Presence of Cook Inlet Sockeye Salmon in the Kodiak Management Area Commercial Harvest

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Oral Report: RC 3 Tab 10

Outline

1. Background
2. Historical Studies
    a) Tagging
    b) Stock Composition
    c) Genetic Mixed Stock Analysis, 2014-2016
3. Interpreting Results

Background

Management

- Late 1970s, Board of Fisheries set management plans
- Intent to maintain traditional fishing opportunities and allocations
- Recognized they were mixed stock fisheries
- Directed sockeye fisheries (escapement-based management)
- Pink, chum, coho and sockeye fisheries overlap

Stocks Present

- Tagging and harvest sampling form basis of knowledge
- Most recent information comes from genetic analyses

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Historical Studies

Tagging

Requires

1. Tagged fish represent “unit of interest”
2. Recovering fish on spawning grounds

Useful for:

1. Documenting presence
2. Understanding migration routes and timing
3. Estimating travel time, swimming speed

Not useful for stock composition unless conditions are met:

1. Representative capture [equal vulnerability/selectivity]
2. Comprehensive recovery [If you don't look you won't find it]
3. Documented recovery [How many fish examined?]
4. Ability to account for tag loss/mortality/emigration [same loss rate]
5. Composition same at capture and recovery [age structure]

Historical Studies

Tagging

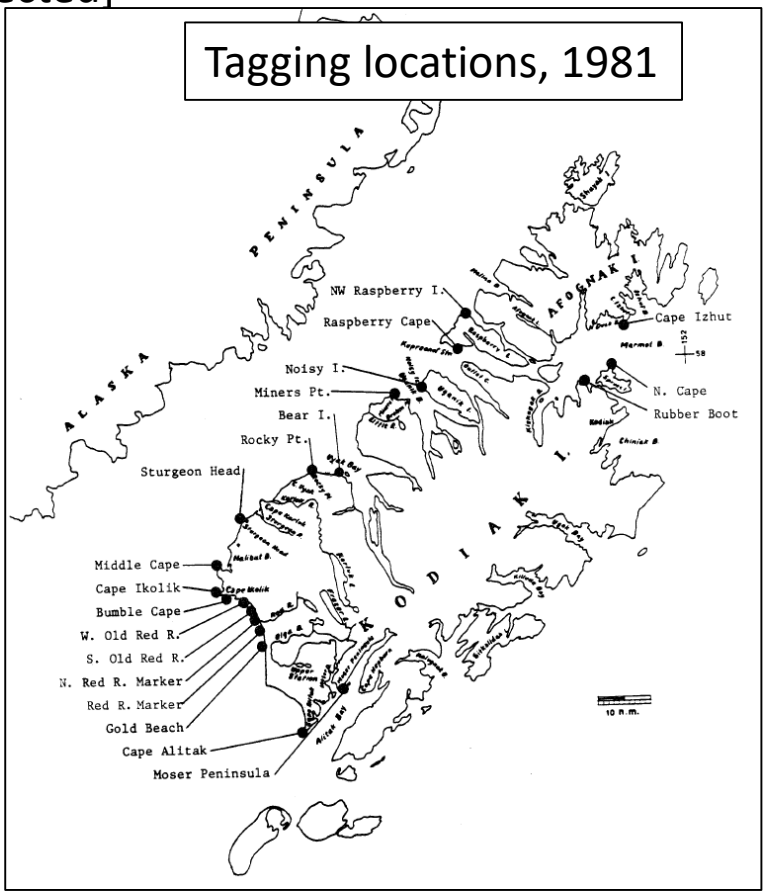
Many sockeye salmon tagging studies near Kodiak

1927/1928 – Rich and Ball 1929
1948/1949 – Bevan 1959
1961 to 1978 [many small studies] – Nicholson 1978
1981 – Tyler et al. 1984 [Comprehensive and directed]

General conclusions

- Most tags applied in Kodiak waters were recovered in Kodiak Archipelago systems

- Nonlocal stocks [Chignik and Cook Inlet] are present in some time/area strata
  - Cook Inlet most present in northern and southern Kodiak waters
  - Cook Inlet most present in July
  - Variable among studies



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Historical Studies

Stock Composition

Requires:

1. Capture/sampling represents "unit of interest"
2. Baseline information for potential contributors

Useful for:

1. Documenting presence
2. Understanding migration routes and timing
3. Estimating travel time, swimming speed
4. **Stock composition of fish “in the water” or in harvest**

Gillnetting in Central Section of the KMA

Historical Studies

Stock Composition

Scale Pattern Analysis - 1984

Objective: Test feasibility of SPA for allocation of Kodiak commercial catches

Scope:

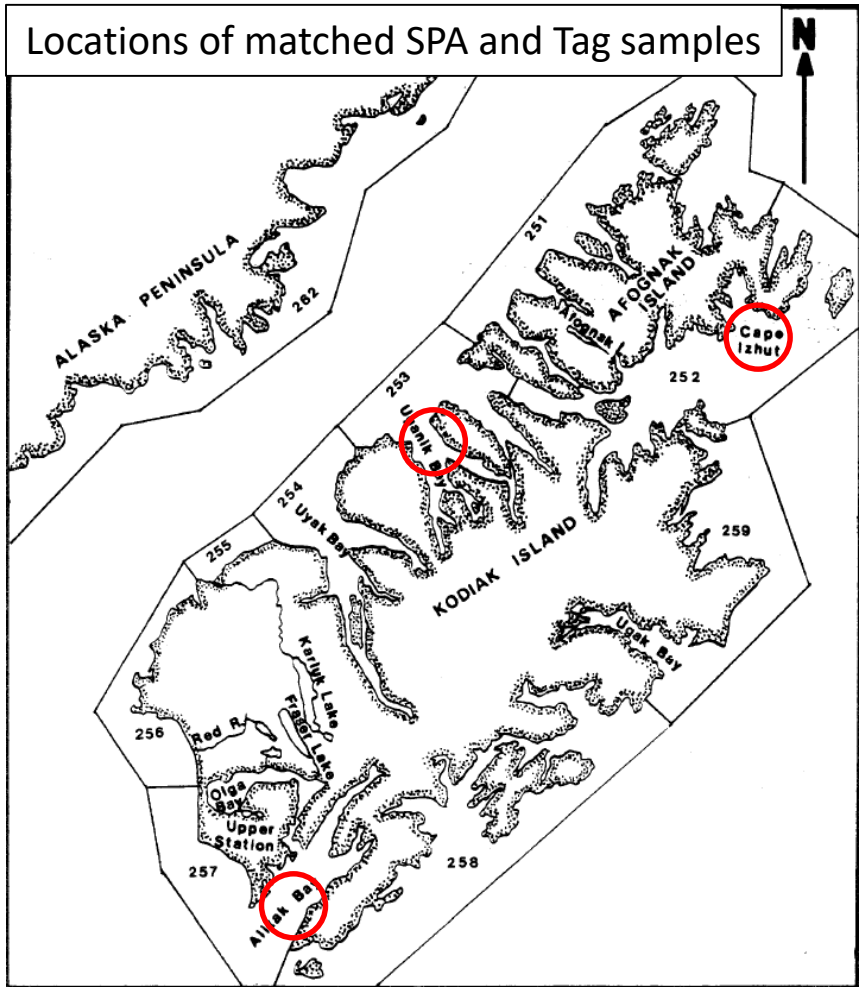
- Commercial fishery samples (1981 tagging)
- Baseline scale samples: Kodiak weirs, Cook Inlet and Chignik

Results:

- Stock composition accuracy ~80%
- SPA detected Cook Inlet only in Uganik early-June

Evaluation:

- SPA could provide usable stock composition
- Uncertainty of estimates is high
- Difficult to build/maintain baseline
- Only Chignik and Cook Inlet in *nonlocal* baseline



Conrad 1984

Historical Studies

Stock Composition

Tags, timing, weight, length, age, scale patterns - 1988 & 1990

Objective: Estimate composition of North Shelikof catch

Review of Tagging, 1927-1981

Scope: Restricted tagging area

- Uganik Bay to Malina Bay (~35 miles)

