Northwest **Power** and **Conservation** Council

April 2, 2019

MEMORANDUM

TO: **Council Members**

FROM: **Lynn Palensky**

SUBJECT: **The International Gulf of Alaska Expedition: Using a Russian research ship to study salmon on the high seas**

BACKGROUND:

Presenter: Laurie Weitkamp, Research Fish Biologist, NW Fisheries Science Center for NOAA in Newport OR.

Summary: Laurie Weitkamp will provide a briefing on her recent expedition aboard the Russian research vessel *R/V Professor Kaganovskiy* in the North Pacific conducting salmon surveys. The international expedition was the first of its kind – to include an international team of scientists conducting a winter survey in areas not covered before in the North Pacific. Laurie and her colleagues were at sea for 30 days. The team included fish biologists, physical and biological oceanographers and geneticists from the U.S., Canada, Russia, South Korea and Japan. While much analysis will occur in the next year, Laurie will share real-time observations and preliminary results; some of which were unexpected.

Relevance: The expedition is supported by the North Pacific Anadromous Fish Commission and private and foundation donations and is a signature event for the *International year of the Salmon* (IYS). The 27th annual NPAFC meeting and the 2nd IYS three-day science workshop is being held in Portland in May 2019. Topic sessions include: 1) current status of salmon and their environments; 2) salmon in changing ocean conditions; and 3) new technologies/integrated information systems for salmon research and management.

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Executive Director

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Workplan: These efforts relate to Fish and Wildlife Program measures under the Public Engagement, Plume and Nearshore Ocean, and Climate Change strategies. Council involvement with this initiative and participation in workshops may help advance our understanding of salmon science and how to improve strategies, measures and investments in the Program.

Background: The North Pacific Anadromous Fish Commission (NPAFC) is an inter-governmental organization established by the Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean, which took effect in 1993. The objective of the Commission is to promote the conservation of anadromous stocks (Pacific salmon and steelhead) in the Convention Area which includes the international waters of the North Pacific Ocean and its adjacent seas north of 33° North (generally north of Los Angeles) beyond the 200-mile zone of the coastal states. The NPAFC member countries include Canada, Japan, Korea, the Russian Federation and the United States.

The IYS is a multi-year outreach and research initiative of the North Pacific Anadromous Fish Commission (NPAFC) and the North Atlantic Salmon Conservation Organization (NASCO). The IYS convenes salmon experts from across the globe to present on and discuss emerging scientific topics related to salmonids, with an emphasis on survival in the marine environment. The IYS has six primary themes that relate to many of our Program strategies: (1) status of salmon; (2) salmon in a changing "salmosphere"; (3) new frontiers; (4) human dimension; (5) information systems; and (6) outreach and communication. The IYS aims to encourage research and leave a legacy of knowledge, information systems, research/analytical tools, and a new generation of scientists better equipped to provide timely advice to inform rational management of salmon.

More Info:
International Year of the Salmon background brochure

Second NPAFC-IYS Workshop - **Salmon Ocean Ecology in a Changing Climate**: May 18-20, 2019, Portland, OR.

Laurie's *Think out Loud* interview with Oregon Public Broadcasting (26 Mar 2019)

Article from the Puget Sound Institute on the expedition (Mar 2019)

Laurie's Blog Post on "Life aboard the Russian R/V *Professor Kaganovskiy* (Mar 2019)

Expedition Abstract and Laurie's Bio **(attached**) March 2019

Attachment

Expedition Abstract

Many years ago, Dr. Richard “Dick” Beamish (Canadian Department Fish and Oceans) had the audacious idea of sending an international scientific research team to international waters in the Gulf of Alaska in late winter to study the ecology of salmon. This area and time were thought to regulate year class strength of salmon, but no directed sampling had been done to support or dismiss this idea. Through Herculean effort and relentless tenacity, Dick finally managed to get this privately-funded expedition off the ground in late winter 2019, which has become the signature event for the International Year of the Salmon. Laurie Weitkamp was fortunate to be invited as one of 21 scientists representing U.S., Canada, Russia, Japan, and South Korea on the International Gulf of Alaska Expedition. The team spent 30 days (mid-February to mid-March) on the Russian Research Vessel *Professor Kaganovskiy* documenting salmon and their winter habitat across nearly 700,000 km^2 in the Gulf of Alaska. The scientific team consisted of physical and biological oceanographers, chemists, and fish and invertebrate biologists, allowing measurement of everything from ocean physics to salmon genetics. This talk will describe the initial findings from the expedition (with many more to come once 1,000s of collected samples are analyzed), and the unique experience of spending a month on a Russian research vessel.

Bio

Laurie Weitkamp has been a Salmon Biologist at the Northwest Fisheries Science Center since 1992, moving from Montlake to the Newport Research Station in 2004. She has been involved in the scientific basis for West Coast coho salmon listing and recovery under ESA for over two decades. Her research focuses on the ecology of salmon in estuarine and marine environments, primarily the distribution of juvenile and adult salmon in estuarine and marine waters, and the factors that influence growth and survival, including recent anomalous conditions. Laurie has recently branched out to explore the little-studied estuarine and marine ecology of anadromous lamprey. Laurie serves on a variety of technical committees, including the Coho Technical Committee of the Pacific Salmon Commission. Laurie received her B.S., M.S., and Ph.D. degrees from the University of Washington.

Relevant publications

R. J. Beamish (editor). 2018. The ocean ecology of Pacific salmon and trout. American Fisheries Society, Bethesda.

K. W. Myers, J. R. Irvine, E. A. Logerwell, S. Urawa, S. Naydenko, A. Zavolokin, and N. D. Davis. 2016. Pacific salmon and steelhead: Life in a changing winter ocean. N. Pac. Anadr. Fish Comm. Bull 6:113-138.

The International Gulf of Alaska Expedition:
Using a Russian research ship to study salmon on the high seas

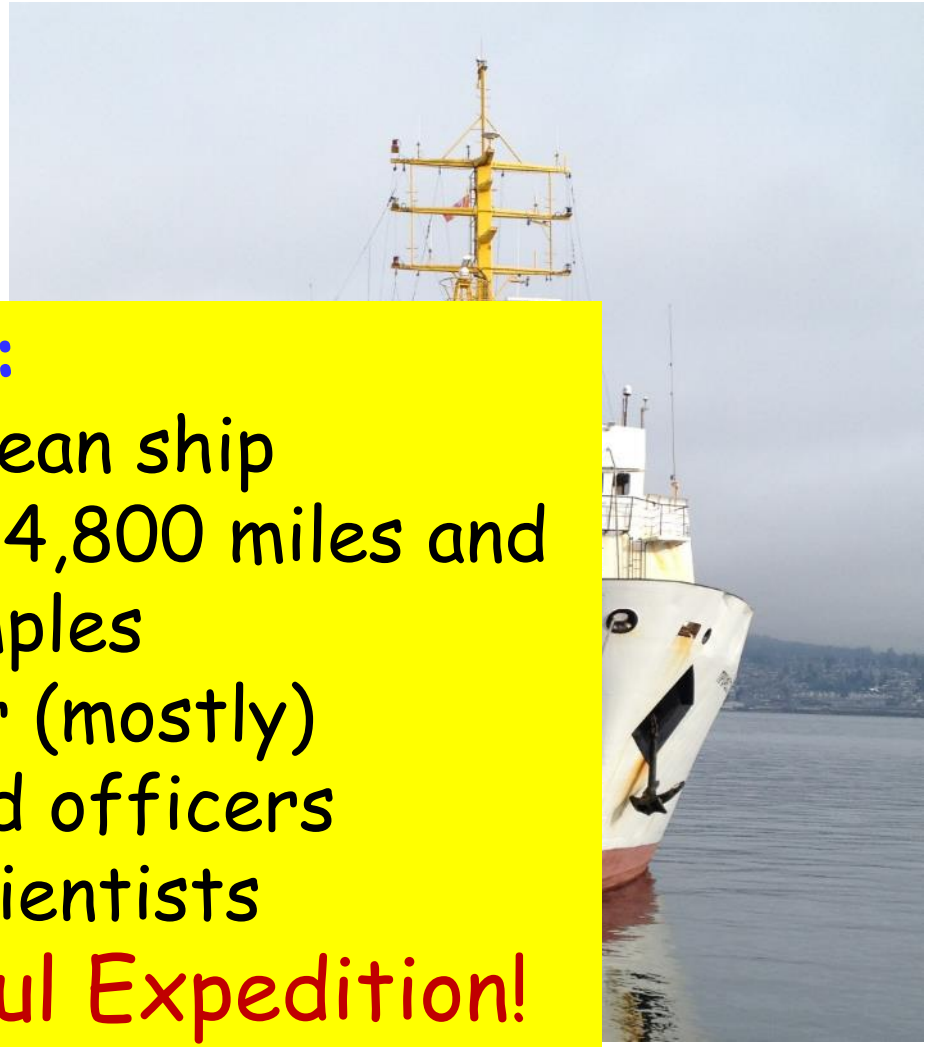
17 February –18 March 2019, R/V *Professor Kaganovskiy*

Laurie Weitkamp
NOAA Fisheries/NWFSC
Laurie.weitkamp@noaa.gov

Photo by Egor Glyzin, 3rd mate

ТИНРО ЦЕНТР
ПРАВИТЕЛЬСТВО РОССИЙСКОЙ ФЕДЕРАЦИИ
NOAA
Canada
NPAFC
INTERNATIONAL YEAR OF THE SALMON

R/V *Professor Kaganovskiy* in Vancouver, BC, Feb 16, 2019



Bottom line:

Reasonable food, clean ship

No breakdowns in 30 days, 4,800 miles and 60 stations samples

Spectacular weather (mostly)

Very helpful crew and officers

Fantastic fellow scientists

➔ Extremely Successful Expedition!

Today's talk

- Why the expedition?
- Methods
- Initial results
- Life on a Russian ship

Dick Beamish's audacious idea comes true

DFO emeritus

and ensuring international participation.

Privately funded by:

North Pacific Anadromous Fish Commission (NPAFC), Pacific Salmon Foundation, DFO Science Branch, Salmon Farmers Association of BC, Province of British Columbia, Pacific Salmon Commission, Harmac Canada, Port Authority of Nanaimo and private donors

Why the expedition?

