-year average (2003–2007) is 59% of the previous 10-year (1993–2002) average and 49% of the previous 20-year (1983–2002) average (Table 1). In the Northern District, the most recent 5-year average is 31% of the previous 10-year average and 22% of the previous 20-year average. Since the total UCI commercial harvest averages 2.9 million sockeye salmon and our age composition allocation model estimate of the Yentna sockeye salmon harvest is only 8.4% of the total, we have low confidence in the accuracy of our estimate of the Yentna sockeye salmon harvest. The difference (53,309 fish) between the 5-year (2003–2007) average yield and the 10-year (1993–2002) average yield for the Yentna stock is only 2% of the average UCI commercial harvest. The errors in our stock composition estimates are likely greater than 2%, since we know from comparisons to partial weir counts that the error in our Yentna sonar estimate is at least 28%.

The department continues to treat the persistently low escapements of sockeye salmon to the Yentna River as a serious issue. At this juncture, we are hesitant to make a stock of concern recommendation for Yentna River sockeye salmon given the assumptions and unknowns outlined above, in the memo of September 2007, and in various scientific reports prepared for the BOF meeting in February. With the ongoing studies of escapement assessment and improved stock composition in the catch, we will better understand the productivity and sustainability of the stock. Partial and preliminary information from the DIDSON, mark–recapture, and lake productivity studies will be available to the Board at the Upper Cook Inlet meeting this February.

Literature Cited

Barrett, B. M. 1974. An assessment study of the anadromous fish populations in the Upper Susitna River watershed between Devil Canyon and the Chulitna River. Alaska Department of Fish and Game, Division of Commercial Fisheries, Cook Inlet Data Report No. 74-2, Anchorage.

Barrett, B. M., F. M. Thompson, and S. N. Wick. 1985. Adult Salmon Investigations: May-October 1984. Susitna Aquatic Studies Program, Report No. 6. Draft. Alaska Department of Fish and Game, Alaska Power Authority Document #2748, Anchorage.

Bernard, D. R. 1983. Variance and bias of catch allocations that use the age composition of escapements. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 227, Anchorage.

Bue, B. G., and J. J. Hasbrouck. *Unpublished.* Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Fair, L. F., R. A. Clark, and J. J. Hasbrouck. 2007. Review of salmon escapement goals in Upper Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-06, Anchorage.

Friese, N. 1975. Preauthorization assessment of anadromous fish populations of the Upper Susitna River watershed in the vicinity of the proposed Devil Canyon hydroelectric project. Alaska Department of Fish and Game, Division of Commercial Fisheries, Cook Inlet Data Report No. 75-2, Anchorage.

Habicht, C., W. D. Templin, T. M. Willette, L. F. Fair, S. W. Raborn, L. W. Seeb. 2007. Post-season stock composition analysis of Upper Cook Inlet sockeye salmon harvest, 2005-2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-07, Anchorage.

King, B. E., and S. C. Walker. 1997. Susitna River sockeye salmon fry studies, 1994 and 1995. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A97-26, Anchorage.

Namtvedt, T., D. Waltemeyer, and K. Webster. 1978. Investigations of Cook Inlet sockeye salmon. Project No. AFC-53 Anadromous Fish Conservation Act, Completion Report for Period July 1, 1974 to June 30, 1977. Alaska Department of Fish and Game, Juneau.

Thompson, F. M., S. N. Wick, and B. L. Stratton. 1986. Adult salmon investigations: May-October 1985. Susitna Aquatic Studies Program, Technical Data Report No.13. Alaska Department of Fish and Game, Alaska Power Authority Document #3412, Anchorage.

Westerman, D. L., and T. M. Willette. 2006. Upper Cook Inlet salmon escapement studies, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 06-49, Anchorage.

Table 1. Yentna River sockeye salmon catch and escapement, 1983–2007.

	Commercial Catch [a]			
Year	Central District	Northern District	Escapement [b]	Lower Escapement Goal
1983	153,417	34,486	104,414	100,000
1984	149,776	49,254	149,375	100,000
1985	150,827	38,473	107,124	100,000
1986	240,686	34,333	92,076	100,000
1987	142,040	18,828	66,054	100,000
1988	120,069	11,545	52,330	100,000
1989	3,343	40,549	96,269	100,000
1990	234,378	19,011	140,290	100,000
1991	107,291	25,193	109,632	100,000
1992	170,969	8,507	66,074	100,000
1993	193,450	20,689	141,694	100,000
1994	131,844	24,349	128,032	100,000
1995	160,320	21,447	121,220	100,000
1996	117,337	13,124	90,660	100,000
1997	136,803	20,814	157,822	100,000
1998	48,113	14,299	119,623	100,000
1999	83,812	12,951	99,029	100,000
2000	66,782	12,144	133,094	100,000
2001	46,431	10,774	83,532	100,000
2002	58,383	5,548	78,591	90,000
2003	116,154	11,535	180,813	90,000
2004	68,546	3,918	71,281	90,000
2005	32,197	3,572	36,921	75,000
2006 [c]	11,610	1,985	92,045	90,000
2007 [c]	80,306	3,333	79,901	90,000
2003-2007 Avg.	61,763	4,869	92,192	
1993-2002 Avg.	104,327	15,614	115,330	
1983-2002 Avg.	125,804	21,816	106,847	

[a] Catch estimates are based on age composition methodology that (1) assumes equal exploitation of stocks in the fishery, (2) requires representative sampling of the harvest, and (3) accurate estimates of escapement numbers and age composition.

[b] Sonar estimates of escapement are based on Bendix.

[c] Preliminary estimates.

ALASKA DEPARTMENT OF FISH & GAME

SUSITNA SOCKEYE SALMON ACTION PLAN

February 8, 2008

SUSITNA RIVER SOCKEYE SALMON STOCK STATUS AND ACTION PLAN, 2008

INTRODUCTION

SYNOPSIS

In response to the guidelines established in the Sustainable Salmon Fisheries Policy (SSFP; 5 AAC 39.222), the Board of Fisheries has identified the Susitna River sockeye salmon stock as a stock of yield concern. For this determination, the estimated Susitna River commercial harvest for the most recent 5-year average was compared to the previous 10- and 20-year averages for the Central District drift and Northern District fisheries. Identification of Susitna River sockeye salmon as a stock of yield concern is based on the definition of "yield concern" contained in SSFP. A "yield concern" is defined as "a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs; a yield concern is less severe than a management concern, which is less severe than a conservation concern" [5 AAC 39.222 (f) (42)]. The policy defines "chronic inability" as "the continuing or anticipated inability to meet escapement thresholds over a four to five year period, which is approximately the generation time of most salmon species" [5 AAC 39.222 (f) (5)].

This report describes the existing management plans and Emergency Order authority that the department follows to conserve Susitna River sockeye salmon. In addition to the existing management plans, options have been presented regarding management of the Northern District set gillnet fishery and Susitna River sport fishery. In light of increased uncertainty of the department's ability to accurately assess escapements of sockeye salmon into the Susitna River, a research plan has been developed to improve the department's ability to assess sockeye salmon stocks within the drainage. With these ongoing studies, the department will have better information on the productivity and sustainability of the stock at the 2011 Upper Cook Inlet Board of Fisheries meeting.

STOCK ASSESSMENT

Since 1981 the Yentna River daily sonar estimates have been used as an indicator of sockeye salmon escapement into the Susitna River drainage. The sockeye salmon escapement in the Yentna River has been thought to be approximately one half of the total Susitna River sockeye salmon escapement based on a combination of 1981–1985 capture-recapture abundance estimates passing Sunshine (1982-1985; Susitna River rkm 116), and sonar abundance estimates passing Yentna (1981-1985; Yentna River rkm 7) and Susitna Station (1981; Susitna River rkm 116; Westerman and Willette 2006).

Based on Bendix sonar estimates since 1981, the number of Yentna River spawners has ranged from approximately 37,000 to 181,000 sockeye salmon. The sonar estimate of sockeye salmon escapement into the Yentna River has not met the current SEG range of 90,000 to 160,000 for 5 of the past 8 years.

Although sockeye salmon escapements are estimated via a Bendix sonar system, there is great uncertainty surrounding their accuracy and precision. The high variability observed between

various methods of escapement assessment (i.e., ongoing Bendix estimates compared with recent estimates from capture-recapture and DIDSON sonar projects; Yanusz et al. 2007) has added to the uncertainty regarding our previous assessments.

In the Central District drift gillnet fishery, the estimated commercial harvest of Susitna River sockeye salmon for the most recent 5-year average (2003–2007) is 59% of the previous 10-year (1993–2002) average and 49% of the previous 20-year (1983–2002) average. In the Northern District, the most recent 5-year average is 31% of the previous 10-year average and 22% of the previous 20-year average. Since the total Upper Cook Inlet (UCI) commercial harvest averages 2.9 million sockeye salmon and the age composition allocation model estimate of the Susitna sockeye salmon harvest is only 8.4% of the total, the department has low confidence in the accuracy of our estimate of the Susitna sockeye salmon harvest.

ESCAPEMENT GOAL HISTORY

An escapement goal of 200,000 sockeye salmon was established for the Susitna River in 1979. It was set using a return-per-spawner value of 4, and an assumption that the Susitna River could produce about 800,000 adult sockeye salmon. A review of the goal in 1989 based on euphotic volume of rearing lakes suggested the existing goal was valid. In 1986, the sonar site at Susitna Station was destroyed by a flood, and no alternative hydroacoustic site could be found on the mainstem of the Susitna. Therefore, hydroacoustic estimates from a Yentna River site were used to assess total Susitna River escapement. Based on comparisons of estimates for the Yentna and the Susitna Rivers over 5 years, 1981-1985, it was decided that an escapement of 100,000 to 150,000 sockeye salmon into the Yentna River should result in a total escapement of at least 200,000 sockeye salmon into the entire Susitna drainage (Fried 1994). This was based on the average proportion of the total Susitna River escapement, which entered the Yentna River (49%) during the 5 years studied, as well as the range of annual proportions (41-59%) for these 5 years.

In 2001, the biological escapement goal for the Yentna River was changed to a sustainable escapement goal of 90,000-160,000 sockeye salmon based on Yentna sonar data from 1981-2000, because reliable estimates of total return to the system were not available (Bue and Hasbrouck *Unpublished*). Escapement goal reviews since 2001 have resulted in no change recommended to this goal type or range (Hasbrouck and Edmundson 2007, Fair et al. 2007). In 2005, an optimal escapement goal of 75,000-180,000 Yentna River sockeye salmon was adopted by the Alaska Board of Fisheries contingent on the sockeye salmon run to the Kenai River being projected to exceed 4 million.

ACTION PLAN FOR ADDRESSING STOCK OF CONCERN

MANAGEMENT ACTIONS

Commercial Fisheries

There are currently no actions in the Central District Upper Subdistrict (Eastside) set gillnet fishery for the conservation of northern bound salmon stocks. However, in the Northern District set gillnet fishery, the department's primary tools to reduce exploitation on Susitna stocks is to reduce gear from three nets to two or one from July 20 through July 31, or to close the commercial fishery. In practice, the department has done both concurrently, but most commonly the fishery has been closed. For example, from 2005 through 2007, the department closed the

entire Northern District 17 times. In the Central District drift gillnet fishery two regular drift gillnet fishing periods between July 9-15 are restricted to Area 1 (Figure 1) to conserve Susitna sockeye salmon stocks. Furthermore, from July 16-31 the drift gillnet fishery is to be restricted for two regular fishing periods to drift Area 1 when Kenai River sockeye salmon runs are less than two million fish, or drift Area 1 & 2 (Figure 1) when Kenai runs are between two and four million sockeye salmon. These restrictions are for both sockeye and coho salmon conservation. The department will continue to conserve Susitna River sockeye salmon through prescribed management plans and the use of Emergency Order authority.

CURRENT ACTIONS IN NORTHERN DISTRICT SALMON PLAN FOR SALMON CONSERVATION

5 AAC 21.358 **Northern District Salmon Management Plan** (a) The purposes of this management plan are to minimize the harvest of coho salmon bound for the Northern District of upper Cook Inlet and to provide the department direction for management of salmon stocks. The department shall manage the chum, pink, and sockeye salmon stocks primarily for commercial uses to provide commercial fisherman with an economic yield from the harvest of these salmon resources based on abundance. The department shall also manage the chum, pink, and sockeye salmon stocks to minimize the harvest of Northern District coho salmon, to provide sport and guided sport fisherman a reasonable opportunity to harvest these salmon resources over the entire run, as measured by the frequency of inriver restrictions, or as specified in this section and other regulations.

(b) The department shall manage the Northern District commercial salmon fisheries based on the abundance of Yentna River sockeye salmon, the Yentna River escapement goal, or other salmon abundance indices as it deems appropriate. Achievement of the lower end of the Yentna River optimal escapement goal shall take priority over not exceeding the upper end of the Kenai River escapement goal. When the sockeye salmon returns to the Kenai River are four million or greater, the optimal escapement goal is 75,000 to 180,000 sockeye salmon in the Yentna River.

(c) From July 20 through July 31, if the department's assessment of abundance indicates that restrictions are necessary to achieve the escapement goal, the commissioner may, by emergency order, close the commercial set gillnet fishery in the Northern District and immediately reopen the season during which the number of set gillnets that may be used is limited to the following options selected at the discretion of the commissioner:

(1) three set gillnets that are not more than 105 fathoms in aggregate length;

(2) two set gillnets that are not more than 70 fathoms in aggregate length;

(3) one set gillnet that is not more than 35 fathoms in length.

(d) In addition to the provisions specified in (b) and (c) of this section, the department shall manage the Northern District commercial salmon fisheries to minimize the incidental take of coho salmon stocks bound for the Northern District in the following manner:

(1) additional fishing periods, other than the weekly fishing periods described in 5 AAC 21.320(a) (1), may not be provided when coho salmon are expected to be the most abundant species harvested during that period; additional fishing periods may not be provided based on the abundance of Northern District coho salmon;

(2) after August 15, the department shall limit the harvest of coho salmon in the Northern

District by limiting commercial fishing time to the weekly fishing periods described in 5 AAC 21.320(a) (1).

Potential Modifications to 5 AAC 21.358 Northern District Salmon Management Plan

(c) In light of recent department data revealing concerns about the validity of Yentna River sockeye salmon enumeration data, it is the intent of the Board that Susitna River sockeye salmon stocks will be conservatively managed while the Department continues its studies in this drainage. Until the UCI BOF finfish meeting in 2011, Susitna River sockeye salmon will be managed as follows:

(1) From the beginning of the regular commercial salmon fishing season, which occurs on or after June 25, through July 19, the Northern District set gillnet fishery will fish no more than two regular 12-hour Monday and Thursday fishing periods per week.

(2) From July 20 through August 7, the Northern District set gillnet fishery will fish regular 12-hour Monday and Thursday fishing periods, but will be limited to no more than one 35-fathom set gillnet per permit. If it is determined by the Department that the Yentna River sockeye salmon [SEG or OEG] will be achieved during this time frame, the Department may increase the allowable fishing gear from one 35-fathom set gillnet per permit to two 35-fathom set gillnets per permit or the full complement of three set gillnets that are not more than 105 fathoms in aggregate length per permit.

(3) On the first regular fishing period after August 7, and thereafter, the Northern District set gillnet fishery will again return to a full complement of fishing gear of three set gillnets that are not more than 105 fathoms in aggregate length per permit, unless restricted or closed by emergency order.

(4) The Central District drift gillnet fishery will be managed to conserve Susitna drainage sockeye salmon as follows:

(i) The Department will implement all of the provisions of 5AAC 21.353 Central District Drift Gillnet Fishery management plan.

CURRENT ACTIONS IN DRIFT GILLNET PLAN FOR SALMON CONSERVATION

For the Central District drift gillnet fishery, there are two types of possible restrictions currently in place designed to conserve northern bound stocks. First, beginning July 9 the department must restrict the drift gillnet fishing fleet to Area 1 (Figure 1) of the Central District (section A below), which is that area south of the south end of Kalgin Island, and to the Kenai and Kasilof Sections (the corridor). Prior to 2005, restrictions were made to the drift fleet for one period to the Kenai and Kasilof Sections during this time frame, and for one inlet-wide period. In 2005 the BOF also provided the department with an option of an additional period in Area 1 during this time, if the Kenai River sockeye salmon run was greater than 2 million. This option has never been used.

Secondly, restrictions to the drift fleet for the conservation of Susitna stocks can occur from July 16-31 (section B below). For Kenai River sockeye salmon runs less than 2 million, the department must restrict the drift fleet to Area 1 (and the Kenai and Kasilof Sections); for runs of 2 million to 4 million, the drift fleet is restricted to Area 1 and Area 2 (and the Kenai and Kasilof Sections); and for runs greater than 4 million there are no mandatory restrictions. These restrictions apply to any two regular periods during this time frame. The purpose of the July 9-15 restrictions are to allow for the passage of northern-bound sockeye salmon, while the July 16-31 restrictions are primarily for northern-bound sockeye and coho salmon.

5 AAC 21.353. Central District Drift Gillnet Fishery Management Plan

(a) The department shall manage the Central District commercial drift gillnet fishery as follows:
(1) weekly fishing periods are as described in 5 AAC 21.320(b) ;
(2) the fishing season will open the third Monday in June or June 19, whichever is later, and
(A) from July 9 through July 15,
(i) fishing during the two regular fishing periods is restricted to the Kenai and Kasilof Sections and Drift Gillnet Area 1;
(ii) at run strengths greater than 2,000,000 sockeye salmon to the Kenai River, the commissioner may, by emergency order, open one additional 12-hour fishing period in the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Area 1;
(B) from July 16 through July 31
(i) at run strengths of less than 2,000,000 sockeye salmon to the Kenai River, fishing during the two regular 12-hour fishing periods is restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Area 1;
(ii) at run strengths of 2,000,000 to 4,000,000 sockeye salmon to the Kenai River, fishing during the two regular 12-hour fishing periods is restricted to the Kenai and Kasilof Sections of the Upper Subdistrict and Drift Gillnet Areas 1 and 2;
(iii) at run strengths greater than 4,000,000 sockeye salmon to the Kenai River, there will be no mandatory restrictions during regular fishing periods;
(C) from August 11 until closed by emergency order,
(i) Drift Gillnet Areas 3 and 4 are open for fishing during regular fishing periods;
(ii) through the 2007 fishing season, Chinitna Bay may be opened by emergency order.
(b) For the purposes of this section,
(1) "Drift Gillnet Area 1" means those waters of the Central District south of Kalgin Island at 60ø 20.43' N. lat.;

(2) "Drift Gillnet Area 2" means those waters of the Central District enclosed by a line from 60ø 20.43' N. lat., 151ø 54 83' W. long. to a point at 60ø 41.08' N. lat., 151ø 39.00' W. long. to a point at 60ø 41.08' N. lat., 151ø 24.00' W. long. to a point at 60ø 27.10' N. lat., 151ø 25.70' W. long. to a point at 60ø 20.43' N. lat., 151ø 28.55' W. long.;
(3) "Drift Gillnet Area 3" means those waters of the Central District within one mile of mean lower low water (zero tide) south of a point on the West Foreland at 60ø 42.70' N. lat., 151ø 42.30' W. long.;
(4) "Drift Gillnet Area 4" means those waters of the Central District enclosed by a line from 60ø 04.70' N. lat., 152ø 34.74' W. long. to the Kalgin Buoy at 60ø 04.70' N. lat., 152ø 09.90' W. long. to a point at 59ø 46.15' N. lat., 152ø 18.62' W. long. to a point on the western shore at 59ø 46.15' N. lat., 153ø 00.20' W. long., not including the waters of the Chinitna Bay Subdistrict.

Sport Fisheries

5 AAC 75.003. Emergency order authority

The commissioner may, by emergency order, change bag and possession limits and annual limits and alter methods and means in sport fisheries. These changes may not reduce the allocation of harvest among other user groups. An emergency order may not supersede bag and possession limits or methods and means established in regulatory management plans established by the Board of Fisheries. The commissioner will use emergency order authority to manage sport fishing opportunity in the following circumstances:

(1) The commissioner or an authorized designee may decrease sport fish bag and possession limits and annual limits and restrict methods and means of harvest by emergency order when

(A) the total escapement of a species of anadromous fish is projected to be less than the escapement goal for that species listed in management plans that have been adopted by the Board of Fisheries or established by the department; or

(B) the recreational harvest must be curtailed in any fishery for conservation reasons; the department may issue a "catch and release only" emergency order when the estimated hooking mortality is not projected to reduce the population of fish below the number required for spawning escapement or, in the case of resident species, below the level required for maintenance of the desired age and size distribution of the population; "catch and release" as a tool to address conservation under this section shall be labeled "conservation catch and release" to differentiate from catch and release regulations adopted by the Board of Fisheries for special management to create diversity in sport fisheries.

(2) The commissioner or an authorized designee may increase sport fish bag and possession limits and annual limits and liberalize methods and means of harvest by emergency order when

(A) the total escapement of a species of anadromous fish is projected to exceed the escapement goal for that species listed in management plans that have been adopted by the Board of Fisheries or established by the department, if the total harvest under the increased bag and possession limit will not reduce the escapement below the escapement goal; or

(B) hatchery-produced fish escape through existing fisheries to designated harvest areas in numbers that exceed broodstock needs, any natural spawning requirements, or cost recovery goals of private nonprofit hatcheries; the intent of this subparagraph is to allow harvest when there are no other competing user groups.

(3) For purposes of data collection to improve harvest or stock assessment, or for purposes of enforcement of bag and size limits, the commissioner or an authorized designee may establish, by emergency order, times and areas when anglers may not fillet, mutilate, or otherwise disfigure a specific species of fish in a manner that would prevent species identification, examination of the adipose fin of salmonids, recovery of tags, or determination of the number, sex, age, or length of fish taken until the fish are brought to shore and offloaded from a vessel or removed from a shoreline fishing site. The commissioner or an authorized designee may also require in the emergency order that certain parts of a fish remain attached for the purpose of species identification or data collection. However, during these periods, an angler may gill and gut a fish before the fish is brought to shore and offloaded from a vessel or removed from a shoreline fishing site. This section does not prohibit the consumption or preservation of fish aboard a vessel. For the purposes of this section, "shoreline fishing site" means the shoreline where the fish is hooked and removed from the water and becomes part of the angler's bag limit.

Potential Modification to Sport Fishery in Susitna River drainage

(5) The sockeye salmon sport fishery in the Susitna River drainage will be prosecuted with a bag limit of 3 fish. If the Northern District set gillnet fishery is closed to conserve sockeye salmon, the Susitna River drainage sport fisheries will remain open unless the board directs otherwise. The Susitna River sport harvest is not used to determine spawning escapement or in the development of escapement goals.

RESEARCH PLAN

The department currently assesses Yentna River sockeye salmon escapement and commercial and sport harvests annually. The following research projects include current and proposed projects used to gather detailed information about sockeye salmon stocks in the Susitna River.

CURRENT SUSITNA RIVER DRAINAGE SOCKEYE SALMON RESEARCH PROJECTS

YENTNA RIVER SALMON ESCAPEMENT

Objectives: The primary objectives of this project are to estimate (1) the daily and cumulative escapement of sockeye salmon into the Yentna River, and (2) the age, length, and sex composition of those escapements.

Description: Fish passage into the Yentna River is estimated using side-looking (formerly referred to as side-scanning) Bendix sonar. Fish caught and sampled at companion fish wheels are used to apportion sonar counts to estimate species composition of fish passage (i.e., estimate abundance of sockeye salmon) and the age, length, and sex composition of the inriver sockeye salmon run.

COMPARING BENDIX AND DIDSON SONAR PASSAGE ESTIMATES IN THE YENTNA RIVER

Objective: The primary objective of this project is to compare the Bendix sonar estimates of migrating salmon in the Yentna River with estimates from a Dual frequency IDentification SONar (DIDSON).

Description: A DIDSON sonar is placed on both banks of the Yentna River to collect fish passage data independent of the existing Bendix sonar. Both types of sonar equipment are operated at the same time and ensonify the same/similar area of the river so that the passage data is directly comparable.

INRIVER ABUNDANCE AND SPAWNER DISTRIBUTION OF SUSITNA RIVER SOCKEYE SALMON

Objectives: The primary objectives of this study are to (1) estimate the inriver abundance of adult sockeye salmon migrating into the Susitna River with a capture-recapture experiment, and (2) identify sockeye salmon spawning areas in the Susitna River.

Description: In 2006-2008, a capture-recapture experiment is conducted to estimate sockeye salmon abundance in the entire Susitna River. Radio telemetry is used to estimate the spawning distribution throughout the watershed.

EVALUATION OF SOCKEYE SALMON PRODUCTION FROM LAKES IN THE SUSITNA RIVER WATERSHED

Objectives: The primary objectives of this study are to (1) evaluate limnological conditions in seven lakes considered important (major) to sockeye salmon production and compare current conditions to those observed in the 1980s and 1990s, (2) estimate the abundance and mean body size of juvenile sockeye salmon and other juvenile fishes rearing in each lake in the fall, (3) estimate the age composition of the juvenile sockeye salmon in each lake, and (4) evaluate the survival from potential egg deposition to fall fry and from fall fry to smolt.

Description: Estimates of smolt and fall fry abundance, and limnological characteristics such as water chemistry and zooplankton abundance by species are collected (Chelatna, Shell, Byers, Swan, Larson, Stephan, and Judd lakes). Analyses focus on determining carrying capacity of the lakes for sockeye salmon fry and assessing the adequacy of spawning escapements over time.

BIOLOGICAL COMPOSITION OF COMMERCIAL SOCKEYE SALMON HARVEST IN UPPER COOK INLET

Objective: The primary objective of this project is to estimate the age and sex composition of the commercial salmon harvest.

Description: Sockeye salmon harvested in various commercial fisheries in UCI are sampled using a stratified systematic sampling design. Area strata are determined *a priori* using established fishery districts and subdistricts. Temporal stratification is determined post season based on catch patterns in each fishery and the number of samples collected.

STOCK COMPOSITION OF THE UPPER COOK INLET SOCKEYE SALMON COMMERCIAL HARVEST

Objectives: The primary objectives of this study are to (1) estimate the stock composition of sockeye salmon harvested in major commercial fisheries in spatial/time strata, and (2) compare

stock composition among substrata (i.e., fish processors for the drift gillnet fishery and beaches within each management subdistrict for the set gillnet fishery).

Description: This project uses new single nucleotide polymorphism (SNPs) genetic stock identification (GSI) methods to estimate stock-specific composition of the commercial harvest in UCI.

PROPOSED SUSITNA RIVER DRAINAGE SOCKEYE SALMON RESEARCH PROJECTS

A recent review of Division of Commercial Fisheries and Sport Fish Division programs in the Susitna River drainage identified the need for improved escapement, smolt, and habitat information for sockeye salmon. The following research programs are planned to gather further detailed information about sockeye salmon stocks in the Susitna River drainage:

SUSITNA RIVER SOCKEYE SALMON MAJOR SYSTEM ADULT WEIRS

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon spawners entering 7 major rearing lakes in the Susitna River watershed.

Description: Adult weirs will be collaboratively operated by the Department and the Cook Inlet Aquaculture Association (CIAA) on 7 major sockeye salmon rearing lakes (Chelatna, Shell, Byers, Swan, Larson, Stephan, and Judd lakes) in the Susitna River watershed to estimate spawner abundance. The age, sex, and length composition of the adult sockeye salmon escapement will be estimated at each weir. Environmental conditions will be recorded daily (i.e., percent cloud cover, precipitation, and stream and air temperature). Sockeye salmon spawner abundance estimates will be used to (1) evaluate the accuracy of sockeye salmon passage estimates from the Yentna River sonar project, (2) help set escapement goals, and (3) estimate freshwater production of sockeye salmon in the watershed (in conjunction with smolt production project described below).

SUSITNA RIVER SOCKEYE SALMON ADDITIONAL SYSTEM ADULT WEIRS

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon spawners entering 7 additional rearing lakes in the Susitna River watershed.

Description: Adult weirs will be collaboratively operated by the Department and CIAA on 7 additional sockeye salmon rearing lakes (Whiskey, Hewitt, Lockwood, Trapper, Red Shirt, Spink, and Trinity lakes) in the Susitna River watershed to estimate spawner abundance. The age, sex, and length composition of the adult sockeye salmon escapement will be estimated at each weir. Environmental conditions will be recorded daily (i.e., percent cloud cover, precipitation, and stream and air temperature). Sockeye salmon spawner abundance estimates will be used to (1) evaluate the accuracy of sockeye salmon passage estimates from the Yentna River sonar project, (2) help set escapement goals, and (3) estimate freshwater production of sockeye salmon in the watershed (in conjunction with smolt production project described below).

SUSITNA RIVER SOCKEYE SALMON MAJOR SYSTEM SMOLT PRODUCTION

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon smolt emigrating from 7 major rearing lakes in the Susitna River watershed.

Description: The abundance of sockeye salmon smolt emigrating from 7 major sockeye salmon rearing lakes (Chelatna, Shell, Byers, Swan, Larson, Stephan, and Judd lakes) in the Susitna River watershed will be collaboratively estimated by the Department and CIAA. Fyke nets will be operated from late May through June at 6 of the lakes to provide a total smolt enumeration. At the remaining lake (Chelatna Lake), three inclined-plane traps will be operated from late May

through August, and smolt population size will be estimated using standard mark-recapture techniques. Age, weight and length of smolts will be estimated from samples collected daily at each site. Smolt abundance estimates will be used to (1) forecast adult returns, and (2) estimate freshwater production of sockeye salmon in the watershed (in conjunction with adult escapement estimates).

SUSITNA RIVER SOCKEYE SALMON ADDITIONAL SYSTEM SMOLT PRODUCTION

Objective: The primary objective of this project is to estimate the abundance of sockeye salmon smolt emigrating from 7 additional rearing lakes in the Susitna River watershed.

Description: The abundance of sockeye salmon smolt emigrating from 7 additional sockeye salmon rearing lakes (Whiskey, Hewitt, Lockwood, Trapper, Red Shirt, Spink, and Trinity lakes) in the Susitna River watershed will be collaboratively estimated by the Department and CIAA. Fyke nets will be operated from late May through June at all of these lakes to provide a total smolt enumeration. Age, weight and length of smolts will be estimated from samples collected daily at each site. Smolt abundance estimates will be used to (1) forecast adult returns, and (2) estimate freshwater production of sockeye salmon in the watershed (in conjunction with adult escapement estimates).

SUSITNA RIVER FISH PASSAGE RESTORATION

Objective: The primary objective of this project is to restore and improve salmonid access to upstream spawning and rearing habitats in the lower Susitna River.

Description: Upstream access to historically occupied salmonid habitats will be evaluated in the lower Susitna River to facilitate removal of culvert barriers or other in-stream obstructions. As many as 10 upstream fish passage barriers will be identified, prioritized according to cost-benefit analyses of fishery values and project costs, and upstream access improved and restored. During construction and after the fish passage restoration projects have been completed, an established monitoring protocol will be used to track individual restoration project performance.

Literature Cited

Bue, B. G., and J. J. Hasbrouck. *Unpublished.* Escapement goal review of salmon stocks of Upper Cook Inlet. Alaska Department of Fish and Game, Report to the Alaska Board of Fisheries, November 2001 (and February 2002), Anchorage.

Fair, L. F., R. A. Clark, and J. J. Hasbrouck. 2007. Review of salmon escapement goals in Upper Cook Inlet, Alaska, 2007. Alaska Department of Fish and Game, Fishery Manuscript No. 07-06, Anchorage.

Fried, S. M. 1994. Pacific salmon spawning escapement goals for the Prince William Sound, Cook Inlet, and Bristol Bay areas of Alaska. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Special Publication No. 8, Juneau.

Hasbrouck, J. J., and J. A. Edmundson. 2007. Escapement goals for salmon stocks in Upper Cook Inlet, Alaska: report to the Alaska Board of Fisheries, January 2005. Alaska Department of Fish and Game, Special Publication No. 07-10, Anchorage.

Westerman, D. L., and T. M. Willette. 2006. Upper Cook Inlet salmon escapement studies, 2004. Alaska Department of Fish and Game, Fishery Data Series No. 06-49, Anchorage.

Yanusz, R., R. Merizon, D. Evans, M. Willette, T. Spencer, and S. Raborn. 2007. Inriver abundance and distribution of spawning Susitna River sockeye salmon Oncorhynchus nerka, 2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-83, Anchorage.