Results: Cook Inlet fish are present in June North Shelikof fishery

North Shelikof Strait harvest sampling, 1988 & 1990

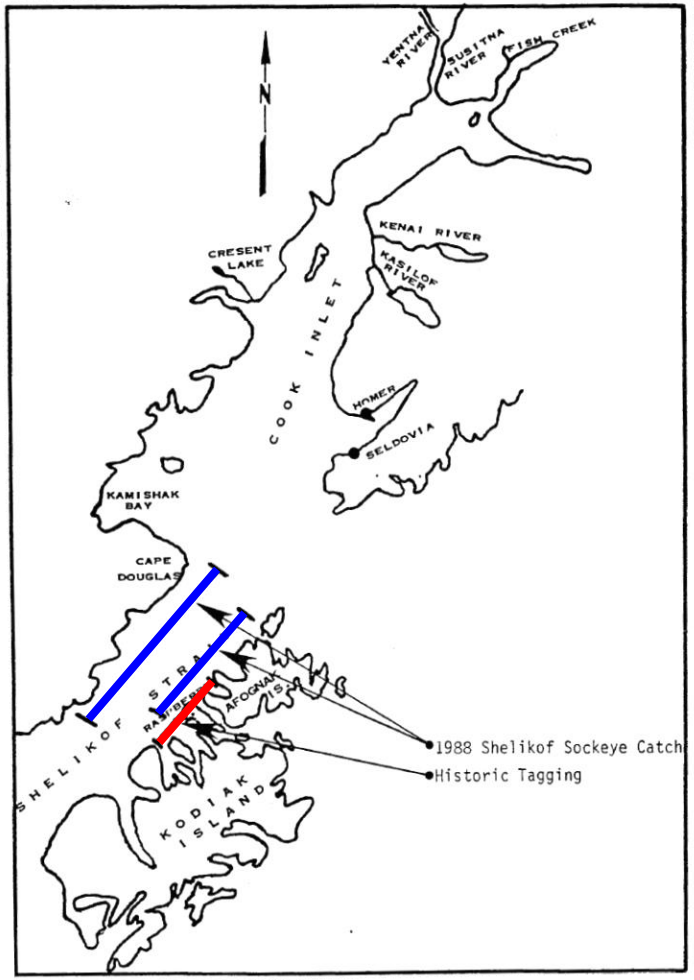
Scope: North Shelikof Strait fishery and Kodiak, Cook Inlet, and Chignik stocks

Results:

Cook Inlet largest part of catch

Differences in time and space

Evaluation: Best available data; used in decisions



Barrett 1989; Barrett and Swanton 1991

Historical Studies

Stock Composition

Weights in July Harvest - 1994

Objective: Provide reasonable estimate of UCI harvest in KMA fisheries

Scope: Kodiak districts [except Igvak and N Shelikof]
July harvest, 1983-1993 (10 years; 1989 not included)
Non-local - Cook Inlet; *Local* – Kodiak

Results: *Non-local* proportions range 29% - 576%

Evaluation:

- Wide coverage across KMA and large number of years
- Low cost use of available data
- High variability across space and time
- Method produces some unreasonable estimates
- Assumes:
  1. *Non-local* is only Cook Inlet
  2. June & August average weights approximate July average weights
  3. Fish ticket information is accurate
  4. Avg. weight in UCI harvest same as in UCI run & UCI catch in KMA

Vining and Barrett 1994

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Historical Studies

Stock Composition

Genetic Stock Identification – 2014-2016

Objective: Provide information for run reconstructions, brood tables for primary KMA sockeye stocks and refine management of KMA fisheries

Scope:

Results:

Evaluation:

Purse seining in Kodiak, 1960s

Shedd et al. 2016 and 2017

Genetic Mixed Stock Analysis, 2014-2016
Study Design/Scope

- Focused on 4 primary sockeye stocks in KMA
  Karluk River, Ayakulik River, South Olga Lakes (Upper Station), and Dog Salmon River

- Sampled at 3 ports in the Kodiak Area
  Kodiak, Larsen Bay, Alitak

- Collected 3-5x the sample goal to allow subsampling post-season

- Analyzed 380 samples per stratum
  6 areas, 3 temporal strata

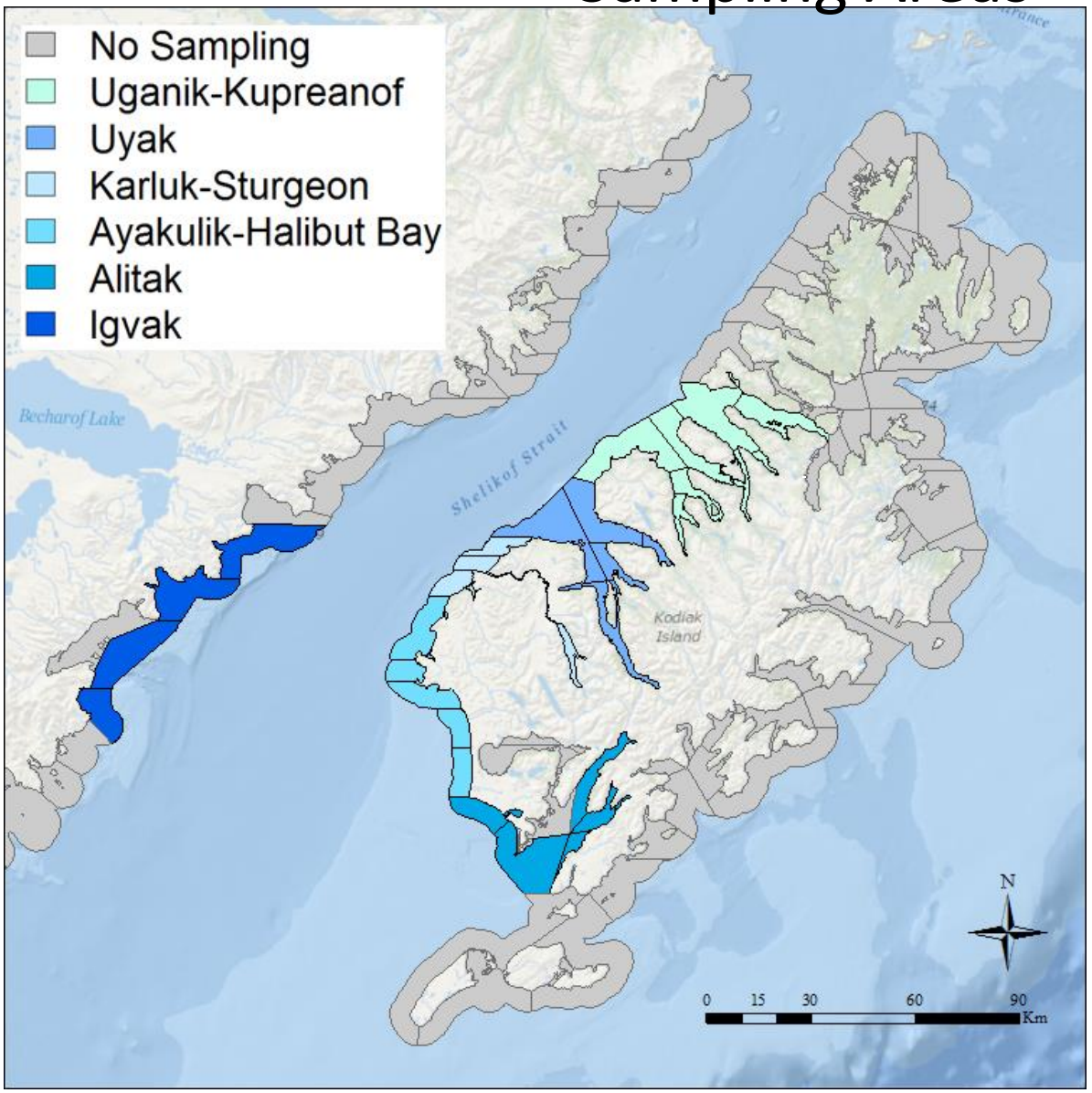
- Temporal strata
  Early: June (early-run sockeye)
  Middle: July (sockeye, pink, chum)
  Late: Aug (late-run sockeye, pink, chum, coho)

- One sample allows testing of assumptions
  – all harvest was Karluk and Upper Station