Expedition goals

- Test hypothesis that adult

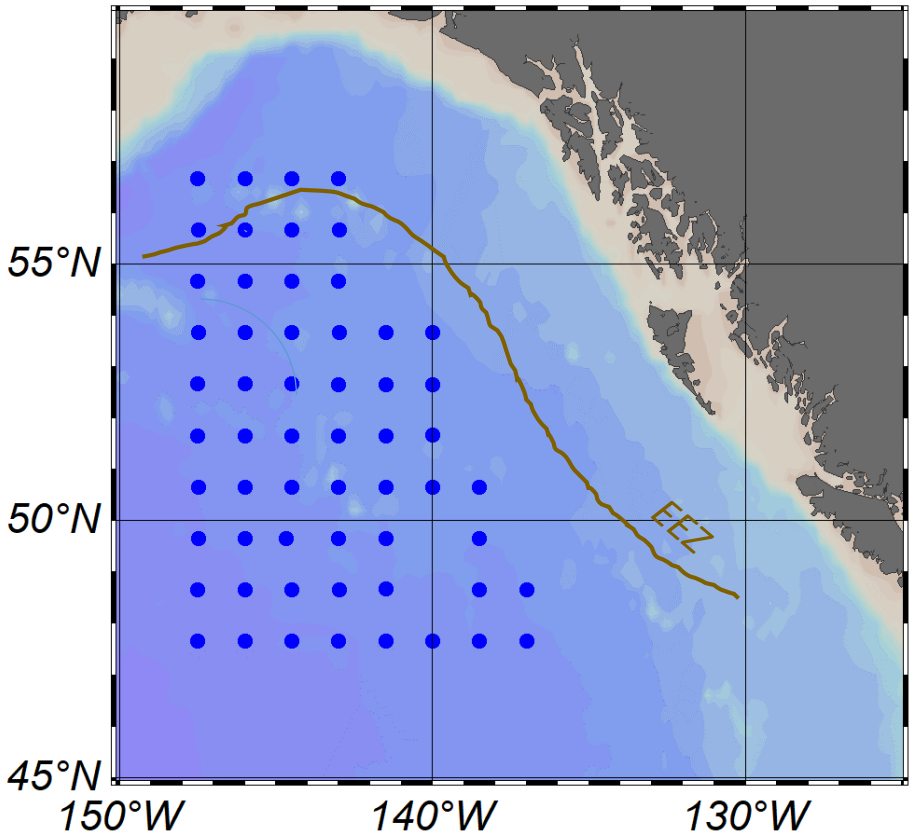
Not shown: 31 crewmembers

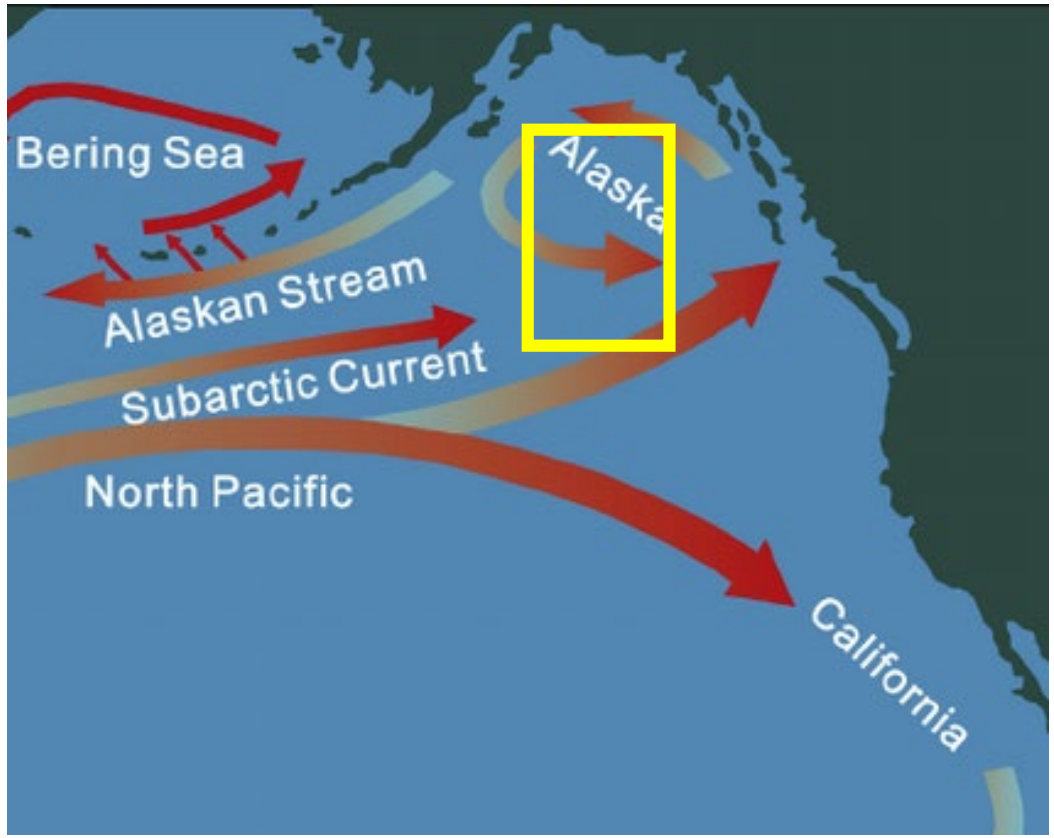
Science team

5 Countries represented: Russia, Canada, U.S., South Korea, Japan

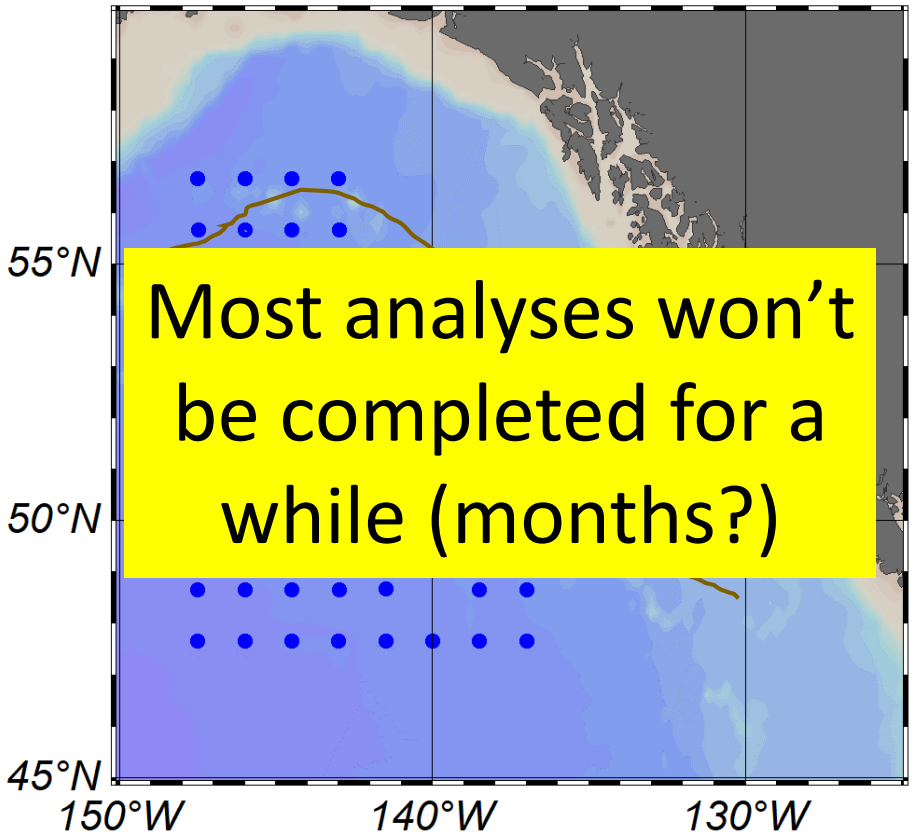
8 Nationalities: Russia, Canada, U.S., South Korea, Japan, South Africa, Germany, India

Study area and key objectives





Study area and key objectives



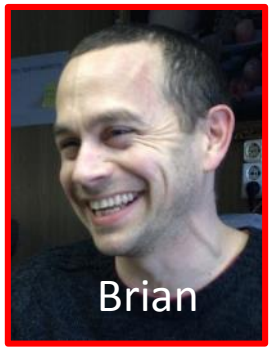
1. Identify Pacific salmon distributions in the Gulf of Alaska in winter.
2. Conduct first abundance estimates of Pacific salmon in GOA in winter
3. Document health and condition of salmon
4. Test key hypothesis regulating salmon production including
    a) Critical size and period
    b) Temperature based distributions
    c) Competition between species

Research Teams

Physical/Chemical Oceanographers

Satellite remote sensing

Biological oceanographers



Russia | Canada | U.S.

Fish Team

Research Teams

Physical/Chemical Oceanographers


Arkadii


Gennady

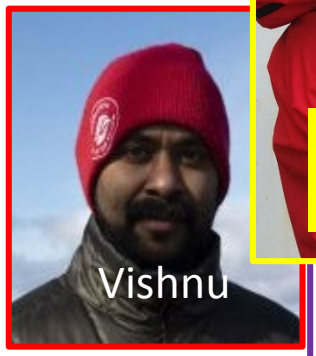

Aleksandr


Jung (S Korea)


Anna


Igor

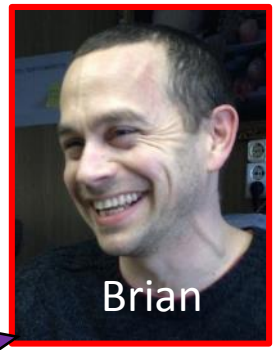
Satellite remote sensing


Vishnu


Communications officer

Biological oceanographers

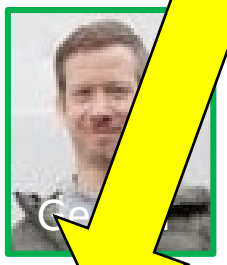

Evgeny


Brian

nada

U.S.

Chief Scientist




Charlie


Laurie

Chief Administrator

Fish Team


Aleksei


Albina


Anton


Mikhail


Chrys


Svetlana


Chris


Vladimir (NPAFC)

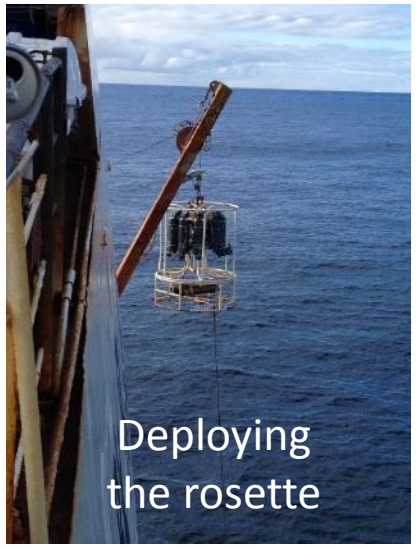

Hiko (Japan)

Methods: Oceanography

Physical/Chemical Oceanography

CTD/Water samples to 600 or 1000m


Collecting water samples


Deploying the rosette


Clear blue water!