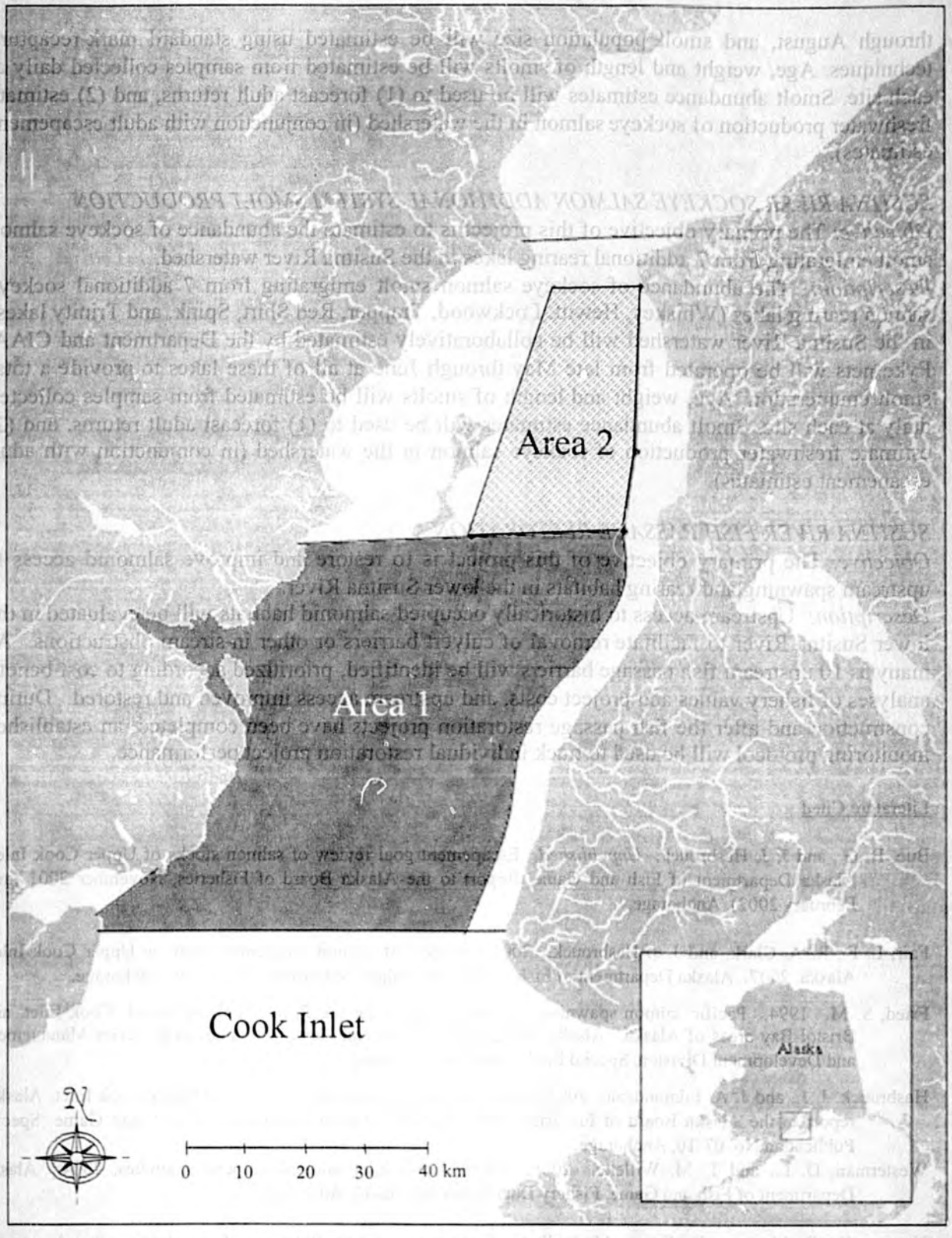


Figure 1.–Map of Central Cook Inlet showing management fishing boundaries for Area 1 and Area 2 for drift gillnet fisheries.

MATANUSKA-SUSITNA REGION SALMON RESEARCH PLAN

Prepared by

Alaska Department of Fish and Game

and

Cook Inlet Aquaculture Association

March 2008

Table of Contents

EXECUTIVE SUMMARY 1

INTRODUCTION 3

SOCKEYE SALMON RESEARCH & RECOVERY PLAN 5

CONTINUATION OF EXISTING STUDIES 5

Current Susitna Sockeye Salmon Studies 5

FUTURE STUDIES 6

Susitna Sockeye Salmon Adult Weirs 6

Susitna Sockeye Salmon Smolt Production 6

Susitna Sockeye Salmon Fish Passage Remediation 7

Susitna Sockeye Salmon Invasive Species Control 7

Fish Creek Sockeye Salmon Investigations 7

Synthesis & Oversight of Sockeye Salmon Lake Investigations 7

COHO, CHUM, & CHINOOK SALMON PROJECTS 8

Susitna River Coho and Chum Salmon Distribution 8

Susitna River Chinook Salmon Distribution 8

Little Susitna River Weir Inseason Assessment 8

Little Susitna River Chum Salmon Escapement 9

Little Susitna River Chum Salmon Spawner Distribution 9

BUDGET SUMMARY 10

LITERATURE CITED 11

APPENDICES 12

Executive Summary

This salmon research plan will provide information important for management of sockeye, coho, chum, and Chinook salmon in the Matanuska-Susitna region.

The sockeye salmon portion of the plan describes a collaborative effort between Alaska Department of Fish and Game (ADF&G) and Cook Inlet Aquaculture Association (CIAA). Research focuses on estimating sockeye salmon production in 15 major sockeye salmon rearing lakes in the Susitna River and Fish Creek watersheds where production has apparently declined in recent years. These investigations will also seek to determine the cause of observed changes in sockeye salmon production through limnological and predator-prey studies in each lake, restore sockeye salmon production through removal of seasonal barriers (mostly beaver dams) to adult salmon migration into spawning habitats, and develop methods for controlling invasive northern pike that feed on juvenile salmon.

CIAA is currently conducting a complete enumeration of both juvenile and adult migrations on seven lakes thought to be key sockeye salmon producers in the Susitna River system and collecting water quality data to better understand the entire salmon life cycle by isolating variables in the lakes that may be limiting productivity. CIAA and ADF&G realize the current cooperative studies need to be expanded to encompass the scale and duration fisheries research demands to build accurate models and management strategies. These projects extend the time frame of the current study and identify additional lakes and creeks where analysis is critical to understanding factors limiting production in the Susitna River basin.

Six projects also provide information important for management of coho, chum, and Chinook salmon in the Susitna and Little Susitna rivers. Attention is focused on these watersheds because they represent the major salmon producing and recreation areas in the Matanuska-Susitna Borough. Two projects would provide information on coho, chum, and Chinook salmon distribution in the Susitna River watershed to better understand salmon spawning distribution in the watershed, and evaluate stock composition of escapements throughout the watershed. Two projects would improve coho and chum salmon escapement estimates through a weir on the Little Susitna River, and a final project would provide information on chum salmon spawner distribution in the Little Susitna watershed.

Annual costs for these projects are projected out over a five year period (Table 1). A number of these projects need to be run well beyond five years in order to provide full value, while the Little Susitna chum salmon spawner distribution could be completed earlier than five years.

Table 1. Summary of annual project budgets for Matanuska-Susitna Salmon Research Plan projects.

PROJECT TITLE	AGENCY	FY09	FY10	FY11	FY12	FY13	TOTAL
SUSITNA SOCKEYE SALMON ADULT WEIRS	CIAA	$422.4	$254.6	$254.6	$254.6	$254.6	$1,441.0
SUSITNA SOCKEYE SALMON SMOLT PRODUCTION	CIAA	$288.8	$256.2	$256.2	$256.2	$256.2	$1,313.5
SUSITNA SOCKEYE SALMON FISH PASSAGE REMEDIATION	CIAA	$58.3	$58.3	$58.3	$58.3	$58.3	$291.5
SUSITNA SOCKEYE SALMON INVASIVE SPECIES CONTROL	CIAA	$193.0	$193.0	$193.0	$193.0	$193.0	$965.0
FISH CREEK SOCKEYE SALMON PRODUCTION	CIAA	$20.2	$20.2	$20.2	$20.2	$20.2	$101.0
FISH CREEK SOCKEYE SALMON PRODUCTION	ADFG	$48.1	$47.8	$47.8	$47.8	$47.8	$239.4
SYNTHESIS & OVERSIGHT OF SOCKEYE SALMON LAKE INVESTIGATIONS	ADFG	$98.2	$98.2	$98.2	$98.2	$98.2	$491.0
SUSITNA RIVER COHO AND CHUM SALMON DISTRIBUTION	ADFG	$276.7	$450.3	$467.6	$484.9	$502.2	$2,181.6
SUSITNA RIVER CHINOOK SALMON DISTRIBUTION	ADFG	$273.0	$394.1	$409.3	$424.4	$439.6	$1,940.4
LITTLE SUSITNA RIVER WEIR INSEASON ASSESSMENT	ADFG	$98.0	$51.8	$53.3	$54.9	$56.6	$314.6
LITTLE SUSITNA RIVER CHUM SALMON ESCAPEMENT	ADFG	$13.2	$13.6	$14.0	$14.4	$14.9	$70.1
LITTLE SUSITNA RIVER CHUM SALMON SPAWNER DISTRIBUTION	ADFG	$126.0	$121.3	$124.9	$128.7	$0.0	$500.9
	TOTAL	**$1,915.9**	**$1,959.4**	**$1,997.4**	**$2,035.6**	**$1,941.7**	**$9,850.0**

Introduction

Cook Inlet Aquaculture Association (CIAA) in a joint effort with Alaska Department of Fish and Game (ADF&G) is currently in the midst of a three year study to evaluate and better understand the apparent failure of recent sockeye salmon runs to the Susitna River (Figure 1). Susitna River maintains a high profile in the Matanuska-Susitna Borough focusing the attention of resource managers, local, and state officials. Concerned citizens are actively engaged and looking to CIAA and ADF&G for leadership on this issue.

Recent sockeye salmon returns to the Northern District of Upper Cook Inlet have been substantially less than expected. Sonar estimates of sockeye salmon escapements into Yentna River have been below the escapement goal in 5 of the past 10 years. There could be a number of causes for this recent trend which can be addressed by two broad questions. The first is whether or not the system is producing juvenile salmon that succeed in migrating to sea. The second question is whether or not a sufficient number of adult fish are failing to reach the spawning grounds.

Future studies, mitigation, and rehabilitation strategies in the Susitna River basin must isolate and remediate obvious changes in habitat and rearing conditions. Since the 1980s several key variables that directly impact productivity in the Susitna River system have become obvious to resource mangers. Urbanization, migration barriers, and invasive species have all impacted productivity in the Susitna River system in recent years. These variables will continue to deteriorate the productivity of the system unless mitigation efforts are funded to address the problem. Preliminary data collected by CIAA and ADF&G already indicates the Susitna River system salmonid productivity has changed. Additional studies must be proactive in rehabilitation strategy focused on increasing productivity and monitoring the success of these mitigation efforts.

ADF&G is also focusing on management of Susitna River sockeye salmon by improving (1) estimates of escapement goal ranges that will maximize yields, (2) estimates of spawner abundance and adult production, and (3) forecasts of adult returns used to achieve escapement goals. Projects described in this plan address all three of these concerns. Better estimates of sockeye salmon production from spawners (potential egg deposition) to smolt in major rearing lakes will provide data needed to set escapement goals to maximize yields. Estimates of numbers of adult spawners entering major rearing lake systems will be used to evaluate accuracy of sockeye salmon escapement estimates from the Yentna River sonar project. Finally, sockeye salmon smolt abundance estimates from major rearing lakes will be used to improve forecasts of adult returns.

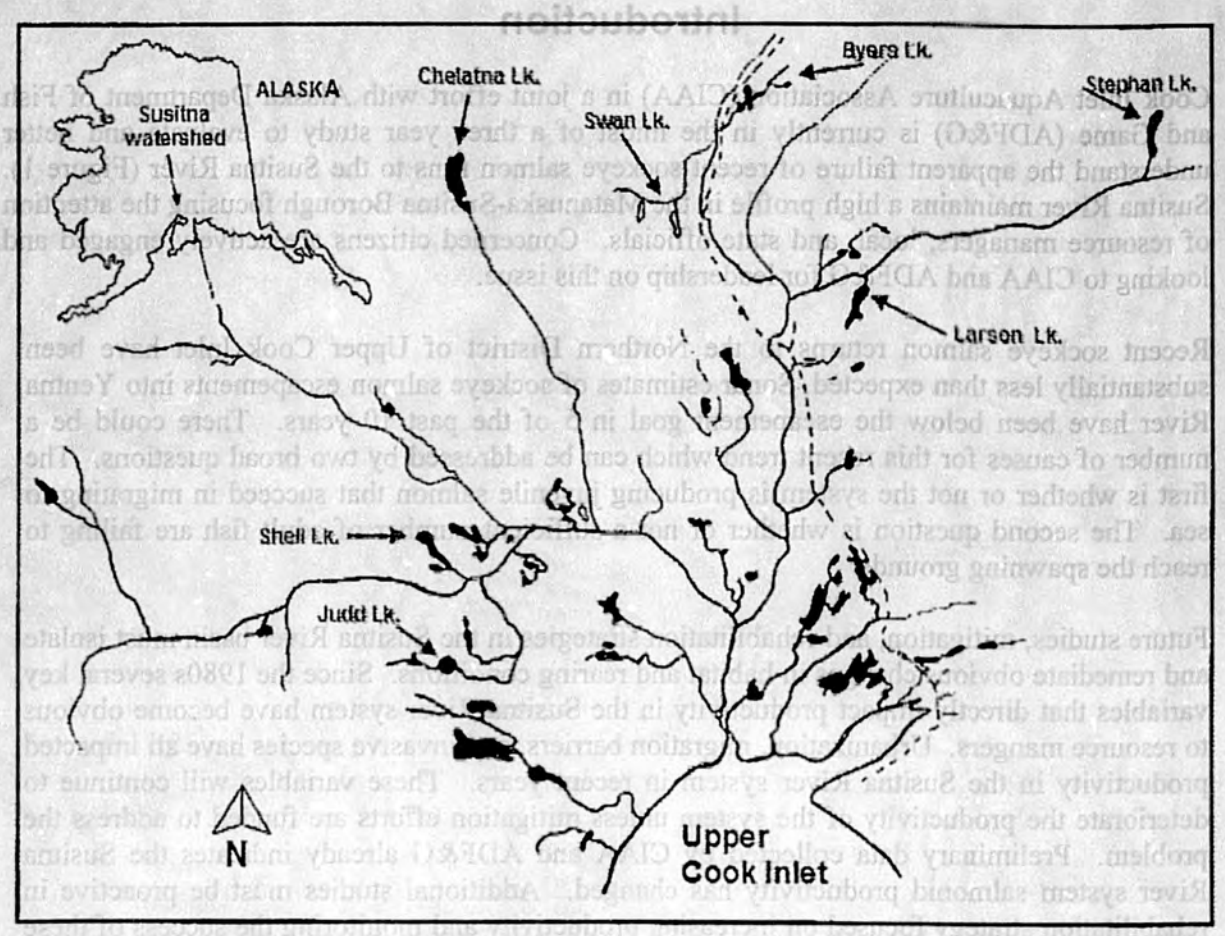


Figure 1. - Susitna River Basin and Study Lakes

Continuation of Existing Studies

ADF&G has implemented a program that focuses primarily on adult fish and management's ability to enumerate the return through a mark recapture study. CIAA is conducting a complete enumeration of both juvenile and adult migrations on seven lakes thought to be key sockeye salmon producers in the system. It is this adult to juvenile relationship that allows us to analyze and evaluate production and rearing conditions of each lake in the study. In addition to collection of physical data on juvenile and adult salmon, CIAA is also collecting water quality data to better understand the entire freshwater salmon life cycle by isolating variables in the study lakes that may be limiting productivity. The goal is to collect sound biological data to provide the foundation on which decisions for management and rehabilitation strategies will be drawn.

Funding the current ongoing partnership in 2008 (FY09) between CIAA and ADF&G is the first step towards the assimilation of key data instrumental in designing future projects to mitigate sockeye salmon yield concerns in the Susitna River basin. Weirs operated over the past two years have provided accurate simple counts that complement studies by ADF&G. It is the combination of these strategies and the reliability of weir counts that focus future efforts and rehabilitation strategies that will produce results. CIAA is seeking the final installment of $150,000 in FY09 to operate the enumeration weirs and complete our initial study. For these reasons it is vital the current ongoing study be funded in full to formulate the questions at the basis of future studies.

Current Susitna Sockeye Salmon Studies

Primary Objective: To estimate abundance of sockeye salmon in seven (7) major rearing lakes in the Susitna River watershed.

Description: Investigation involves studies on seven lakes. Four of the lakes are along the mainstem Susitna River and Talkeetna River (Larson, Stephan, Swan and Byers Lakes); and three are on tributaries of the Yentna River (Judd, Shell, and Chelatna Lakes). Studies include enumeration of adult salmon escapement and smolt emigrations at each lake. Age, sex, weight, and length composition of smolt emigrations will be estimated at each weir from samples collected each day. Age, sex, and length composition of adult sockeye salmon escapement will be estimated at each weir from samples collected each day. Environmental conditions will also be measured each day, i.e. percent cloud cover, precipitation (nearest mm), stream and air temperature. The study includes limnological sampling (water chemistry and zooplankton) and collection of dissolved oxygen, light and temperature profiles within each lake.

Future Studies

CIAA and ADF&G realize current cooperative studies need to be expanded to encompass the scale and duration fisheries research demands to build accurate models and management strategies. These proposals extend the time frame of the current study and identify additional lakes and creeks where analysis is critical to understanding factors limiting production in the Susitna River basin.

CIAA supports the studies identified in ADF&G's document *Preliminary Draft of Susitna Sockeye Salmon Action Plan.* These studies document vital information needed to investigate and manage the Susitna River system but should be expanded to include additional assessment of the lake rearing systems. This information is essential to understanding factors limiting production throughout the Susitna River basin, since remedial efforts may not be effective if this remains unknown. After just two years of investigation, two such issues have surfaced - fish passage restrictions and invasive predatory pike. Addressing these issues provides proactive mitigation today. We have included two proposals in this plan to ensure adult salmon can transit their natal creeks unabated by excessive fish passage restrictions and invasive species.

Susitna Sockeye Salmon Adult Weirs

Primary Objective: To estimate abundance of sockeye salmon spawners entering fourteen (14) rearing lakes in the Susitna River watershed.

Description: CIAA will conduct adult salmon investigations on fourteen (14) lakes; Byers, Chelatna, Hewitt, Judd, Larson, Lockwood, Red Shirt, Shell, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey. Studies include enumeration of adult sockeye salmon escapement at each lake. Age, sex, and length composition will be estimated at each weir from samples collected each day. Environmental conditions will also be measured each day, i.e. percent cloud cover, precipitation (nearest mm), stream and air temperature. The study includes limnological sampling (water chemistry and zooplankton) and collection of dissolved oxygen, light, and temperature profiles within each lake.

Susitna Sockeye Salmon Smolt Production

Primary Objective: To estimate abundance of sockeye salmon smolt emigrating from fourteen (14) rearing lakes in the Susitna River watershed.

Description: CIAA will conduct salmon smolt investigative studies on fourteen (14) lakes; Byers, Chelatna, Hewitt, Judd, Larson, Lockwood, Red Shirt, Shell, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey. Studies include enumeration of smolt emigration at each lake. Age, sex, weight, and length composition will be estimated at each weir from samples collected each day. Environmental conditions will also be measured each day, i.e. percent cloud cover, precipitation (nearest mm), stream and air temperature. The study includes limnological sampling (water chemistry and zooplankton) and collection of dissolved oxygen, light, and temperature profiles within each lake.

Susitna Sockeye Salmon Fish Passage Remediation

Primary Objective: Identification and remediation by notching of beaver dams blocking fish passage into spawning lakes, creeks, and sloughs.

Description: CIAA will survey major sockeye salmon migration corridors and implement remediation strategies to enable fish passage into critical spawning locations where adult fish are failing to reach spawning grounds due to beaver dams.

Susitna Sockeye Salmon Invasive Species Control

Primary Objective: Identification of invasive species in fourteen (14) lake systems.

Description: CIAA will survey major sockeye salmon producing rearing lakes; Byers, Chelatna, Hewitt, Judd, Larson, Lockwood, Red Shirt, Shell, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey in the Susitna River watershed for invasive northern pike and assess fish community structure. CIAA will identify predator prey relationships that may be contributing to the decline in system productivity from historical record. Alaska Dept. of Fish and Game (2007) identified 64 water bodies in the Matanuska-Susitna Borough region where invasive northern pike were either confirmed or suspected to occur. CIAA will develop control techniques to abate northern pike infestation.

Fish Creek Sockeye Salmon Production

Primary Objective: To estimate freshwater production of sockeye salmon in the Fish Creek watershed and determine limits to production.

Description: CIAA and ADFG will jointly estimate freshwater production of sockeye salmon in the Fish Creek watershed from potential egg deposition to smolt over five years. ADFG will conduct limnological sampling monthly from May through September each year to estimate the rearing potential of Big Lake. Hydroacoustic and townet surveys will be conducted in September to estimate abundance of sockeye salmon fry and other juvenile fishes in Big Lake. Abundance of sockeye salmon smolts emigrating from the watershed will be estimated by CIAA. Project results will be used to (1) estimate survival from potential egg deposition to smolt, (2) evaluate limits to sockeye salmon production and identify potential restoration actions, (3) help set an escapement goal, and (4) forecast adult returns.

Synthesis & Oversight of Sockeye Salmon Lake Investigations

Primary Objective: To provide training of field crews at smolt and adult weir camps, coordinate activities among projects, and synthesize results of lake investigations.

Description: This project will fund a seasonal ADF&G biologist to coordinate activities among sockeye salmon lake investigation projects improving efficiency and consistency of research efforts. Each smolt and adult weir field camp will be visited several times per month to provide training for field crews, data quality assurance, and other assistance where needed. After the field season, results from various lake investigations (limnology, predator-prey, fall

fry, smolt, and adult production data) will be assembled into a database and synthesized into a useful product for resource managers.

Coho, Chum, and Chinook Salmon Projects

Projects listed here would provide information important for management of coho, chum, and Chinook salmon in the Susitna and Little Susitna rivers. Attention is focused on these watersheds because they represent the major salmon producing and recreation areas in the Matanuska-Susitna Borough. Annual costs for these projects are projected out over a five year period. A number of these projects need to be run well beyond five years in order to provide full value, while the Little Susitna chum salmon spawner distribution could be completed earlier than five years.

Susitna River Coho and Chum Salmon Distribution

Primary Objective: To estimate spawning distribution and stock composition of coho and chum salmon in the Susitna River watershed.

Description: Four fish wheels will be operated at Flathorn (Susitna River kilometer 31) each year to capture and apply radio tags to coho *(Oncorhynchus kisutch)* and chum (0. *keta)* salmon for the duration of the run (July through mid-September). Radio tagged salmon will be tracked using a fixed-wing aircraft multiple times throughout the season. Coho and chum salmon distribution estimates will be used to 1) better understand coho and chum salmon spawning distribution in the Susitna River watershed, and 2) evaluate stock composition of escapements throughout the Susitna watershed.

Susitna River Chinook Salmon Distribution

Primary Objective: To estimate spawning distribution and stock composition of Chinook salmon in the Susitna River watershed.

Description: Drift gillnets will be used at Flathorn (Susitna River kilometer 31) each year to capture and apply radio tags to Chinook salmon *(Oncorhynchus tshawytscha)* for the duration of the run (May through July). Tissue samples will also be collected for genetic baseline development. Tissue samples will also be collected for genetic baseline development. Radio tagged salmon will be tracked using a fixed-wing aircraft multiple times throughout the season. Chinook salmon distribution estimates will be used to 1) better understand Chinook salmon spawning distribution in the Susitna River watershed, and 2) evaluate stock composition of escapements throughout the Susitna watershed.

Little Susitna River Weir Inseason Assessment

Primary Objective: To count coho salmon escapement and obtain a partial count of chum salmon escapement into the Little Susitna River.

Description: A weir to count coho salmon currently operates on the Little Susitna River at river kilometer 115. However, weir counts at river kilometer 115 are too late for inseason

management and it is not certain what proportion of coho and chum salmon escapements spawn below river kilometer 115. The weir will be moved back to river kilometer 51 to remedy these concerns.

Little Susitna River Chum Salmon Escapement

Primary Objective: To count escapement of chum salmon in the Little Susitna River.

Description: A weir is currently used to count escapement of coho salmon into the Little Susitna River. But, the weir is installed in late July, which provides only a partial count of chum salmon escapement. This project would initiate weir activities on approximately July 10 to count the entire chum salmon escapement.

Little Susitna River Chum Salmon Spawner Distribution

Primary Objective: To estimate distribution of spawning chum salmon in the Little Susitna River.

Description: Adult chum salmon will be captured in the lower Little Susitna River and marked with a radio tag throughout the run. Mobile tracking will be done by boat and aircraft to identify and define important spawning areas.

Budget Summary

Table 1. Summary of annual project budgets for Matanuska-Susitna Salmon Research Plan projects.

PROJECT TITLE	AGENCY	FY09	FY10	FY11	FY12	FY13	TOTAL
SUSITNA SOCKEYE SALMON ADULT WEIRS	CIAA	$422.4	$254.6	$254.6	$254.6	$254.6	$1,441.0
SUSITNA SOCKEYE SALMON SMOLT PRODUCTION	CIAA	$288.8	$256.2	$256.2	$256.2	$256.2	$1,313.5
SUSITNA SOCKEYE SALMON FISH PASSAGE REMEDIATION	CIAA	$58.3	$58.3	$58.3	$58.3	$58.3	$291.5
SUSITNA SOCKEYE SALMON INVASIVE SPECIES CONTROL	CIAA	$193.0	$193.0	$193.0	$193.0	$193.0	$965.0
FISH CREEK SOCKEYE SALMON PRODUCTION	CIAA	$20.2	$20.2	$20.2	$20.2	$20.2	$101.0
FISH CREEK SOCKEYE SALMON PRODUCTION	ADFG	$48.1	$47.8	$47.8	$47.8	$47.8	$239.4
SYNTHESIS & OVERSIGHT OF SOCKEYE SALMON LAKE INVESTIGATIONS	ADFG	$98.2	$98.2	$98.2	$98.2	$98.2	$491.0
SUSITNA RIVER COHO AND CHUM SALMON DISTRIBUTION	ADFG	$276.7	$450.3	$467.6	$484.9	$502.2	$2,181.6
SUSITNA RIVER CHINOOK SALMON DISTRIBUTION	ADFG	$273.0	$394.1	$409.3	$424.4	$439.6	$1,940.4
LITTLE SUSITNA RIVER WEIR INSEASON ASSESSMENT	ADFG	$98.0	$51.8	$53.3	$54.9	$56.6	$314.6
LITTLE SUSITNA RIVER CHUM SALMON ESCAPEMENT	ADFG	$13.2	$13.6	$14.0	$14.4	$14.9	$70.1
LITTLE SUSITNA RIVER CHUM SALMON SPAWNER DISTRIBUTION	ADFG	$126.0	$121.3	$124.9	$128.7	$0.0	$500.9
	TOTAL	**$1,915.9**	**$1,959.4**	**$1,997.4**	**$2,035.6**	**$1,941.7**	**$9,850.0**

Literature Cited

Alaska Department of Fish and Game. 2007. Management Plan for Invasive Northern Pike in Alaska. Alaska Department of Fish and Game. Alaska Department of Fish and Game, Division of Sport Fish, Anchorage. 58 pp.

Appendices

CURRENT SUSITNA SOCKEYE SALMON STUDIES

Primary Objective: To estimate abundance of sockeye salmon in seven (7) major rearing lakes in the Susitna River watershed.

Description: Investigation involves studies on seven lakes. Four of the lakes are along the mainstem Susitna River and Talkeetna River (Larson, Stephan, Swan and Byers Lakes); and three are on tributaries of the Yentna River (Judd, Shell, and Chelatna Lakes). Studies include the enumeration of adult salmon escapement and smolt emigrations at each lake. Age, sex, weight, and length composition of smolt emigrations will be estimated at each weir from samples collected each day. Age, sex, and length composition of adult sockeye salmon escapement will be estimated at each weir from samples collected each day. Environmental conditions will also be measured each day, i.e. percent cloud cover, precipitation (nearest mm), stream and air temperature. The study includes limnological sampling (water chemistry and zooplankton) and collection of dissolved oxygen, light and temperature profiles within each lake.

Duration: One Year

Budget Summary: Total cost of the CIAA component of the current ongoing study is budgeted at $750,000. In 2006 CIAA requested $500,000, a two-to-one match for our commitment of $250,000 to be used over the three year study to make this joint effort possible. In 2006 CIAA received $200,000 of the CIP funding request, in 2007 CIAA received $150,000. CIAA is asking for the allocation of the **remaining $150,000** in funding to match our commitment to the current ongoing Susitna River sockeye salmon study.

SUSITNA SOCKEYE SALMON ADULT WEIRS

Primary Objective: To estimate abundance of sockeye salmon spawners entering fourteen (14) rearing lakes in the Susitna River watershed.

Description: CIAA will conduct adult salmon investigative studies on fourteen (14) lakes; Byers, Chelatna, Hewitt, Judd, Larson, Lockwood, Red Shirt, Shell, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey. Studies include enumeration of adult sockeye salmon escapement at each lake. Age, sex, and length composition will be estimated at each weir from samples collected each day. Environmental conditions will also be measured each day, i.e. percent cloud cover, precipitation (nearest mm), stream and air temperature. The study includes limnological sampling (water chemistry and zooplankton) and collection of dissolved oxygen, light, and temperature profiles within each lake.

Duration: Five Years

CIAA Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$134.1	$115.0	$115.0	$115.0	$115.0	$593.9
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$119.7	$104.3	$104.3	$104.3	$104.3	$536.9
400 Supplies	$168.7	$35.4	$35.4	$35.4	$35.4	$310.1
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$422.4	$254.6	$254.6	$254.6	$254.6	$1,441.0

SUSITNA SOCKEYE SALMON SMOLT PRODUCTION

Primary Objective: To estimate abundance of sockeye salmon smolt emigrating from fourteen (14) rearing lakes in the Susitna River watershed.

Description: CIAA will conduct salmon smolt investigative studies on fourteen (14) lakes; Byers, Chelatna, Hewitt, Judd, Larson, Lockwood, Red Shirt, Shell, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey. Studies include enumeration of smolt emigration at each lake. Age, sex, weight, and length composition will be estimated at each weir from samples collected each day. Environmental conditions will also be measured each day, i.e. percent cloud cover, precipitation (nearest mm), stream and air temperature. The study includes limnological sampling (water chemistry and zooplankton) and collection of dissolved oxygen, light, and temperature profiles within each lake.

Duration: Five Years

CIAA Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$128.0	$115.0	$115.0	$115.0	$115.0	$588.1
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$104.3	$104.3	$104.3	$104.3	$104.3	$521.5
400 Supplies	$56.5	$36.8	$36.8	$36.8	$36.8	$203.9
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$288.8	$256.2	$256.2	$256.2	$256.2	$1,313.5

SUSITNA SOCKEYE SALMON FISH PASSAGE REMEDIATION

Primary Objective: Identification and remediation (notching) of beaver dams blocking fish passage into spawning lakes, creeks, and slews.

Description: CIAA will survey major sockeye salmon migration corridors and implement remediation strategies to enable fish passage into critical spawning habitats where adult fish are failing to reach spawning grounds due to beaver dams.

Duration: Five Years

CIAA Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$14.7	$14.7	$14.7	$14.7	$14.7	$73.3
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$40.0	$40.0	$40.0	$40.0	$40.0	$200.0
400 Supplies	$3.7	$3.7	$3.7	$3.7	$3.7	$18.3
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$58.3	$58.3	$58.3	$58.3	$58.3	$291.5

SUSITNA SOCKEYE SALMON INVASIVE SPECIES CONTROL

Primary Objective: Assess impacts of invasive species on sockeye salmon production in fourteen (14) lake systems.

Description: CIAA will survey major sockeye salmon rearing lakes (Byers, Chelatna, Hewitt, Judd, Larson, Lockwood, Red Shirt, Shell, Spink, Stephan, Swan, Trapper, Trinity, and Whiskey) in the Susitna River watershed to assess invasive northern pike populations and fish community structure. CIAA will identify predator-prey relationships that may be contributing to decline in sockeye salmon productivity. CIAA will investigate control techniques to reduce northern pike abundance. A blue-ribbon panel will be assembled to develop a detailed research plan for these investigations.