Sampler collecting fin clips in Alitak

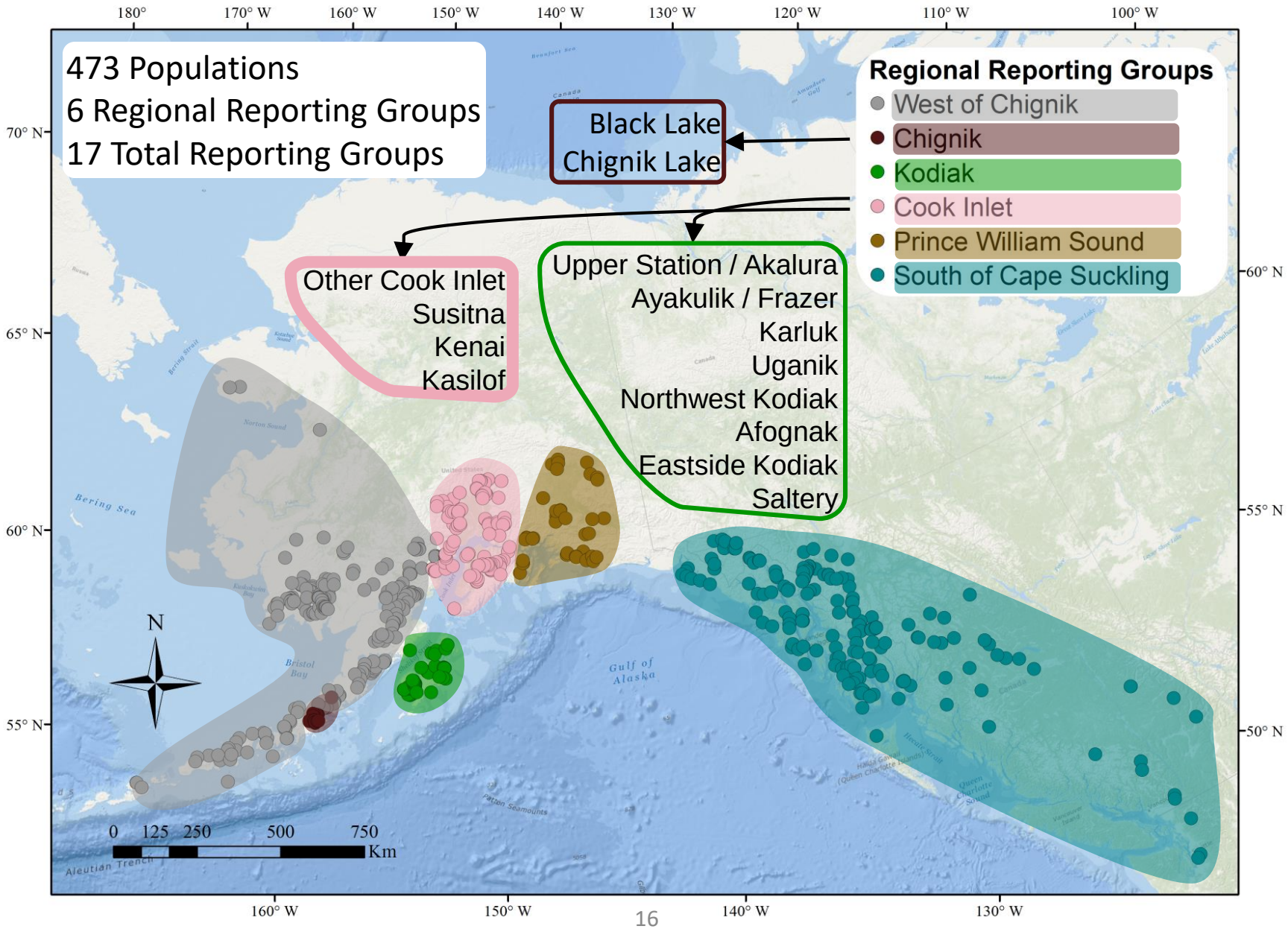
Genetic Mixed Stock Analysis, 2014-2016

Sampling Areas



- 6 Areas
- 3 Years (2014-16)
- 45K samples
- 18K genotyped

Genetic Baseline



Historical Studies

Stock Composition

Genetic Stock Identification – 2014-2016

Objective: Provide information for run reconstructions and brood tables for primary KMA sockeye stocks and refine management of KMA fisheries

Scope:

- 6 KMA districts
- 3 time periods
- 3 years
- Comprehensive baseline; Alaska to Washington

Results:

Evaluation:

Shedd et al. 2016 and 2017

Study has Two Reports

Original Objective: Provide information for run reconstructions, brood tables, for primary KMA sockeye stocks and refine management of KMA fisheries (FMS 16-10)

Fishery Manuscript Series No. 16-10

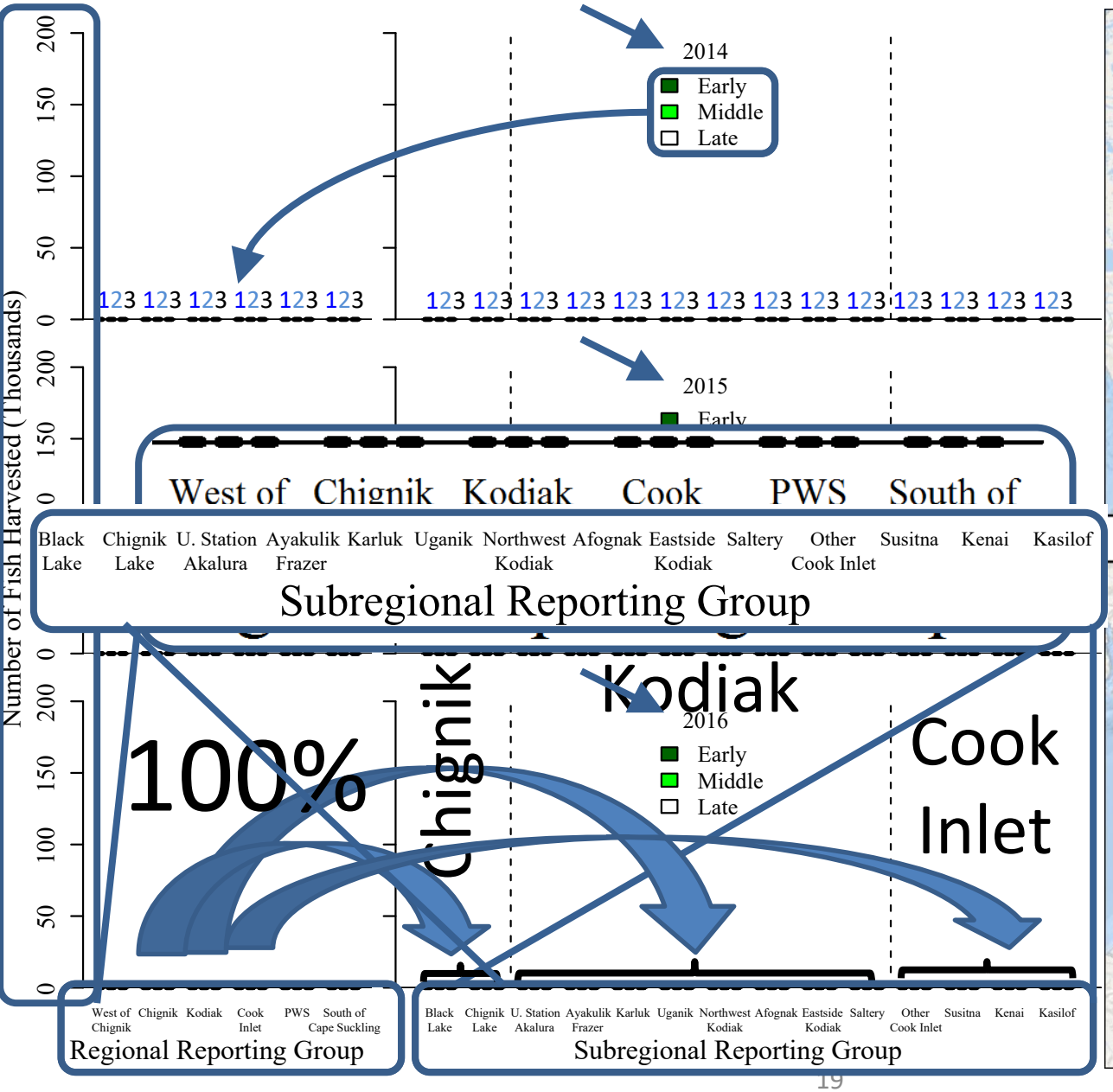
Genetic Stock Composition of the Commercial Harvest of Sockeye Salmon in Kodiak Management Area, 2014–2016

Post-hoc Objective: Board of Fish requested breakout of Cook Inlet into 4 groups to assess effects of KMA harvest on Cook Inlet stocks (FMS17-07; RC-23 2017 Work session)

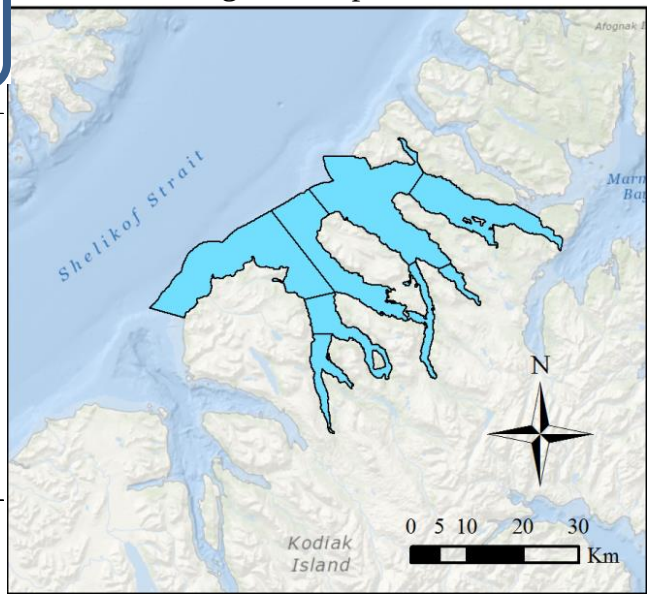
Fishery Manuscript No. 17-07

Addendum to FMS 16-10: Redefinition of Reporting Groups to Separate Cook Inlet into Four Groups for the Genetic Stock Composition of the Commercial Harvest of Sockeye Salmon in Kodiak Management Area, 2014–2016