Biological Oceanography

Juday net, 0-50, 0-200 m

Bongo (vertical) 0-250m


Juday net


Bongo net


Anton running the zooplankton winch

Neuston for microplastics (Gennady Kantakov)

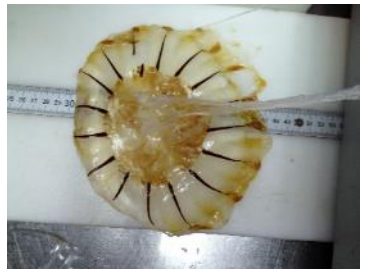

Rope-covered plankton weights

Methods: Fishing

Rope trawl (40m x 30m) towed for 1 hour near surface

Methods: Fish processing

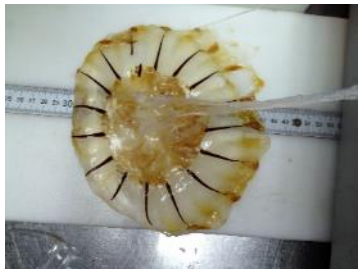
- Everything IDed, counted, measured



Methods: Fish processing

- Everything IDed, counted, measured
- Salmon had stomachs, fin clips, otoliths, scales, and muscle collected

Closet-size fish lab



Methods: Fish processing

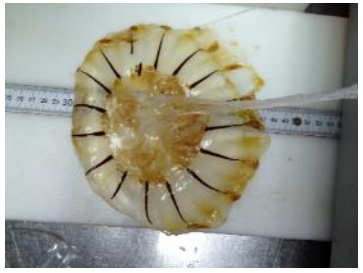
- Everything IDed, counted, measured
- Salmon had stomachs, fin clips, otoliths, scales, and muscle collected
- Fish health salmon (*n*=10/set) also had blood, spleen, heart, kidney, liver, pyloric caeca, brain tissues collected







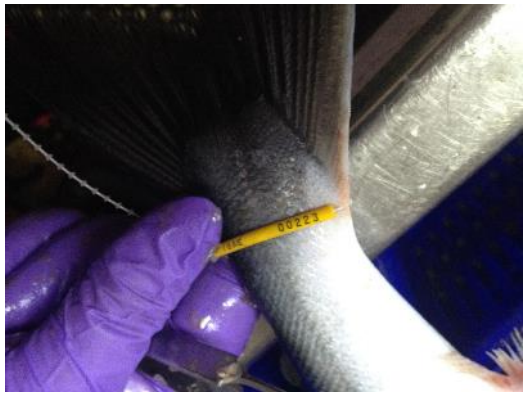


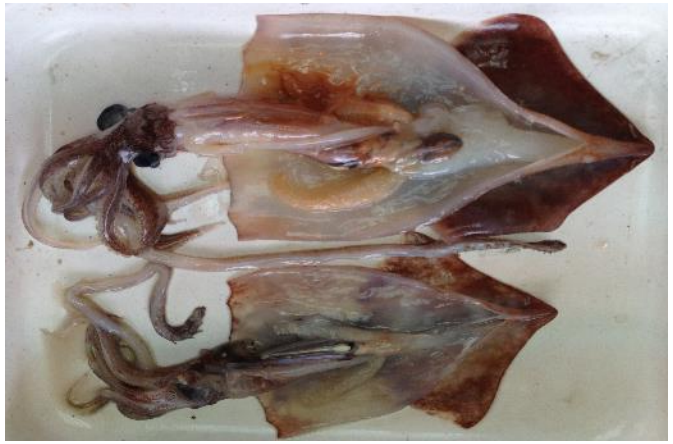




Initial results

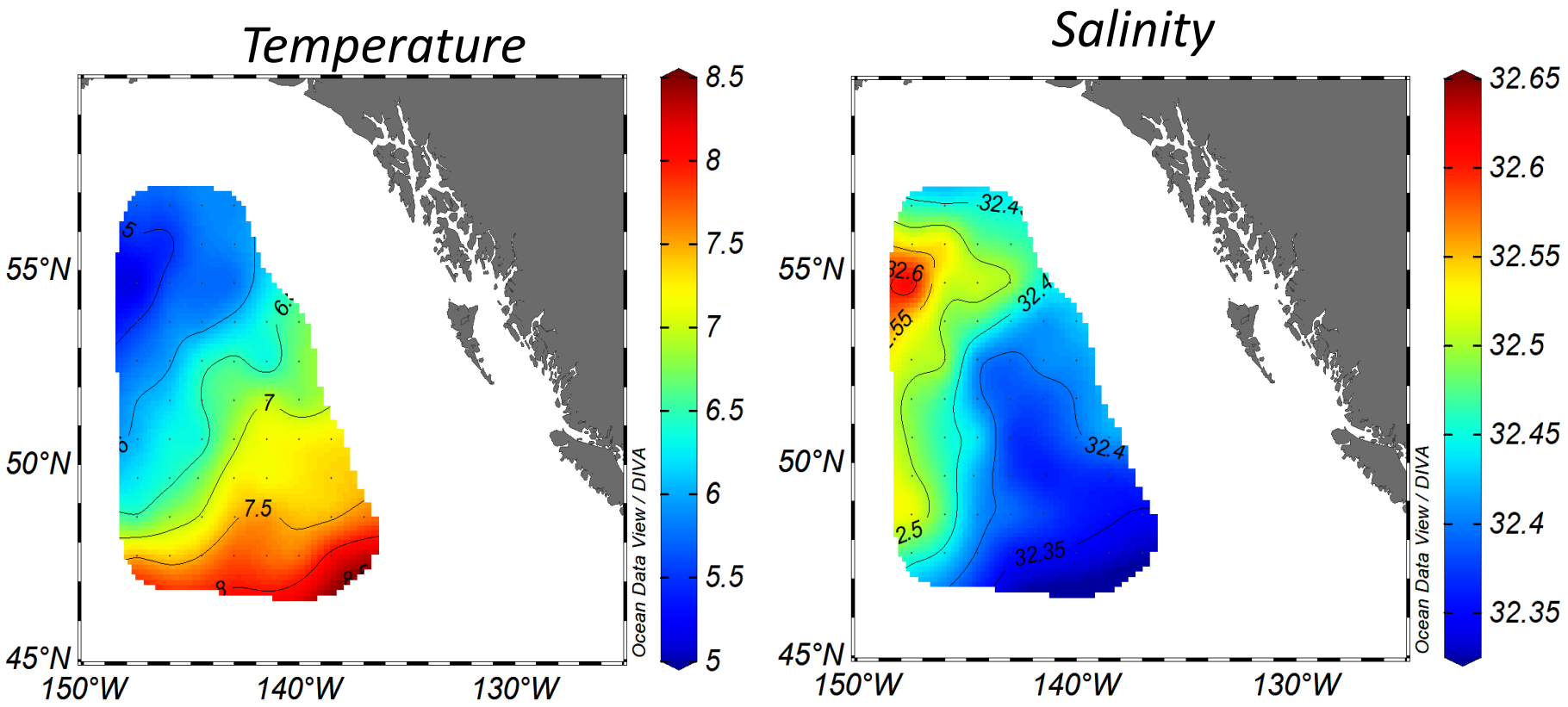
- Physical oceanography
  - Surface temperature and salinity
- Salmon catches
  - Abundance estimates
  - Diets
  - Catch distribution by species
  - Coho GSI data





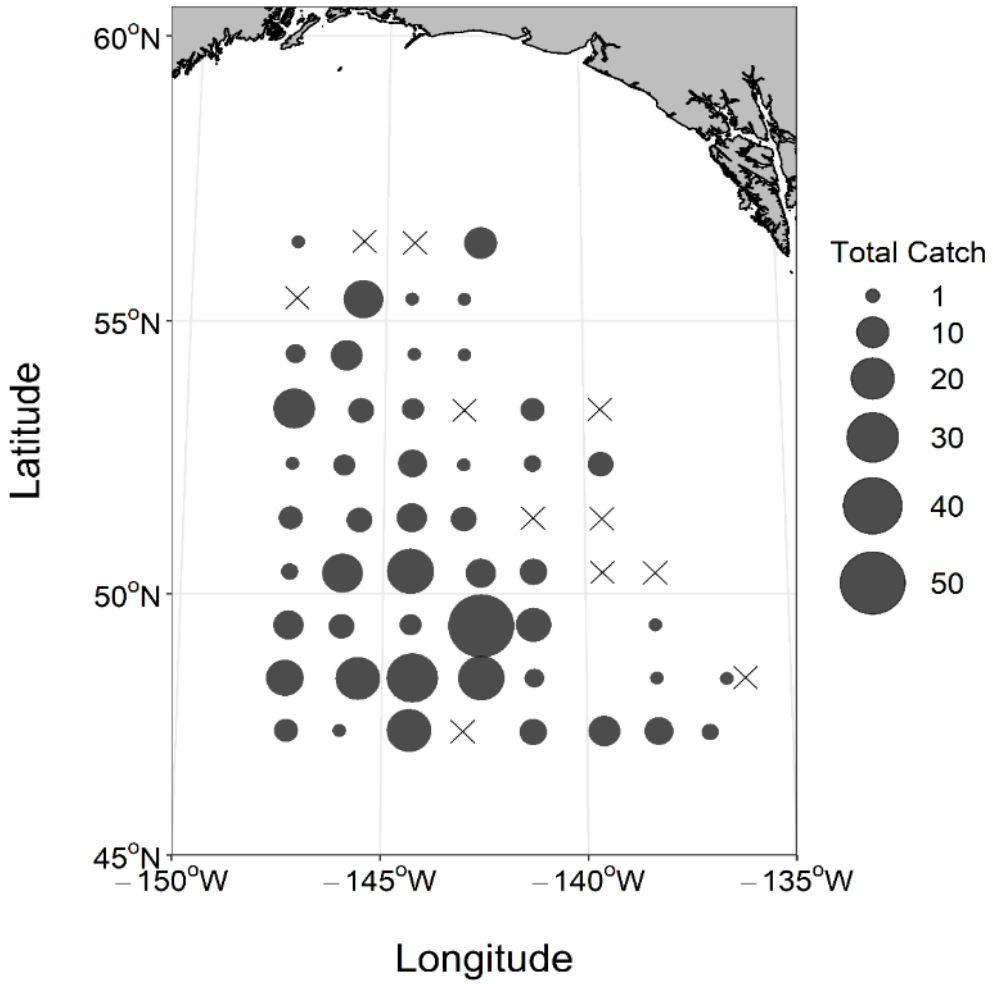
Surface temperature and salinity

Anna Vazhova, Arkadii Ivanov, Gennady Kantakov, Igor Shurpa -Russia
Hae Kun Jung – South Korea



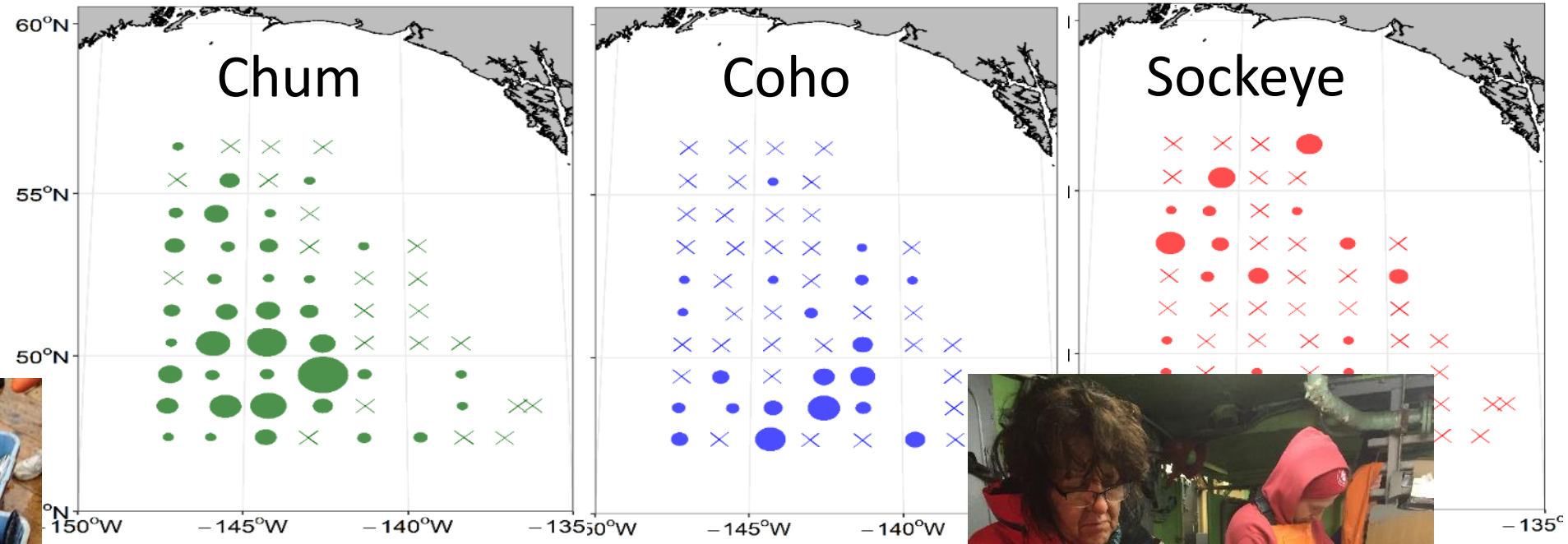
Total salmon catch (all species)