Duration: Five Years

CIAA Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$40.3	$40.3	$40.3	$40.3	$40.3	$201.3
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$110.0	$110.0	$110.0	$110.0	$110.0	$550.0
400 Supplies	$42.8	$42.8	$42.8	$42.8	$42.8	$213.8
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$193.0	$193.0	$193.0	$193.0	$193.0	$965.0

FISH CREEK SOCKEYE SALMON PRODUCTION

Primary Objective: To estimate freshwater production of sockeye salmon in the Fish Creek watershed and determine limits to production.

Description: CIAA and ADFG will jointly estimate freshwater production of sockeye salmon in the Fish Creek watershed from potential egg deposition to smolt over a five year period. An adult weir, currently operated by ADF&G on Fish Creek, will provide estimates of spawner abundance, as well as, age, sex, and length composition of escapement. Otoliths will be collected from escapement to estimate hatchery contribution. ADF&G will conduct limnological sampling monthly from May through September each year to estimate rearing potential of Big Lake. Measured parameters will include water temperature, dissolved oxygen, light penetration, phytoplankton and zooplankton density and species composition. ADF&G will conduct hydroacoustic and tow net surveys in September to estimate abundance of sockeye salmon fry and other juvenile fishes in Big Lake. Tow netting with a mid-water trawl will be conducted in conjunction with acoustic surveys at night to estimate species composition of ensonified targets, mean size of each species of juvenile fish and age composition of juvenile sockeye salmon in the lake. Abundance of sockeye salmon smolts emigrating from the watershed will be estimated by CIAA using a fyke net. All smolts will be directed into the live box by wings extending from the shoreline to the front of the fyke trap providing a total smolt enumeration. Otoliths will be collected from a sample of fall fry and smolts to estimate hatchery contribution. Fall fry and smolt samples will be analyzed at the ADF&G Pathology Laboratory to estimate incidence of disease and parasites in juveniles. Fall fry samples will also be analyzed to estimate occurrence of enzymes produced when fish are exposed to hydrocarbons. Project results will be used to (1) estimate survival from potential egg deposition to smolt, (2) evaluate limits to sockeye salmon production and identify potential restoration actions, (3) help set an escapement goal, and (4) forecast adult returns.

Duration: Five Years

CIAA Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$16.0	$16.0	$16.0	$16.0	$16.0	$80.0
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$1.2	$1.2	$1.2	$1.2	$1.2	$6.0
400 Supplies	$3.0	$3.0	$3.0	$3.0	$3.0	$15.0
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$20.2	$20.2	$20.2	$20.2	$20.2	$101.0

FISH CREEK SOCKEYE SALMON PRODUCTION, (continued).

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$13.3	$13.3	$13.3	$13.3	$13.3	$66.7
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$33.2	$33.2	$33.2	$33.2	$33.2	$166.1
400 Supplies	$1.6	$1.3	$1.3	$1.3	$1.3	$6.6
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$48.1	$47.8	$47.8	$47.8	$47.8	$239.4

Project Total Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$29.3	$29.3	$29.3	$29.3	$29.3	$146.7
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$34.4	$34.4	$34.4	$34.4	$34.4	$172.1
400 Supplies	$4.6	$4.3	$4.3	$4.3	$4.3	$21.6
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$68.3	$68.0	$68.0	$68.0	$68.0	$340.4

SYNTHESIS and OVERSIGHT of SOCKEYE SALMON LAKE INVESTIGATIONS

Primary Objective: To provide training of field crews at smolt and adult weir camps, coordinate activities among projects, and synthesize results of lake investigations.

Description: This project will fund a seasonal ADF&G biologist to coordinate activities among sockeye salmon lake investigation projects improving efficiency and consistency of research efforts. Each smolt and adult weir field camp will be visited several times per month to provide training for field crews, data quality assurance, and other assistance where needed. After the field season, results from various lake investigations (limnology, predator-prey, fall fry, smolt, and adult production data) will be assembled into a database and synthesized into a useful product for resource managers.

Duration: Five Years

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$31.0	$31.0	$31.0	$31.0	$31.0	$155.0
200 Travel	$2.4	$2.4	$2.4	$2.4	$2.4	$12.0
300 Contractual	$62.0	$62.0	$62.0	$62.0	$62.0	$310.0
400 Supplies	$2.8	$2.8	$2.8	$2.8	$2.8	$14.0
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$98.2	$98.2	$98.2	$98.2	$98.2	$491.0

SUSITNA RIVER COHO AND CHUM SALMON DISTRIBUTION

Primary Objective: To estimate spawning distribution and stock composition of coho and chum salmon in the Susitna River watershed.

Description: Four fish wheels will be operated at Flathorn (Susitna River kilometer 31) each year to capture and apply radio tags to coho *(Oncorhynchus kisutch)* and chum (0. *keta)* salmon. Salmon will be captured and tagged throughout the day for the duration of the run (July through mid-September) to account for differential migration timing. Tags will be deployed based on individual fish wheel catch rates to account for differential catchability. Age, sex, and length composition of adult coho and chum salmon escapement will be estimated from samples collected each day. Tissue samples will also be collected for genetic baseline development. Radio tagged salmon will be tracked using a fixed-wing aircraft multiple times throughout the season. Coho and chum salmon distribution estimates will be used to 1) better understand coho and chum salmon spawning distribution in the Susitna River watershed, and 2) evaluate stock composition of escapements throughout the Susitna watershed.

Duration: Five Years

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$66.5	$230.6	$239.4	$248.3	$257.2	$1,042.0
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$0.0	$47.0	$48.8	$50.6	$52.4	$198.9
400 Supplies	$174.2	$172.7	$179.3	$186.0	$192.6	$904.8
500 Equipment	$36.0	$0.0	$0.0	$0.0	$0.0	$36.0
Total Direct Costs	$276.7	$450.3	$467.6	$484.9	$502.2	$2,181.6

SUSITNA RIVER CHINOOK SALMON DISTRIBUTION

Primary Objective: To estimate spawning distribution and stock composition of Chinook salmon in the Susitna River watershed.

Description: Drift gillnets will be used at Flathorn (Susitna River kilometer 31) each year to capture and apply radio tags to Chinook salmon *(Oncorhynchus tshawytscha).* Chinook salmon will be captured and tagged for the duration of the run (May through July) to account for differential migration timing. Tags will be deployed based on relative abundance among channels and fishing sites to account for differential catchability. Age, sex, and length composition of adult Chinook salmon escapement will be estimated from samples collected each day. Tissue samples will also be collected for genetic baseline development. Radio tagged salmon will be tracked using a fixed-wing aircraft multiple times throughout the season. Chinook salmon distribution estimates will be used to 1) better understand Chinook salmon spawning distribution in the Susitna River watershed, and 2) evaluate stock composition of escapements throughout the Susitna watershed.

Duration: Five Years

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$105.7	$230.6	$239.5	$248.3	$257.2	$1,081.3
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$2.0	$47.0	$48.8	$50.6	$52.4	$200.8
400 Supplies	$129.3	$116.5	$121.0	$125.5	$130.0	$622.3
500 Equipment	$36.0	$0.0	$0.0	$0.0	$0.0	$36.0
Total Direct Costs	$273.0	$394.1	$409.3	$424.4	$439.6	$1,940.4

LITTLE SUSITNA RIVER WEIR INSEASON ASSESSMENT

Primary Objective: To count coho salmon escapement and obtain a partial count of chum salmon escapement into the Little Susitna River.

Description: A weir to count coho salmon currently operates on the Little Susitna River at river kilometer 115. The weir is too far upstream to provide data for inseason assessment of run strength. Previously, the weir was operated at river kilometer 51 but was moved to river kilometer 115 at the public's request. However, weir counts at river kilometer 115 are too late for in season management and it is not certain what proportion of coho and chum salmon escapements spawn below river kilometer 115. The weir will be moved back to river kilometer 51 to remedy these concerns. Change in location will require a wider weir (spanning larger stream channel) and a remote field camp. Additional staffing will be required to accommodate the heavy boat traffic at river kilometer 51. The table below shows only the additional funds needed to operate the weir at river kilometer 51, the balance will be derived using existing project funds currently expended at the existing river kilometer 115 site.

Duration: Five Years

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$69.9	$44.4	$45.7	$47.1	$48.5	$255.6
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$1.7	$1.8	$1.8	$1.8	$1.9	$9.0
400 Supplies	$18.4	$5.6	$5.8	$6.0	$6.2	$42.0
500 Equipment	$8.0	$0.0	$0.0	$0.0	$0.0	$8.0
Total Direct Costs	$98.0	$51.8	$53.3	$54.9	$56.6	$314.6

LITTLE SUSITNA CHUM SALMON ESCAPEMENT

Primary Objective: To count escapement of chum salmon in the Little Susitna River.

Description: Total escapement of chum salmon into the Little Susitna River is currently not assessed. A weir used to count escapement of coho salmon into the Little Susitna River is installed in late July, which provides only a partial count of chum salmon escapement. This project would initiate weir activities on approximately July 10 to count the entire chum salmon escapement. Age, sex, and length data will also be collected from chum salmon. The table below depicts funds necessary to extend the duration of the existing counting weir.

Duration: Five Years

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$9.4	$9.7	$10.0	$10.3	$10.6	$50.0
200 Travel	$0.0	$0.0	$0.0	$2.7	$2.8	$5.5
300 Contractual	$2.5	$2.6	$2.6	$0.0	$0.0	$7.7
400 Supplies	$1.3	$1.3	$1.4	$1.4	$1.5	$6.9
500 Equipment	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total Direct Costs	$13.2	$13.6	$14.0	$14.4	$14.9	$70.1

LITTLE SUSITNA RIVER CHUM SALMON SPAWNER DISTRIBUTION

Primary Objective: To estimate distribution of spawning chum salmon in the Little Susitna River.

Description: Distribution and location of spawning habitat for chum salmon in the Little Susitna River is not well documented. To better understand where chum salmon spawn, adult chum salmon will be captured in the lower Little Susitna River and marked with a radio tag. Tagged fish will be monitored throughout the spawning season. Mobile tracking will be done by boat and aircraft to identify and define important spawning areas. Two stationary monitoring sites, one each at river kilometer 51 and 115, would provide distribution of spawners relative to these locations. These locations are the former and current locations, respectively, of a weir used to assess coho salmon and partial assessment of chum salmon escapement.

Duration: Four Years

ADFG Budget:

Line Item	FY09	FY10	FY11	FY12	FY13	Total
100 Personnel	$60.3	$91.6	$94.4	$97.2	$0.0	$343.5
200 Travel	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
300 Contractual	$3.0	$3.4	$3.5	$3.6	$0.0	$13.5
400 Supplies	$31.7	$26.3	$27.0	$27.9	$0.0	$112.9
500 Equipment	$31.0	$0.0	$0.0	$0.0	$0.0	$31.0
Total Direct Costs	$126.0	$121.3	$124.9	$128.7	$0.0	$500.9

Report to the Alaska Board of Fisheries **RC18**

Anchor River Chinook Salmon Stock Status and Action Plan, 2001

By

Cook Inlet Staff

November 2001

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)	
Centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)	
cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature	
day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry	
all atomic symbols	
alternating current	AC
ampere	A
calorie	Cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General	
All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
And	&
At	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
Trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

REPORT TO THE ALASKA BOARD OF FISHERIES

ANCHOR RIVER CHINOOK SALMON STOCK STATUS AND ACTION PLAN, 2001

by

Cook Inlet Staff
Alaska Department of Fish and Game: Division of Sport Fish, Habitat Division

November 2001

The Alaska Department of Fish and Game administers all programs and activities free from discrimination on the basis of sex, color, race, religion, national origin, age, marital status, pregnancy, parenthood, or disability. For information on alternative formats available for this and other department publications, contact the department ADA Coordinator at (voice) 907-465-4120, or (TDD) 907-465-3646. Any person who believes s/he has been discriminated against should write to: ADF&G, PO Box 25526, Juneau, AK 99802-5526; or O.E.O., U.S. Department of the Interior, Washington, DC 20240.

TABLE OF CONTENTS

Page

LIST OF TABLES V

LIST OF FIGURES V

EXECUTIVE SUMMARY 1

Synopsis 1
Stock Assessment 1
Outlook And Fish Habitat Assessment 2
Alaska Board of Fisheries Action 2

ESCAPEMENT GOAL EVALUATION 3

Escapement Goal History 3
Spawner Data and SEG Analysis 3
Escapement Goal Recommendation 3

MANAGEMENT ACTION PLAN OPTIONS FOR ADDRESSING STOCK OF CONCERN AS OUTLINED IN THE SUSTAINABLE FISHERIES POLICY 4

Anchor River chinook salmon management plan review/development 4
- Current Stock Status 4
- C&T Use Finding and the Amount Necessary 4
- Habitat Factors Adversely Affecting the Stock 4
- Do New or Expanding Fisheries on this Stock Exist? 4
- Existing Management Plans 4
- Identify Research Needed on Stock and Habitat 5

ACTION PLAN DEVELOPMENT 6

Anchor River Chinook Salmon Action Plan Goal 6
Action Plan Alternatives 6
- Objective 6
- Background 6
- Specific Action Recommended to Implement the Objective 6
- Cost/Benefit Analysis 6
- Subsistence Issues/Considerations 6
- Performance Measures 6
- Sport Fish Research Plan to Address Stock of Concern 6
- Cost/Benefit Analysis 7
- Subsistence Issues/Considerations 8
- Performance Measures 8

RESEARCH PLAN 9

Current Research Projects – Sport Fish Division 9
Proposed Research Projects – Sport Fish Division 9
Current Research Projects – Habitat and Restoration Division 10
Proposed Research Projects – Habitat and Restoration Division 11

LITERATURE CITED 11

LIST OF TABLES

Table **Page**

1. Total effort, chinook salmon harvest, and chinook salmon escapement in the Anchor River, and total chinook salmon harvest in the early-run marine recreational fishery north of Bluff Point, 1976-2001 13

LIST OF FIGURES

Figure **Page**

1. Escapement index of chinook salmon in the Anchor River (bars) relative to the current SEG range of 750-1,500 fish (dotted lines), 1976-2001 14
2. Freshwater harvest (dotted line) and escapement index (solid line) of chinook salmon in the Anchor River, 1976-2001.....14

EXECUTIVE SUMMARY

SYNOPSIS

In response to the guidelines established in the Sustainable Salmon Fisheries Policy (SSFP; 5 AAC 39.222), ADF&G has identified the Anchor River chinook salmon stock as a candidate stock of concern. Identification of Anchor River chinook salmon as a candidate stock is based on the definition of "management concern" contained in the policy. A "management concern" is defined as "a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, OEG, or other specified management objectives for the fishery" (5 AAC 39.222 (f) (21)). For this determination, escapements of chinook salmon to the Anchor River were compared to the current SEG range (750 to 1,500 fish indexed by aerial survey). The policy defines "chronic inability" as "the continuing or anticipated inability to meet escapement thresholds over a four to five year period, which is approximately the generation time of most salmon species" (5 AAC 39.222 (f) (5)). Escapements of chinook salmon have fallen below the lower end of the current SEG range for the Anchor River in four of the past six years. The most recent management actions taken to correct this trend were the regulatory changes adopted in the 1995-1996 Board of Fisheries meeting cycle. These have proven to be insufficient to achieve the current SEG.

The SSFP recommends that salmon habitats be maintained to assure sustained yields by avoiding perturbations beyond normal levels of variability. The policy requires completion of detailed science-based assessments prior to authorization of development projects to assess any possible adverse effects on salmon habitat and populations from habitat alteration. Salmon habitat should be protected on a watershed basis including appropriate levels of protection of riparian habitat, water quality, and sufficient water flows to allow for salmon movements. All degraded salmon habitat resources should be restored to previously known natural productivity levels. Access to all essential habitat features should be protected. Long term monitoring should be conducted to assess current status of habitat and the effectiveness of restoration efforts.

STOCK ASSESSMENT

Escapement has been indexed via single aerial surveys beginning in 1976; 19 years of data are available. Aerial surveys are conducted when fish are on the spawning grounds and well after the sport fishery occurs. A general decline in escapement is apparent, with 6 of 12 escapement indices measured since 1989 (1989-2001) below the current SEG range of 750 to 1,500 fish (Table 1; Figure 1). Moreover, escapements in four of the last six consecutive years (1996-2001) have been below the current SEG range.

In-river sport harvest estimation began with a creel survey in 1976. Sport harvests from 1977-present have been estimated from the Statewide Harvest Survey. Harvests have ranged from a low of 578 (1989) to a high of 2,787 (1993) with an average harvest of 1,304 fish (1976-2000; Table 1; Figure 2). Annual harvests have exceeded the 1976-2000 mean in 9 of the 12 years since 1989, and average 1,371 since the regulatory actions of 1996-97.

Anchor River chinook salmon are likely harvested in the nearby marine sport fisheries at Deep Creek, Whiskey Gulch, and Anchor Point. No estimates of contribution are available, as no formal mark/recapture program has been conducted on Anchor River chinook salmon. However, chinook salmon stocks in both Deep Creek and Ninilchik River have been marked and recovered in the marine sport fishery. These stocks contribute 2-3% each of the total annual marine harvest.

It is assumed that Anchor River chinook salmon also contribute only a small fraction of the marine harvest. Early-run marine harvests peaked in 1995 at 8,230 chinook salmon (Table 1). Regulatory actions in 1996-97 created a guideline harvest of 8,000 fish in this fishery and restricted the fishery to reduce harvest of local chinook salmon stocks. Since this regulatory action, harvests have ranged from 4,702 to 5,783 chinook salmon (Table 1).

OUTLOOK AND FISH HABITAT ASSESSMENT

Although no formal forecast of chinook salmon return can be made for the Anchor River, it is likely that escapements will continue to be less than or at the lower end of the SEG range if exploitation rate is not reduced on this stock.

Applications for activities affecting fish habitat on the southern Kenai Peninsula have increased 30% since 1998, which is reflective of the increasing amount of recreational, commercial and industrial development in this area. Additional logging and road construction will occur on private lands in the lower drainage. The State 5-year Timber Sales Schedule includes sales on very large blocks (35 sq. miles) of State land in the upper Anchor River water shed. The Kenai Peninsula Borough owns adjacent lands, which could be sold if access is developed across state lands. If current exploratory wells are successful additional oil and gas wells, pipelines, roads and other facilities will be developed in the Anchor River drainage. ORV use and the existing trail system will continue to expand. Large blocks of private land on the lower Anchor River drainage will be subdivided into smaller recreational lots.

ALASKA BOARD OF FISHERIES ACTION

In response to the guidelines established in the Sustainable Salmon Fisheries Policy, the Alaska Board of Fisheries, during the November 8-12 regulatory meeting, classified the Anchor River chinook salmon stock as a management concern.

ESCAPEMENT GOAL EVALUATION

ESCAPEMENT GOAL HISTORY

Prior to 1999, the escapement goal for chinook salmon on the Anchor River was determined from a combination of rotary and fixed-wing aerial surveys and foot surveys done in the lower-middle river index area during 1966-1991 (Fried 1994; Szarzi and Begich 2001). The escapement goal adopted in 1993 was a minimum of 1,790 fish as determined from a combination of aerial and foot surveys. A more thorough analysis of these data in 1998 indicated that the foot surveys did not increase accuracy of the aerial surveys, so that the foot survey data were dropped from the escapement goal analysis. In addition, only rotary-wing survey data (1976-1997) were used to set an escapement goal range of 1,050 to 2,200 fish (Fried 1999). This range represented the 40th to 80th percentiles of the rotary-wing aerial survey counts from 1976-1997 rounded to the nearest 50 fish. This escapement goal range was adopted in 1999 (Fried 1999).

SPAWNER DATA AND SEG ANALYSIS

Per the Policy for Statewide Salmon Escapement Goals (5 AAC 39.223) spawner and return data were reviewed to determine the type (BEG or SEG) of escapement goal and recommend an escapement goal range for Anchor River chinook salmon. Chinook salmon harvest data are available from freshwater, but are not available for Anchor River fish in marine waters (Table 1). In addition escapements are indexed via rotary-wing aerial survey rather than enumerated (e.g., weir count, sonar, mark-recapture) so that total annual returns cannot be enumerated. No age composition data are available from harvests or escapements. Based on the limitations of these data, the escapement goal policy indicates that a Sustainable Escapement Goal (SEG) be set based on 5 AAC 39.223 (a)(3), "establish sustainable escapement goals (SEG) for salmon stocks for which the department can reliably estimate escapement levels when there is not sufficient information to enumerate total annual returns and the range of escapements that are used to develop BEGs."

In the escapement goal review of Bue and Hasbrouck (2001), spawner index counts from 1976-2001 were inspected and found to have a contrast (ratio of highest escapement to lowest escapement) of greater than 8 (Table 1). In addition, the level of exploitation was deemed to be at least moderate. This indicated that a SEG range should be set from the 25th and 75th percentiles of the escapement data and rounded to the nearest 50 fish (Bue and Hasbrouck 2001). The 25th percentile was 771 fish and the 75th percentile was 1,476, for a SEG range of 750 to 1,500 fish.

ESCAPEMENT GOAL RECOMMENDATION

The most recent escapement goal review for Anchor River recommended a SEG range of 750 to 1,500 chinook salmon based on a single rotary-wing aerial survey (Bue and Hasbrouck 2001). This goal was adopted by the department in October 2001.

MANAGEMENT ACTION PLAN OPTIONS FOR ADDRESSING STOCK OF CONCERN AS OUTLINED IN THE SUSTAINABLE FISHERIES POLICY

ANCHOR RIVER CHINOOK SALMON MANAGEMENT PLAN REVIEW/DEVELOPMENT

Current Stock Status

In response to the guidelines established in the Sustainable Salmon Fisheries Policy (5 AAC 39.222), the department during the October 11-13 work session identified Anchor River chinook salmon as a candidate for stock of management concern status. The Board of Fisheries, after reviewing stock status information and public input during the November 2001 regulatory meeting, classified Anchor River chinook salmon as a stock of management concern. This determination was based on the inability, despite the use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG during four of the last six years.

C&T Use Finding and the Amount Necessary

The Anchor River is entirely within the Anchorage-Matsu-Kenai Nonsubsistence Area described in 5 AAC 99.015(a)(3). Based on this and 5 AAC 99.016, there are no subsistence fisheries on the Anchor River for any fish species.

Habitat Factors Adversely Affecting the Stock

Habitat alterations caused by increased recreational ATV use, continued salvage logging, extensive road and trail network, increased oil and gas exploration, development and transportation, gravel mining and recreational and residential development in the Anchor River drainage may be negatively affecting chinook salmon production in the Anchor River. However, habitat alteration is not thought to be the most significant factor in recent reductions in chinook escapement in the Anchor River. Recent studies by the USGS BRD, the USFS, and others have shown that fish population declines may lag more than 10 years behind habitat alterations. There are currently no projects in place to determine if habitat alterations are affecting the ability of the Anchor River or other southern Kenai drainage's to produce fish at this time.

Do New or Expanding Fisheries on this Stock Exist?

Presently there are no new or expanding fisheries on this stock. There are six proposals that would potentially expand fishing opportunities on Anchor River chinook salmon. Proposals 15 and 20 would reduce the size of the saltwater conservation zone at the mouth of the Anchor River. Proposal 16 would decrease the size of the special harvest zone south of the Anchor River conservation zone. Proposal 18 would eliminate the guideline harvest range in the UPPER COOK INLET MARINE EARLY-RUN KING SALMON MANAGEMENT PLAN. Proposal 19 would remove the restrictions to the special harvest zone in the UPPER COOK INLET MARINE EARLY-RUN KING SALMON MANAGEMENT PLAN on June 25 instead of July 1. Proposal 23 would increase the guideline harvest level in the UPPER COOK INLET MARINE EARLY-RUN KING SALMON MANAGEMENT PLAN by 25%.

Existing Management Plans

There is no existing management plan specific to Anchor River chinook salmon. The current regulations pertinent to chinook salmon in the Anchor River are:

5 AAC 56.022 WATERS; SEASONS; BAG, POSSESSION, AND SIZE LIMITS; AND SPECIAL PROVISIONS. (a)(2) Anchor River drainage.

Although not entirely specific to Anchor River chinook salmon, the following management plan does regulate the marine recreational fishery to protect local chinook salmon stocks on the Kenai Peninsula, including the Anchor River:

5 AAC 58.055 UPPER COOK INLET MARINE EARLY-RUN KING SALMON MANAGEMENT PLAN.

And in particular:

5 AAC 58.055 UPPER COOK INLET MARINE EARLY-RUN KING SALMON MANAGEMENT PLAN (d)(3).

There is no habitat management plan for the Anchor River drainage. Approximately one third of the drainage is privately owned, and the State and Kenai Peninsula Borough own the remainder. State lands within the Anchor River are managed under the provisions of the Kenai Area Plan. The bed and banks of the navigable portion of the Anchor River is state land. The Anchor River and its specified anadromous tributaries below the ordinary high water mark are protected under the provisions of the Anadromous Fish Act. Approximately 14 miles of the south Fork of the Anchor River are contained within the Anchor River Fritz Creek Critical Habitat Area which is managed to protect and preserve fish and wildlife habitat. There is a small amount of State Park Land on the lower Anchor River, which is managed for public recreation.

Identify Research Needed on Stock and Habitat

See the Research Plan on pages 8-10.

ACTION PLAN DEVELOPMENT

ANCHOR RIVER CHINOOK SALMON ACTION PLAN GOAL

To rebuild the Anchor River chinook salmon run back to levels that attain the current SEG range.

ACTION PLAN ALTERNATIVES

ACTION 1. Reduce the recreational harvest of chinook salmon in the Anchor River.

Objective

Modify existing regulations to reduce the harvest of chinook salmon in the Anchor River recreational fishery so that the SEG range can be achieved.

Background

Prior to 1990, the Anchor River was open to chinook salmon fishing on four or less consecutive weekends starting with the Memorial Day holiday weekend. Harvests of chinook salmon in the Anchor River averaged 1,077 fish and the escapement index averaged 1,674 fish during this time (Table 1). The current SEG range of 750 to 1,500 fish was attained or exceeded in all 14 years surveyed. After regulations were changed to five consecutive weekends open to fishing in 1989, harvests of chinook salmon increased to an average of 1,644 fish and the escapement index decreased to an average of 624 fish. The current SEG range was attained in only four of 10 years surveyed since 1991.

Specific Action Recommended to Implement the Objective

Proposal 30 seeks to reduce the number of weekends open to chinook salmon fishing on the Anchor River. A reduction in exploitation rate by reducing the number of open weekends from five to four could increase escapement levels in the Anchor River to within the SEG range.

Cost/Benefit Analysis

There would be an immediate loss of fishing opportunity and potential harvest of chinook salmon by recreational anglers on the Anchor River. Use of the Anchor River during the remaining four weekends could increase as a reaction to loss of the fifth weekend, causing increased crowding. Use of other Peninsula streams could also increase in reaction to the loss of fishing time on the Anchor River. However, if the SEG range is consistently attained as result of this action, fishing success in future years during the remaining four weekends could be improved due to larger returns.

Subsistence Issues/Considerations

None.

Performance Measures

The SEG range for Anchor River chinook would be met annually.

Sport Fish Research Plan to Address Stock of Concern

See Research Plan on page 9.

Action 2. Protect, maintain, and enhance anadromous and resident fish habitat throughout the Anchor River watershed.

Objective

Modify current land use patterns that may adversely affect fish habitat resource values in the Anchor River watershed through education in the form of technical assistance by ADF&G, increased community planning involvement, monitoring, and research.

Background

ADF&G regulates human use activities affecting the Anchor River watershed through issuance of Title 16 permits and enforcement of our authorities detailed in these statutes. The department interacts with other governmental agencies and the public in land use planning, oil and gas leasing, forestry-related plans, and issues related to community expansion and other land use activities. The number of these projects is increasing significantly within the Anchor River watershed. Specific projects include oversight of construction projects and restoration of habitat damage from illegal activities associated with commercial development. ADF&G has documented the extent of ORV use and culverts along with their associated impacts to fish habitat throughout the Anchor River watershed.

Specific Action Recommended to Implement the Objective

- Maintain existing levels of publicly-held (i.e. state, municipal, and federal) lands that support fish habitat
- Increase Title 16 bio-monitoring and enforcement in the Anchor River watershed
- Oppose any new large-scale commercial timber sales on public lands
- Enhance free and efficient fish passage and improve water quality by removing or repairing any stream crossing structures (primarily culverts) assumed to block fish movements or impair water quality as sources of sediment input
- Consult with the Board of Game and user groups to identify the growing problem of illegal ORV crossings of fish streams and adverse impacts to riparian habitat
- Pending availability of funds, purchase lands that will provide protection for fish habitat and investigate the use of conservation easements to protect riparian habitat and maintain healthy streambank conditions
- Foster development of a community-based watershed council for educating the public on proper land use practices that protect fish habitat and for monitoring watershed health and condition

Cost/Benefit Analysis

Maintenance of current levels of fish habitat quality and its geographic extent would result in stable levels of chinook salmon productivity and sustained regional economic values. Costs attributable to implementation of the action plan include costs to repair ORV trail damage, reduced access available to ORV users, and repairing culverts. Prevention of future damage to fish habitat will result in future restoration cost savings.

Subsistence Issues/Considerations
None.

Performance Measures
Maintain, restore and rehabilitate chinook salmon habitat in the Anchor River watershed based on an inventory of chinook salmon habitat and shoreline development (Cumulative Impacts Characterization Project).

Habitat Research Plan to Address Stock of Concern

See Research Plan on Page 10.

RESEARCH PLAN

CURRENT RESEARCH PROJECTS – SPORT FISH DIVISION

To date there has been little research directed at chinook salmon in the Anchor River. Aside from the current aerial survey program and ancillary information collected from chinook salmon during other projects there has been no research to estimate the total abundance of chinook salmon or age composition information needed to better determine productivity parameters of this stock.

The following research programs have been and are being conducted to gather detailed information about chinook salmon stocks in the lower Kenai Peninsula:

- *Lower Cook Inlet Salmon Escapement* – This program supports an enumeration project for chinook salmon in the Ninilchik River and an enumeration project for coho salmon in Deep Creek. Chinook salmon are enumerated at a weir on the Ninilchik River and are sampled for age composition and contribution of hatchery to the escapement. In addition, this program supports catch sampling of chinook salmon in the recreational chinook salmon fishery in the Ninilchik River. Aerial surveys of chinook salmon in Deep Creek, Ninilchik River and Anchor River are conducted as part of this program. Total annual budget of this program is approximately $25,000.

- *Lower Cook Inlet Egg Takes and Releases* – This program supports a chinook salmon egg take at the Ninilchik River and releases of chinook and coho salmon at various sites in Lower Cook Inlet (Homer Spit, Halibut Cove Lagoon, Seldovia Boat Harbor, Ninilchik River). Total annual budget of this program is approximately $80,000.

- *Central Cook Inlet Marine Chinook Salmon CWT Recovery* – This program supports catch sampling of chinook salmon at marine recreational fisheries conducted out of the Homer, Anchor Point, and Deep Creek areas. This program also supports a full-time assistant area biologist position in the Homer area office. Chinook salmon are sampled for maturity, presence of a CWT, and location of capture. Total annual budget of this program is approximately $115,000.

- *Southcentral Chinook Salmon Hatchery CWT* – This program supports the marking and tagging of 500,000 hatchery-reared chinook salmon in Cook Inlet and PWS, some of which are released at sites in Lower Cook Inlet. Total annual budget of this program is approximately $90,000.

PROPOSED RESEARCH PROJECTS – SPORT FISH DIVISION

A recent review of Sport Fish Division programs in Lower Cook Inlet identified the need for better escapement and age composition information for chinook and coho salmon and steelhead, and the development of long-term monitoring of smolt abundance relative to changes in habitat due to logging, urbanization, and oil and gas exploration. As a result, existing programs in Sport Fish Division are being reprogrammed to develop a long-term monitoring program for salmon and resident species in the lower Kenai Peninsula.

The following research programs are planned to gather detailed information about chinook salmon stocks in the lower Kenai Peninsula:

- *Lower Cook Inlet Salmon Escapement* – This program will support an enumeration project for chinook and coho salmon in either the Anchor River (1st choice) or Deep Creek (2nd choice). A permanent weir structure will be installed immediately above the forks of the Anchor River in the south fork and a removable weir structure installed at the mouth of the North Fork, each will be sufficient to withstand high water during spring breakup. All salmon species will be enumerated along with steelhead trout and Dolly Varden. A CWT program will be initiated on wild chinook and coho smolts to determine smolt abundance and marine survival rates. The companion adult and juvenile enumeration projects will allow monitoring of long term changes in salmon abundance and production. Aerial surveys of chinook salmon in Deep Creek and Anchor River will be continued. Aerial survey counts will be compared to weir counts on Anchor River or Deep Creek to determine accuracy and precision of the aerial survey program. If weirs cannot be effectively deployed in the Anchor River, aerial survey counts will likely remain the chief method of assessing escapement. Aerial survey methodology concerning timing and distribution of chinook spawning will be calibrated periodically with multiple aerial surveys, comparison of aerial with ground surveys, and surveys extended into additional spawning habitats. The proposed annual budget of this program will be approximately $125,000. The timeline for this program will likely be: 1) site location, permitting, and construction of permanent weir in 2002-2004, 2) begin capture and tagging of chinook and coho smolt in 2003-2004, 3) begin enumeration of adult salmon and steelhead in 2004.