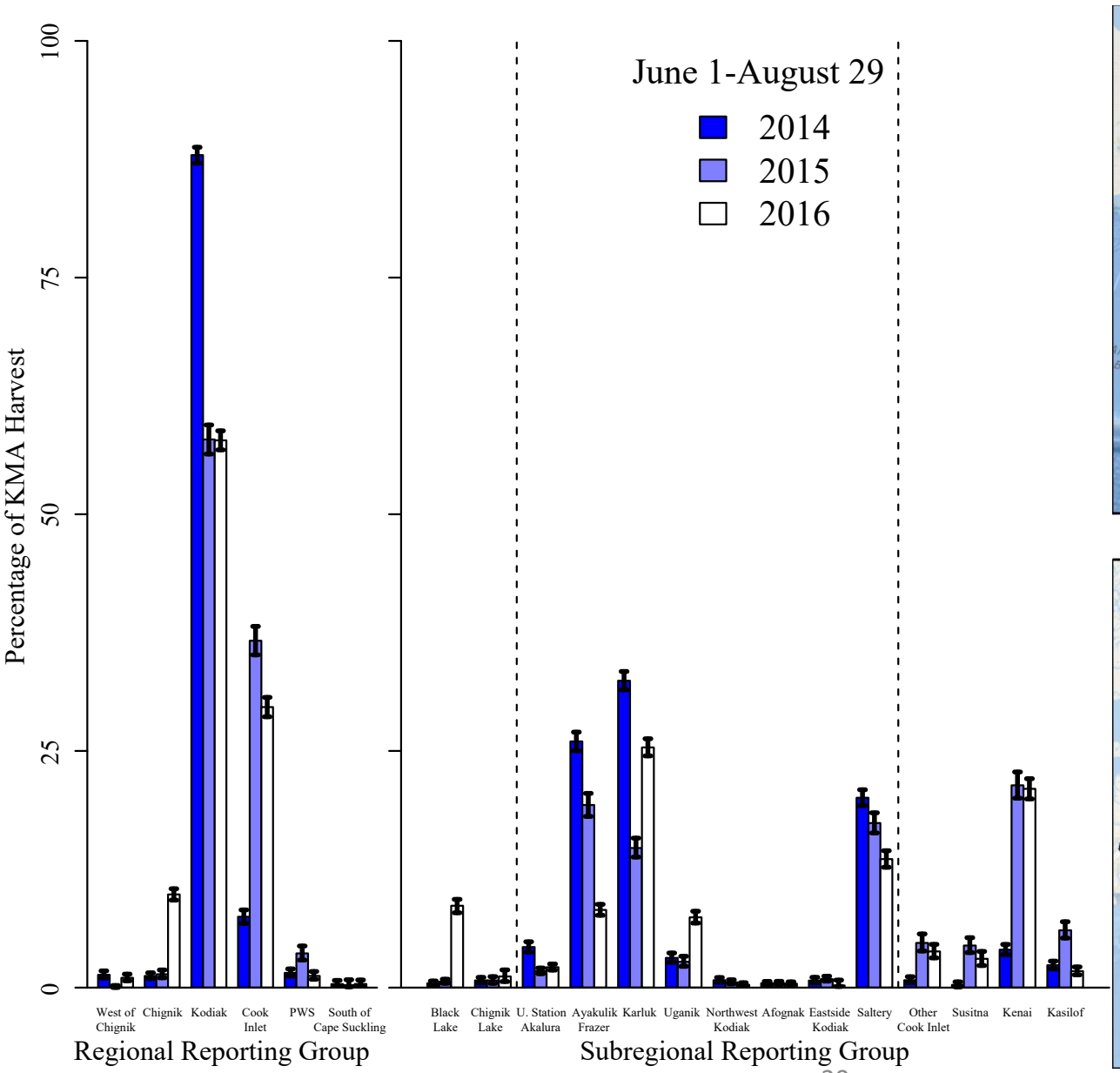
Results-Example

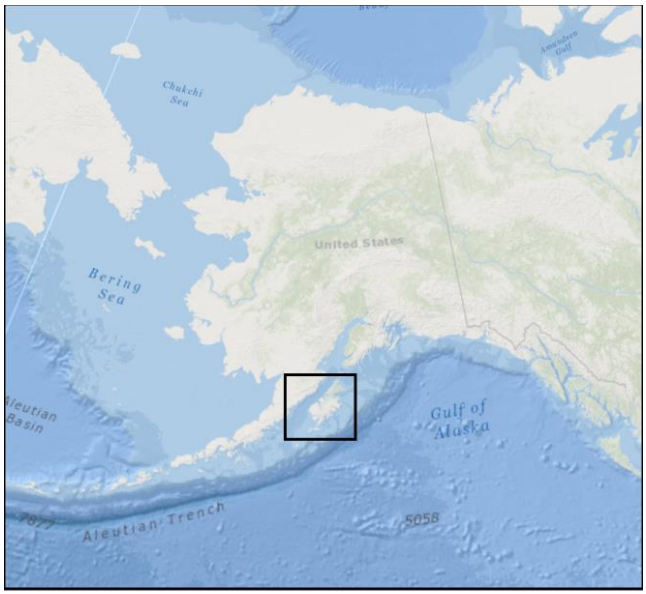


Uganik-Kupreanof

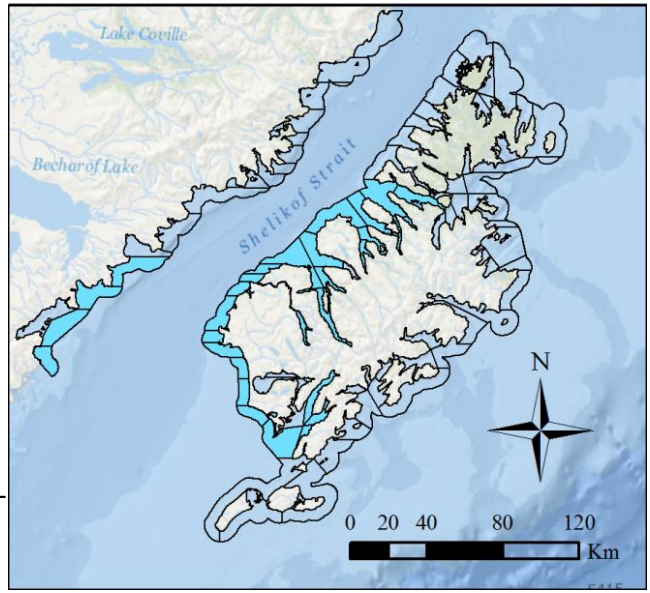


KMA Stock Composition (%)





Kodiak Management Area



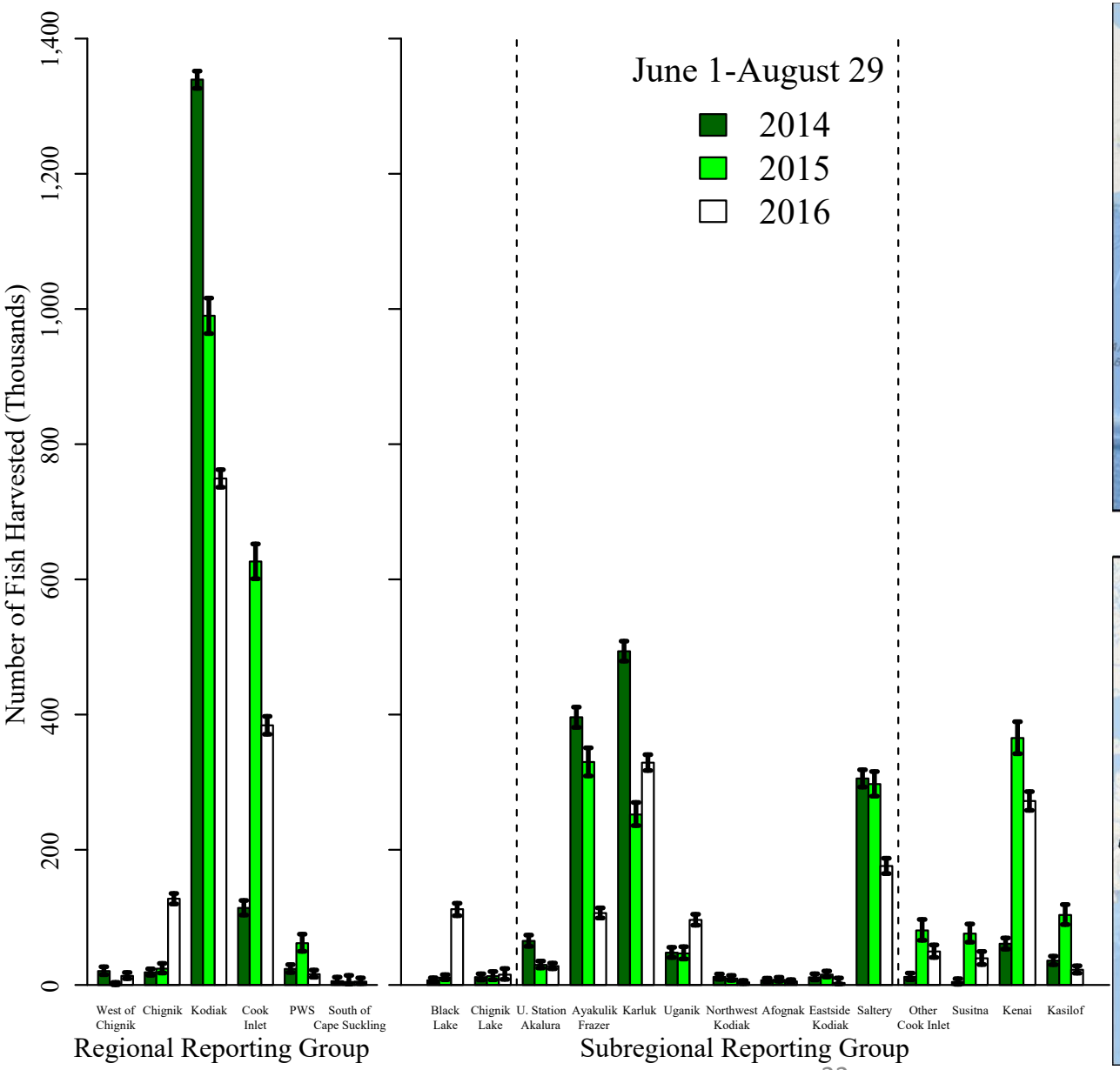
KMA Stock Composition (%)