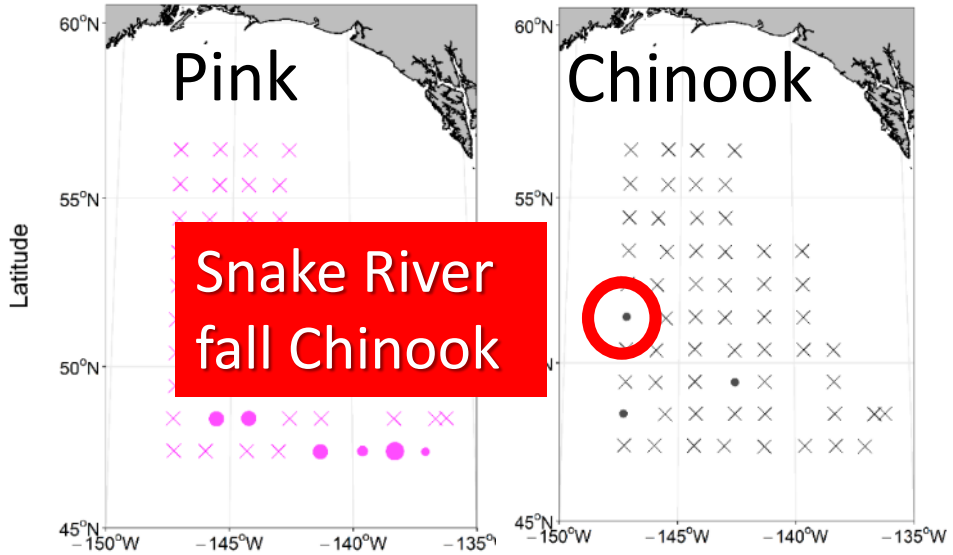
FISH TEAM: Chrys Neville – Canada; Charlie Waters, Laurie Weitkamp, Gerard Foley – US; Hiko Urawa – Japan; Aleksei Somov, Albina Kanseparova, - Russia; Vladimir Radchenko - NPAFC



- Salmon caught in 83% of sets although numbers lower than expected.
- Possible day/night signal in catch but may be species specific

Fish team cont.





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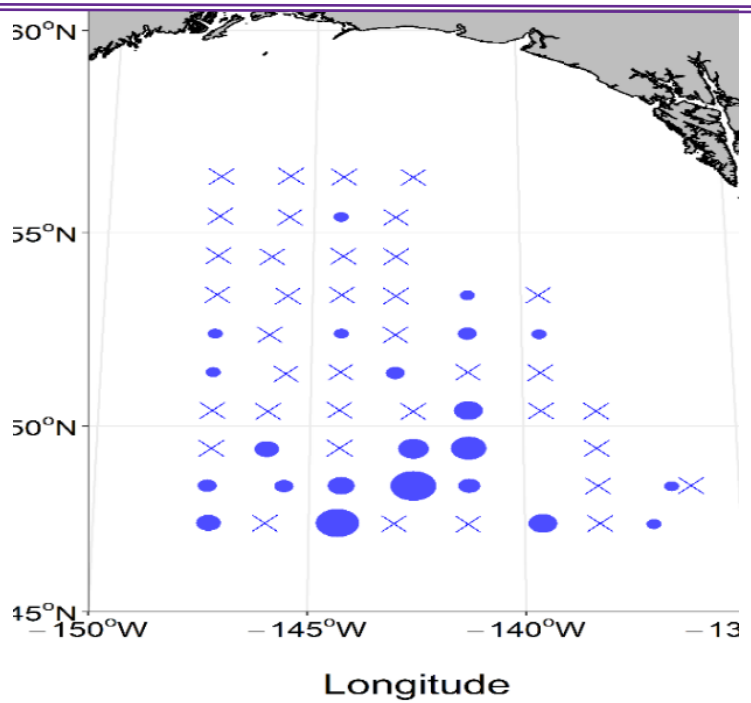
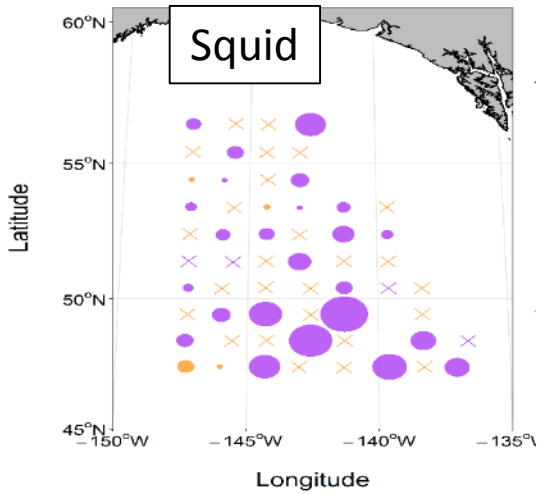
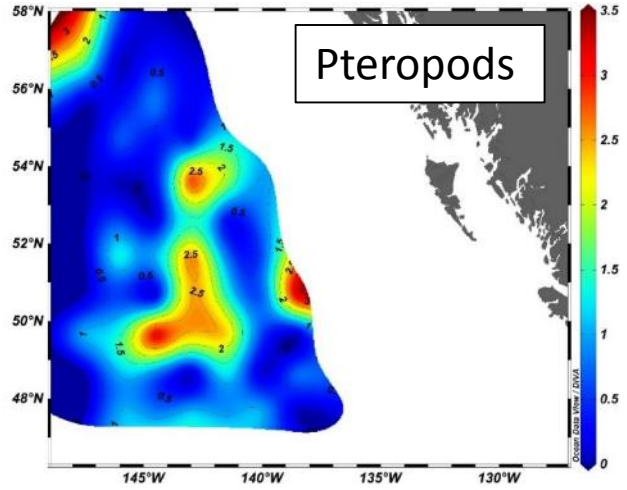
Coho salmon

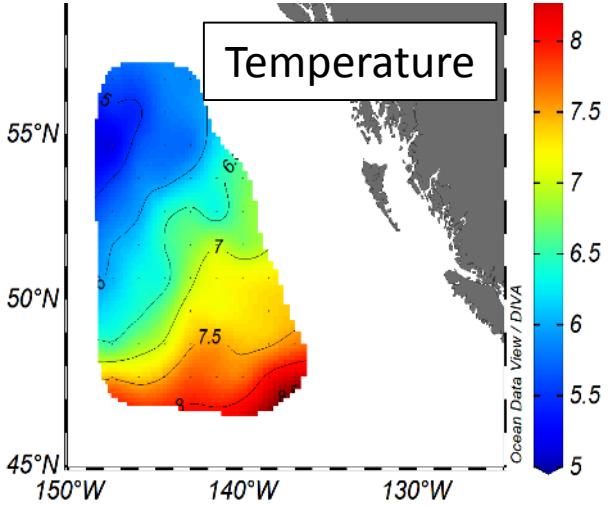
Squid in coho stomach



- Most in warmer waters of survey area.
- Distribution overlap with pteropods, which were important prey.
- Also overlap with squid, which were minor prey.