- *Lower Cook Inlet Egg Takes and Releases* – This program will continue to support a chinook salmon egg take at the Ninilchik River and releases of chinook and coho salmon at various sites in Lower Cook Inlet (Homer Spit, Halibut Cove Lagoon, Seldovia Boat Harbor, Ninilchik River). Total annual budget of this program will likely remain approximately $80,000.

- *Central Cook Inlet Marine Chinook Salmon CWT Recovery* – This program will be phased out in 2002 to fund the permanent weir structure and long-term monitoring of the Anchor River or Deep Creek.

- *Southcentral Chinook Salmon Hatchery CWT* – This program will continue to support the marking and tagging of 500,000 hatchery-reared chinook salmon in Cook Inlet and PWS, some of which are released at sites in Lower Cook Inlet through 2002. Total annual budget of this program is approximately $90,000. Marking of chinook salmon with CWTs will be replaced with otolith banding in 2003.

CURRENT RESEARCH PROJECTS – HABITAT AND RESTORATION DIVISION

At this time, only a small number of basic research projects have been completed in the Anchor River watershed. The stimulus for these projects was based on a lack of fundamental information necessary for the division to fulfill its responsibilities to enforce Title 16 provisions and field observations that pointed to a growing problem with culverts and fish passage and unregulated ORV use.

The following research projects have been or are being conducted to address these informational needs:

- *Geographic Distribution of Anadromous Fish Habitat* – This is an ongoing project that attempts to identify anadromous fish presence and absence throughout the lower Kenai Peninsula, classifies and describes stream channels from basic morphology and metrics, and identifies habitat usage by species and life stage class.
- *Assessment of Off-road Vehicle (ORV) Use in the Lower Kenai Peninsula* -- This project documented all ORV trails and stream crossings on the lower Kenai Peninsula. Many of these stream crossings are unpermitted and result in adverse effects to fish habitat. Results of the project are available in a GIS product. Project findings are being used to work cooperatively with ORV user groups to develop guidelines for protecting fishery values.
- *Operational Effectiveness of Culverts for Fish Passage on Kenai Peninsula Logging Roads* – Project fieldwork was completed in 1999. Data analysis and a detailed GIS product for the lower Kenai Peninsula is available for current use. H&R staff are currently developing a draft report.
- *Inventory, Assessment, and Prioritization of Culverts on State Roads on the Kenai Peninsula* – Fieldwork for this project was completed during summer 2001. Program results for the Anchor River watershed will be used to identify and prioritize culverts for renovation, repair and maintenance on state roads. Total budget is approximately $70,000.

PROPOSED RESEARCH PROJECTS – HABITAT AND RESTORATION DIVISION

The following new research projects are necessary to gather detailed information about chinook salmon habitat in the lower Kenai Peninsula:

- *An Assessment of the Cumulative Impacts of Development and Human Uses on Fish Habitat in the Anchor River Watershed (Cummulatie Impact Characterization Study)* – This project will quantify and inventory natural and disturbed streambank conditions and fish habitat impacts and will assess chinook salmon habitat quality and cumulative impacts of shoreline development on fish habitat throughout the Anchor River watershed.
- *Development of a Geographic Information System for Characterizing and Predicting Potential Land Use Problems for Fish Habitat in the Anchor River Watershed* -- This project will develop a GIS specific to the Anchor River watershed that would document anadromous and resident fish habitat, land ownership, vegetation, flood plain delineation, KPB streambank protection zone, soils, human constructed structures, roads and trails, oil and gas activity, forestry, locations of ORV activity, stream crossing structures, and other pertinent mapped coverages.

LITERATURE CITED

Bue, B. G. and J. J. Hasbrouck. 2001. Escapement goal review of salmon stocks of Upper Cook Inlet. Report to the Board of Fisheries, Alaska Department of Fish and Game, Sport Fish Division, Anchorage.

Fried, S. M. 1994. Pacific salmon spawning escapement goals for the Prince William Sound, Cook Inlet, and Bristol Bay areas of Alaska. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Special Publication No. 8, Juneau.

Fried, S. M. 1999. Upper Cook Inlet Pacific salmon biological escapement goal review: Department findings and recommendations to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A99-05, Anchorage.

Szarzi, N. and R. Begich, 2001. Recreational fisheries in the Lower Cook Inlet management area, 1995-2000. Report to the Board of Fisheries, Alaska Department of Fish and Game, Sport Fish Division, Anchorage.

Table 1. Total effort, chinook salmon harvest, and chinook salmon escapement in the Anchor River, and total chinook salmon harvest in the early-run marine recreational fishery north of Bluff Point, 1977-2001.

Year	Effort[a]	Harvest[b]	Escapement[c]	Marine Harvest[d]
1976	Not available	830	2,125	5,495
1977	31,515	1,077	3,585	4,617
1978	42,671	2,109	2,209	2,669
1979	44,220	1,913	1,335	3,088
1980	33,272	605	No survey	521
1981	34,257	1,069	1,066	2,363
1982	24,709	718	1,493	2,497
1983	28,881	1,269	1,033	1,000
1984	26,919	998	1,087	2,386
1985	31,715	672	1,328	5,087
1986	34,938	1,098	2,287	3,106
1987	39,045	761	2,524	3,613
1988	24,356	976	1,458	4,243
1989	19,145	578	940	3,863
1990	28,829	1,479	967	4,694
1991	22,187	1,047	589	4,824
1992	24,028	1,685	99	5,996
1993	29,338	2,787	1,110	8,136
1994	27,856	2,478	837	6,867
1995	25,888	1,475	No survey	8,230
1996	16,016	1,483	277	4,702
1997	17,020	1,563	477	5,646
1998	14,310	783	789	5,783
1999	21,184	1,409	685	4,907
2000	23,141	1,727	752	4,773
2001	Not available	Not available	414	Not available
Mean (76-00)	27,727	1,304	1,263	4,364

a Effort is the number of recreational angler-days expended on the Anchor River for all species.

b Harvest is the harvest of chinook salmon from the Anchor River.

c Escapement is the aerial survey index of escapement of chinook salmon into the Anchor River.

d Marine harvest is the harvest of all chinook salmon in saltwater north of Bluff Point prior to June 25.

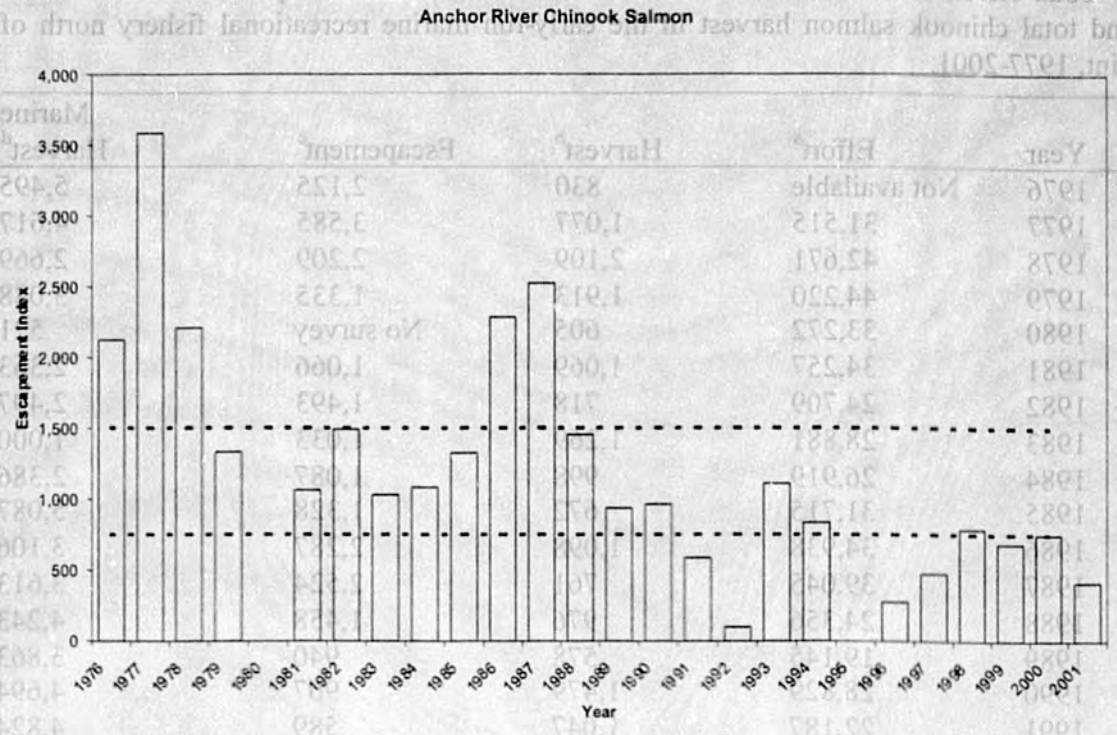


Figure 1. Escapement index of chinook salmon in the Anchor River (bars) relative to the current SEG range of 750-1,500 fish (dotted lines), 1976-2001.

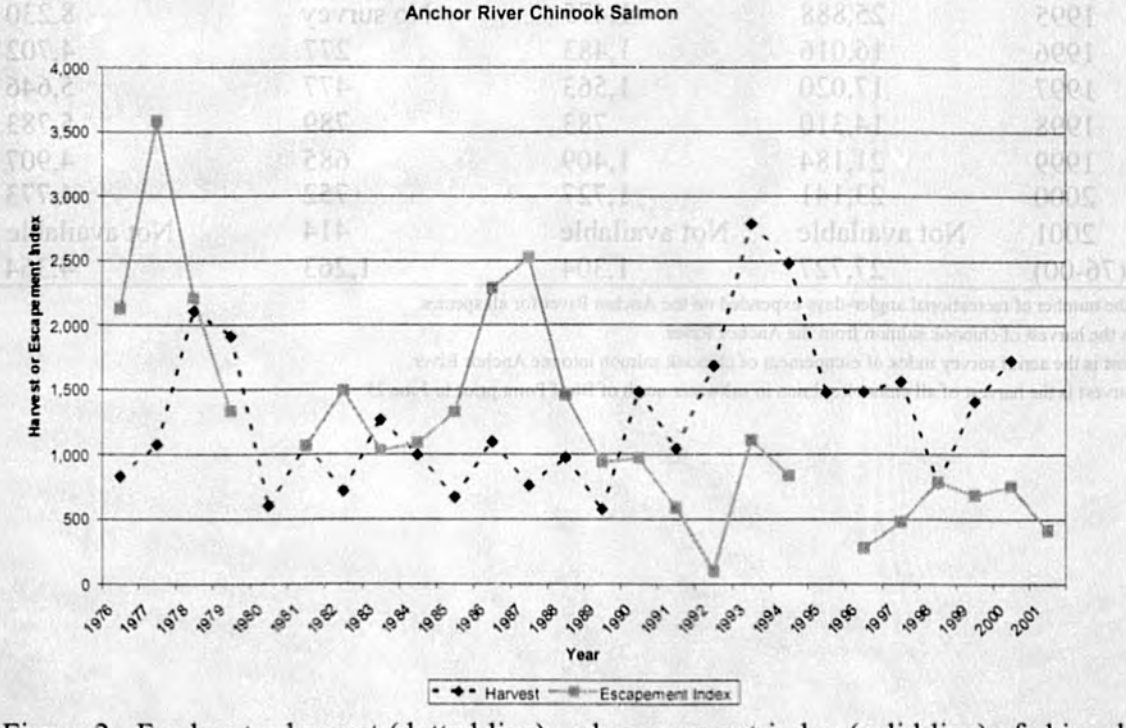


Figure 2. Freshwater harvest (dotted line) and escapement index (solid line) of chinook salmon in the Anchor River, 1976-2001.

Special Publication No. 06-26

Kvichak River Sockeye Salmon Stock Status and Action Plan, 2006; a Report to the Alaska Board of Fisheries

by

Steve Morstad

and

Timothy T. Baker

November 2006

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)	
centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm
Weights and measures (English)	
cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd
Time and temperature	
day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s
Physics and chemistry	
all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General	
Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)	
fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL
Mathematics, statistics	
all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

SPECIAL PUBLICATION NO. 06-26

KVICHAK RIVER SOCKEYE SALMON STOCK STATUS AND ACTION PLAN, 2006; A REPORT TO THE ALASKA BOARD OF FISHERIES

by

Steve Morstad
Alaska Department of Fish and Game, Division of Commercial Fisheries, King Salmon
and

Timothy T. Baker
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-15965

November 2006

The Division of Sport Fish Special Publications series was established in 1991 for the publication of techniques and procedures manuals, informational pamphlets, special subject reports to decision-making bodies, symposia and workshop proceedings, application software documentation, in-house lectures, and other documents that do not fit in another publication series of the Division of Sport Fish. Since 2004, the Division of Commercial Fisheries has also used the same Special Publication series. Special Publications are intended for fishery and other technical professionals. Special Publications are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm. This publication has undergone editorial and peer review.

Steve Morstad
Alaska Department of Fish and Game, Division of Commercial Fisheries,
PO Box 37, King Salmon, AK 99613, USA
and
Timothy T. Baker
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518, USA

This document should be cited as:
Morstad, S. and T. T. Baker. 2006. Kvichak River sockeye salmon stock status and action plan, 2006; a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Special Publication No. 06-26, Anchorage.

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:

ADF&G ADA Coordinator, P.O. Box 115526, Juneau AK 99811-5526

U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648, (Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:

ADF&G, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage AK 99518 (907)267-2375.

TABLE OF CONTENTS

Page

LIST OF TABLES ii
LIST OF FIGURES ii
ABSTRACT 1
INTRODUCTION 1
Kvichak River sockeye salmon 1
Stock Assessment 1
Commercial Fisheries Management 2
Previous Alaska Board of Fisheries Actions 3
Regulatory History 3
Stock of Concern Analyses 4
Escapement 4
Yield 4
Exploitation Rate 5
Return per Spawner 5
Stock of Concern Recommendation 5
KVICHAK RIVER SOCKEYE SALMON ACTION PLAN 5
Action Plan Review 5
Current Stock Status 5
Customary and Traditional Use Finding and the Amount Necessary 5
Habitat Factors Adversely Affecting the Stock 5
Do New Or Expanding Fisheries On This Stock Exist? 6
Existing Management Plans 6
Action Plan Development 6
Kvichak Sockeye Salmon Action Plan Goal 6
Previous Actions 6
Management Under Current Regulations 7
Action Plan Alternatives 7
REFERENCES CITED 7
TABLES AND FIGURES 9

LIST OF TABLES

Table		Page
1.	Historical yield, escapement and total inshore run of Kvichak River sockeye salmon.	10
2.	Escapement analysis of Kvichak River sockeye salmon, 2002–2006.	11
3.	Comparison of recent (2002–2006) pre-peak, peak and off-cycle yields to historical median yield for Kvichak River sockeye salmon.	12

LIST OF FIGURES

Figure		Page
1.	Bristol Bay commercial salmon fishery management area, Alaska.	13
2.	Kvichak River drainage, Bristol Bay, Alaska.	14
3.	Kvichak River sockeye salmon lower escapement goals and number of spawners, 1996–2006.	15
4.	Kvichak River sockeye salmon yield by year.	16
5.	Kvichak River sockeye salmon catch, escapement, and exploitation rate, 1956–2006.	17
6.	Total returns and return per spawner by brood year for sockeye salmon in the Kvichak River system, 1956–2002.	18

ABSTRACT

In response to the guidelines established in the *Sustainable Salmon Fisheries Policy* (ADF&G 2000), the Alaska Department of Fish and Game (ADF&G) first classified the Kvichak River sockeye salmon *Oncorhynchus nerka* stock as a "Stock of Yield Concern" in 2001 (Bristol Bay Staff 2000). The classification of Kvichak River sockeye salmon was subsequently changed to a "Stock of Management Concern" in 2003. This classification change was based on the definition of "management concern" found in the policy. A "management concern" is defined as, "a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for salmon stocks within the bounds of Sustainable Escapement Goal (SEG), Biological Escapement Goal (BEG), Optimal Escapement Goal (OEG), or other specified management objectives for the fishery." The increased protection provided by commercial, sport, and subsistence fisheries restrictions and closures that have occurred in recent years appears to be helping the Kvichak River sockeye salmon stock recover: there was a surplus harvest of Kvichak River sockeye salmon in the commercial fishery in 2006; minimum escapement goals were met in 2005 and 2006; recruits per spawner have improved in recent years; and the Kvichak River sockeye salmon stock exploitation rates have been significantly reduced in recent years. Even with these recent improvements, there is still need for concern. The sockeye salmon escapements to the Kvichak River have fallen below the lower end of the current escapement goal during 7 of the past 11 years, including 5 of the past 7 years. Therefore, it is recommended that the Kvichak River sockeye salmon stock remain classified as a "Stock of Management Concern." ADF&G would like to see the continued improvement of the Kvichak River sockeye salmon stock before demoting to a lower classification.

Key words: Kvichak River, sockeye salmon, *Oncorhynchus nerka*, stock of concern, commercial, fishing, ADF&G, sustainable salmon fisheries policy, Alaska Board of Fisheries, Bristol Bay, Alaska.

INTRODUCTION

The *Sustainable Salmon Fisheries Policy* (SSFP; 5 AAC 39.222) directs the Alaska Department of Fish and Game (ADF&G) to provide the Alaska Board of Fisheries (BOF), at regular meetings, with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation. In the Bristol Bay Management Area one stock (Kvichak River sockeye salmon, *Oncorhynchus nerka*) has been identified (Figures 1 and 2). This report provides ADF&G's assessment of this candidate stock of concern and recommendation that Kvichak River sockeye salmon remain a stock of management concern.

KVICHAK RIVER SOCKEYE SALMON

Stock Assessment

Previously the Kvichak River sockeye salmon stock, on average, was the largest contributor to the Bristol Bay salmon harvest. The Kvichak stock has historically had a 5-year cycle with individual years labeled as: peak, pre-peak and off-cycle years. Since 1955, the number of Kvichak River spawners has ranged from 227,000 to 24 million sockeye salmon (Table 1). The largest recorded total run was 48 million in 1965, a peak cycle year (Table 1). ADF&G has operated a counting tower to enumerate salmon escapements on the Kvichak River since 1955. Additionally, each spring from 1975 to 2003, the number of migrating smolt were estimated using hydroacoustics. In conjunction, age, length, and weight information was obtained from smolt sampled with fyke nets (Crawford and Fair 2003); this also began in 1975 and is ongoing.

The current Biological Escapement Goal (BEG) for Kvichak River sockeye salmon, adopted in 1997, is 2 million to 6 million for off-cycle years and 6 million to 10 million for pre-peak and peak years (Fair 2000). Setting a BEG for the Kvichak River sockeye salmon run has proven difficult because of divergence in productivity between cycle years and off-cycle years, poor density dependence in spawner-recruit data, and a lack of fit for Ricker type spawner-recruit

curves. In addition to the goal, an exploitation rate of 50% was set on runs of 4–20 million to provide guidance in setting goals within the range. The management objective for a given off-cycle year would then be defined as 50% of the total inshore Kvichak River run, and would never be less than 2 million or greater than 10 million. The management objective for a given pre-peak or peak cycle year would then be defined as 50% of the total inshore Kvichak River run, and would never be less than 6 million or greater than 10 million. Beginning in 1996, escapements were frequently less than the lower goal with 7 of the past 11 years below the goal (Figure 3).

Commercial harvests have also declined in recent years from a combined average of approximately 5.7 million (1966 to 1995) to an average of approximately 1.4 million (1996 to 2005; Figure 4). Moreover, commercial fishing was restricted in the Naknek-Kvichak District at some point each year since 1996, forcing the fishery into the Naknek River Special Harvest Area. In recent years, as directed in *Kvichak River Sockeye Salmon Management Plan* (5 AAC 67.025), sport fishing restrictions have routinely been imposed when escapements were projected to be less than 2 million fish. Restrictions have generally taken the form of bag limit reductions and area closures designed to minimize potential conflicts with subsistence users. Prior to enacting the current management plan, the poor return in 2000 resulted in a closure of the sockeye salmon sport fishery in the entire Kvichak drainage.

Prior to commercial fishing, area residents harvested Bristol Bay salmon for subsistence uses. The BOF determination of the amount reasonably necessary for subsistence uses is described in 5 AAC 01.336 as 157,000–172,171 salmon in the Bristol Bay area, "including 55,000 to 65,000 Kvichak River sockeye salmon; this finding does not include salmon stocks in the Alagnak River." In the Naknek-Kvichak District, sockeye subsistence harvest averaged about 92,000 from 1985–1994 and 72,000 from 1995–2004. Annual subsistence harvest of Kvichak River sockeye salmon averaged 60,000 fish from 1985 to 2004 (Westing et al. 2006) with recent harvests ranging from 33,000 to 53,000 (2000–2005).

In April 2006 an interdivisional salmon escapement goal review team, including staff from the Divisions of Commercial Fisheries and Sport Fish, was formed to comprehensively review the existing salmon escapement goals in the Bristol Bay Management Area based on the *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222 and the *Policy for Statewide Salmon Escapement Goals* (5 AAC 39.223). While this review is ongoing, fisheries data analyses indicate that the current Kvichak River sockeye salmon escapement goal will be changed from a BEG to an Sustainable Escapement Goal (SEG), but otherwise remain unchanged. Results of this escapement goal review will be presented at the December 2006 BOF meeting.

Commercial Fisheries Management

The Bristol Bay commercial fishery is managed using several measures of inseason run strength so that spawning escapement goals are met by distributing the escapement through time based on the historical run timing schedule. Commercial fishing periods are opened based on both spawning escapement and harvest indicators. Commercial fishing in Bristol Bay is not opened by emergency order until indicators suggest a harvestable surplus of sockeye salmon is available.

Daily and cumulative inseason escapement estimates, based on visual counts from towers, are compared to expected counts derived from historical averages of counts and run timing. This gives managers the ability to determine whether a run is smaller, the same, or larger than

expected. Unfortunately, sockeye salmon often require several days to travel from fishing districts to the counting towers. Therefore, inriver test fishing projects have been established to estimate the number of sockeye salmon that have left the fishing district but have not yet reached the counting tower (West and Fair 2006). This allows managers to provide adequate fishing opportunity to harvest surplus production while still achieving spawning escapement goals.

Commercial harvest information is used in a similar fashion to spawning escapement information. The actual daily and cumulative number of sockeye salmon harvested is compared to expected numbers derived from pre- and inseason projections to provide information on run size. Additionally, ADF&G conducts district test fishing during closed fishing periods to gauge the relative abundance and distribution of sockeye salmon within areas that may be open to harvest.

Previous Alaska Board of Fisheries Actions

The Kvichak River sockeye salmon stock was found to be a "Stock of Yield Concern" during the January 2001 Alaska Board of Fisheries meeting. In response to the "Stock of Yield Concern" designation, the BOF modified 5AAC 06.357 *Ugashik River Sockeye Salmon Special Harvest Area Management Plan*, 5AAC 06.359 *Egegik River Sockeye Salmon Special Harvest Area Management Plan*, 5AAC 06.360 *Naknek River Sockeye Salmon Special Harvest Area Management Plan*, and 5AAC 67.025 *Kvichak River Drainage Sockeye Salmon Management Plan* to provide additional protection for Kvichak River sockeye salmon. Bristol Bay fisheries were managed in accordance with these plans with no directed commercial fishing and a reduced sport fishery for Kvichak River sockeye salmon.

During the 2003 December Bristol Bay BOF meeting, several regulation changes were adopted concerning the Naknek/Kvichak District. The Kvichak sockeye salmon stock was elevated from a Stock of Yield Concern to a Stock of Management Concern due to the recent chronic inability to meet escapement goals. A Stock of Management Concern is defined (5 AAC 39.222) as "a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, Optimal Escapement Goal (OEG), or other specified management objectives for the fishery."

With this 2003 action came the stipulation that if the Kvichak River run is forecasted to be less than 30% above the minimum BEG, fishing will begin in the Special Harvest Areas of Naknek, Egegik and Ugashik Rivers (5 AAC 06.360 (h)).

Regulatory History

Kvichak River sockeye salmon have been utilized for subsistence for centuries. This system's main producer is sockeye salmon and its importance is increased due to the system's inclusion of the villages of Levelock, Igiugig, Pedro Bay, Kokhanok, Iliamna/Newhalen, Nondalton, and Port Alsworth.

Permits are required to harvest salmon for subsistence purposes in the Kvichak River drainage. Since 1990, under state regulations, all state of Alaska residents have been eligible to participate in subsistence salmon fishing in all Bristol Bay drainages. Gillnets up to 25 fathoms are the only recognized legal subsistence gear.

The commercial fishery is closed between June 1 and September 30, but it can be opened by emergency order. There are three management plans addressing commercial fishing within the Naknek-Kvichak District.The first is referred to as the *Commercial Set and Drift Gillnet Sockeye*

Salmon Fisheries Management and Allocation Plan (5AAC 06.355; ADF&G 2001). This plan specifies the allocation of sockeye salmon between commercial set and drift gillnet fisheries within the district and establishes management measures to achieve allocation. Part of this plan (5AAC 06.364 (e); ADF&G 2001) attempts to provide adequate Kvichak River sockeye salmon spawning escapement by managing, to the extent practicable, a fishery in the Naknek Section with limited set and drift gillnet gear fishing during ebb tides.

The second plan is referred to as the *Naknek River Sockeye Salmon Special Harvest Area Management Plan* (5AAC 06.360; ADF&G 2001). This plan states that on or after June 27, if Kvichak River cumulative escapement is one or more days behind the historical schedule for meeting the goal, the following actions are taken:

1. The Naknek-Kvichak District will be closed, and to reduce the potential for interception of Kvichak River sockeye salmon in other districts,
    a. Fishing in the Egegik District may be restricted to the Egegik River Special Harvest Area;
    b. Fishing in the Ugashik District will occur within a restricted area prior to June 29; and
    c. If Naknek River spawning escapement is projected to be greater than 800,000 sockeye salmon, the Naknek River Special Harvest Area can open, and the upper spawning escapement goal for the Naknek River will be raised from 1.4 million to 2.0 million sockeye salmon.

The third plan is referred to as the *Naknek-Kvichak District Commercial Set and Drift Gillnet Sockeye Salmon Fisheries Management and Allocation Plan* (5AAC 06.364; ADF&G 2001). The purpose of this plan is to establish the allocation of sockeye salmon between the commercial set and drift gillnet fisheries within the Naknek-Kvichak District and to establish management measures for ADF&G to achieve the allocation.

Stock of Concern Analyses

Escapement

During the most recent 5 years, the minimum escapement goal was achieved in 2005 and 2006 (Table 2; Figure 3). The minimum escapement goal has been met in only 4 out of the last 11 years: 1998, 1999, 2005, and 2006 (Figure 3). It should be noted that the off-cycle escapement goal was changed from 4 million to 2 million (variable) in 1997 (implemented in 1998; Table 2). Escapements in 1996 and 1997 would not have met the current off-cycle goal of 2 million although the shortfall is not alarming. However, ADF&G was concerned with the 70% escapement shortfall during a Kvichak peak year (2000). There have been two pre-peak (1959 and 1964) and no peak year escapements which were less than the escapement in 2000. ADF&G was encouraged that the minimum escapement goal was met in 2005 and 2006.

Yield

The actual yield was less than the median yield in all years (both peak and off-cycle) except one (2006) of the most recent 5-year period (Table 3 and Figure 4). The term "lower range of historic harvest" was not defined in the "Sustainable Salmon Fisheries Policy." Therefore, the degree of yield concern and the point at which a yield concern was classified were subject to interpretation.

Exploitation Rate

The commercial fishing exploitation rate on Kvichak sockeye salmon was significantly reduced in recent years, especially for very low runs (Figure 5). For example, in 2002 and 2003, the exploitation rate of Kvichak stocks was less than 2%.

Return per Spawner

There has been an increase in the production of the Kvichak River sockeye salmon stock in recent years. The return per spawner from brood years 1991–1999 averaged 0.8 fish per spawner (Figure 6). There has been an increase in the return per spawner in recent years (brood years 2000–2002) averaging 3.1 returns per spawner since 2000. We expect the return per spawner to increase for these recent years even further because the return for these broods has not been completed.

Stock of Concern Recommendation

The increased protection provided by commercial and sport fisheries restrictions and closures that have occurred in recent years appears to be helping the Kvichak River sockeye salmon stock recover: there was a surplus harvest of Kvichak River sockeye salmon in the commercial fishery in 2005 and 2006; minimum escapement goals were met in 2005 and 2006; recruits per spawner have improved in recent years; and Kvichak River sockeye salmon stock exploitation rates have been significantly reduced in recent years. Even with these recent improvements, there is still need for concern. The sockeye salmon escapements to the Kvichak River have fallen below the lower end of the current escapement goal during 7 of the past 11 years, including 5 of the past 7 years. Therefore, it is recommended that the Kvichak River sockeye salmon stock remain classified as a "Stock of Management Concern". AD&FG would like to see the continued improvement of the Kvichak River sockeye salmon stock for 4 or 5 years before demoting to a lower classification.

KVICHAK RIVER SOCKEYE SALMON ACTION PLAN

ACTION PLAN REVIEW

Current Stock Status

In response to the guidelines established in the Sustainable Salmon Fisheries Policy, the Alaska Board of Fisheries during the October 1–3, 2003 work session classified the Kvichak River sockeye salmon stock as a management concern. This determination was based on the inability, despite the use of specific management measures, to maintain escapement for a salmon stock within the bounds of the BEG for 4 of the past 5 years.

Customary and Traditional Use Finding and the Amount Necessary

The Alaska Board of Fisheries has made a positive finding for Customary and Traditional Use for all salmon in the Bristol Bay area of 157,000 to 172,171 salmon. Of those, 55,000 to 65,000 sockeye salmon were determined reasonably necessary for Kvichak River drainage.

Habitat Factors Adversely Affecting the Stock

There are no habitat factors adversely affecting the Kvichak stock within the entire drainage.

Do New Or Expanding Fisheries On This Stock Exist?

Presently, there are no new or expanding fisheries on this stock. There are no proposals specific to expanding fisheries on this stock.

Existing Management Plans

The Board reviews existing management plans for consistency with principles and criteria of the Sustainable Salmon Fisheries Policy or adopts new management for the stock consistent with the principles and criteria of the Sustainable Salmon Fisheries Policy.

The following are the current regulations:

5 AAC 06.200. FISHING DISTRICTS, SUBDISTRICTS, AND SECTIONS.

5 AAC 06.310. FISHING SEASONS.

5 AAC 06.320. FISHING PERIODS.

5 AAC 06.355. BRISTOL BAY COMMERCIAL SET AND DRIFT GILLNET SOCKEYE SALMON FISHERIES MANAGEMENT AND ALLOCATION PLAN.

5 AAC 06.359. EGEGIK RIVER SOCKEYE SALMON SPECIAL HARVEST AREA MANAGEMENT PLAN.

5 AAC 06.360. NAKNEK RIVER SOCKEYE SALMON SPECIAL HARVEST AREA MANAGEMENT PLAN.

5 AAC 06.364. NAKNEK/KVCHIAK DISTRICT COMMERCIAL SET AND DRIFT GILLNET SOCKEYE SALMON FISHERIES MANAGEMENT AND ALLOCATION PLAN.

5 AAC 06.365. EGEGIK DISTRICT COMMERCIAL SET AND DRIFT GILLNET SOCKEYE SALMON FISHERIES MANAGEMENT AND ALLOCATION PLAN.

5 AAC 09.200. DESCRIPTION OF DISTRICTS AND SECTIONS.

5 AAC 09.310. FISHING SEASONS.

ACTION PLAN DEVELOPMENT

Kvichak Sockeye Salmon Action Plan Goal

To rebuild the Kvichak sockeye salmon run back to historical levels by attaining the escapement goal.