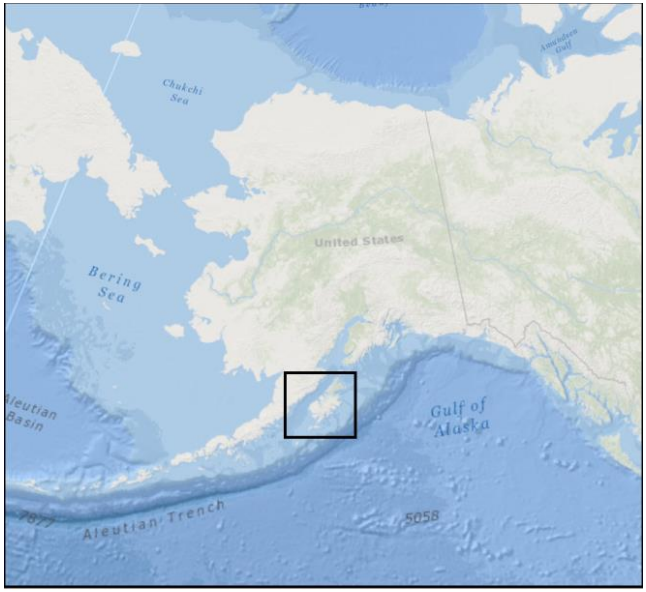
Detailed stock composition information:

Information	Report	Pages
Tables:		
By area and time period (within years)	FMS17-07	52-115
By year (all areas and time periods combined)	FMS17-07	116-118
Figures:		
By year (all areas and time periods combined)	FMS17-07	35

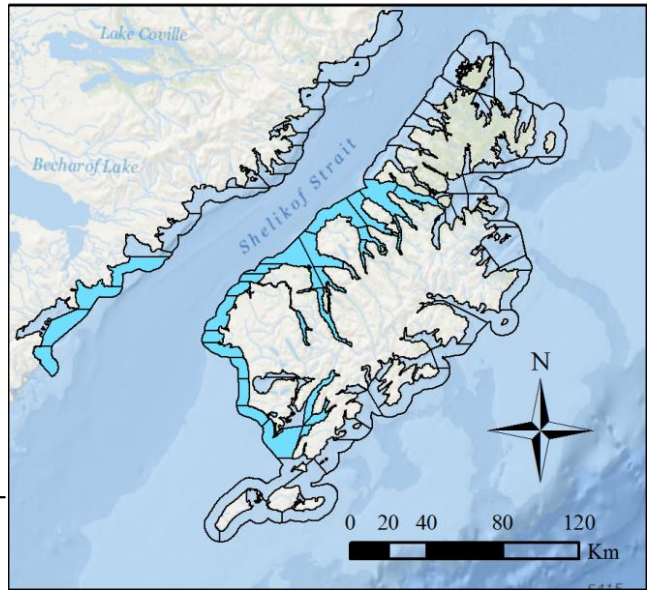
Shedd, K. R., M. B. Foster, and C. Habicht. 2017. Addendum to FMS 16-10: Redefinition of reporting groups to separate Cook Inlet into four groups for the genetic stock composition of the commercial harvest of sockeye salmon in Kodiak Management Area, 2014–2016. Alaska Department of Fish and Game, Fishery Manuscript No. 17-07, Anchorage.

KMA Stock-Specific Harvest (#)





Kodiak Management Area



KMA Stock-Specific Harvest (#)

Detailed stock-specific harvest information:

Information	Report	Pages
Tables:		
By area and time period (within years)	FMS17-07	52-115
By year (all areas and time periods combined)	FMS17-07	116-118
Figures:		
By area and time period (within years)	FMS17-07	29-34
By year (all areas and time periods combined)	FMS17-07	36

Shedd, K. R., M. B. Foster, and C. Habicht. 2017. Addendum to FMS 16-10: Redefinition of reporting groups to separate Cook Inlet into four groups for the genetic stock composition of the commercial harvest of sockeye salmon in Kodiak Management Area, 2014–2016. Alaska Department of Fish and Game, Fishery Manuscript No. 17-07, Anchorage.

Example Plot

Harvest

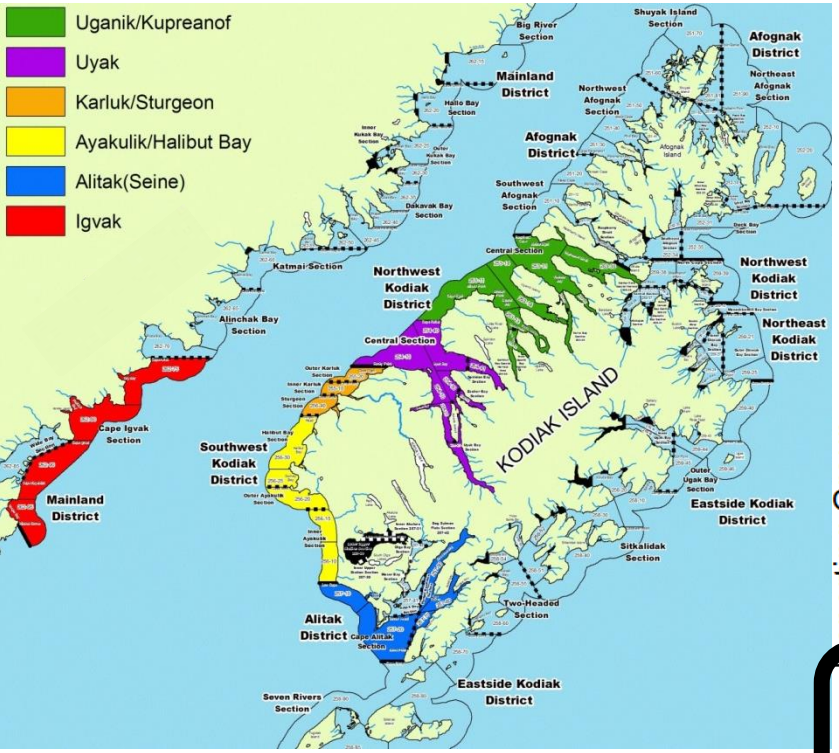
Detailed stock-specific harvest information plots

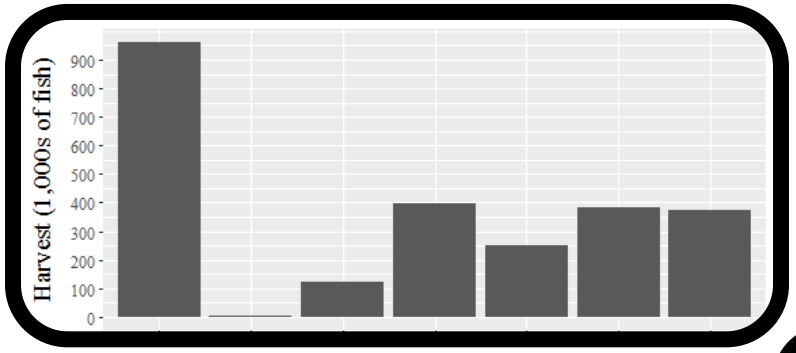
Information	Report	Pages
Tables:		
By area and time period (within years)	FMS17-07	52-115
By year (all areas and time periods combined)	FMS17-07	116-118
Figures:		
By year and time period	FMS-17-07	37-48

Shedd, K. R., M. B. Foster, and C. Habicht. 2017. Addendum to FMS 16-10: Redefinition of reporting groups to separate Cook Inlet into four groups for the genetic stock composition of the commercial harvest of sockeye salmon in Kodiak Management Area, 2014–2016. Alaska Department of Fish and Game, Fishery Manuscript No. 17-07, Anchorage.