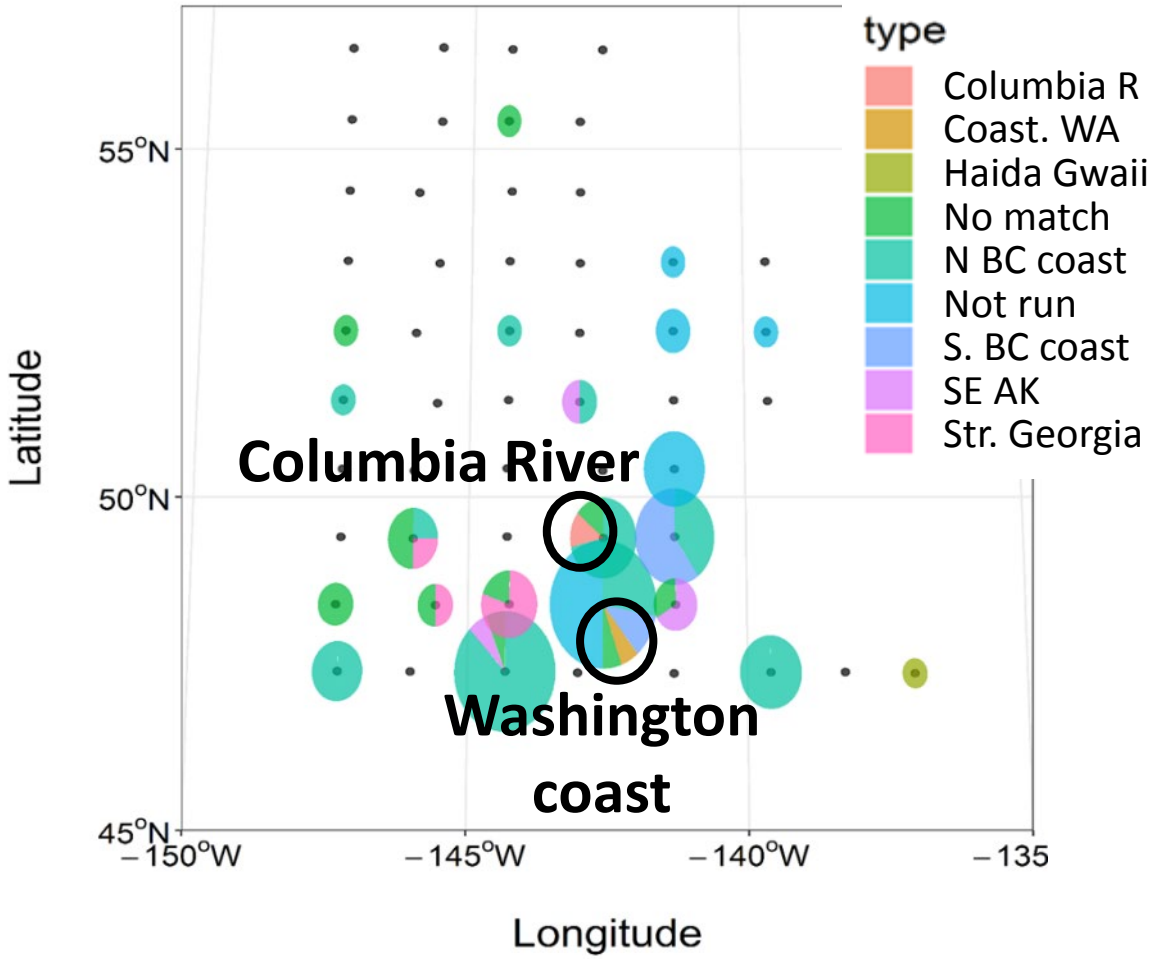




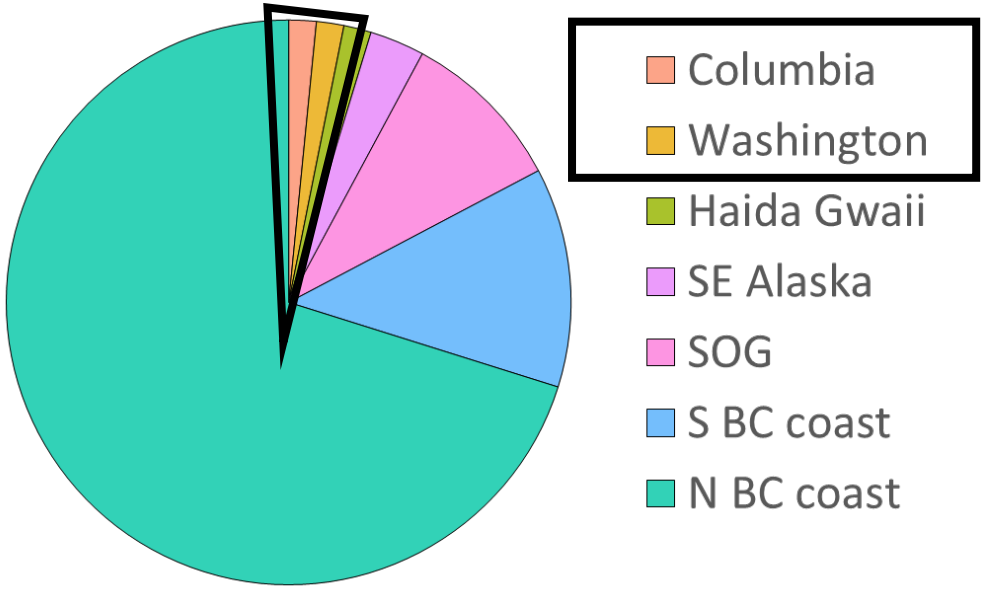


Coho at-sea genetic stock identification

Christoph Deeg, Canada

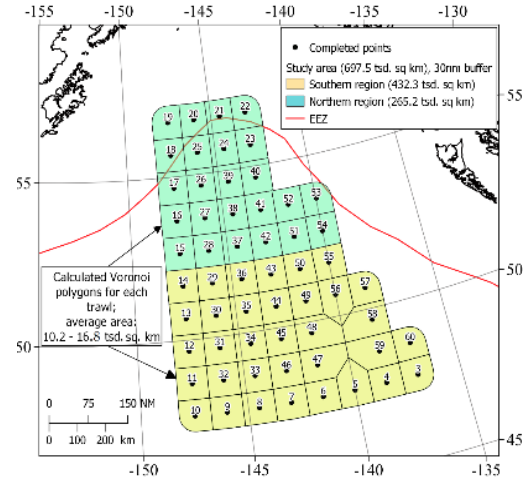


- Proof of concept testing of field based DNA analysis
  - DFO lead development
- Originate from Alaska to Columbia River with no spatial separation by stock



Salmon Abundance Estimates

Vladimir Radchenko (NPAFC) and
Aleksei Somov (Russia)

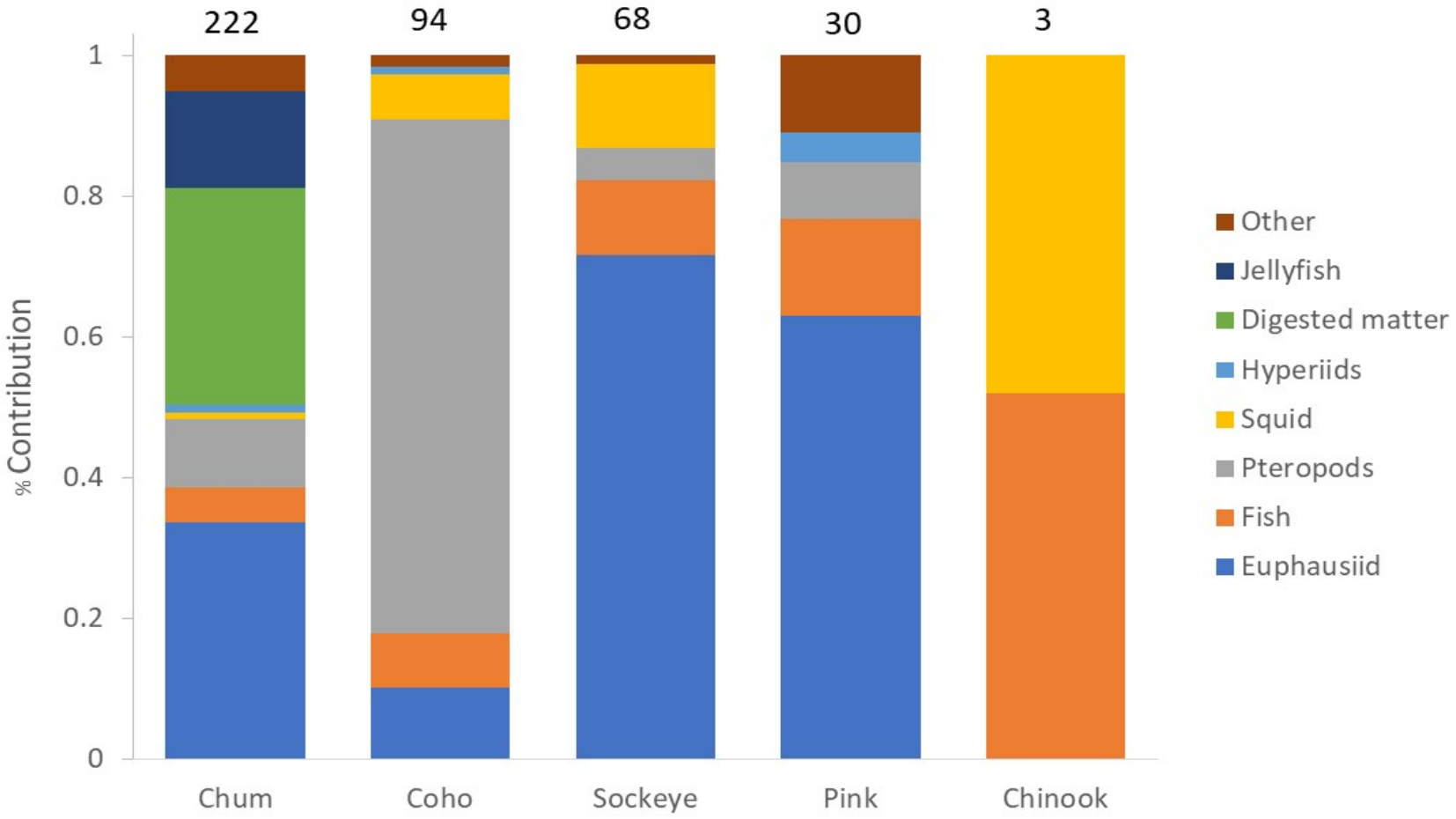


Salmon species	Number caught	% Frequ. of occurrence	Number (millions)	Biomass (1000 tons)
Chum	222	64	28	28
Coho	94	38	14	10
Sockeye	68	31	9	10
Pink	30	17	4	2
Chinook	3	5	0.4	1
All species	417	83	55	51

Major prey taxa by salmon species

Fish Team and prey ID's done by Anton Khleborodov, Russia

(number of stomachs above histogram)



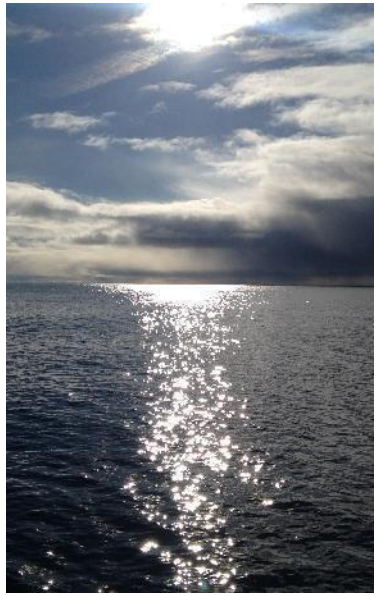
Cool catches

Deep sea squid in dogfish and Chinook stomachs

Threespine stickleback
Gasterosteus aculeatus

Transparent eel,
Thalassenchelys coheni

Microstomus pacificus

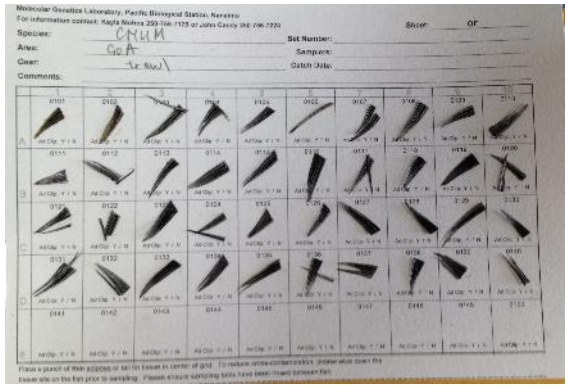


Initial impressions

- Winter surveys in the Gulf of Alaska are possible.
- International collaboration works (and is fun)!
- 1st ever estimate of salmon in the Gulf of Alaska (55 million)
- Salmon species differed substantially in their distributions with some showing potential links to environmental conditions
  - Sockeye and cool water
  - Pink and Coho warmer water
- Large variation in condition of fish (esp. chum) even in same haul
- At-sea genetic sequencing worked for coho!
  - Originate from Columbia R to SE Alaska
- Many more results to come…….

More to be done when samples reach shore …

- Genetic stock ID's of all salmon and confirmation of on-vessel analysis (proof of concept)
- Stock specific abundance estimates
- Fish health assessments
- Bioenergetics (energy density)
- Otolith analysis for early marine growth dynamics
- Otolith analysis for thermal marks
- Stable isotope and fatty acid analysis of salmon, by-catch and zooplankton
- eDNA analysis
- Integration of data and informatio
- Spectral analysis for primary produ
- and still more…….