Previous Actions

During the BOF meeting in January of 2001, ADF&G presented a summary of four potential action plans (Bristol Bay staff, 2000) of which three reduced the exploitation rate on Kvichak stocks in each eastside district. In deliberation the BOF made the following changes: (1) In the Ugashik District, when the preseason forecast of Kvichak sockeye salmon does not provide for an exploitation rate greater than 40%, fishing time between June 16 to June 23 can not exceed 48-hours. In addition, if the Naknek River Special Harvest Area (NRSHA) is in effect anytime before June 29, fishing will be restricted to the Ugashik River Special Harvest Area (URSHA); (2) In the Egegik District, when the NRSHA is open to commercial fishing then fishing in the Egegik District is restricted to the Egegik River Special Harvest Area (ERSHA) and will remain in the ERSHA until fishing resumes in the Naknek/Kvichak District; and (3) In the

Naknek/Kvichak District, the district is closed to both gear groups when Kvichak River escapement falls one or more days behind the cumulative escapement goal curve on or after June 27. When fishing the NRSHA, an OEG is in effect raising the upper end of the escapement goal range from 1.4 million to 2.0-million sockeye salmon. During the 2003 BOF meeting, ADF&G presented one additional action plan item to further reduce the exploitation rate on Kvichak stocks (Bristol Bay 2003). The BOF required that fishing will begin in the Special Harvest Areas of Naknek, Egegik and Ugashik Rivers if the Kvichak River run is forecasted to be less than 30% above the minimum biological escapement goal (5 AAC 06.360 (h)).

Management Under Current Regulations

In 2004, the forecast for the Kvichak River projected a harvestable surplus of 6.6 million sockeye salmon with an escapement goal of 6.0 million. The BOF authorized a General District fishery in 2004, which opened areas outside of the normal district boundaries. With these additional areas open and a projected harvest of 6.6 million sockeye no restrictions were placed on the eastside fisheries. Limited fishing occurred in the Naknek/Kvichak District prior to June 23 with most of the harvest caught in the General District. Commercial fishing was restricted to the Naknek Section for the drift fleet and marginal fishing in the Kvichak Section for set gillnet gear. Escapement to Kvichak River was on track until July 6 when it fell more than 1 day behind. At that time, the District was closed and fishing was restricted to the NRSHA. The final escapement was 5.5 million sockeye salmon which was slightly less than the minimum escapement goal of 6.0 million. In 2005 and 2006, the preseason forecast projected a surplus of less than 30% above the minimum escapement goal and the eastside fisheries began in their respective special harvest areas. The outcome both in 2005 and 2006 was that the Kvichak River met its escapement objectives.

It is ADF&G's opinion that it has the necessary regulations to meet escapement objectives for Kvichak River sockeye salmon when the total run exceeds the minimum escapement goals and is forecasted within 30%. Further, it is the department opinion that the restrictions in current regulations are sufficient to minimize the exploitation and insure the vast majority of the sockeye salmon returning to the Kvichak River will escape the commercial fishery when total run is less than the minimum escapement goal.

Action Plan Alternatives

No new action plans necessary, continue under current plans.

REFERENCES CITED

ADF&G (Alaska Department of Fish and Game) and the Alaska Board of Fisheries (BOF). 2000. Sustainable salmon fisheries policy for the State of Alaska. Alaska Department of Fish and Game, Juneau. 14 pp.

ADF&G (Alaska Department of Fish and Game). 2001. 2001-2004 Bristol Bay, Alaska Peninsula, Atka-Amilla, and Aleutian Island Areas commercial fishing regulations. Alaska Department of Fish and Game, Division of Commercial Fisheries, Juneau.

Bristol Bay Staff. 2000. Kvichak River sockeye salmon stock status and action plan 2000. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A00-37, Anchorage.

REFERENCES CITED (Continued)

Bristol Bay Staff. 2003. Kvichak River sockeye salmon stock status and action plan 2003. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A03-26, Anchorage.

Crawford, D. L., and L. F. Fair. 2003. Bristol Bay sockeye salmon smolt studies using upward-looking sonar, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A03-17, Anchorage.

Fair, L. F. 2000. Report to the Alaska Board of Fisheries on spawning escapement goal evaluations for Bristol Bay salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A00-38, Anchorage.

West, F. W. and L. F. Fair. 2006. Abundance, age, sex, and size statistics for Pacific salmon in Bristol Bay, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 06-47, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds06-47.pdf

Westing, C., T. Sands, S. Morstad, P. Salomone, L. Fair, F. West, C. Brazil, and K. A. Weiland. 2006. Annual management report 2005 Bristol Bay area. Alaska Department of Fish and Game, Fishery Management Report No. 06-37, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr06-37.pdf

TABLES AND FIGURES

Table 1.–Historical yield, escapement and total inshore run of Kvichak River sockeye salmon.

	Actual Yield		Actual Escapement		Total Inshore Run	
Year	Pre-Peak & Peak	Off-cycle	Pre-Peak & Peak	Off-Cycle	Pre-Peak & Peak	Off-Cycle
1959	281,930		680,000		961,930	
1960	7,976,500		14,630,000		22,606,500	
1961		6,863,814		3,705,849		10,569,663
1962		1,833,401		2,580,884		4,414,285
1963		223,459		338,760		562,219
1964	763,486		957,120		1,720,606	
1965	17,785,664		24,325,926		42,111,590	
1966		4,168,575		3,775,184		7,943,759
1967		1,800,652		3,216,208		5,016,860
1968		387,565		2,557,440		2,945,005
1969	3,760,565		8,394,204		12,154,769	
1970	16,581,224		13,935,306		30,516,530	
1971		3,764,861		2,387,392		6,152,253
1972		342,150		1,009,962		1,352,112
1973		21,791		226,554		248,345
1974	148,595		4,433,844		4,582,439	
1975	1,605,407		13,140,450		14,745,857	
1976		1,458,180		1,965,282		3,423,462
1977		739,464		1,341,144		2,080,608
1978		3,815,636		4,149,288		7,964,924
1979	13,418,829		11,218,434		24,637,263	
1980	12,743,074		22,505,268		35,248,342	
1981		5,234,733		1,754,358		6,989,091
1982		1,858,475		1,134,840		2,993,315
1983		16,534,901		3,569,982		20,104,883
1984	12,523,803		10,490,670		23,014,473	
1985	6,183,103		7,211,046		13,394,149	
1986		787,303		1,179,322		1,966,625
1987		3,526,824		6,065,880		9,592,704
1988		2,654,364		4,065,216		6,719,580
1989	11,456,509		8,317,500		19,774,009	
1990	10,551,217		6,970,020		17,521,237	
1991		3,808,873		4,222,788		8,031,661
1992		5,718,947		4,725,864		10,444,811
1993		5,287,523		4,025,166		9,312,689
1994	13,893,613		8,337,840		22,231,453	
1995	17,391,906		10,138,720		27,530,626	
1996		1,983,269		1,450,578		3,433,847
1997		179,480		1,503,732		1,683,212
1998		1,069,294		2,296,074		3,365,368
1999	6,392,296		6,196,914		12,589,210	
2000	1,026,986		1,827,780		2,854,766	
2001		330,538		1,095,348		1,425,886
MED	9,263,859	1,858,475	8,366,022	2,387,392	18,647,623	4,414,285
MAX	17,785,664	16,534,901	24,325,926	6,065,880	42,111,590	20,104,883
MIN	148,595	21,791	680,000	226,554	961,930	248,345
2002				703,884		703,884
2003		34,244		1,686,804		1,721,048
2004	2,211,186		5,500,134		7,711,320	
2005		532,450		2,320,332		2,852,782
2006		2,736,218 [a]		3,068,226		5,804,444

[a] Yield is a preliminary estimate in 2006.

Table 2.–Escapement analysis of Kvichak River sockeye salmon, 2002–2006.

Year	Actual Escapement	Minimum Escapement Goal	Difference	% Deviation from Goal [a]	Escapement > Goal	Frequency of Occurrence [b]
2002	703,884	2,000,000	-1,296,116	-65%	No	3 (n=27)
2003	1,686,804	2,000,000	-313,196	-16%	No	9 (n=27)
2004	5,500,134	6,000,000	-499,866	-8%	No	4 (n=27)
2005	2,320,332	2,000,000	320,332	16%	Yes	13 (n=27)
2006	3,068,226	2,000,000	1,068,226	53%	Yes	18 (n=27)

[a] Percent deviation = (Actual - Goal) / Goal.

[b] The number of escapement observations (1956–1998) which are less than the escapement of the current year.

Table 3.–Comparison of recent (2002–2006) pre-peak, peak and off-cycle yields to historical median yield for Kvichak River sockeye salmon.

Year	Actual Yield	Historical Median Yield: Pre-peak, Peak 1959–2000, n=18	Historical Median Yield: Off-cycle 1961–2001, n=25	Difference	% Deviation from Median[a]	Yield < Lower Range[b]	Frequency of Occurrence[c]
2002	0		1,858,475	-1,858,475	-100%	Yes	0 (n=27)
2003	34,244		1,858,475	-1,824,231	-98%	No	2 (n=27)
2004	2,211,186	9,263,859		-7,052,673	-76%	No	5 (n=27)
2005	532,450		1,858,475	-1,326,025	-71%	No	8 (n=27)
2006	2,736,218		1,858,475	877,743	47%	No	18 (n=27)

[a] Percent deviation = (Actual - Median) / Median.

[b] Lower range of Pre-Peak and Peak years was 148,595 and off-cycle years were 21,791.

[c] The number of yield observations (1959–2001) which are less than the yield of the current year.

[d] Yield is a preliminary estimate in 2006.

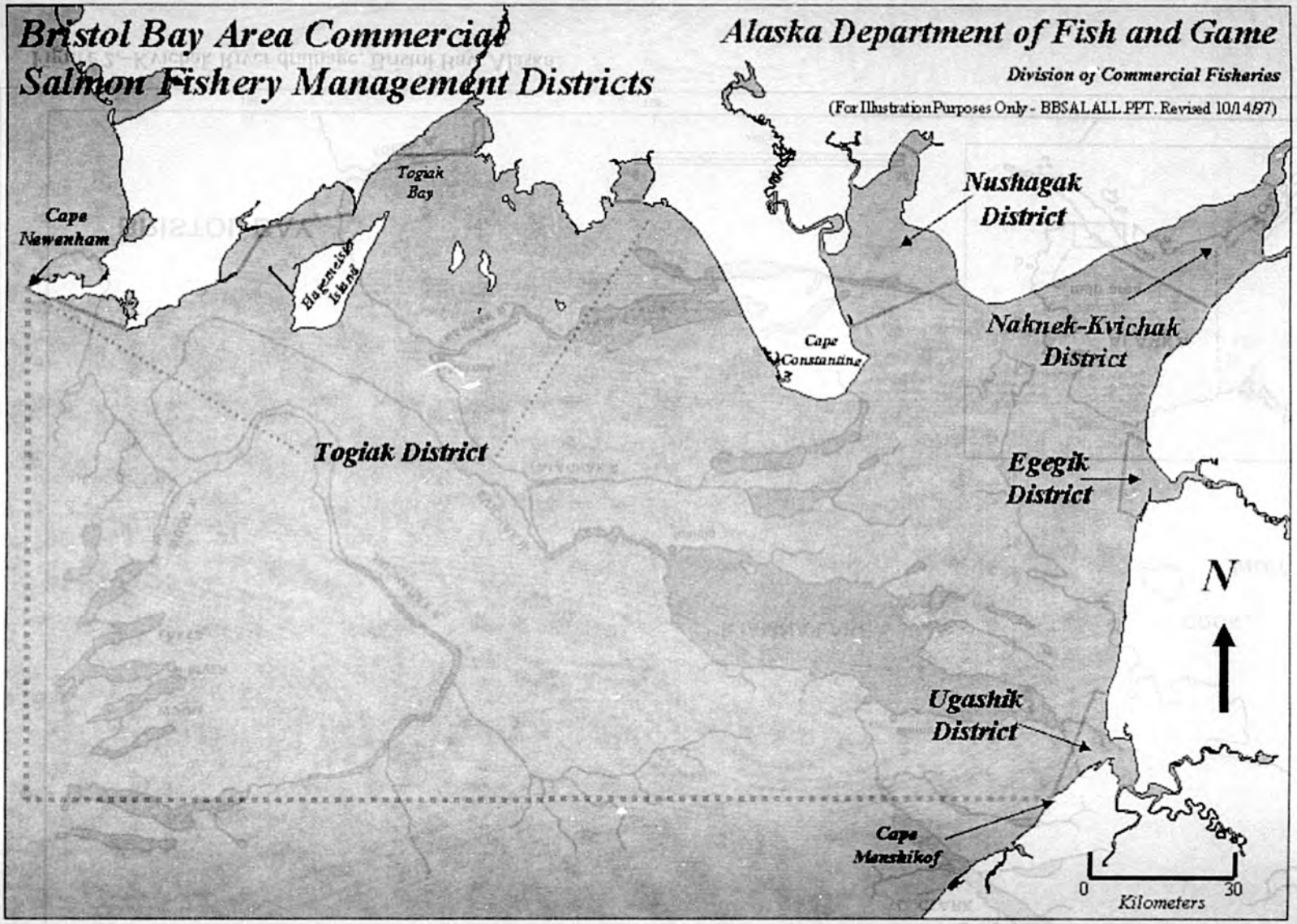


Figure 1.–Bristol Bay commercial salmon fishery management area, Alaska.

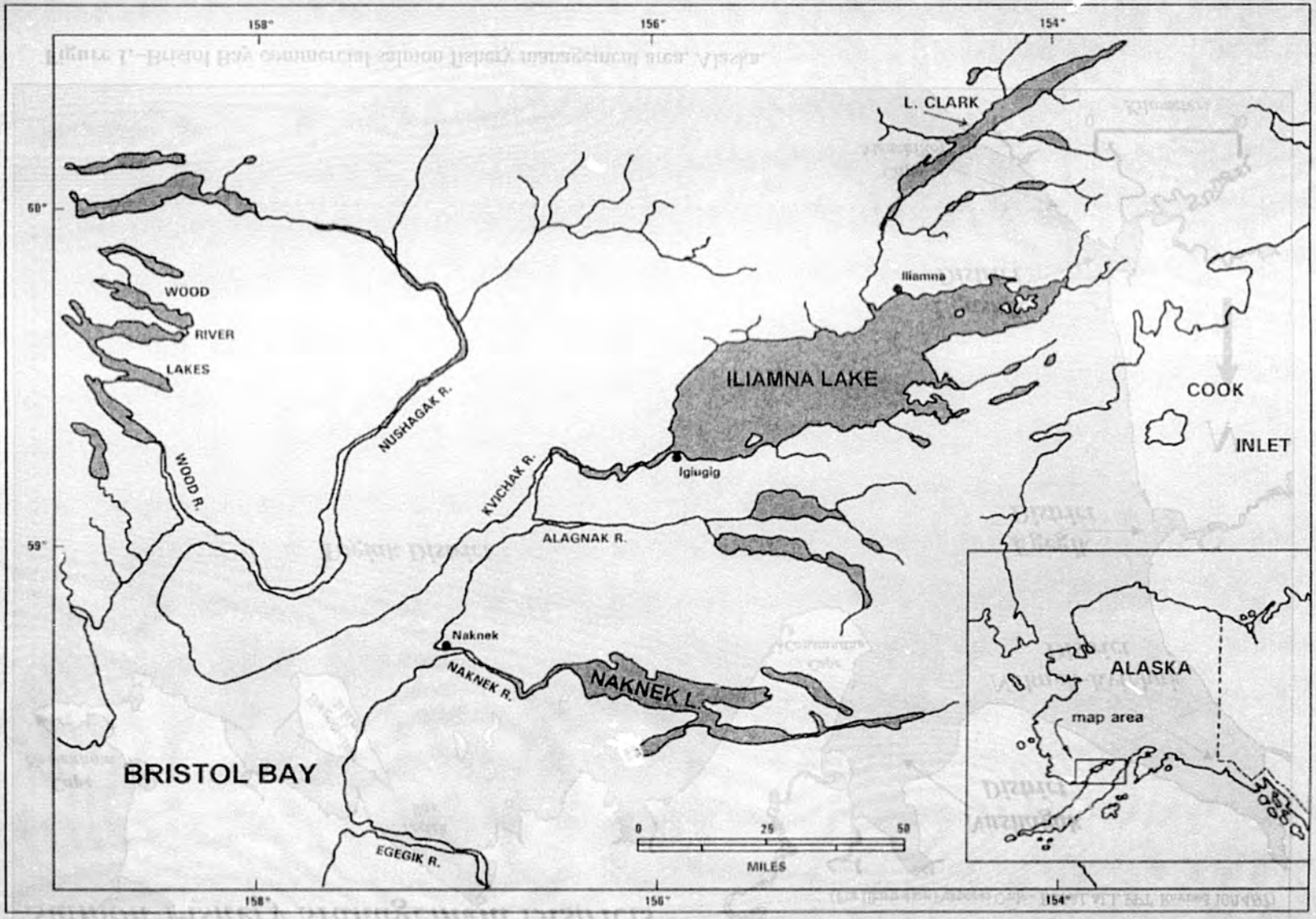


Figure 2.–Kvichak River drainage, Bristol Bay, Alaska.

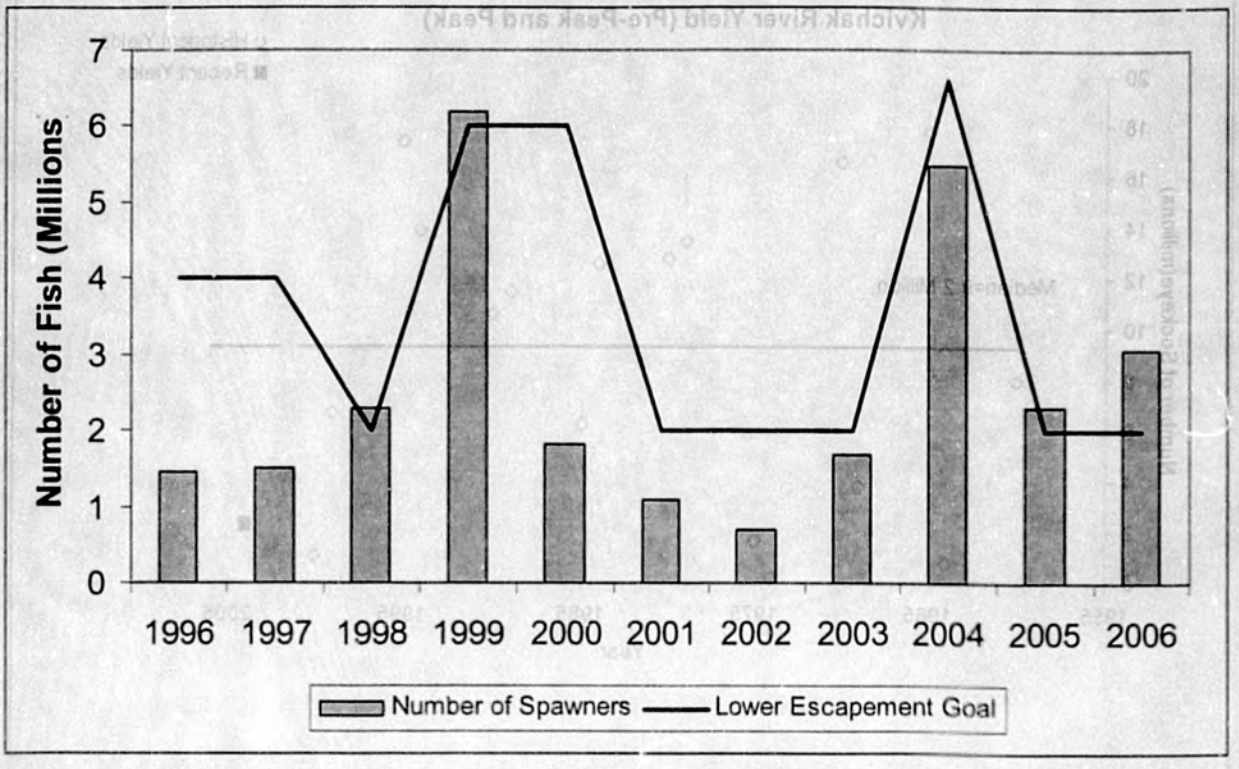


Figure 3.–Kvichak River sockeye salmon lower escapement goals and number of spawners, 1996–2006.

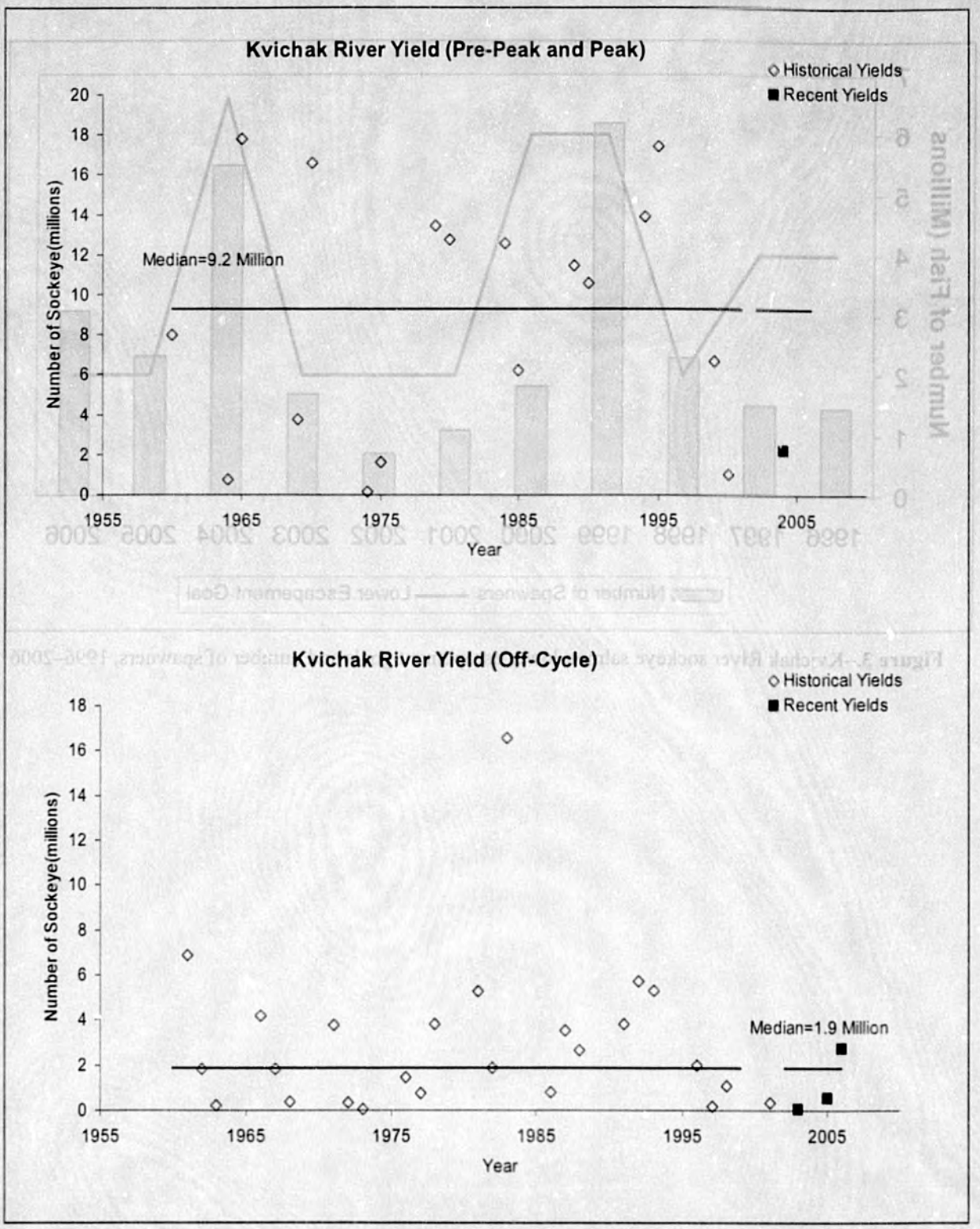


Figure 4.–Kvichak River sockeye salmon yield by year.

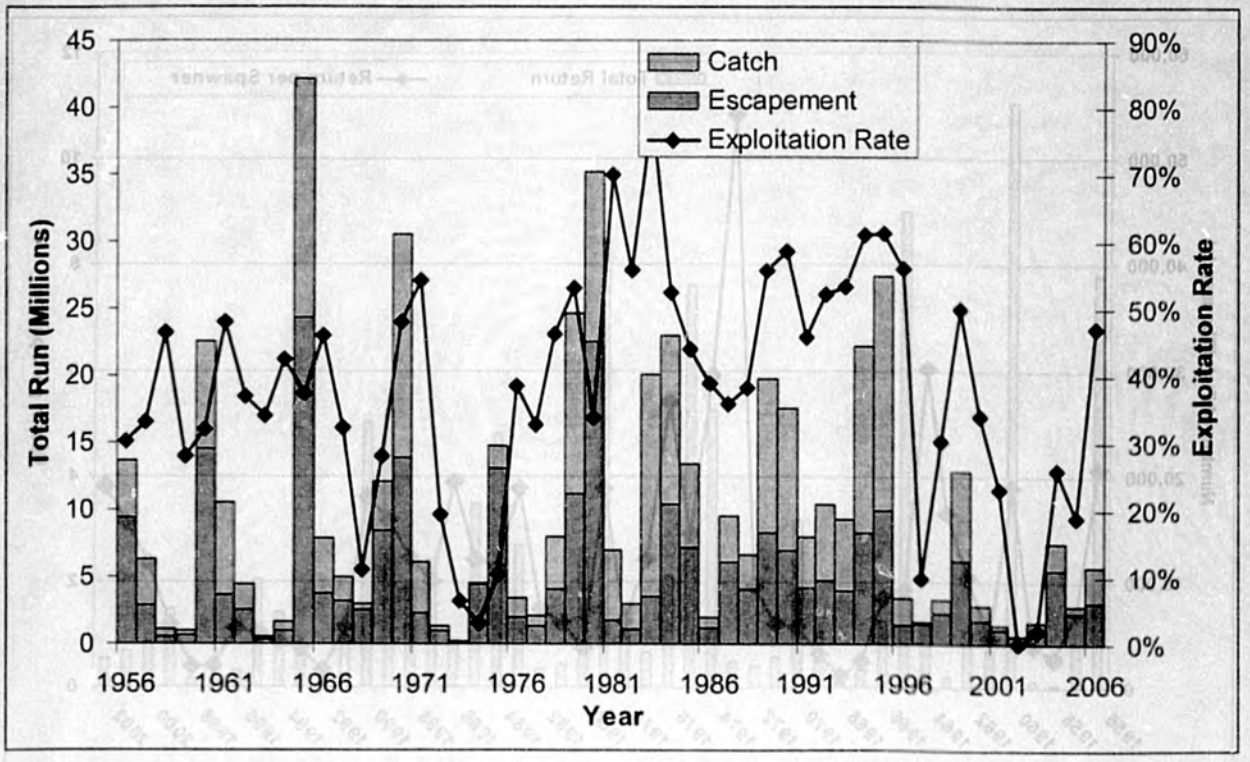


Figure 5.–Kvichak River sockeye salmon catch, escapement, and exploitation rate, 1956–2006.

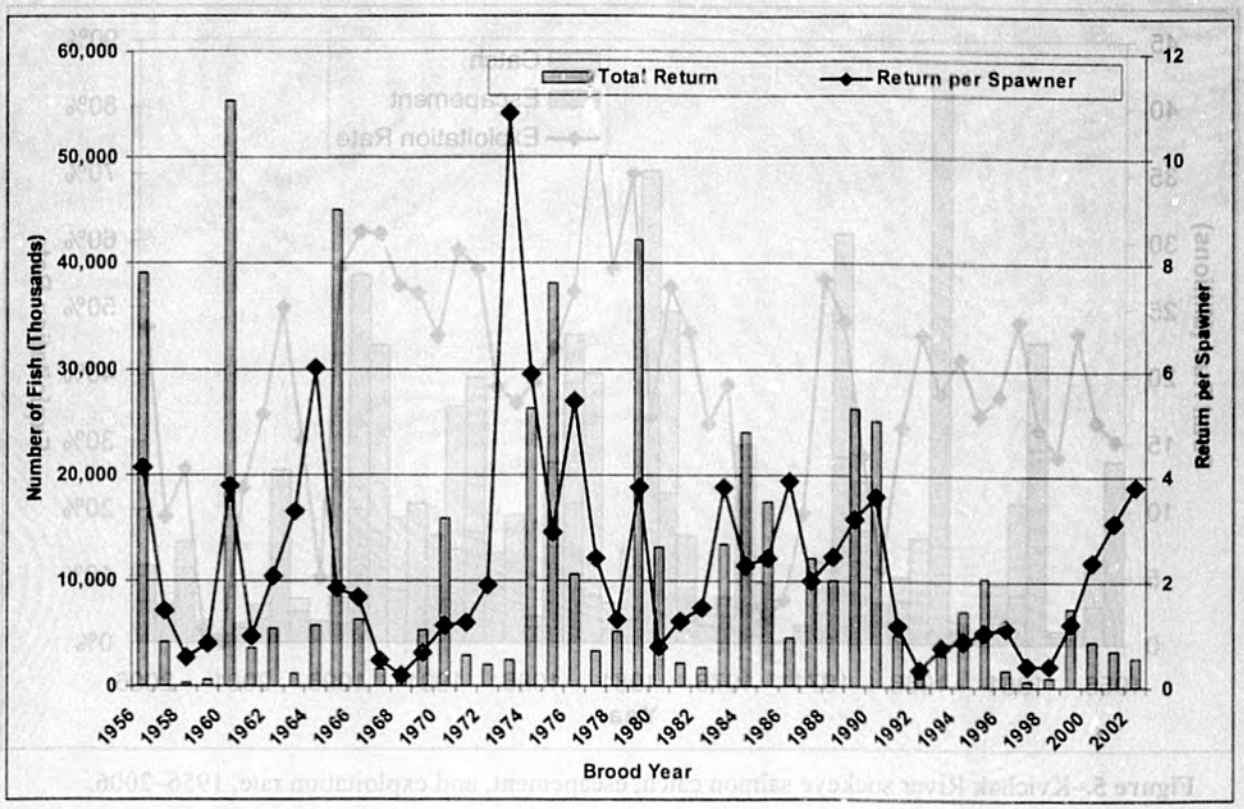


Figure 6.–Total returns and return per spawner by brood year for sockeye salmon in the Kvichak River system, 1956–2002.