Sampling Area

2014 Annual


Uganik/Kupreanof
Uyak
Karluk/Sturgeon
Ayakulik/Halibut Bay
Alitak(Seine)
Igvak
Mainland District
Southwest Kodiak District
Northwest Kodiak District
Northeast Kodiak District
Eastside Kodiak District
Afognak District
Alitak District
KODIAK ISLAND


Harvest (1,000s of fish)
0
100
200
300
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600
700
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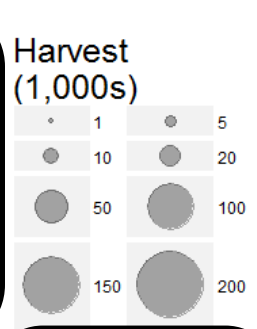
Harvest (1,000s)
1
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150
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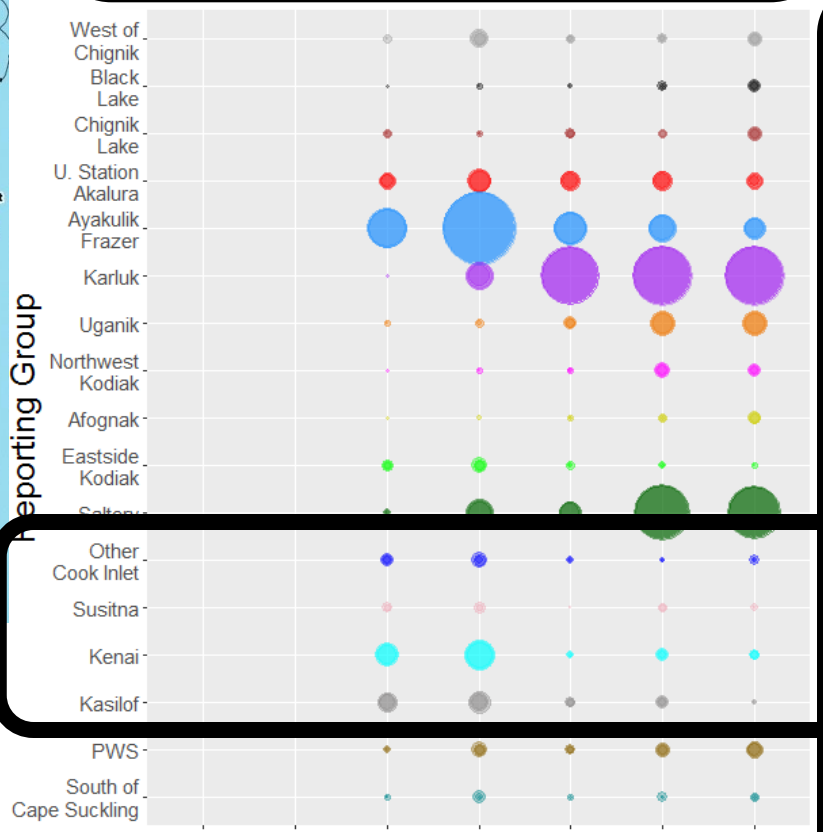
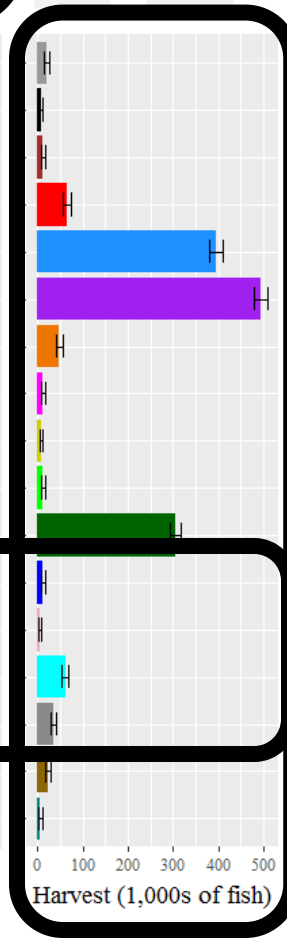

Reporting Group
West of Chignik
Black Lake
Chignik Lake
U. Station Akalura
Ayakulik Frazer
Karluk
Uganik
Northwest Kodiak
Afognak
Eastside Kodiak
Other Cook Inlet
Susitna
Kenai
Kasilof
PWS
South of Cape Suckling
Unsampled Areas
Igvak
Alitak
Ayakulik Halibut Bay
Karluk Sturgeon
Uyak
Uganik Kupreanof
Sampling Area


0
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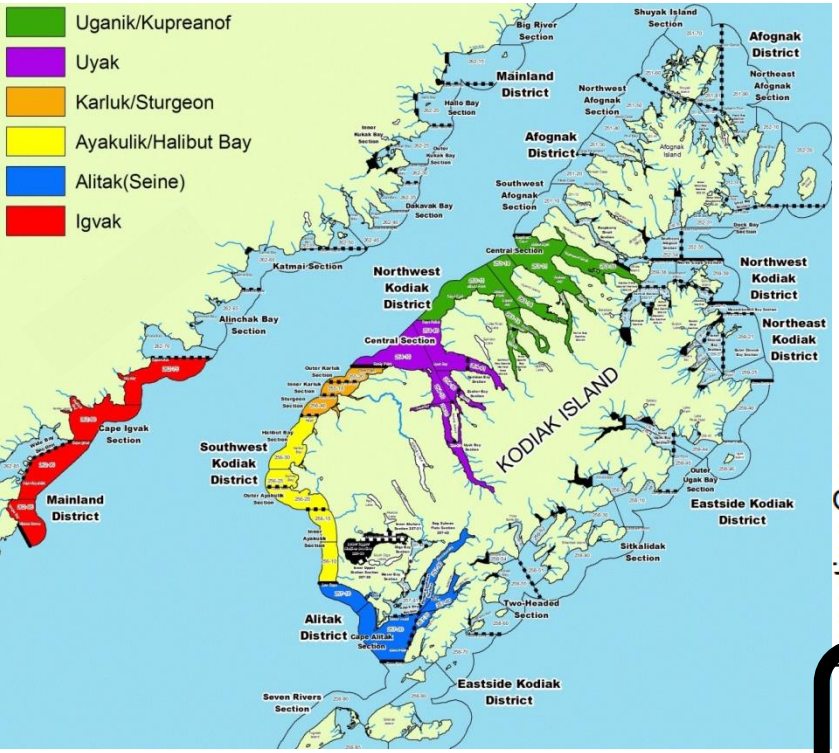
Harvest (1,000s of fish)