Life on a Russian ship

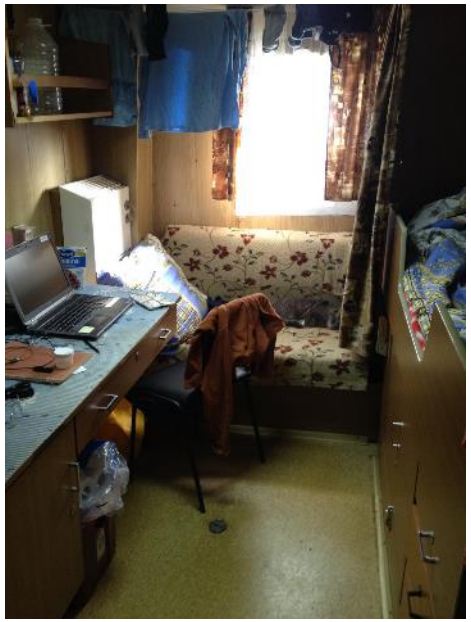
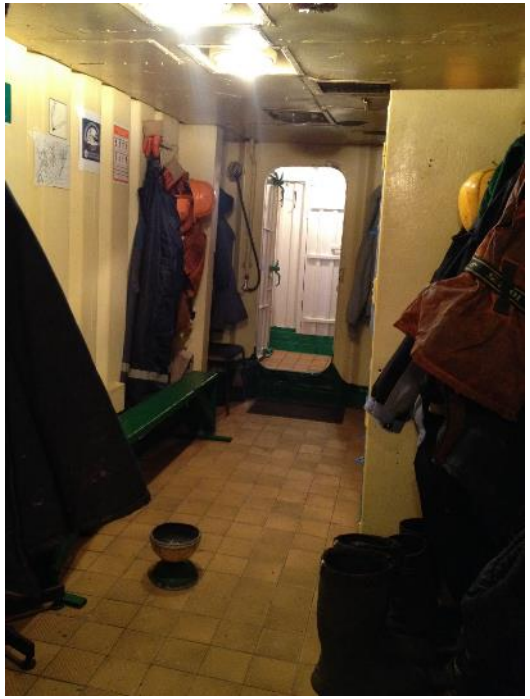
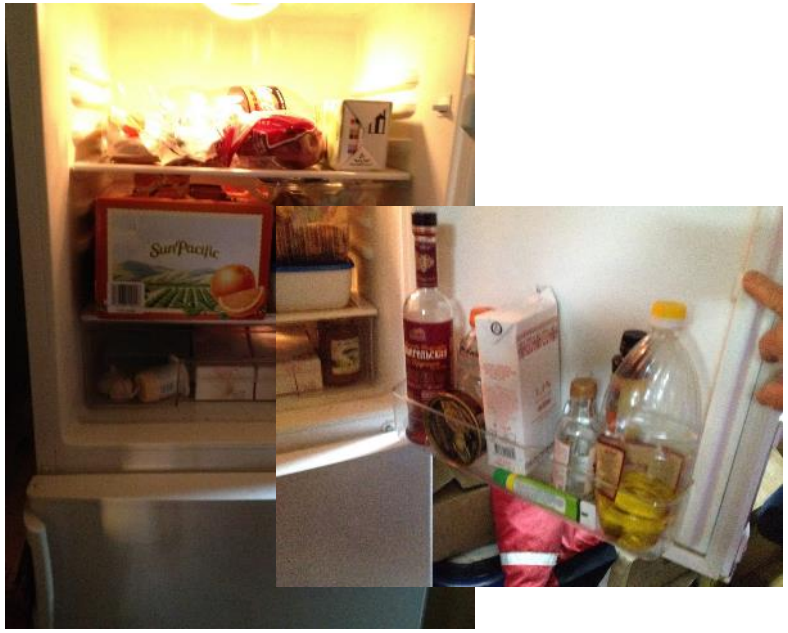


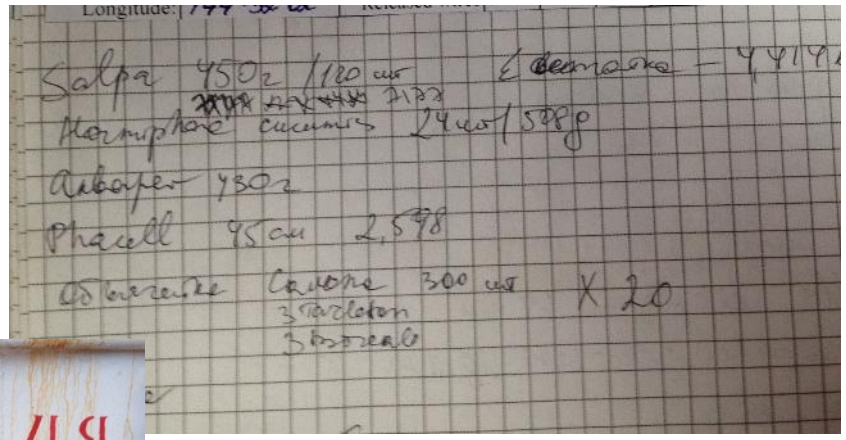
Photo by S. Esenkulova

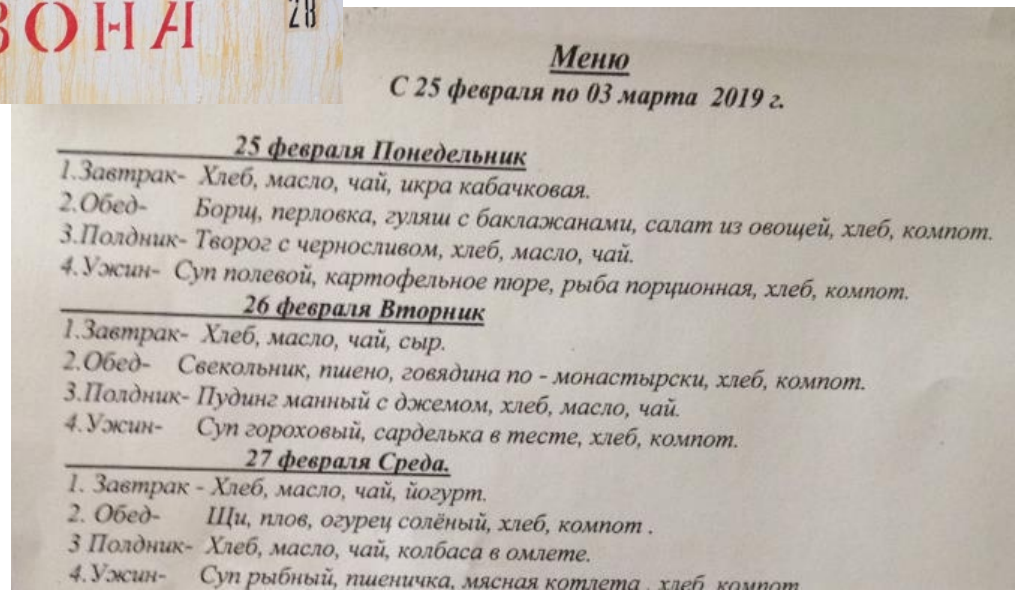


Like a well lived-in house, stuff everywhere! The fish lab



Deciphering written Russian (not!)





Меню

С 25 февраля по 03 марта 2019 г.

25 февраля Понедельник

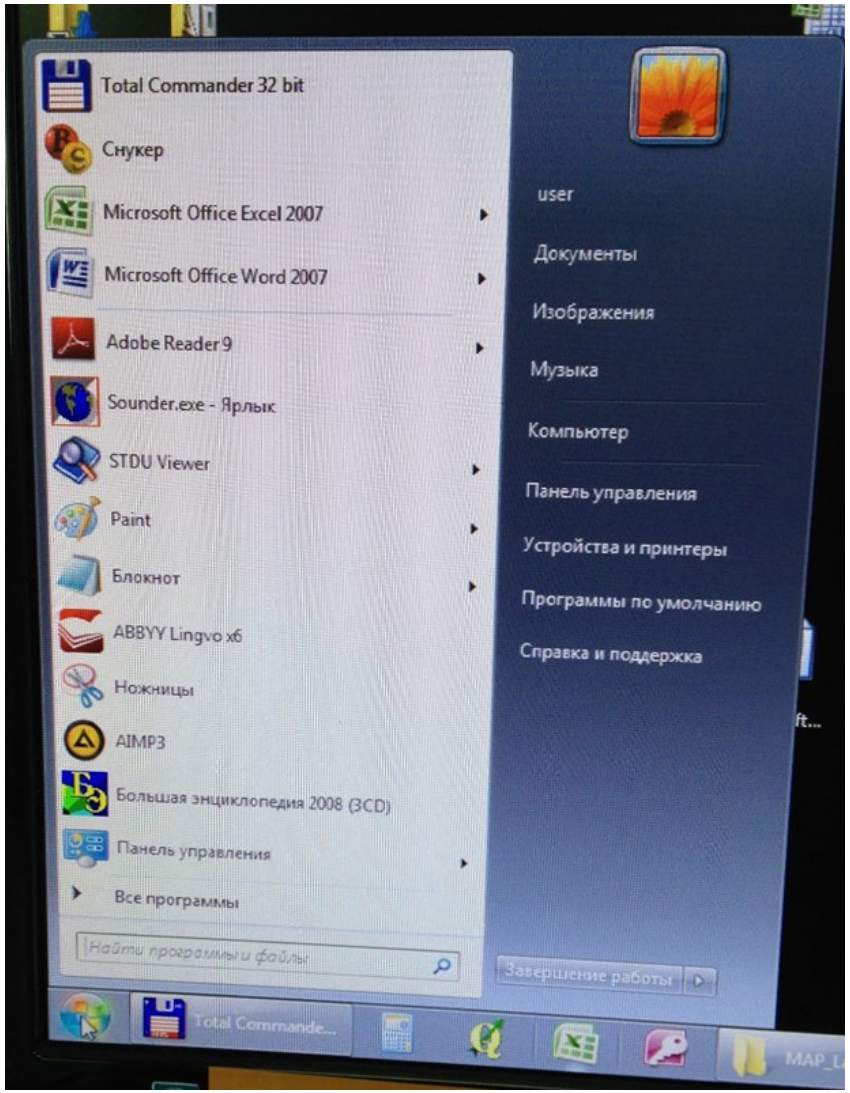
1.Завтрак- Хлеб, масло, чай, икра кабачковая.
2.Обед- Борщ, перловка, гуляш с баклажанами, салат из овощей, хлеб, компот.
3.Полдник- Творог с черносливом, хлеб, масло, чай.
4.Ужин- Суп полевой, картофельное пюре, рыба порционная, хлеб, компот.

26 февраля Вторник

1.Завтрак- Хлеб, масло, чай, сыр.
2.Обед- Свекольник, пшено, говядина по - монастырски, хлеб, компот.
3.Полдник- Пудинг манный с джемом, хлеб, масло, чай.
4.Ужин- Суп гороховый, сарделька в тесте, хлеб, компот.

27 февраля Среда.

1. Завтрак - Хлеб, масло, чай, йогурт.
2. Обед- Щи, плов, огурец солёный, хлеб, компот .
3 Полдник- Хлеб, масло, чай, колбаса в омлете.
4.Ужин- Суп рыбный, пшеничка, мясная котлета , хлеб, компот