Economic Significance of Fishing in Alaska during 2007

Prepared for
Upper Cook Inlet Salmon Task Force
June 25, 2008
Anchorage, Alaska

Bill Romberg
Fisheries Biologist
Alaska Department of Fish and Game
Sport Fish Division
907-267-2366

Background

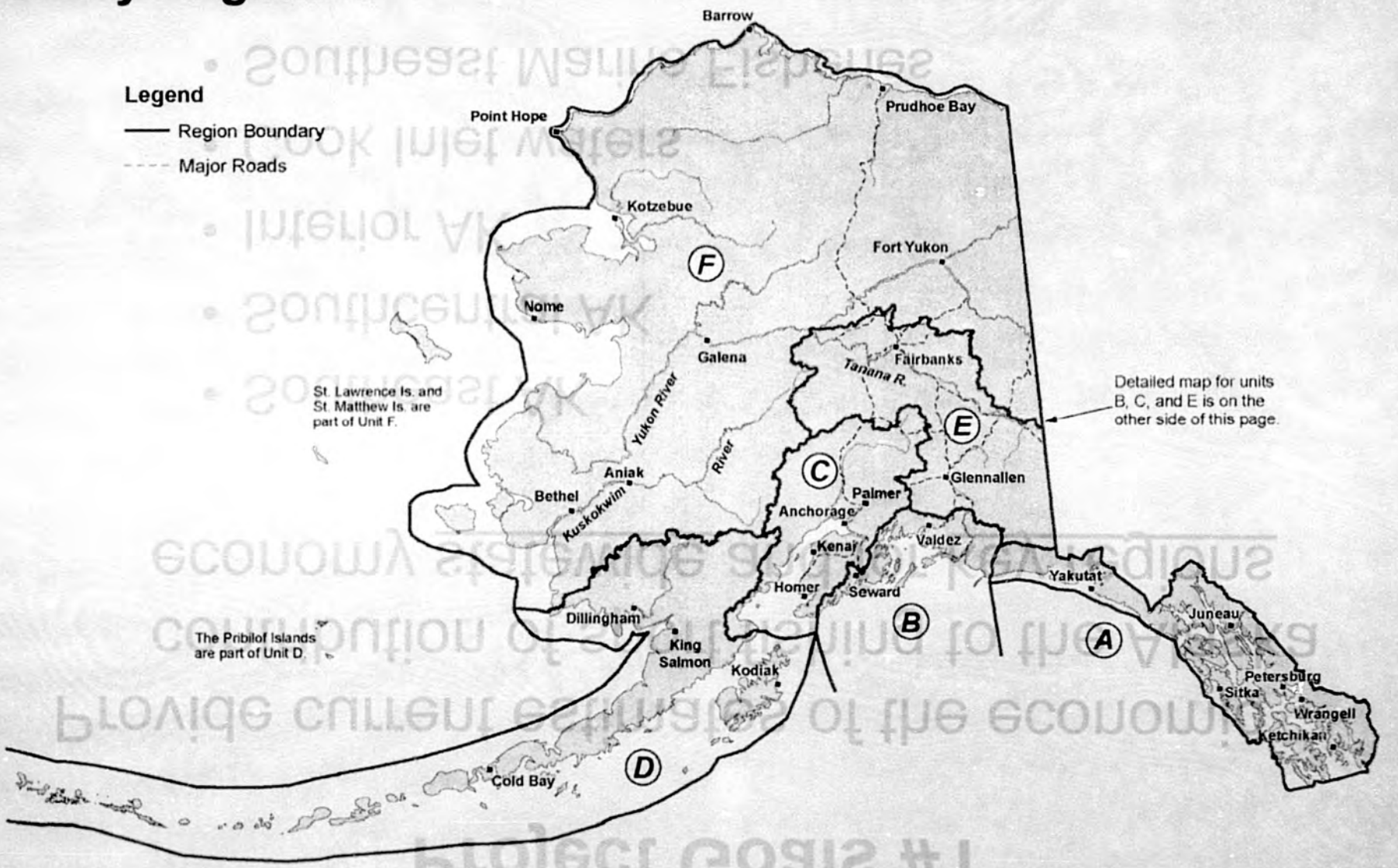
- USFWS National Survey—every 5 years, small sample, statewide only. Limited utility.
- ADF&G-SF has periodically contracted statewide and regional economic analysis
  - Jones & Stokes 1986, 1988
  - UAA- ISER 1993-1998
  - Several regional and fishery-based studies
- Reliable estimates for Alaska are nearly 15-years old

Project Goals #1

Provide current estimates of the economic contribution of sport fishing to the Alaska economy statewide and for key regions

- Southeast AK
- Southcentral AK
- Interior AK
- Cook Inlet waters
- Southeast Marine Fisheries

Study Regions



Project Goal #2

- Establish a consistent and repeatable method for collecting and reporting estimates of economic contribution of sportfishing to the Alaska economy.
  - Make estimates available on a more regular basis--every 2-3 yrs.
  - Track and compare such estimates over time
  - Scalable-allowing for more detailed analyses or expansion in future

Type of Study

Economic Significance/Impact Analysis:

A) Estimate what residents and non-residents actually spent on sport fishing activities in Alaska in 2007 (total expenditures)

B) Estimate the direct, indirect, and induced economic benefits of such spending to Alaska economy using an economic input/output model (IMPLAN) customized to Alaska's economy

NOT an economic valuation study that attempts to estimate the total value or net economic value (willingness to pay – expenses) of sportfishing in Alaska.

Definitions

- Economic Significance= total economic activity within a region (e.g. economic benefits of both resident & nonresident spending)
- Economic Impact= economic benefits from dollars originating outside the region (e.g. nonresident spending in region)
- Angler Expenditures= dollars spent for the primary reason of sportfishing.

Definitions (cont.)

Angler Expenditures include:

- Fishing trip-related expenditures in Alaska
  (licenses, fuel, guide/charter fees, bait, ice, processing, & travel expenses such as lodging, food, etc.)
- Sportfishing equipment purchases in Alaska
  (rods, reels, fishing tackle, coolers, boat, etc.)
- Other purchases in Alaska for the primary purpose of supporting sportfishing activities
  (fishing magazines, equipment maintenance, etc.

Study Approach

- Angler expenditure surveys to collect spending amounts by trip in 2007 (~7,000 surveys, 40%) response rate)
- Licensed guide/charter business surveys--how expenses distributed (~500, 35% response rate)
- IMPLAN Economic model—customized for Alaska using business survey

Economic Measures Produced

Statewide & for <u>each</u> region:

- <u>Total expenditures</u> for sportfishing by residency and water type (freshwater, saltwater)
- <u>Avg expenditures per day of sportfishing</u> by residency, water type, and guided/non-guided fishing
- Total full and part-time jobs generated
- Total wages and salaries generated
- Total govt. tax receipts generated
- Total <u>combined</u> economic impact (of resident and nonresident spending) to Alaska

**Breakdown by species groups (salmon vs. bottomfish) may be possible at statewide level only—data dependent

Information NOT Provided By Study

- Economic benefits by species or specific fisheries (maybe in future with more $)
- Total economic value of sport fishing in Alaska
- Direct comparisons of the economic benefits/values of sport and commercial fisheries in Alaska

Project Timeline

- Project proceeding per RFP timeline, report(s) by Dec 31, 08
- Spring 2006: Division receives additional funding to conduct updated economic study
- Summer 2006: Detailed Request for Proposals (RFP) developed—with independent review by outside economist
- Fall 2006: Division releases RFP
  Division evaluates/scores bid proposals
- Jan/Feb 2007: Southwick Associates proposal wins competitive bid proposal process and contract is issued.

Project Timeline (cont.)

- Feb-May 2007: ADF&G and Southwick Associates develop and sign detailed research plan
- July 2007 – Feb 2008: Angler expenditure surveys, Guide Business survey
- Feb-July 2008: Data entry, editing, analysis, and economic modeling with review/oversight by ADF&G team.
- Sept 2008: Draft reports to ADF&G
- **<u>Dec 31, 2008</u>: Final reports to ADF&G for distribution, communication of results to staff and other stakeholders**

Project Information & Updates

- The project webpage http://www.sf.adfg.state.ak.us/Statewide/economics/2007Study.cfm
- Technical Questions about the project contact Bill Romberg at 907-267-2366
- Alternative contacts:
  - Bob Clark, 907-267-2222
  - Lisa Evans 907-267-233

Management and Stock Status of Northern and Western Cook Inlet Sport Fisheries

A Report to the Legislative Salmon Task Force

Department of Fish & Game
Sport Fish Division,
By: ***Dave Rutz***

The Northern & Western Cook Inlet Management Area

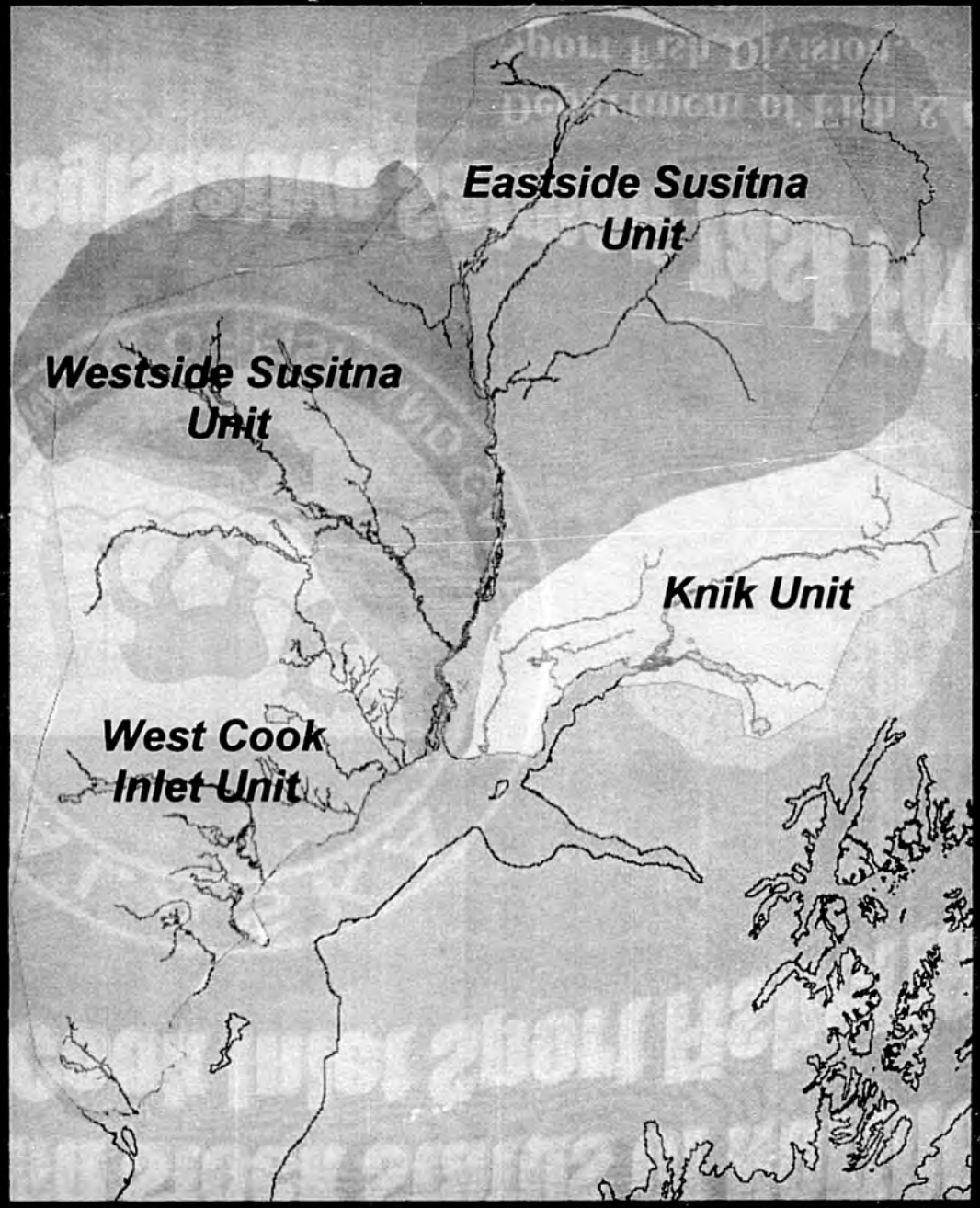


Figure 1. Sport Fishing Effort in Angler Days for Northern and Western Cook Inlet For All Species, 1990-2006

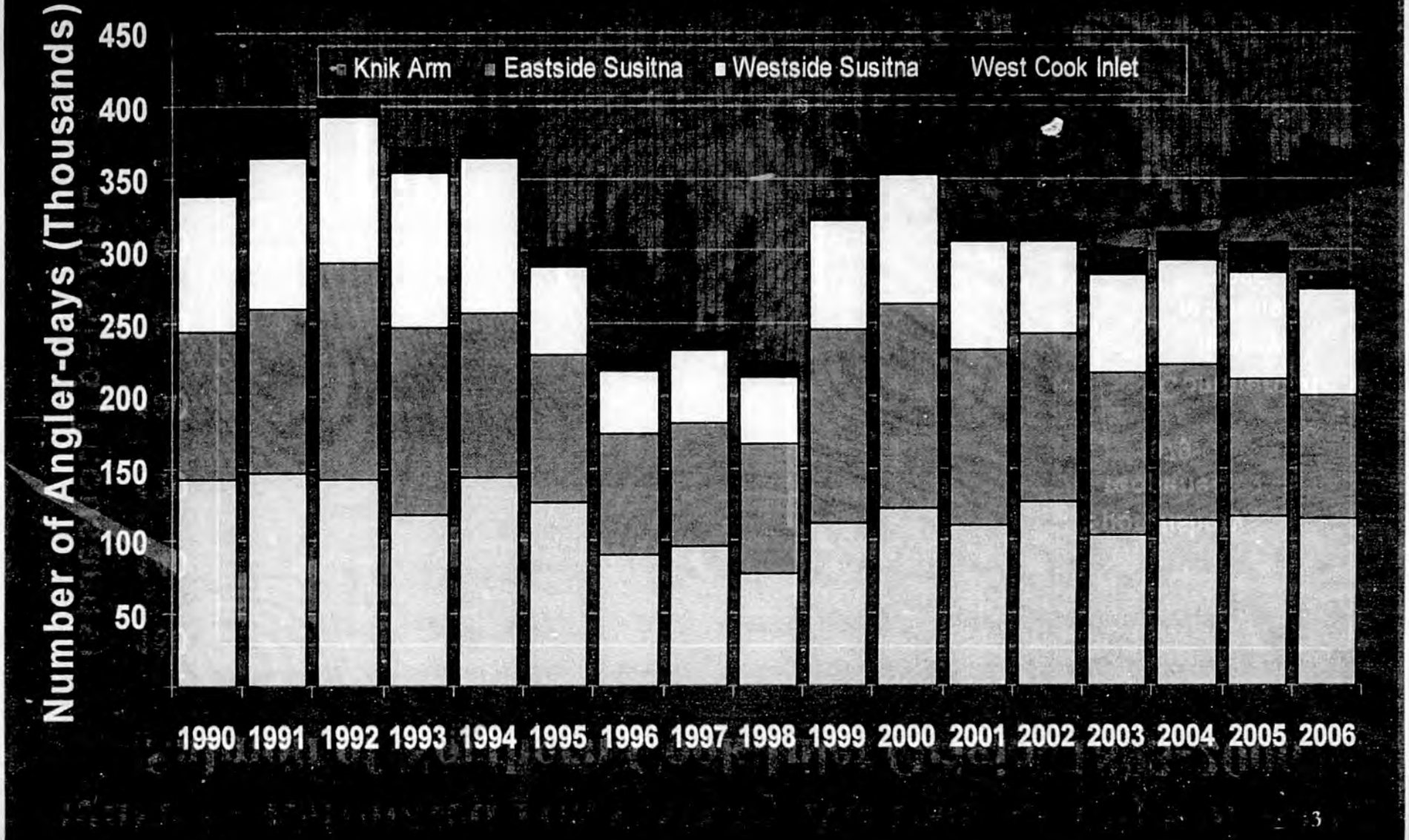


Figure 2. Estimated Harvests by All User Groups of King Salmon of Northern Cook Inlet Origin, 1893-2006

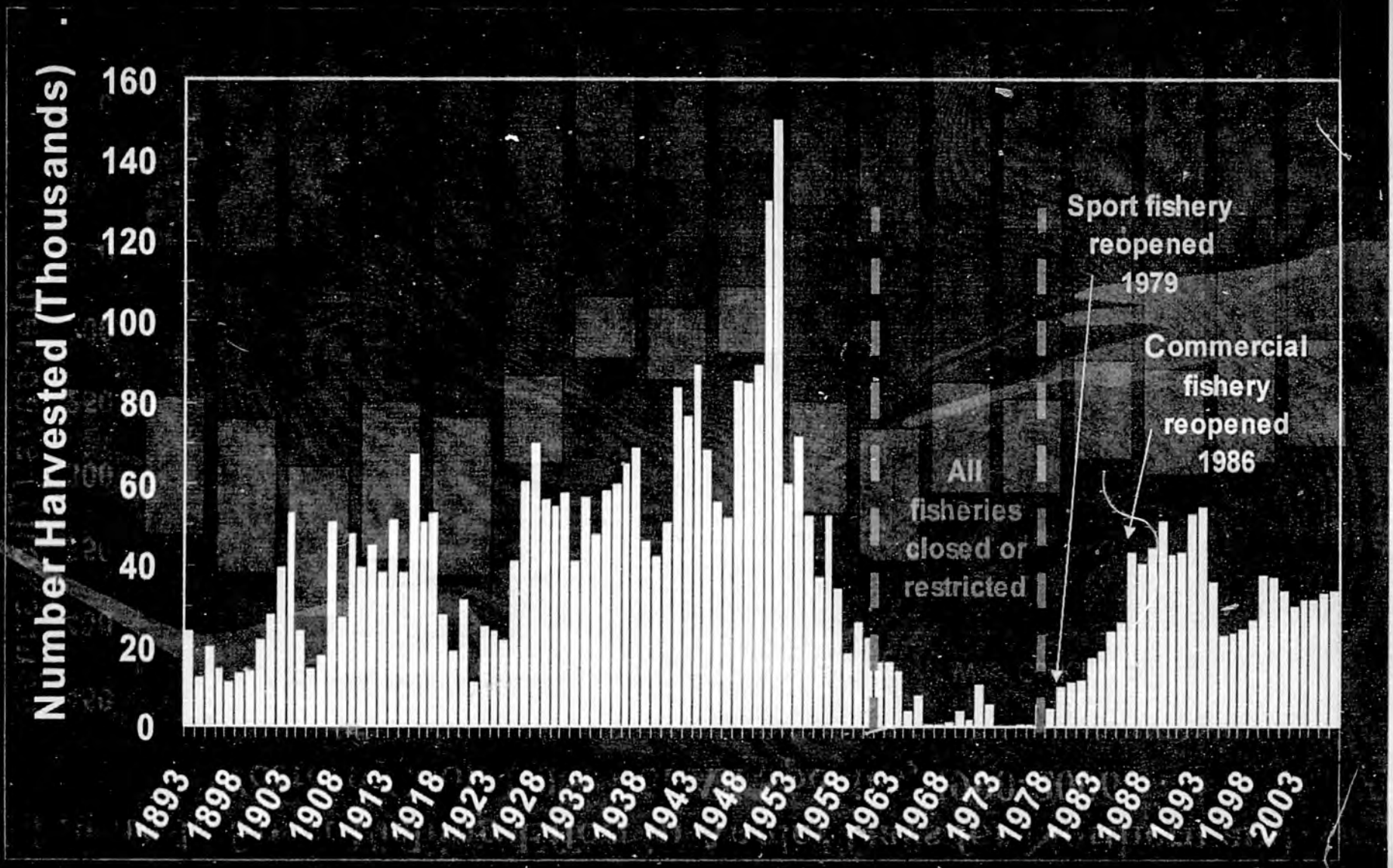
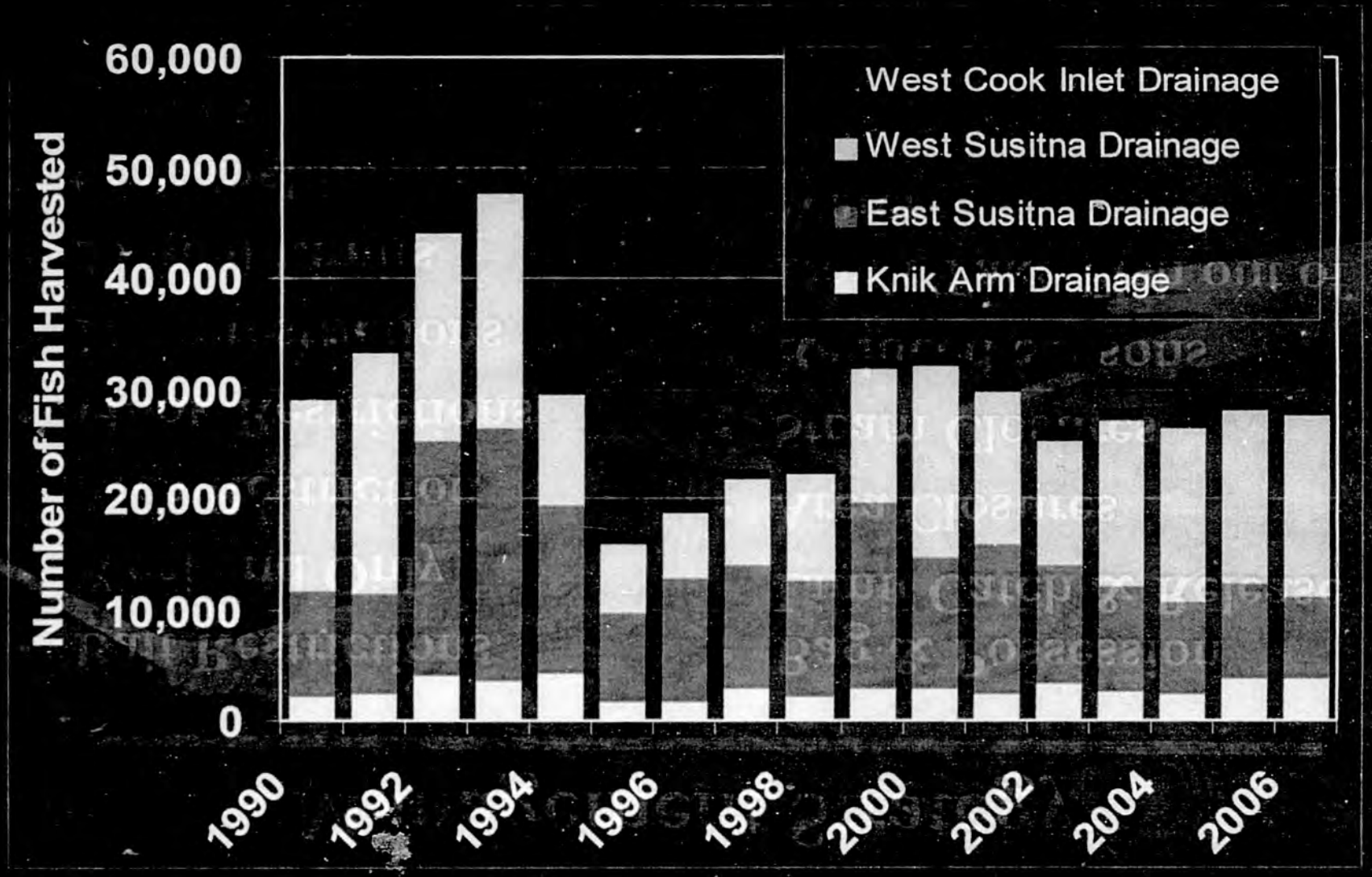


Figure 3. King Salmon Sport Harvest for Northern and Western Cook Inlet, 1990 - 2006



King Salmon Sport Fish Management Strategy

- Bait Restrictions
- Weekend Only
- Area Restriction
- Hook Restrictions
- Hour restrictions
- Annual Limits
- Quit Fishing After Harvest
- Bag & Possession Limit Catch & Release
- Area Closures
- Steam Closures
- Reduced Seasons
- Don't Take Fish out of Water

Historical Average Harvest of Northern Cook Inlet King Salmon By User Group, 1990-2006

King Salmon Sport Fish Management Tools

- Commercial Catch Statistics
- Little Susitna Exit Survey
- Deshka Weir
- Statewide Harvest Survey
- Post Season Escapement Surveys

King Salmon Escapement Index Sites

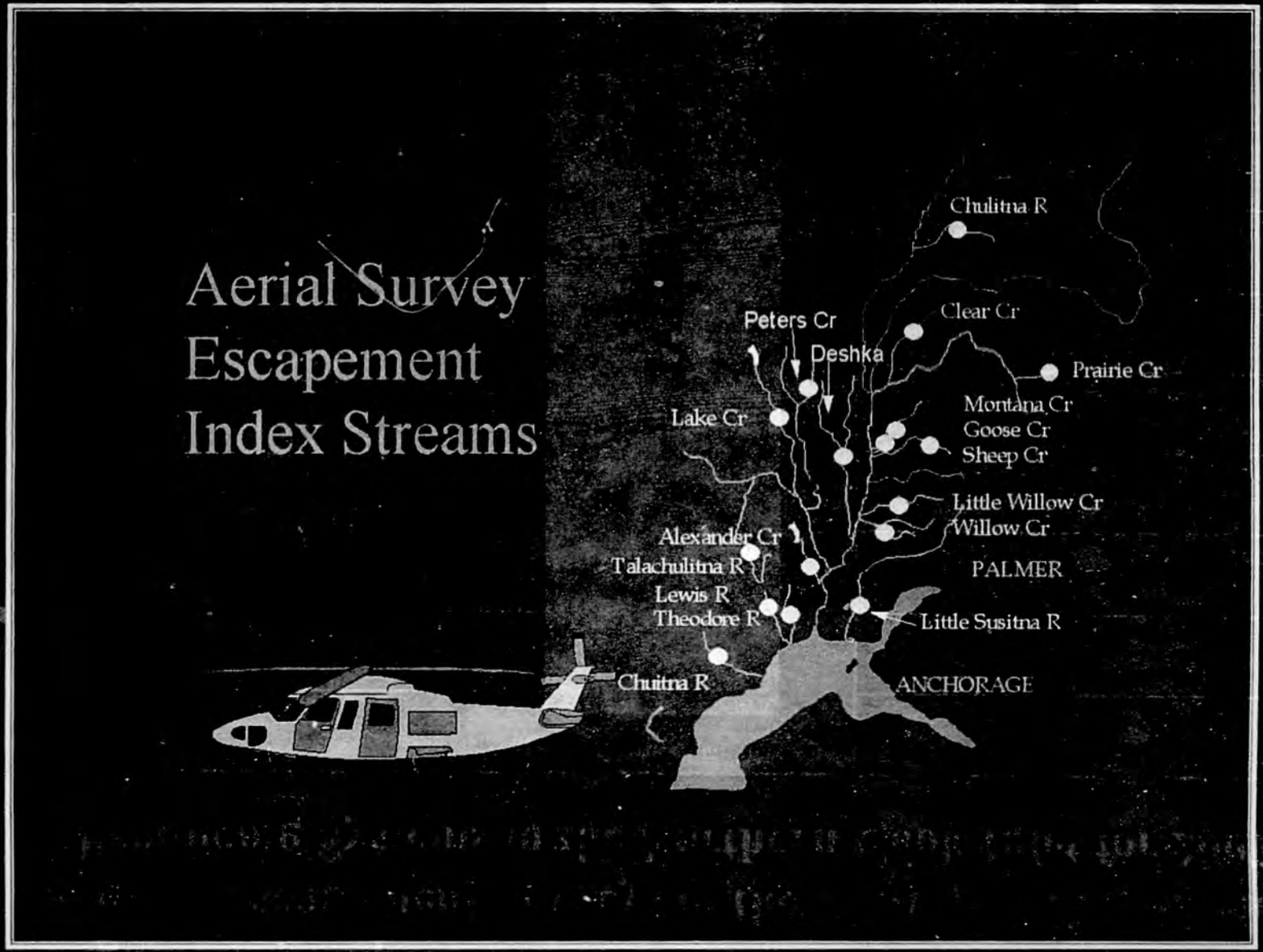
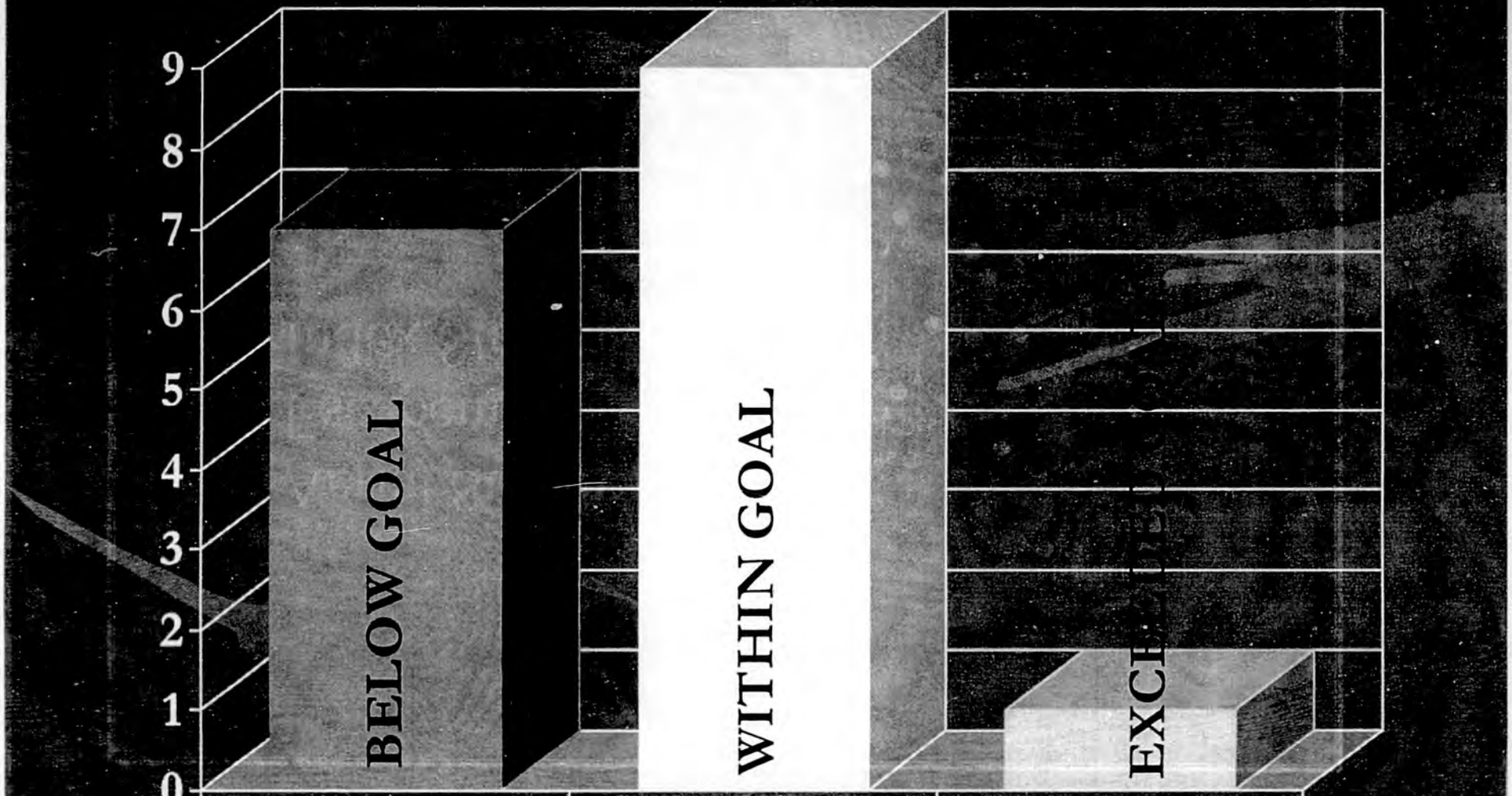


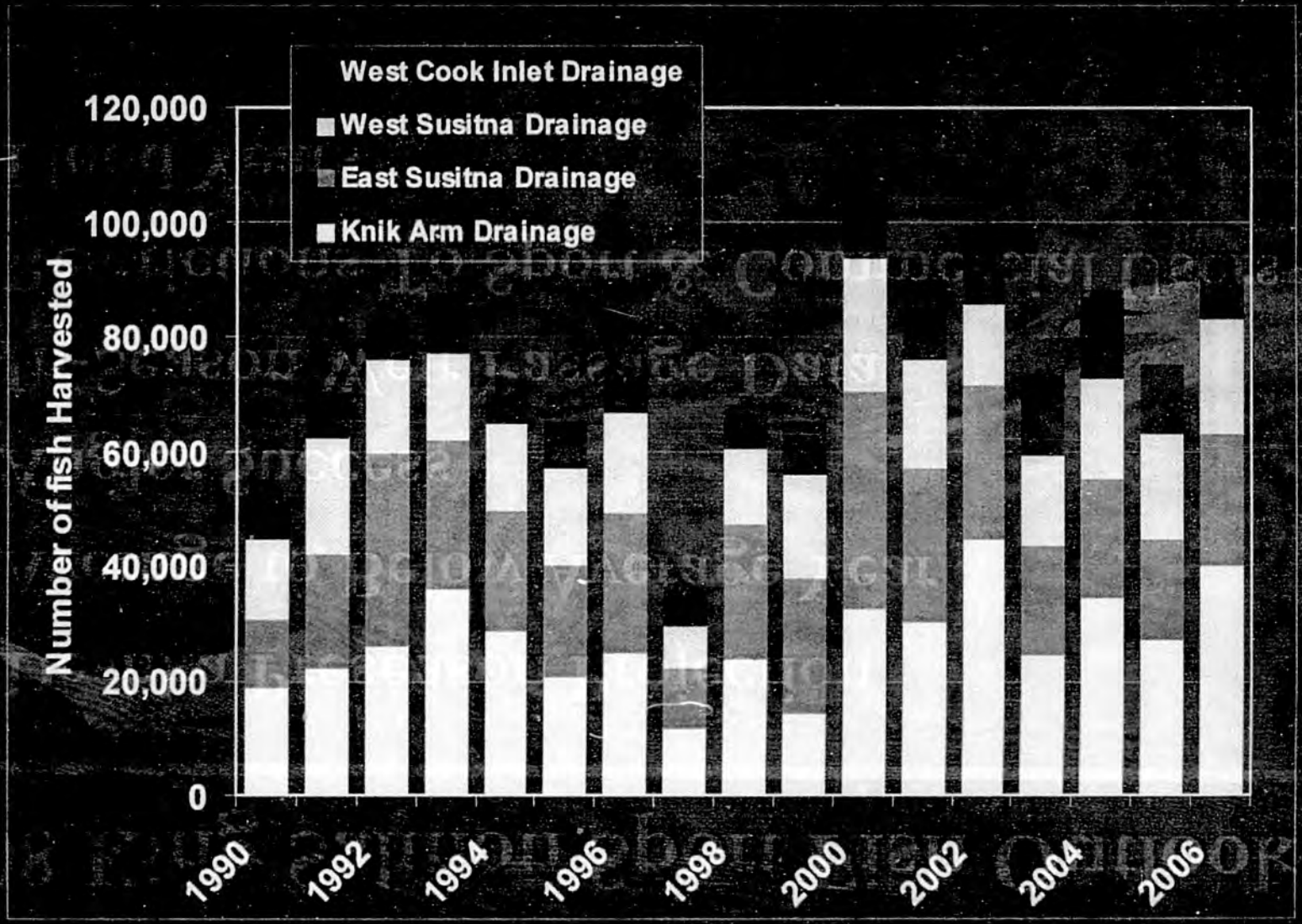
Figure 4. Escapement Goal Achievement Status For King Salmon Escapement Surveys of the 17 Major King Salmon Producing Systems in the Northern Cook Inlet for 2007