2015 Annual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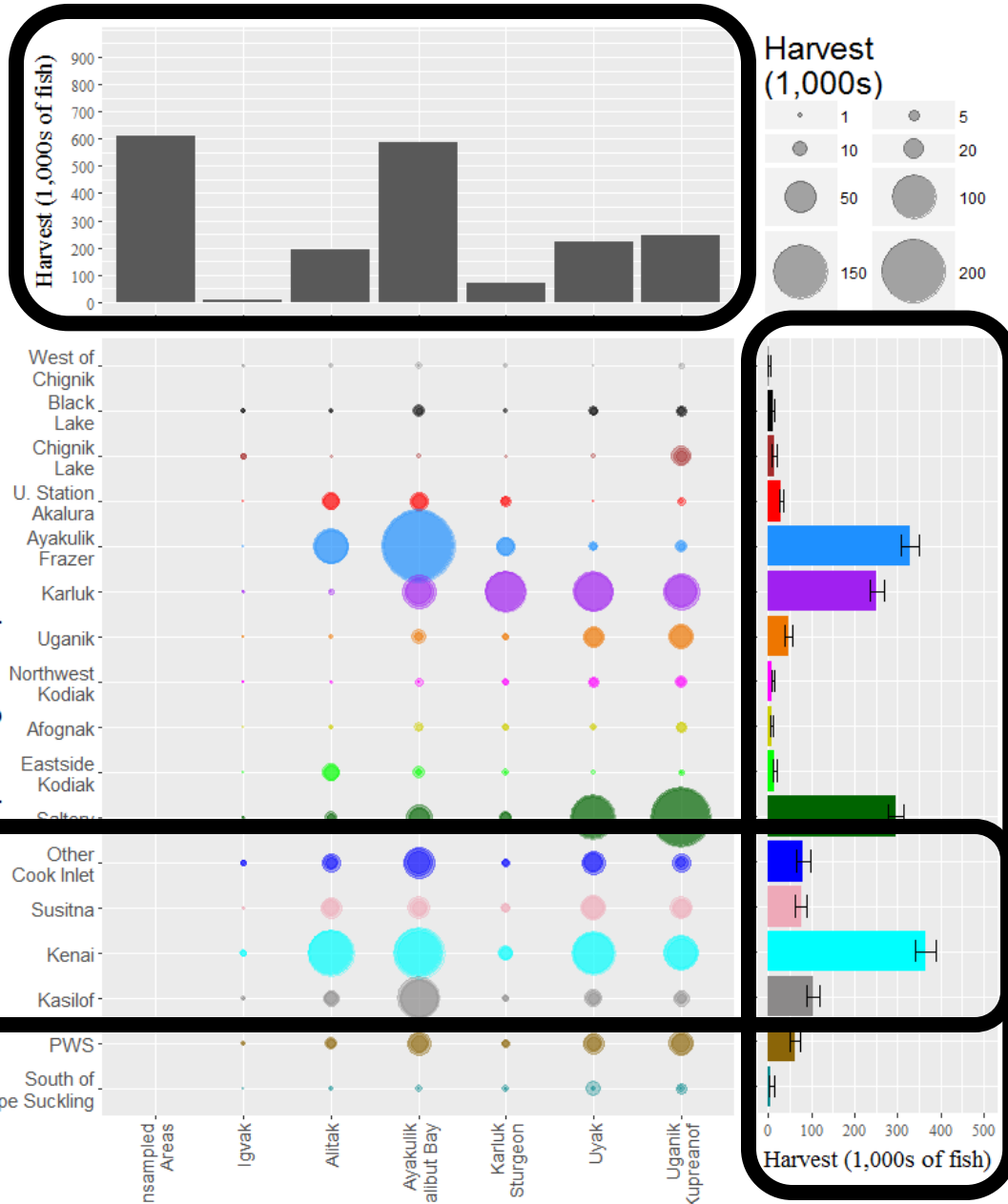
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0
100
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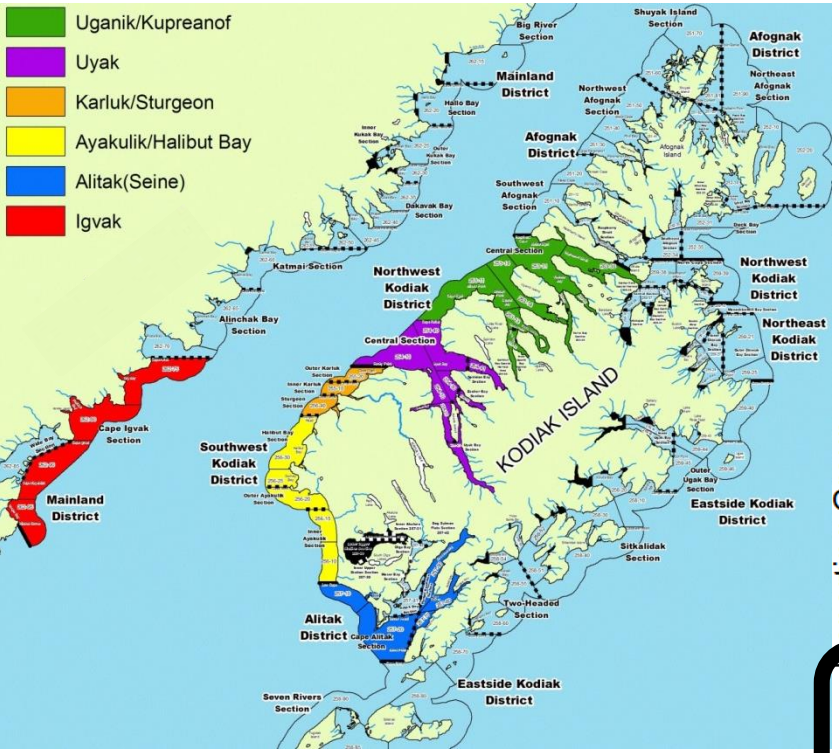
500
Harvest (1,000s of fish)

2016 Annual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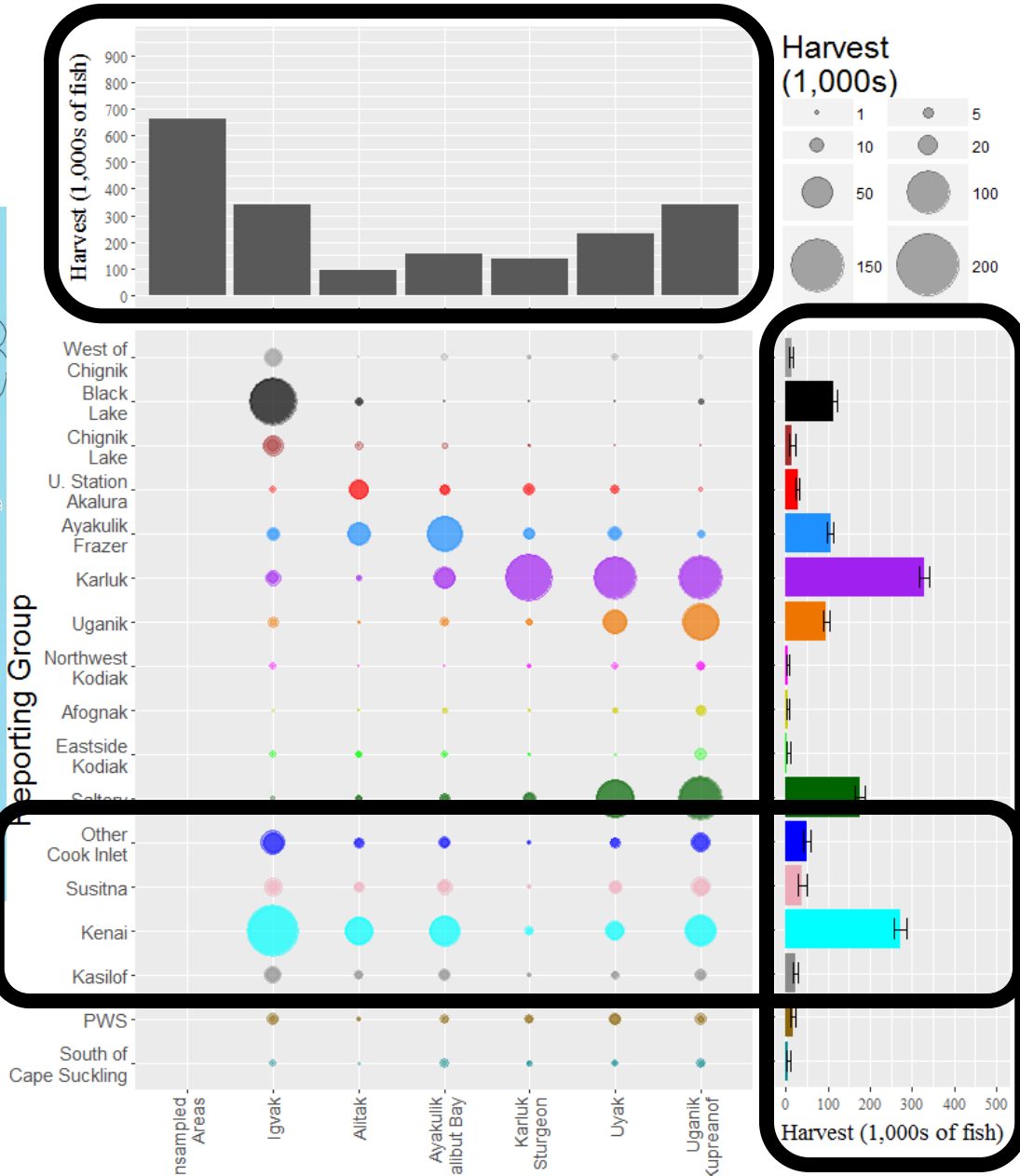
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Sampling Area
0
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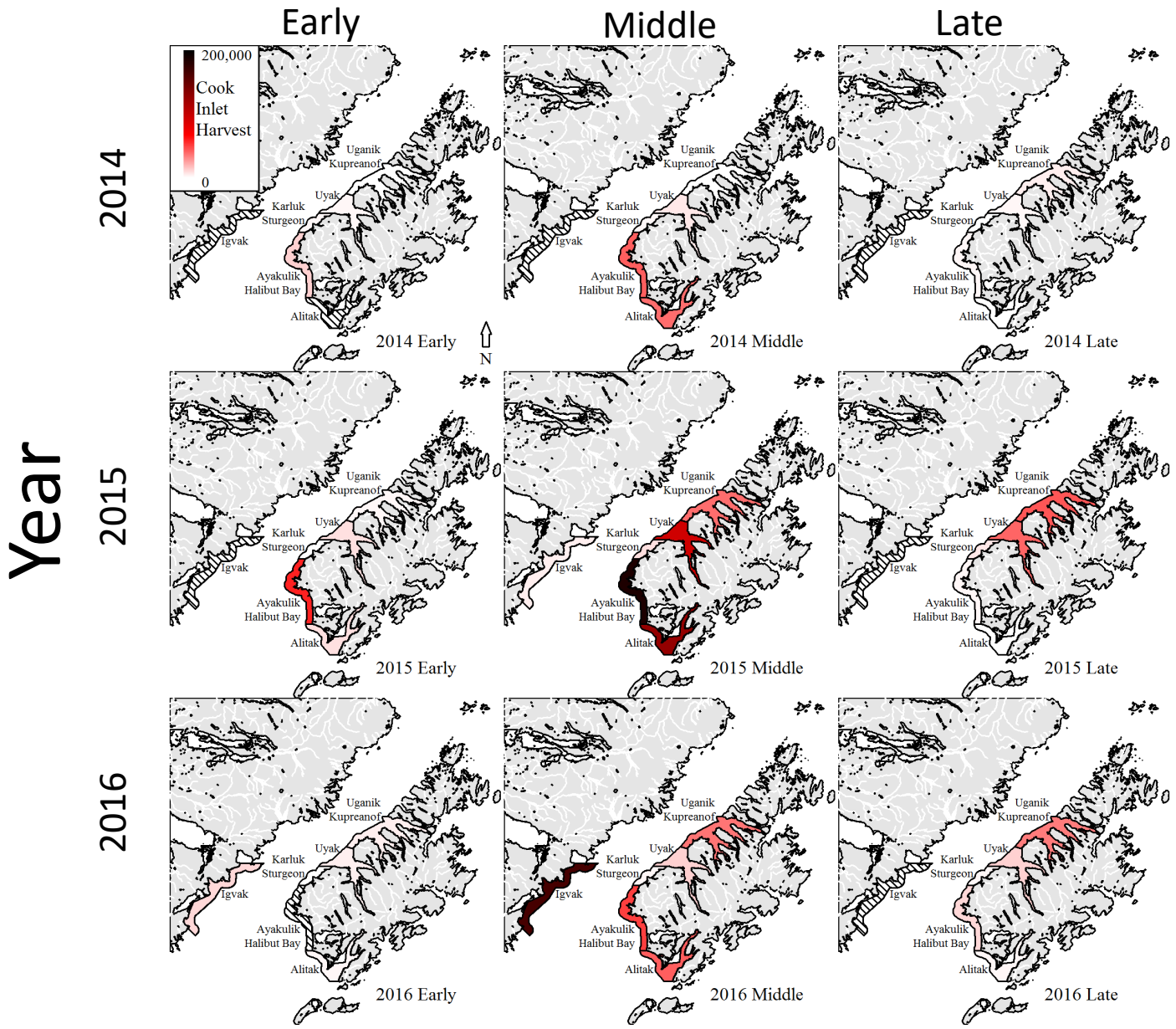
Harvest (1,000s of fish)