Food


Photo by C. Waters

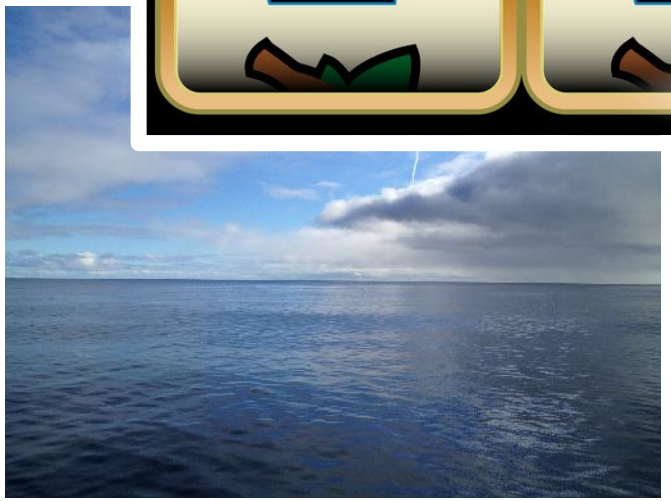

Photo by C. Waters

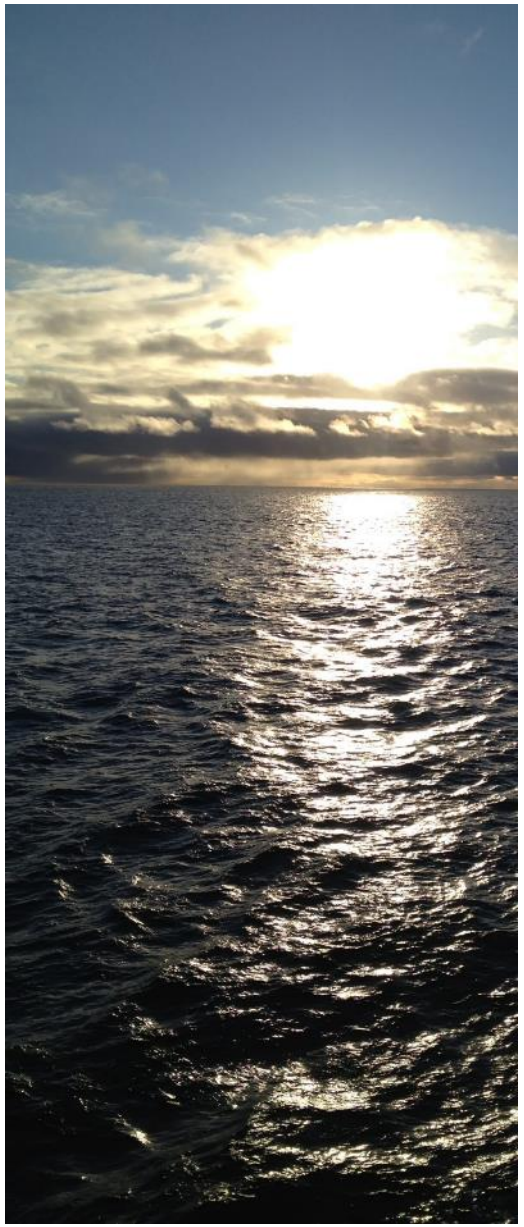

Photo by C. Waters


Photo by C. Waters


Photo by C. Waters

Weather







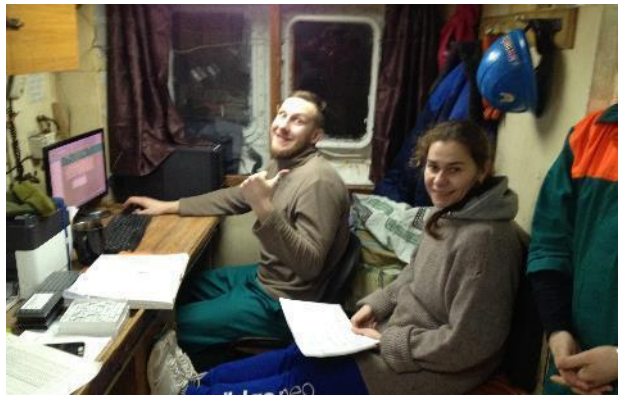
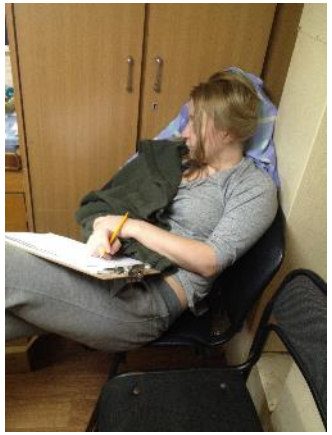
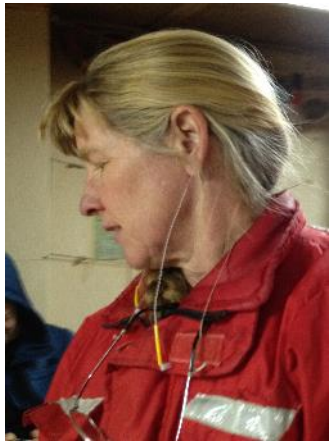


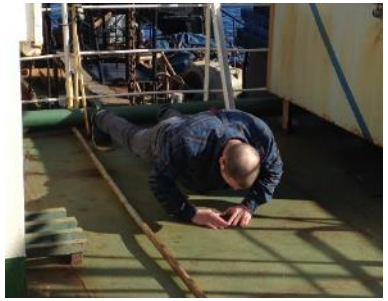




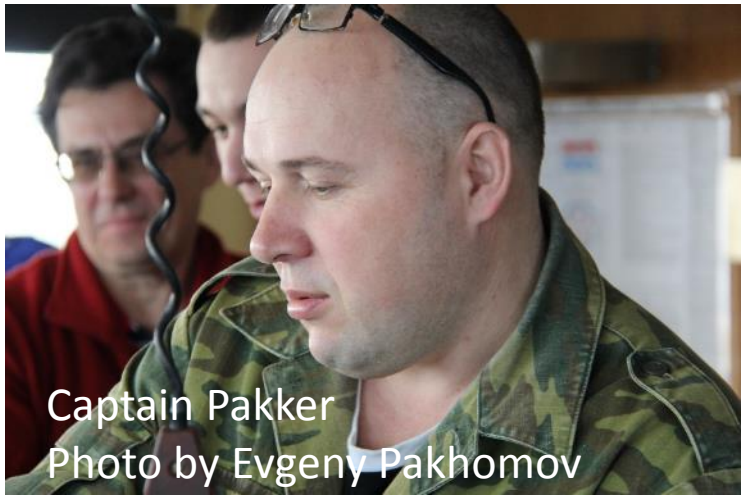


Photo by L. Palensky

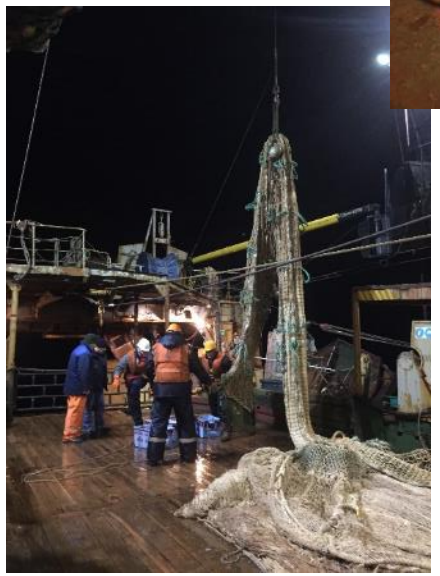






Deepest gratitude to the sponsors! And to the Prof. Kaganovsky crew, officers, mechanics and Captain Alexander Pakker !!!



Captain Pakker
Photo by Evgeny Pakhomov



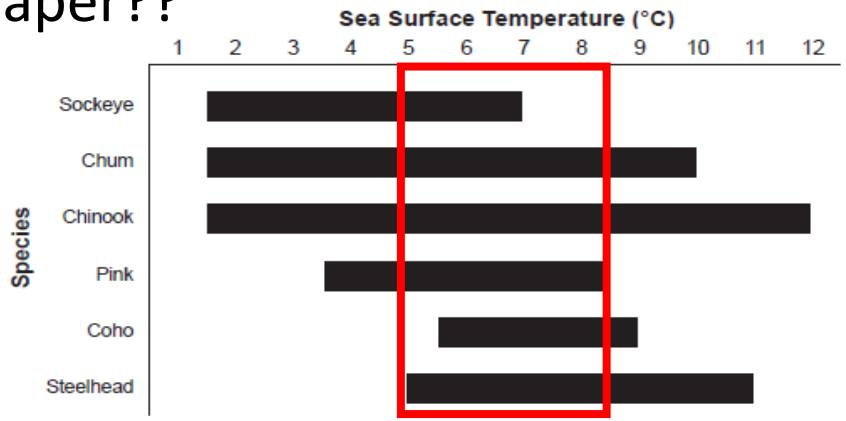

Questions?
https://yearofthesalmon.org/gulf-of-alaska-expedition/

New salmon questions

Where are all the **pink** salmon?

- Most abundant salmon species in N Pacific
- 2019 should be big return year

Salmon winter temperature preferences (Myers et al. 2016) cover our entire study area, yet we observed fine-scale temperature selectivity. Didn't they read the paper??



Myers et al. 2016. NPAFC Bull 6.

Coho are a "coastal" species and were minor species in previous winter surveys

➔ 2nd most abundant species in our survey.

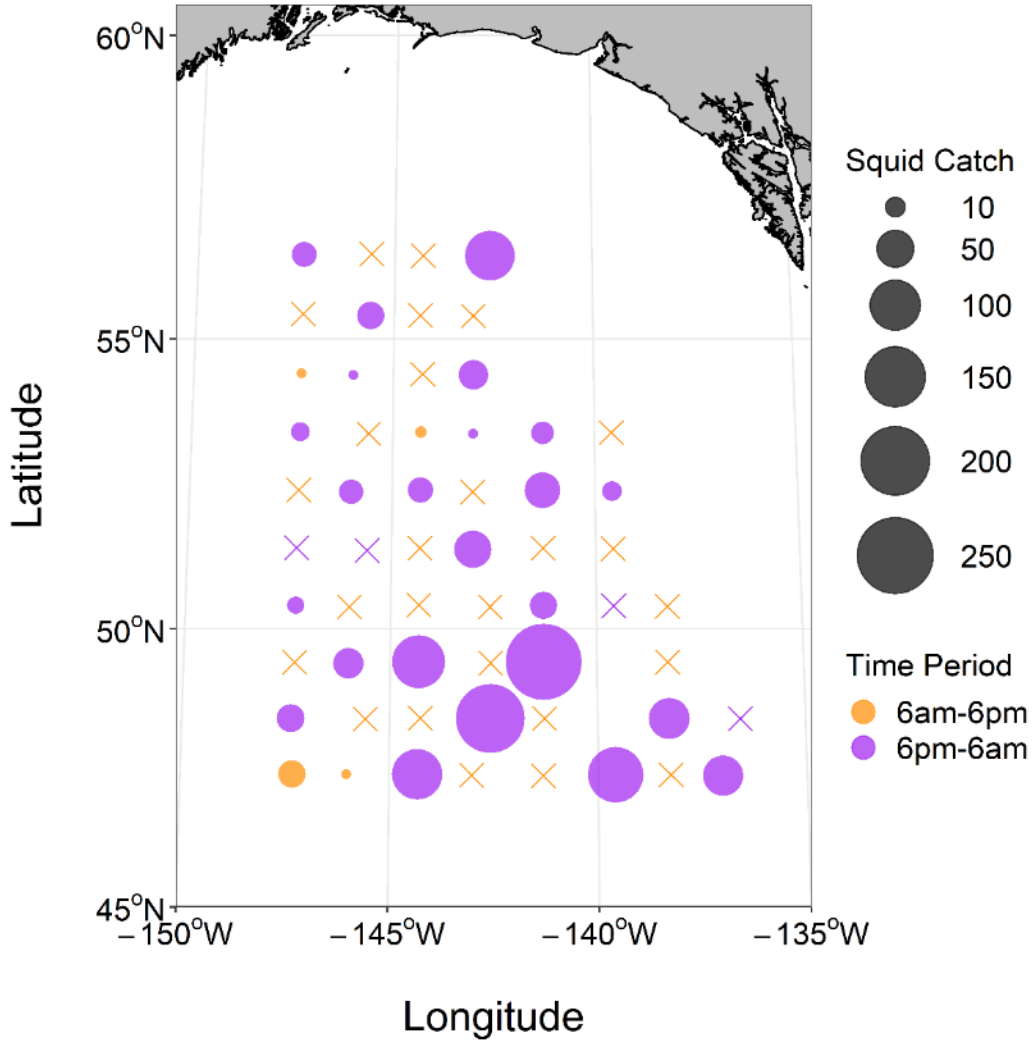
- Bumper crop to come?
- Change in distributions? Why?