08 King Salmon Sport Fish Outlook

- Deshka Preseason Projection
- Averaged to Below Average Year
- Angler Success
- In-Season Weir Passage Data
- Restrictions To Sport & Commercial Users
- Flood Years

Figure 5. Coho Salmon Sport Harvest for Northern and Western Cook Inlet,1990 - 2006



Coho Salmon Sport Fish Management Strategy

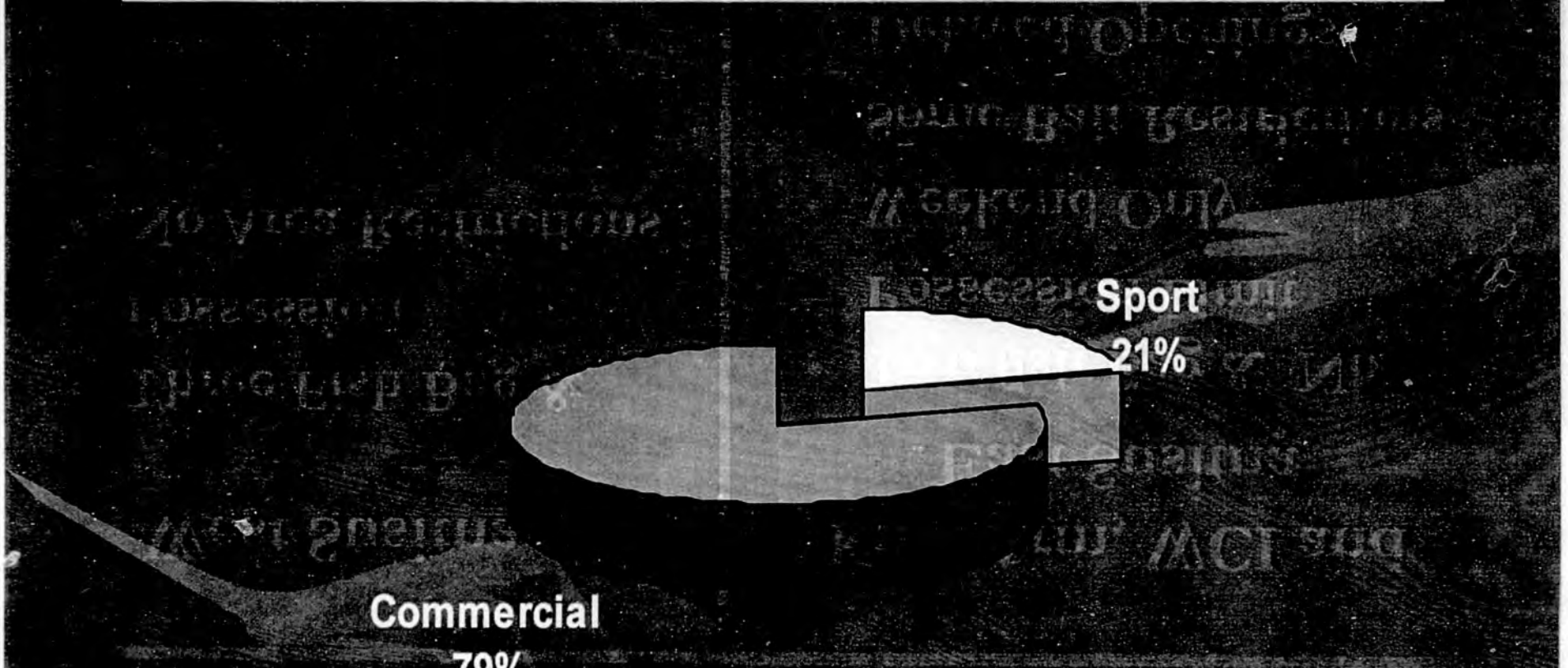
West Susitna

- Three Fish Bag & Possession
- No Area Restrictions

Knik Arm, WCI and East Susitna

- Two fish Bag & No Possession Limit
- Weekend Only
- Some Bait Restrictions
- Delayed Openings
- Area Closures
- Quit Fishing After Limit

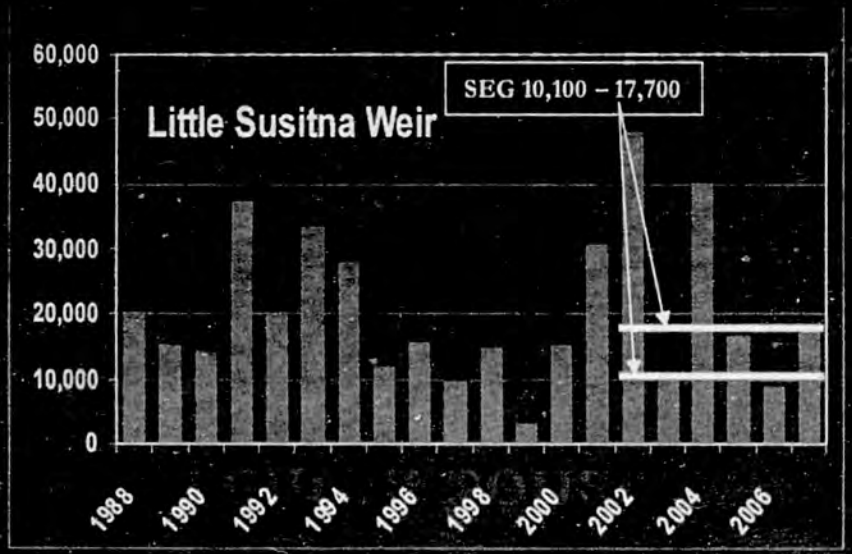
Historical Average Harvest of Northern Cook Inlet Coho Salmon By User Group, 1990-2006

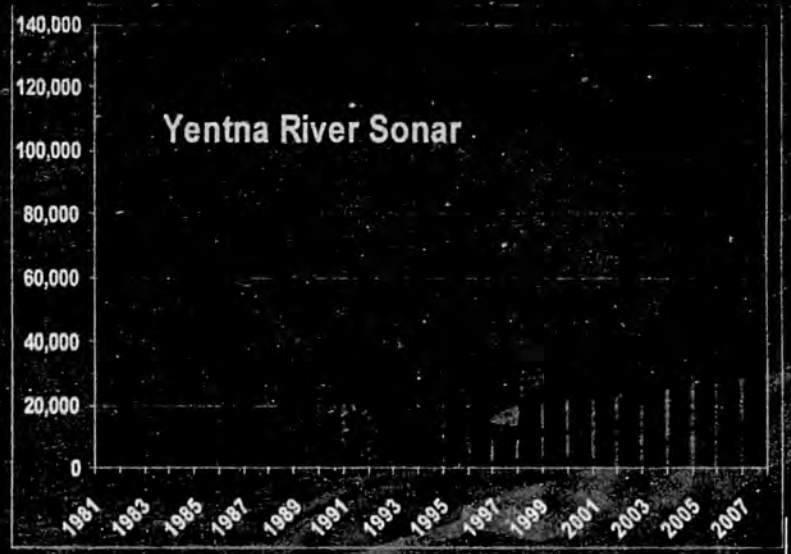


Coho Salmon Sport Fish Management Tools

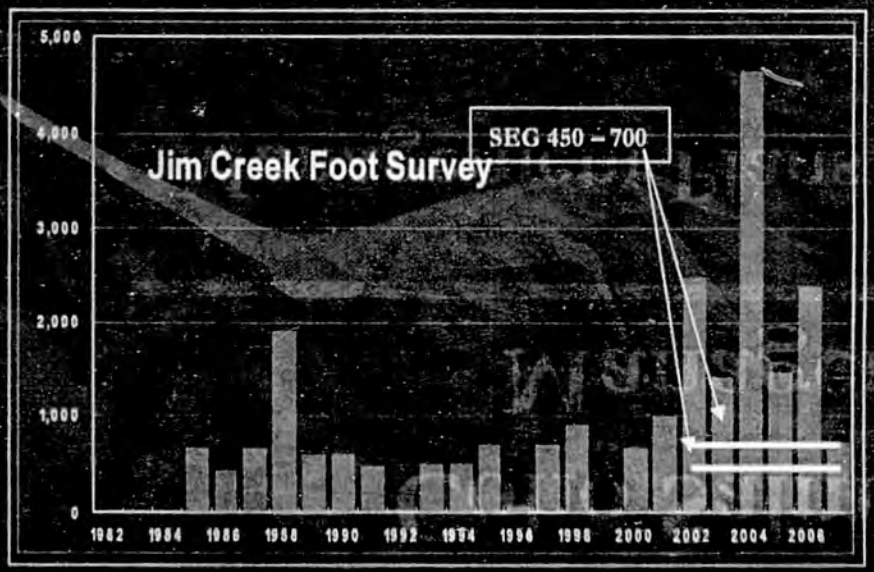
- Management Plans
- Commercial Catch
- Little Susitna and Deshka River Weirs and Yentna Sonar
-
-
- Statewide Harvest Survey
- Post Season Foot Surveys

Figure 6. Coho Salmon Escapement Counts Into N&WCI Streams

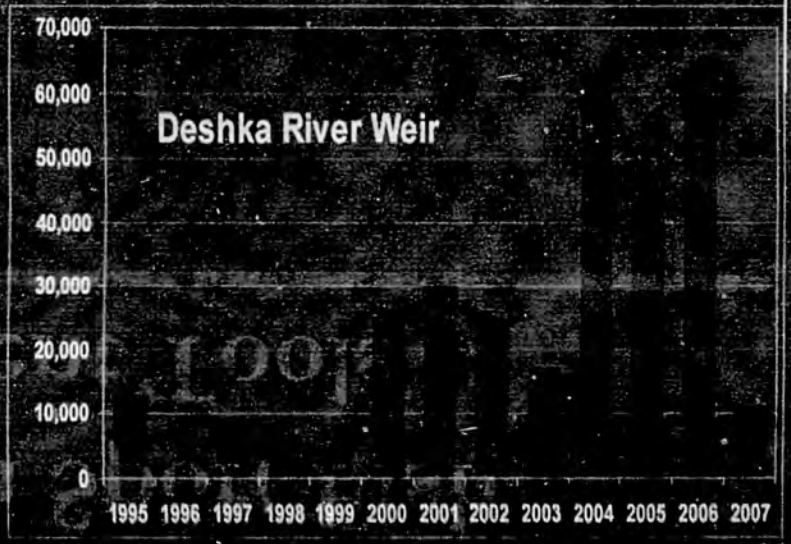




Knik Arm



Susitna River



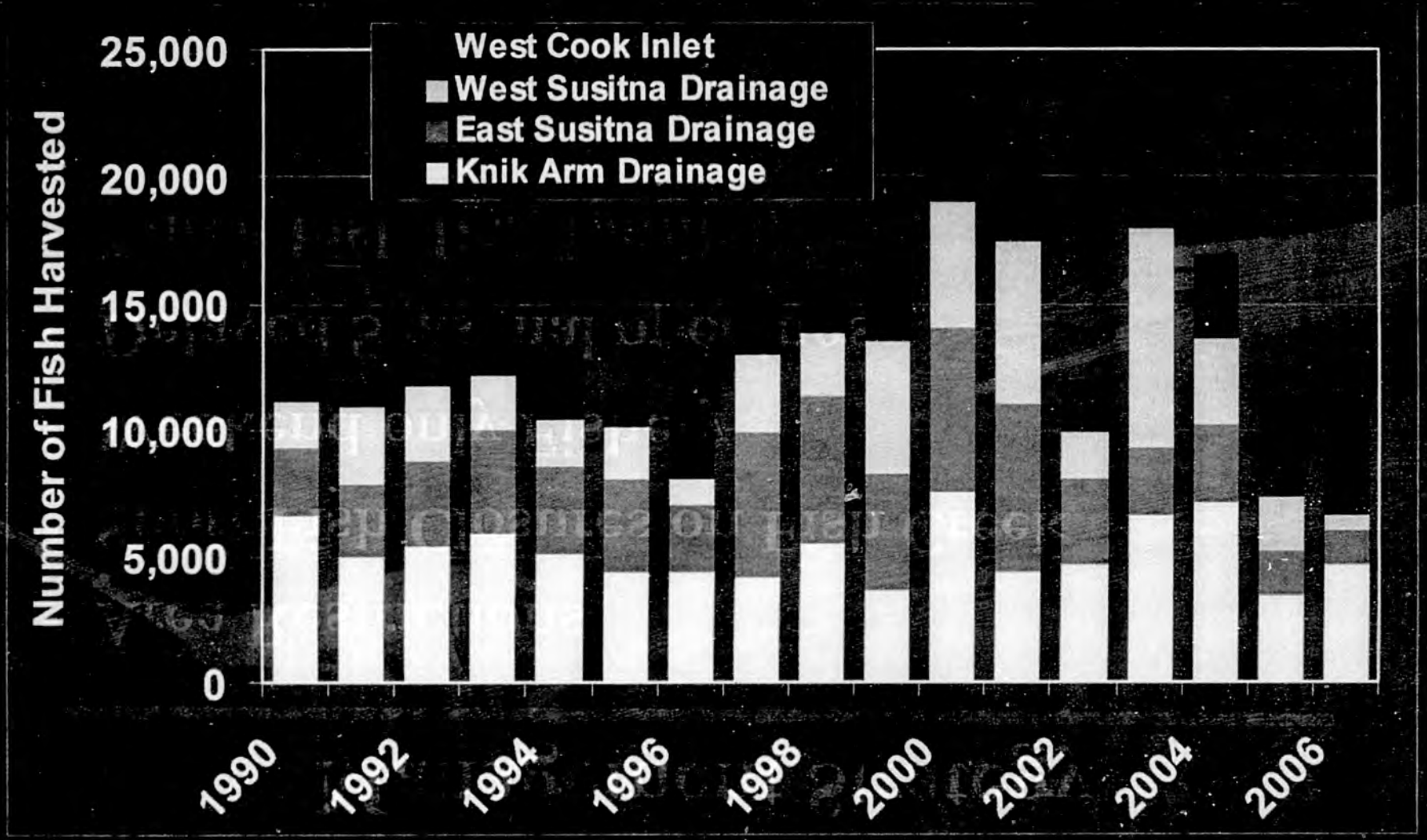
Coho Salmon Foot Survey Index Areas

Stream Walk Escapement Index Systems For Coho Salmon

08 Coho Salmon Sport Fish Outlook

- 2008 return is progeny of the 2004 an 2005 brood year which were both strong returns
- 2006 Flood may impact this years return
- 08 Possible Management Actions

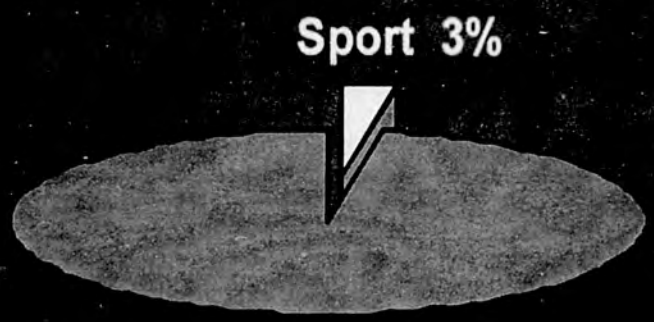
Figure 7. Sockeye Salmon Sport Harvest for Northern and Western Cook Inlet, 1990 - 2006



Sockeye Salmon Sport Fish Management Strategy

- Area Restrictions
- Sport Fish Closures on Fish Creek
- Weekend only Fishery
- Delayed Seasonal openings
- Three Fish Bag Limit

Historical Average Harvest of Northern Cook Inlet Sockeye Salmon By User Group , 1990 - 2006



Sockeye Salmon Sport Fish Management Tools

- Numerous Management Plans
- Commercial Catch & Offshore Test Fish Data
- Angler Reports
-
-
- Fish Creek Weir
- CIAA Susitna Drainage Weirs
- Mark Recapture Project
-
- Stream Walks
- Statewide Harvest Survey

Figure 8. Escapement of Sockeye Salmon Into Fish Creek, 1968-2007

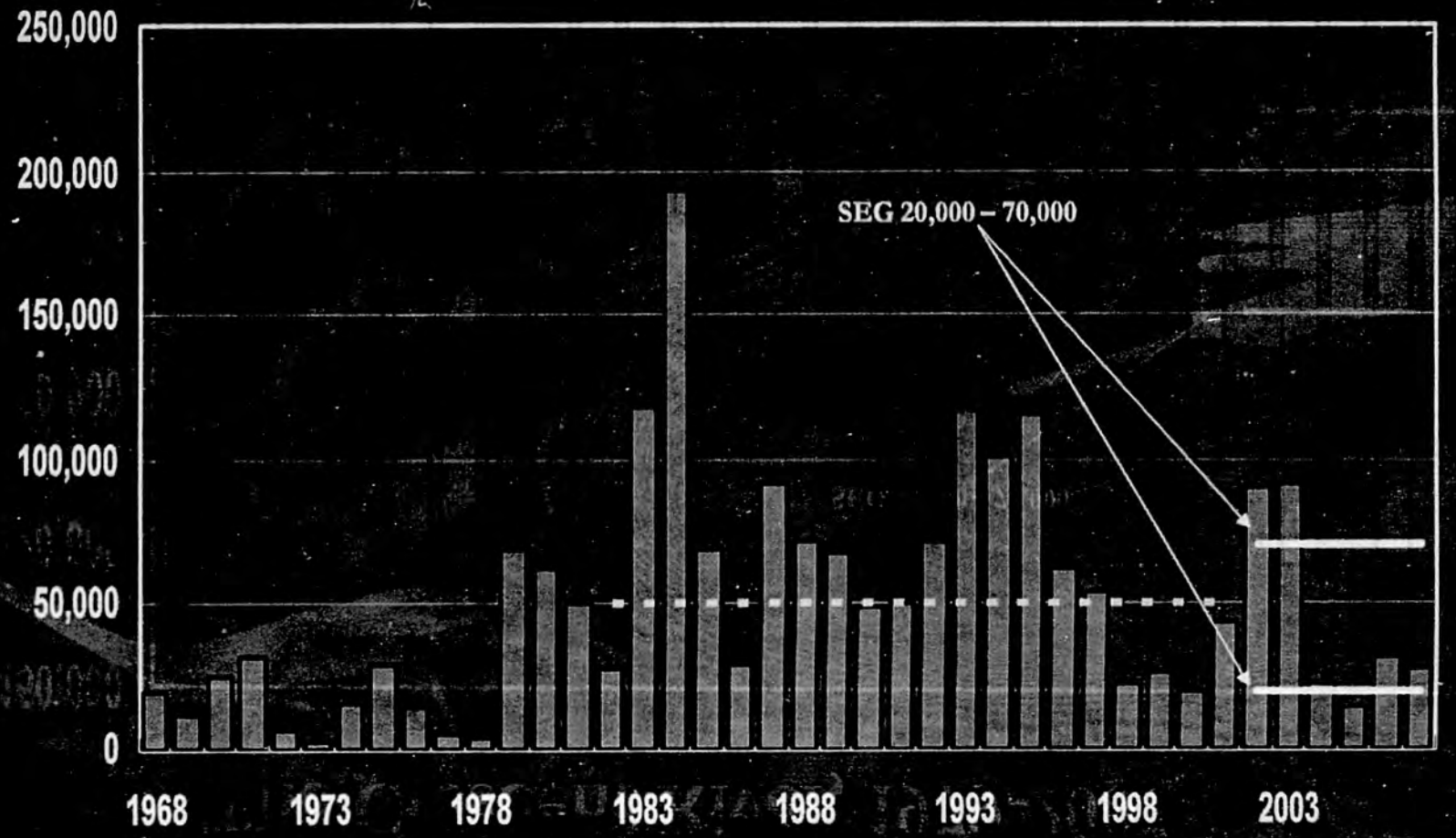


Figure 9. Escapement of Sockeye Salmon Into The Crescent River, 1979-2007

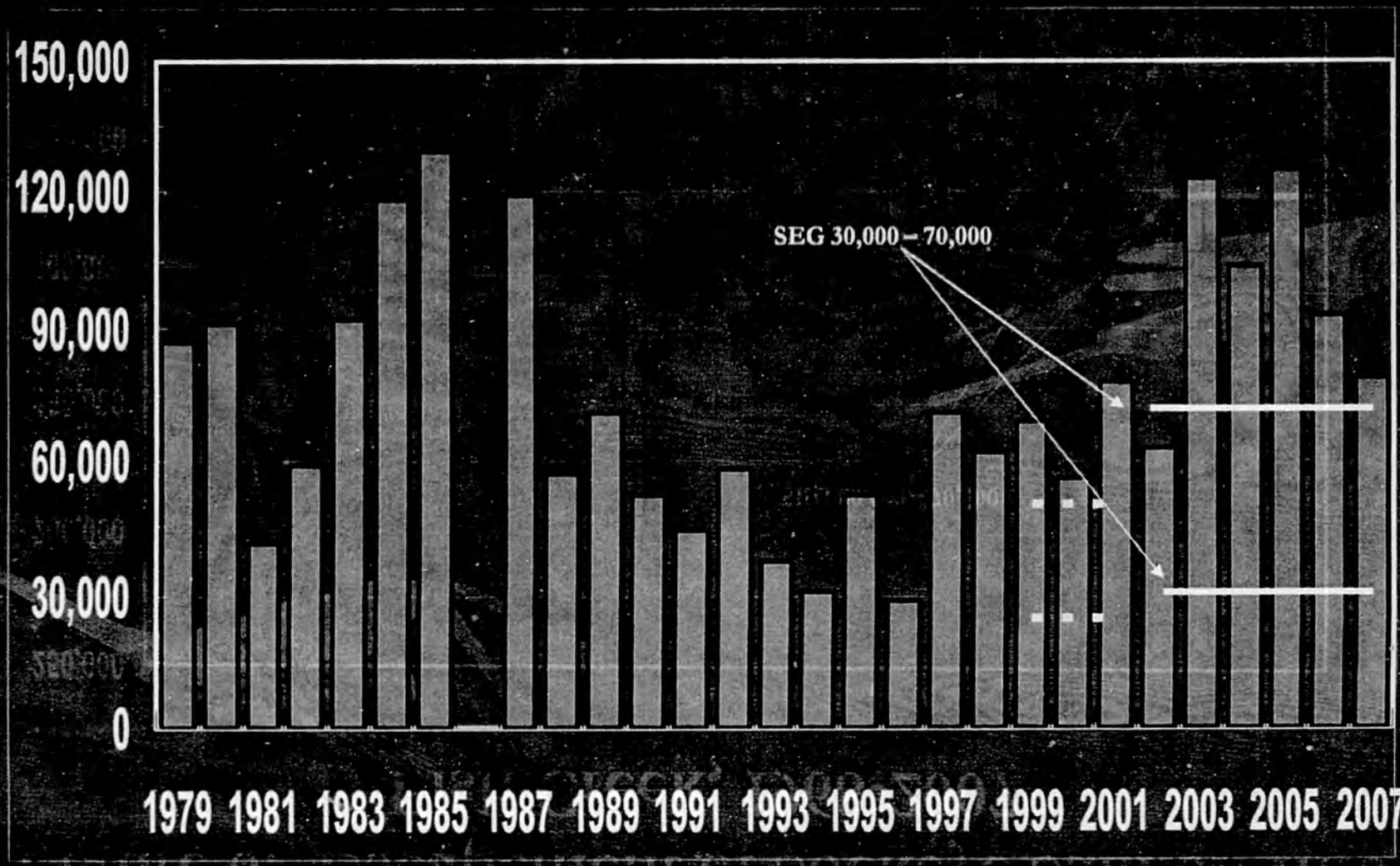
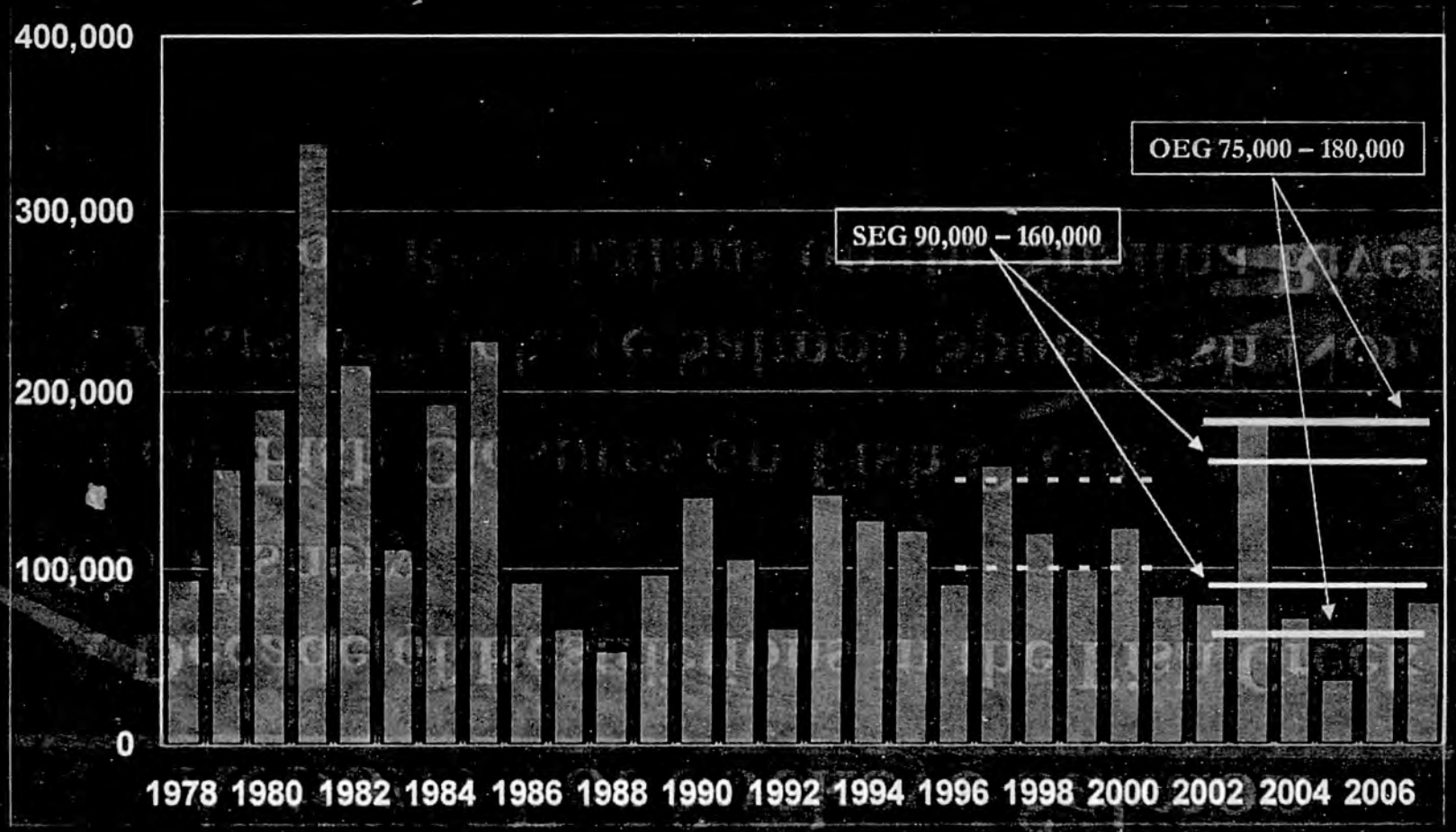


Figure 10. Escapement of Sockeye Salmon Into The Yentna River, 1978-2007



Recent Sport and Personal Use Actions For Sockeye Salmon

- A Decade of Restrictions in the Fish Creek PU Fishery
- Sport Fish Closures on Fish Creek
- 3 Years of Sockeye Salmon Sport Fish Non Retention Restrictions on the Susitna River

08 Sport Fish Sockeye Salmon Outlook

- Forecast
- Recent Performance
- Commercial Restrictions
- Sport Restrictions (Bendix Sonar)

Figure 11. Pink Salmon Sport Harvest for Northern and Western Cook Inlet, 1977- 2006