Cook Inlet stock composition and harvest information plots

Information	Report	Pages
Tables:		
By area and time period (within years)	FMS17-07	52-115
Figures:		
Cook Inlet stock composition:		
By year, time period, and area	FMS-17-01	49
Cook Inlet stock harvest:		
By year, time period, and area	FMS-17-01	50

Shedd, K. R., M. B. Foster, and C. Habicht. 2017. Addendum to FMS 16-10: Redefinition of reporting groups to separate Cook Inlet into four groups for the genetic stock composition of the commercial harvest of sockeye salmon in Kodiak Management Area, 2014–2016. Alaska Department of Fish and Game, Fishery Manuscript No. 17-07, Anchorage.

Pattern of Cook Inlet stock harvest in sampled KMA districts



Historical Studies

Stock Composition

Genetic Stock Identification – 2014-2016

Objective: Provide information for run reconstructions, brood tables for primary KMA sockeye stocks and refine management of KMA fisheries

Post hoc – Board of Fish requested breakout of Cook Inlet into 4 groups to assess effects of KMA harvest on Cook Inlet stocks (FMS17-07; RC-23 2017 Work session)

Scope:

- 6 KMA districts; 3 time periods; 3 years
- Comprehensive baseline; Alaska to Washington

Results:

- Highly accurate stock composition estimates (+/- 5%, 90% of the time)
- Stock composition variable across years and areas
- General patterns of stock composition observed
- Most of the sampled harvest was Kodiak sockeye
- Cook Inlet stocks contributed to the annual KMA sockeye harvest sampled
  - 8% – 37%
  - 114,000 – 626,000 sockeye
  - *Post hoc* – primarily Kenai
  - *Post hoc* – average partial harvest rates: 5.2%-7.2% (Kenai, Kasilof, Susitna)

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Interpreting Results

What do these studies tell us about Cook Inlet sockeye salmon in Kodiak area commercial fisheries?

Study	Years	Area	Precision	Summary Result
Tagging	1927-1981	AK Peninsula and Kodiak Archipelago	None	Cook Inlet sockeye are present
SPA feasibility	1981	Cape Izhut, Uganik Bay, Ugak Bay, Alitak Bay	*Local* v. *Nonlocal:* Medium Stock composition: Low	Cook Inlet sockeye present only in Uganik sample early June
SPA, Size, Age	1988, 1990	North Shelikof Strait	Low	Cook Inlet stocks were the majority of sampled catch
Avg weight	1983-1993	Most of Kodiak [not Igvak or N Shelikof]	Medium [Low accuracy]	Percent of Cook Inlet run in KMA harvest: 0.0% - 9.5%
Genetic Stock ID	2014-2016	West & SW Kodiak Island districts and Cape Igvak	High	Cook Inlet contribution (sampled harvests): 8%-37%

Interpreting Results

What does the GSI study tell us about Cook Inlet sockeye salmon in Kodiak area commercial fisheries?

1. Accurate and precise estimates of stock compositions and stock-specific harvest for sockeye salmon caught by the commercial fleet in sampled KMA districts in June, July and August in 2014-2016.

2. In sampled fishery harvests, 2014-2016:
   - Most of the harvest was of Kodiak sockeye stocks, 58% - 88%
   - Second most common contributor annually was Cook Inlet, 8% - 37%

3. Some patterns were consistent across years
   - Example: Higher proportions of Cook Inlet fish were harvested in southern districts in July

4. Partial harvest rates of UCI stocks from sampled harvests, 2014-2016:
   - All Upper Cook Inlet: 1.8% - 8.7%
   - Stock-specific: Susitna 1.5% - 11.7%; Kenai 1.8% - 8.7%; Kasilof 3.2% - 8.1%; Other – *Not Done*

Interpreting Results

What are the stock compositions for harvests in the same KMA strata for other years?

Most useful source:

1) Genetic stock identification 2014-2016
2) Other tagging and stock composition studies

Assumptions:

Sampled and unsampled years have similar:

- Relative stock run sizes
- Migratory pathways
- Harvest methods and management

Support

- Some patterns in stock composition through time and among districts emerged among the three years of the GSI study
- Other stock composition studies using SPA, fish length, harvest date showed similar patterns in stock-specific harvest as this study

Lack of support

- Most multi-year studies show high interannual variation

Further studies

Meta-analysis of existing tagging and stock composition studies to assess assumptions

Low-level of monitoring to assess assumptions

Interpreting Results

What are the stock compositions for harvests in KMA strata not sampled in GSI study?

Most useful source:

1) Other tagging and stock composition studies
2) Strata selection process for the GSI study

Assumptions for using other tagging and stock composition studies:

- Sampling representative of "unit of interest"
- Recovery efforts (tagging) or baseline (stock composition) is adequate
- Methods provide precision and accuracy

Strata selection process for GSI study

- Excluded strata where local stocks are likely harvested
  - Terminal harvest areas
  - Post-August time periods
- Excluded strata distant from primary sockeye systems

Interpreting Results

Can harvest rates be estimated for Cook Inlet stocks in KMA harvests?

Definitions:
Harvest rate – the harvest of a stock in an area divided by the total run (harvest + escapement).
Total Run – the total number of salmon in a stock surviving to adulthood and returning to the "vicinity" of the natal stream

Traditionally, total run for Cook Inlet includes only harvest and escapement within Cook Inlet. At the request of the board, the department expanded the harvest to include selected KMA time/area strata from the GSI study (RC 23, Oct 16, 2017).

This partial harvest rate is neither traditional harvest rate (outside of Cook Inlet), a combined Cook Inlet/KMA harvest rate (because not all KMA harvest is included) nor a comprehensive harvest rate (because not all harvest of Cook Inlet stock is included).

This is a straight-forward calculation and can provide a measure of harvest of Cook Inlet stocks in select KMA fisheries relative to harvest in Cook Inlet, but it is an incomplete measure.

Potential study: WASSIP-type project for western Gulf of Alaska

Parting Thoughts

Recognizing that the Board is charged with making decisions using best available information

- Limited data
- Studies not designed to answer the questions being asked

The goal of this presentation has been to provide:

- Overview of historical studies that provide the best available information
- General evaluation of the studies
- Guidelines and considerations for using the information in deliberations
- Recommendations for future work to help inform specific questions


Questions?