- Where were the skinny **chum** when they were getting skinny? Are the skinny **chum** largely one stock and the fat ones another (N America or Asia)?
- Where were the fat **sockeye** that allowed them to get to fat?

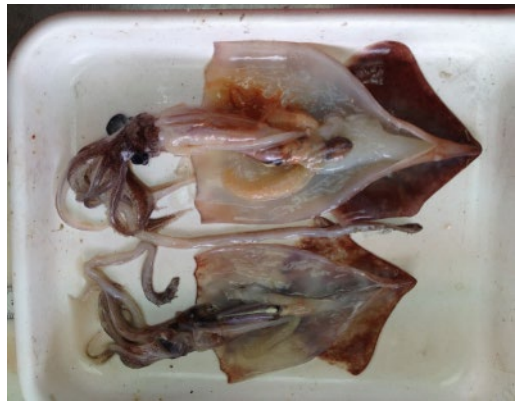
➔Obvious visceral fat, subcutaneous fat layer.

Total catch of squid by day/night

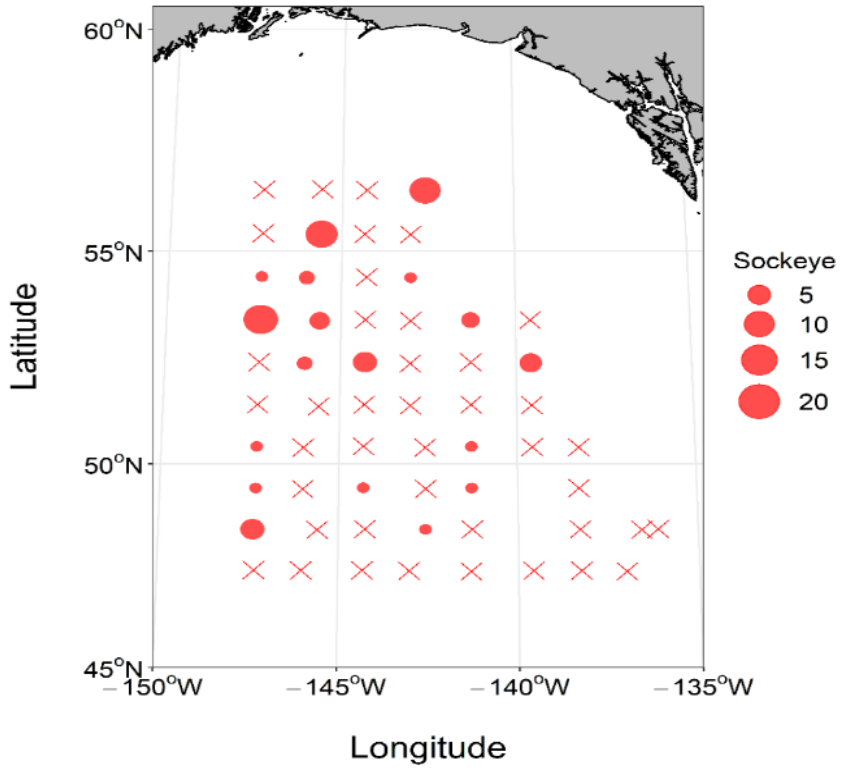
Mikhail Zuev (Russia), Svetlana Esenkulova (Canada)

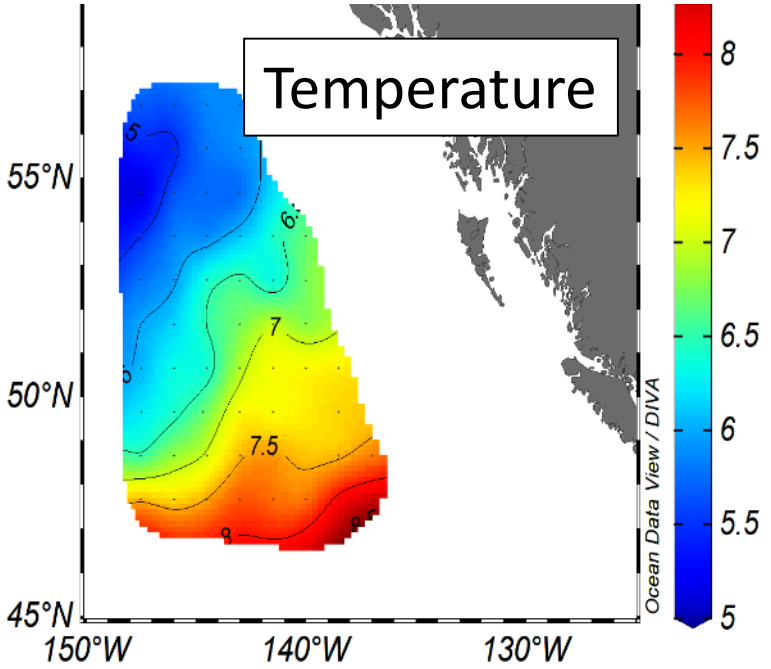


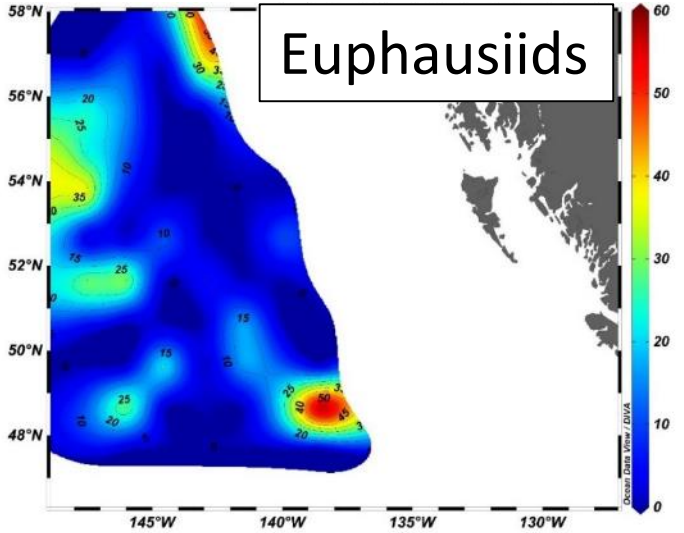
- 95% caught at night
- 1 to 5 species in any set
- 90% of catch one species (*Boreteothis* [=*Gonatopsis*] *borealis*), juv & adults
- All species pelagic
- Possible spawning range extension for some species



Sockeye salmon





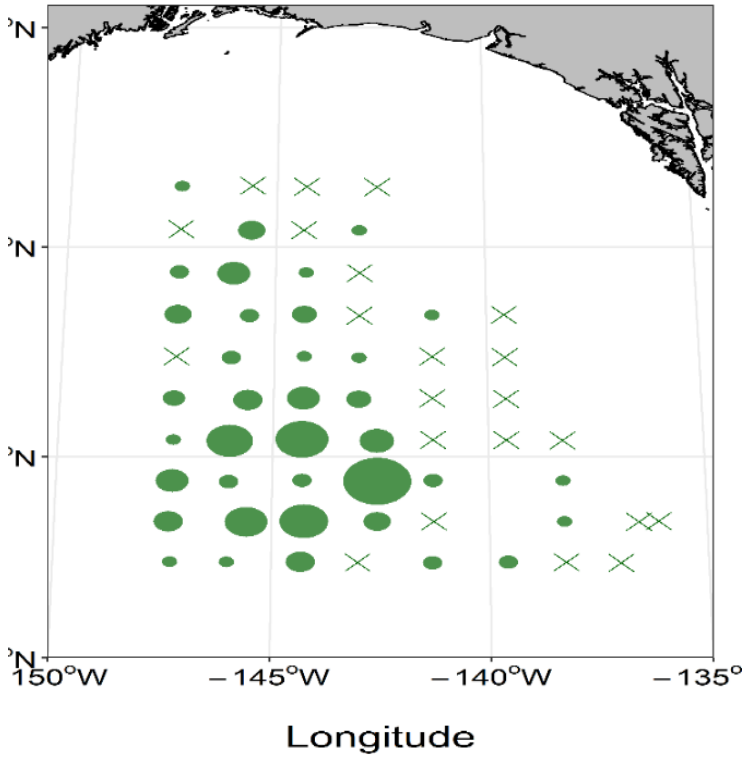


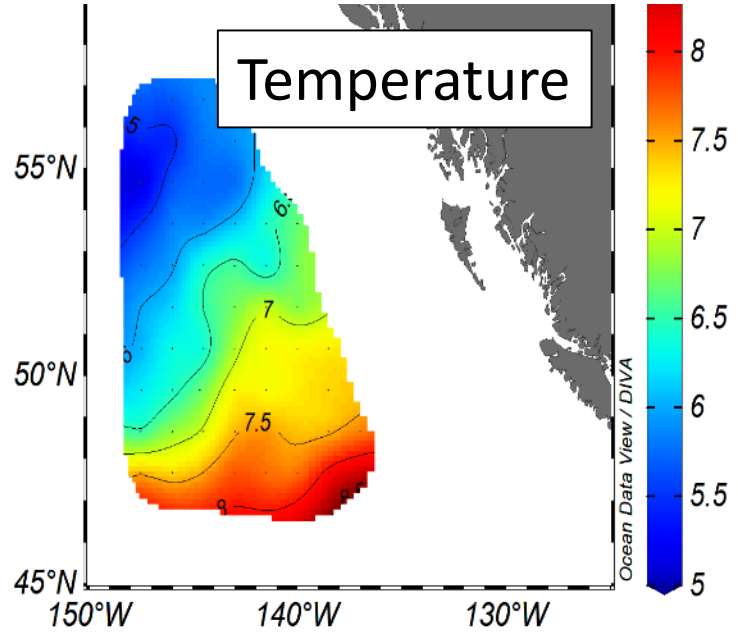
-Distribution primarily in cooler waters in north.

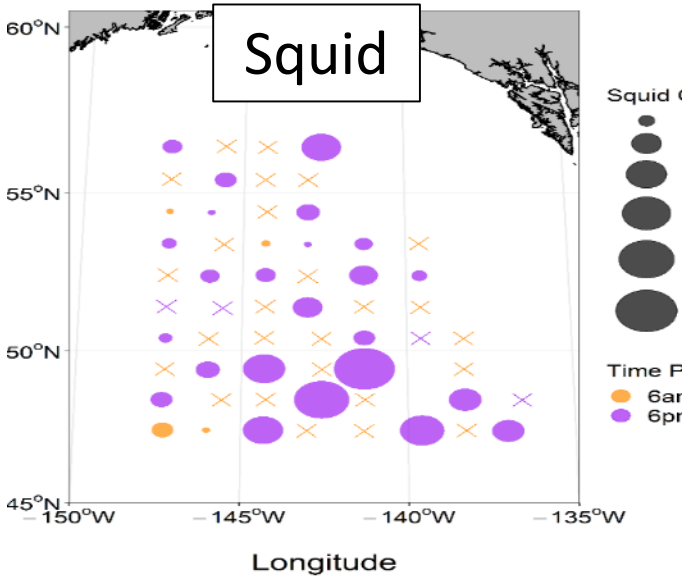
- Distribution overlapped euphausiid concentrations, which were dominant prey in north.

Chum salmon

Skinny chum







-Widely distributed, but highest in south (=wide temp range).

- Lowest condition and many empty stomachs

- Possible overlap with squid, but not eating squid