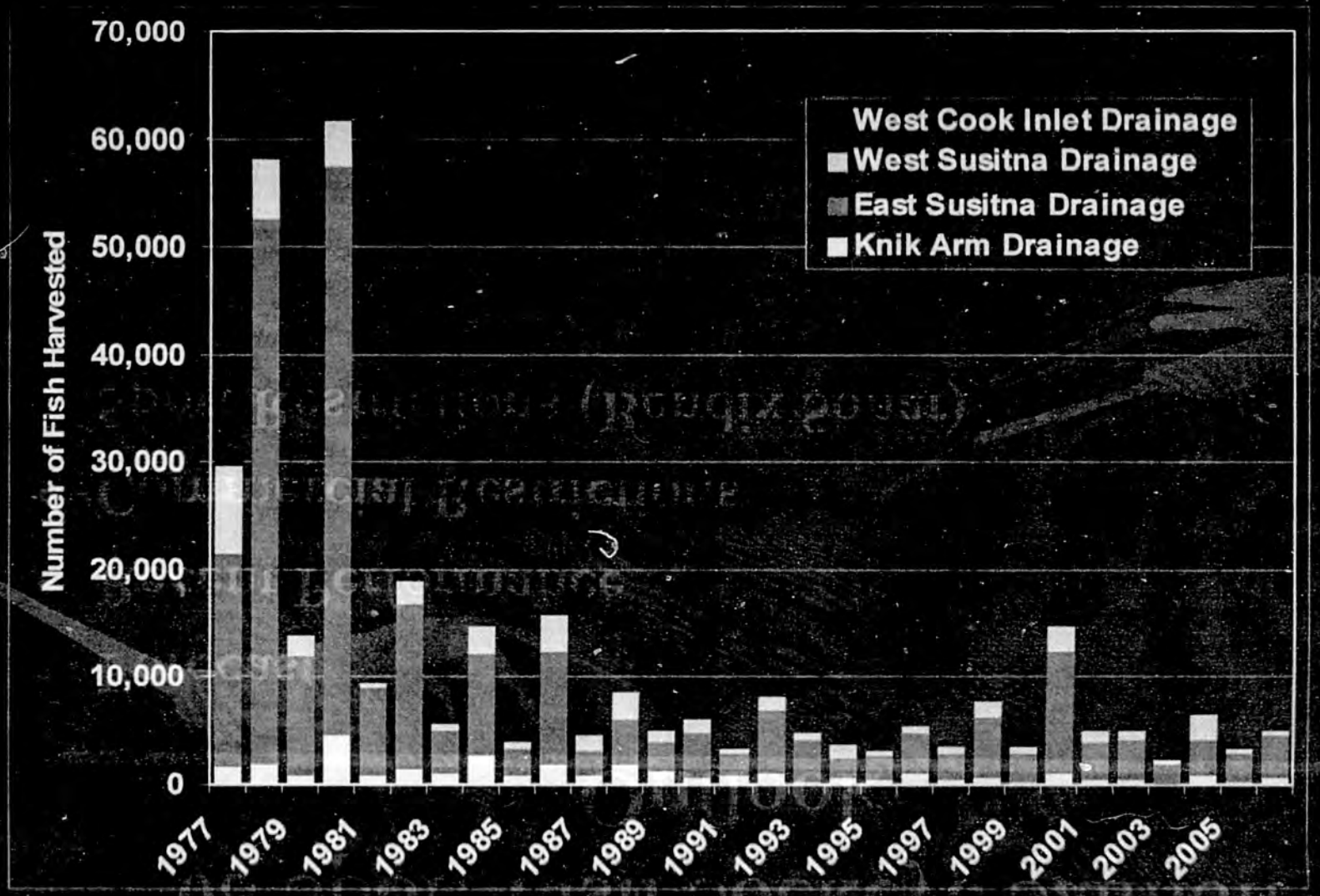
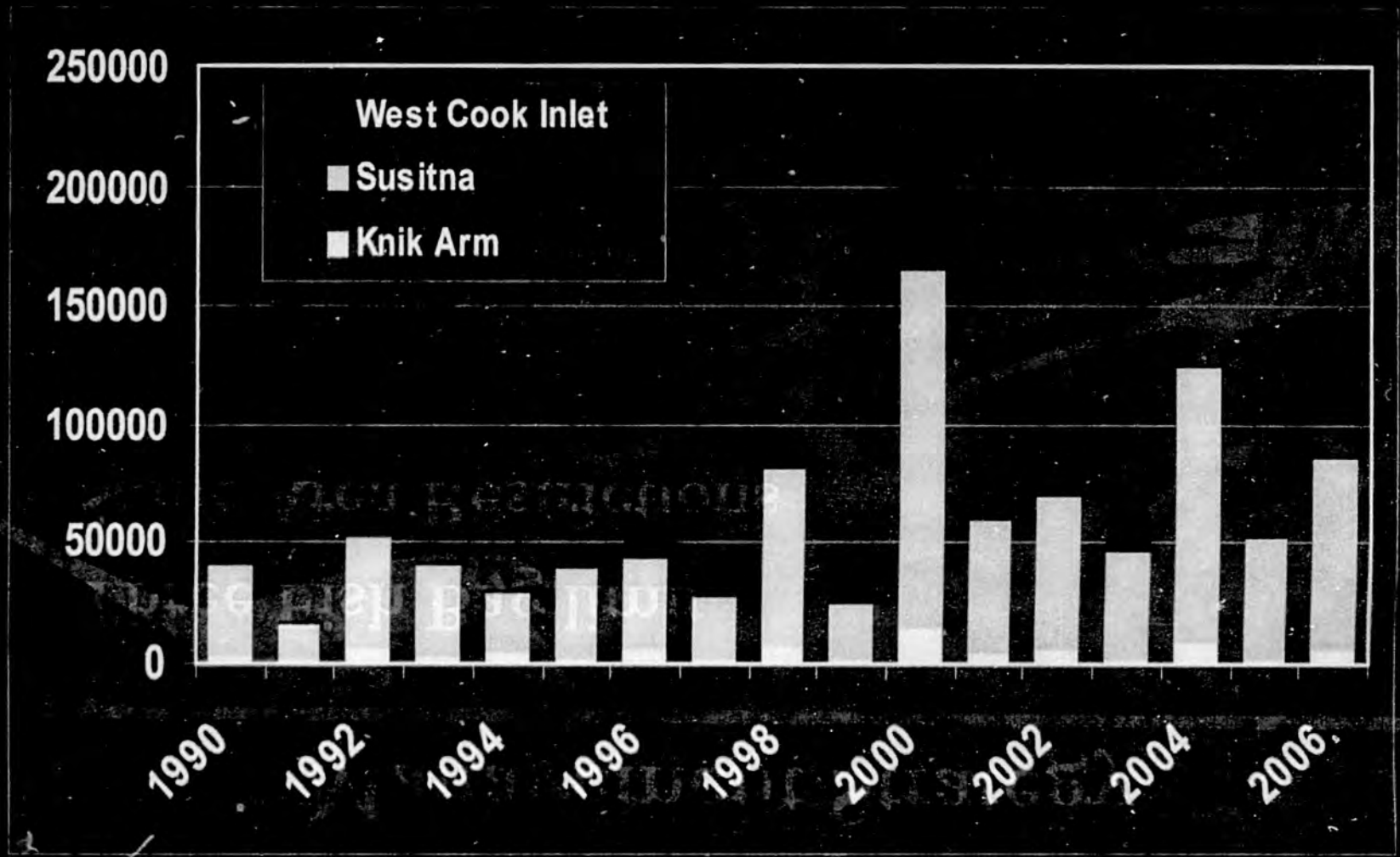
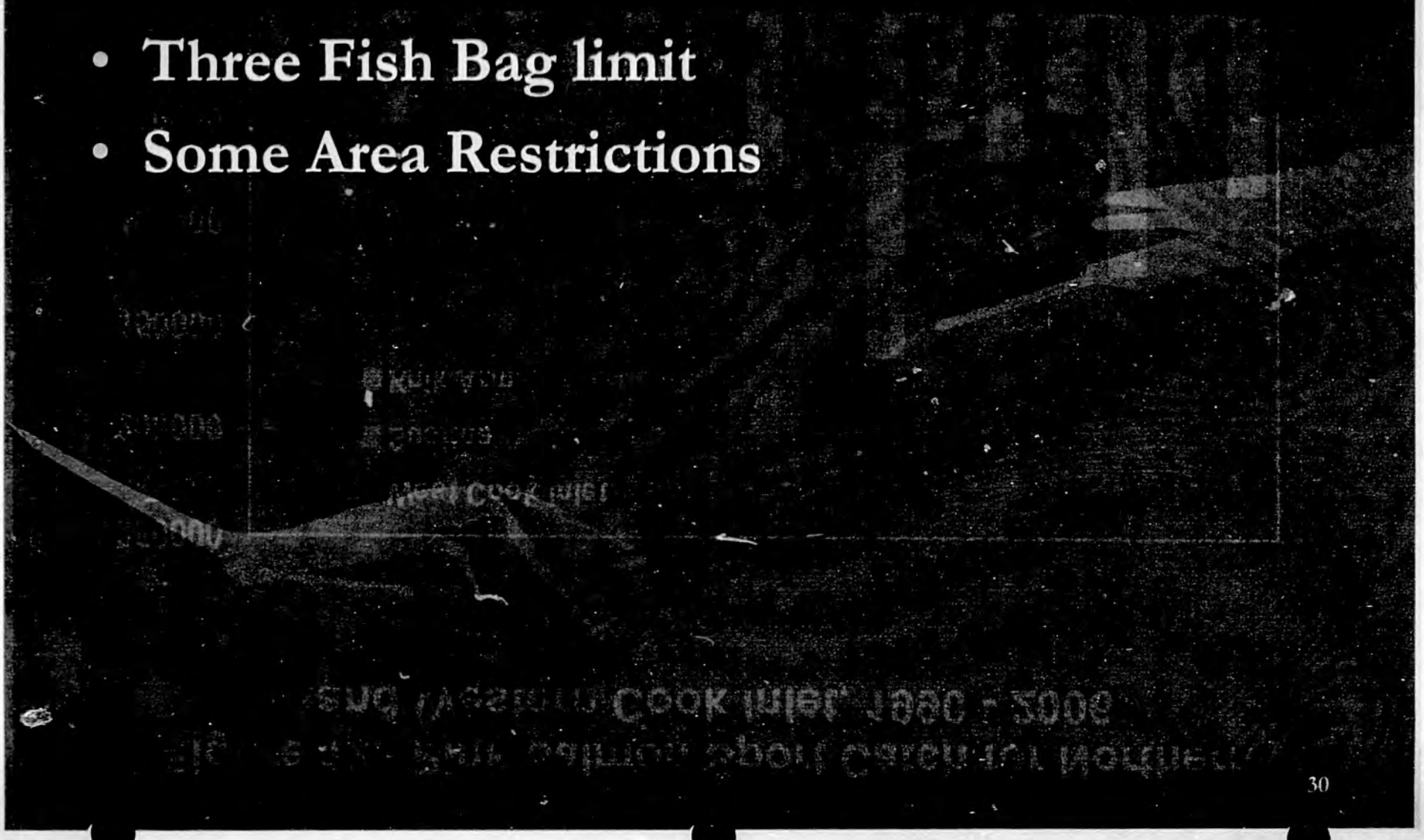


Figure 12. Pink Salmon Sport Catch for Northern and Western Cook Inlet, 1990 - 2006

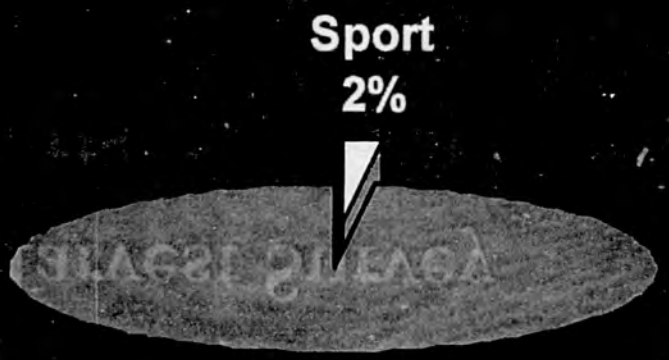


Pink Salmon Sport Fish Management Strategy

- Three Fish Bag limit
- Some Area Restrictions



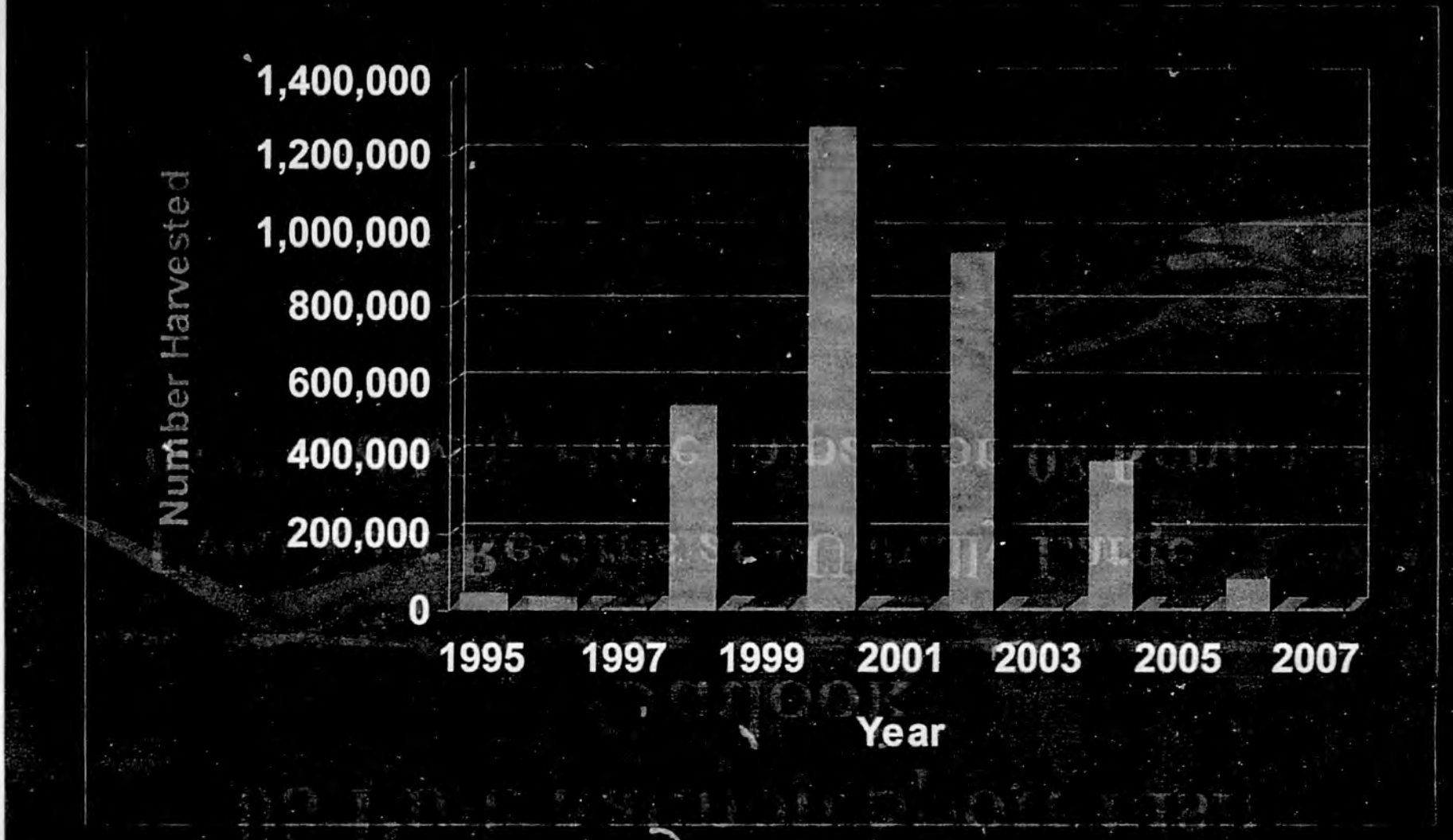
Historical Average Harvest of Northern Cook Inlet Pink Salmon By User Group, 1990 - 2006



Sport Fish Pink Salmon Management Tools

- Commercial Catch Information
- Statewide Harvest Survey
- Angler Reports
- Deshka Weir

Figure 13. Pink Salmon Escapement Into the Deshka River, 1995 - 2007



08 Pink Salmon Sport Fish Outlook

- Even Year Returns are Usually Large
- 06 Flood May Have Impact on 08 Return

Figure 14. Chum Salmon Sport Harvest for Northern and Western Cook Inlet, 1977- 2006

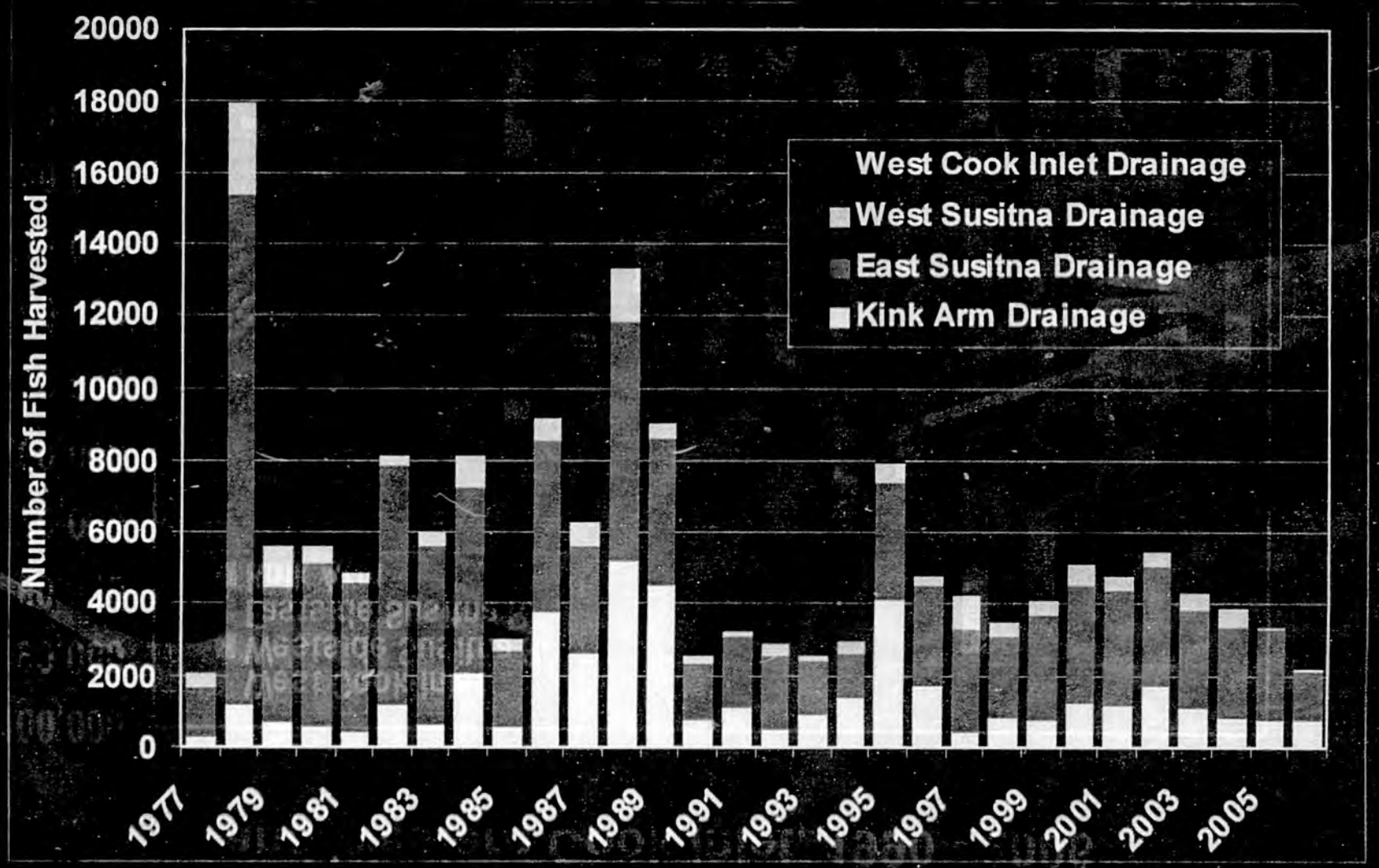
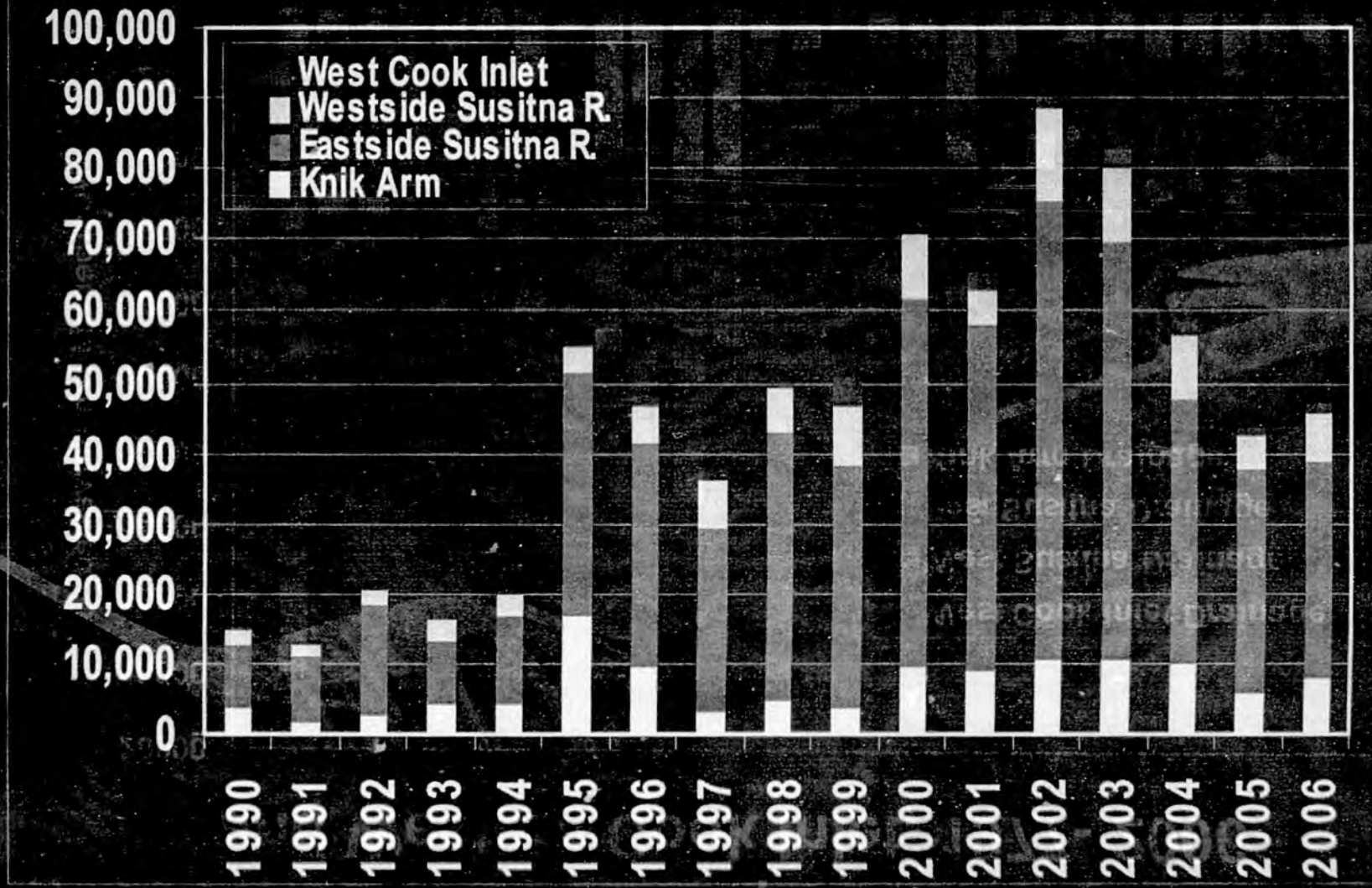


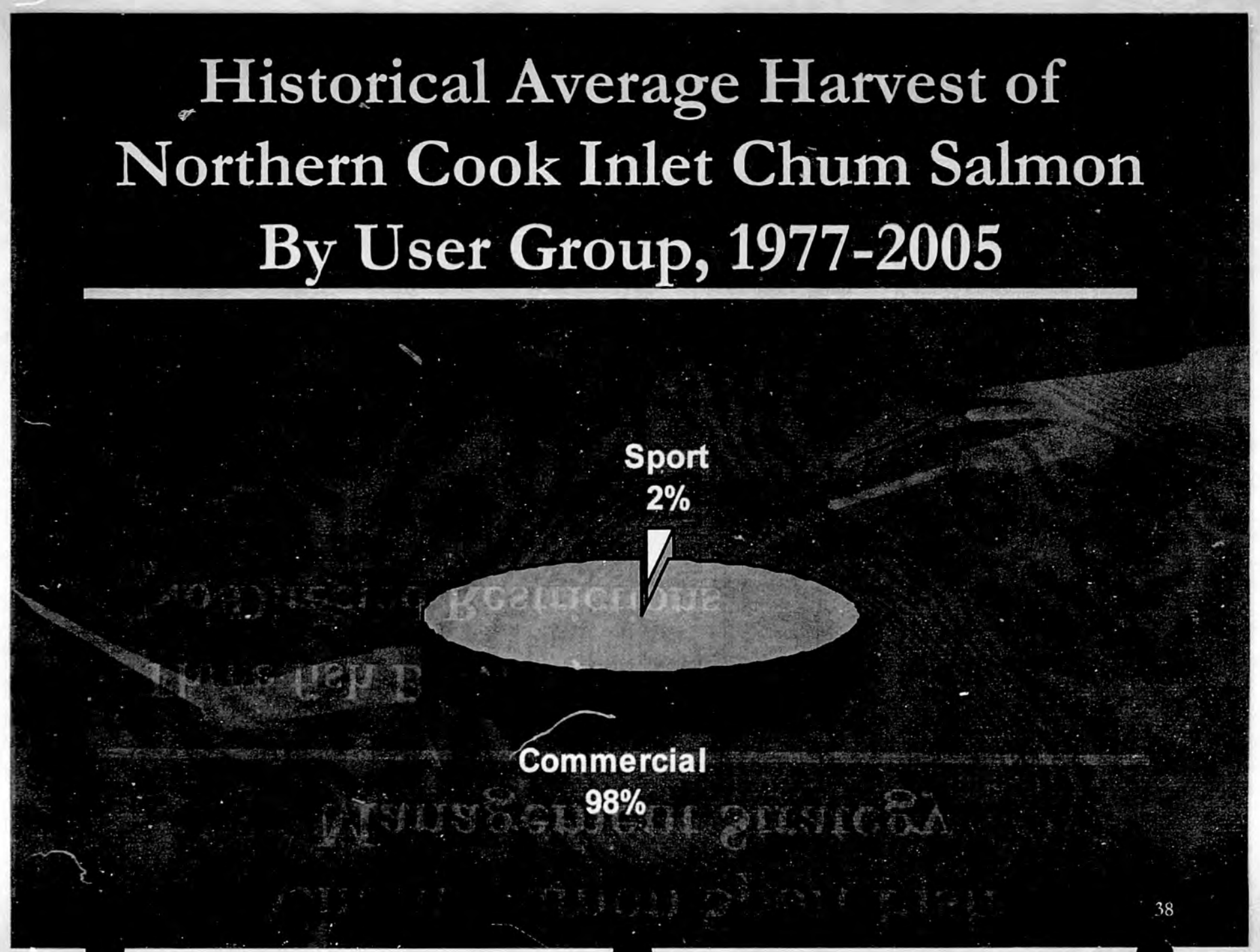
Figure 15. Chum Salmon Sport Catch for Northern and Western Cook Inlet, 1990 - 2006



Chum Salmon Sport Fish Management Strategy

- Three fish Bag limit
- No Directed Restrictions

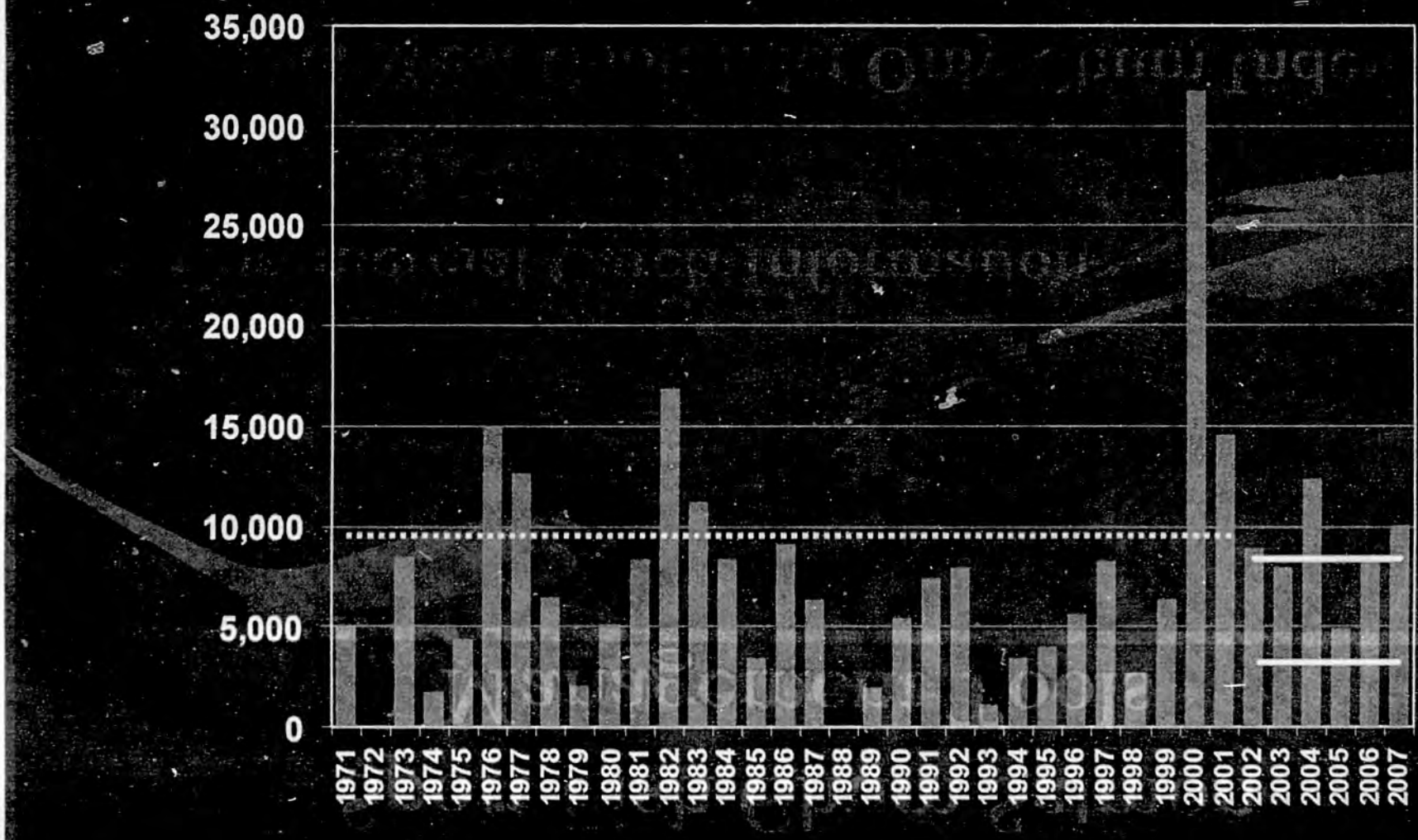
Historical Average Harvest of Northern Cook Inlet Chum Salmon By User Group, 1977-2005



Sport Fish Chum Salmon Management Tools

- Management Plans
- Commercial Catch Information
- Angler Reports
- Lower West Cook Inlet Only Chum Index Area

Figure 14. Chum Salmon Escapement (Single Aerial Survey) Into Clearwater Creek in Lower Cook Inlet (Chinitna Bay) 1971 - 2007

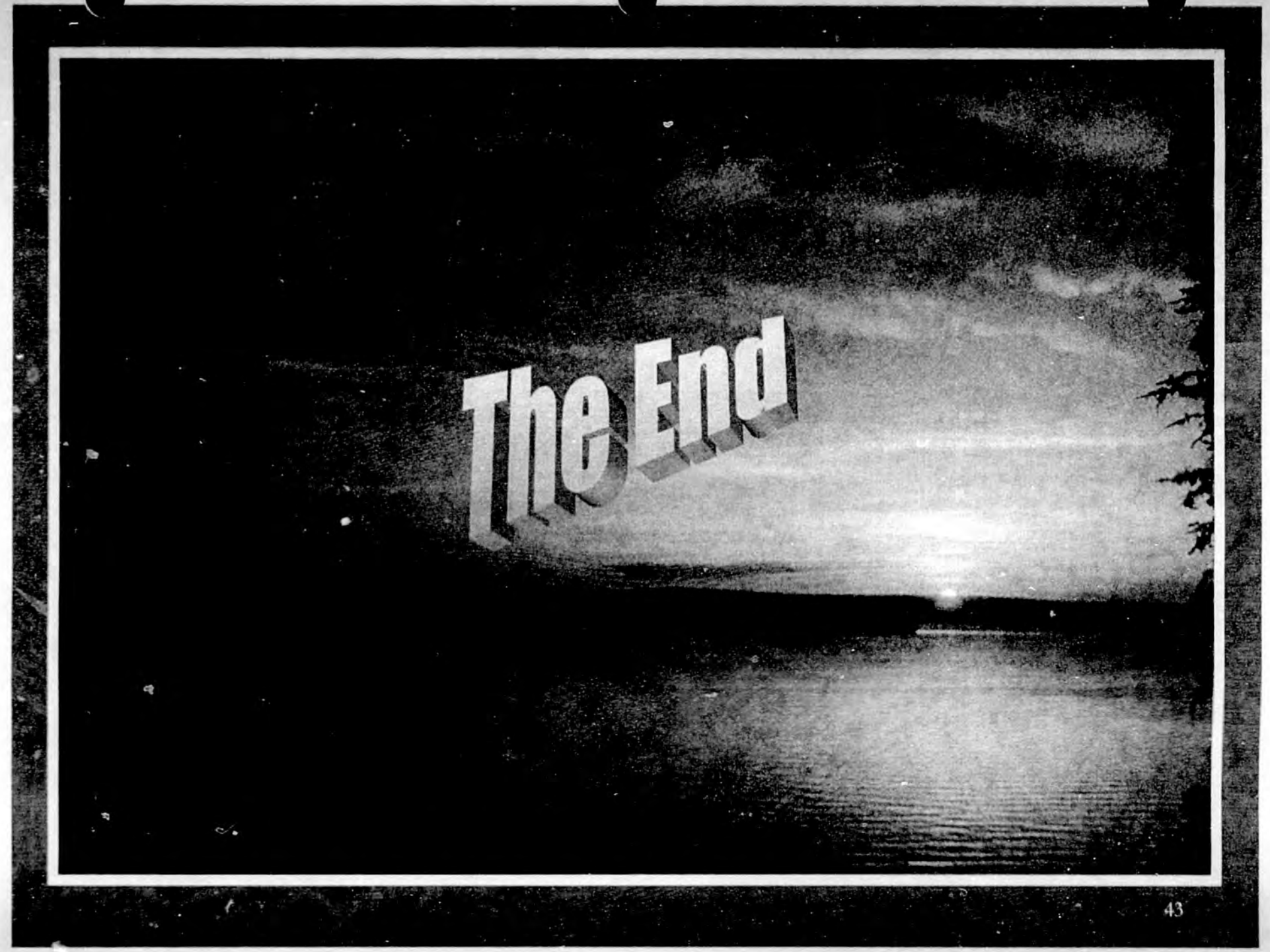


08 Chum Salmon Sport Fish Outlook

- Production Level down from the late 70's to Mid 80's
- No Restriction

Conclusion

- Sport Fishing Effort Has Decreased in the Northern Cook Inlet
- Sport Harvest of Chinook, Sockeye, Chum and Pink salmon have decreased
- Coho Salmon Returns Appear to be Strong
- Chinook Returns Appear to be Below Average
- 06 Flood May Impact Pink and Coho Returns in 08 and King Salmon Production in Future


The End