Overview of methodology and high level results of Russian salmon research and comparison with obtained results in 2019 GoA salmon expedition

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This speech is about:

• Brief history of Russian high seas research on salmon

• Modern Russian survey program overview

• Main results of 3-decades of salmon research in high seas

• 2019 GoA survey in comparison with surveys in the western and central North Pacific
Stages of high-seas trawl research

• Forecast crash in 1985

• First winter surveys 1986-1992

• Methodology development (1991-2000)

• Modern survey plan (2000-present)
Modern high-seas surveys

• Focused on Pink salmon which is the most abundant and commercially important salmonid species for Russia
• Cover three phases of salmon marine period
  a) Fall surveys on juveniles (Bering and Okhotsk seas)
  b) Winter-spring surveys (Northwestern and Central Pacific)
  c) Early summer surveys on mature salmon (Northwestern Pacific and Bering Sea)
Total overview

- More than 6500 samples

![RV «Professor Kaganovsky»](image1)
![RV «Professor Levanidov»](image2)
![RV «TINRO»](image3)

Trawl samples for the period of 1999-2018
Methods

- Trawlings
- Plankton samples
- Oceanographic samples
- Acoustic sounding
- Trophological analysis

V = 4-5 knots
Time - 1 hour
Headrope depth - 0 m
Vertical opening - 30 m
Horizontal opening - 45-50 m

Database
Fall surveys on juveniles – Bering Sea

• Period:
  End of September-beginning of October (30 days)

• Frequency – annually

• One major stock

• Precise forecast
Fall surveys on juveniles – Bering Sea

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\[
\text{approaches} = 19,0763 + 0,1607x; \quad 0,95 \text{ Conf.Int.}
\]
Fall surveys on juveniles – Okhotsk Sea

• Period: End of October-beginning of November (40-45 days)
• Frequency – annually
• Mixed stocks
• Needs genetic differentiation
• Forecast is not very precise

[Diagram showing the Okhotsk Sea with mixed aggregations and arrows indicating movement.]

Sea of Okhotsk
Mixed aggregations
Russia
Kamchatka
Japan
Fall surveys on juveniles – Okhotsk Sea

- **Period:** October-November (40-45 days)
- **Frequency:** annually
- **Mixed stocks**
- **Needs genetic differentiation**
- **Forecast is not very precise**

map with arrows indicating:
- make sure salmon is offshore
- Process the remain area
- cut off Kuril Straits
Summer surveys on maturing salmon

- **Period:**
  - June-July (40-45 days)

- **Frequency**
  - annually in Kuril waters
  - odd years in Bering sea

- Vessels predominantly move against the migration flow
Summer surveys on maturing salmon

• No problem for Bering Sea
  • One major stock
  • Precise estimation

• Problems for Kuril waters
  • Mixed stocks
  • Precise estimations but for the whole basin
  • Express differentiation is needed
Summer surveys on maturing salmon

- No problem for Bering Sea
  - One major stock
  - Precise forecast

- Problems for Kuril waters
  - Mixed stocks
  - Forecast only for the whole basin
  - Express differentiation is needed
Winter surveys

• Period: February-April (30 days)
• Frequency – occasionally
• Cons:
  • Mixed stocks
  • Salmon spread spatially and vertically
  • Hard to estimate total abundance
  • Not applicable for the forecast
• Pros:
  • winter environment
  • biological condition
  • survival

Reliable abundance estimations are possible if the whole winter habitat is covered by several vessels
Surveys comparison

• Fall and Summer surveys (migration)
  • Salmon are more aggregated (spatially – within basin, vertically – within 30 m)
  • Total abundance estimations (survey covers almost all salmon concentrations of pink salmon)
  • Applicable for the **forecast**
  • Require precise time period as the salmon migrates rapidly

• Winter surveys (quasi-stable)
  • Salmon are mixed and distributed spatially and vertically (down to 100 m and deeper)
  • Abundance estimations are not reliable
  • Not applicable for the forecast
  • More appropriate to study fundamental issues
    • Distribution patterns
    • Food supply and feeding condition
    • Biological condition
    • Survival
Main results of Russia’s high-seas research

- Distribution patterns and abundance estimations
Main results of Russia’s high-seas research

• Wide-front migrations
Main results of Russia’s high-seas research

• Seasonal changes in feeding intensity (ISF ‰) - stomach content/fish weight ratio

Salmon/zooplankton abundance ratio is very low for every season
Main results of Russia’s high-seas research

- Ecosystem role and trophic interactions of salmon and other ecosystem components

Food web model of pelagic community in western Bering Sea

Food web model of pelagic community in Northwestern Pacific

Zavolokin, 2014
2019 GoA IYS Survey

- Partially filled the spatial gap in salmon winter ecology study
- Gave comparable data on:
  - zooplankton abundance and composition
  - pelagic nektonic community
  - abundance, distribution and biological information on salmon
2019 GoA IYS Survey

• Chum salmon:
  • Abundance of 1\textsuperscript{st} winter individuals decreased eastward. The highest abundance was in the Central Pacific
  • Abundance of 2\textsuperscript{nd} winter and older individuals increased eastward
  • Size (age) structure changed eastward:
    • No second years in WP
    • Older individuals in GoA

![Chum salmon distribution map and relative abundance and size composition graph]

Blue – 30-50 cm
Red – 10-30 cm
2019 GoA IYS Survey

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  - Abundance of 1\textsuperscript{st} winter individuals decreased eastward. The highest abundance was in the Central Pacific.
  - Abundance of 2\textsuperscript{nd} winter and older individuals increased eastward.
  - Size (age) structure changed eastward:
    - No second years in WP
    - Older individuals in GoA
  - In agreement with migration model (Urawa 2000, 2004)

*Relative abundance and size composition*

- Blue – 30-50 cm
- Red – 10-30 cm
2019 GoA IYS Survey

• Sockeye salmon:
  • 1<sup>st</sup> winter individuals were abundant in CP, less in WP and rare in GoA
  • 2<sup>nd</sup> winter and older individuals distributed more smooth with the highest abundance in CP

• Habitat differentiation:
  • Early-years mostly in CP
  • Older-years in WP and GoA

Relative abundance and size composition

Blue – 30-50 cm
Red – 10-30 cm
2019 GoA IYS Survey

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From Beacham et al., 2014 and after Myers et al., 2007
2019 GoA IYS Survey

• Pink salmon:
  • Abundance decreased eastward (but we do not know reliability of data in GoA)
  • Similar size structure
2019 GoA IYS Survey

- Coho salmon:
  - More abundant in central pacific
  - Average size is higher in GoA
Conclusion

• Forecast crash in 1985 was a trigger of high-seas research development
• Modern Russia’s research program aims at Pink salmon forecasting
• Fall and Summer surveys are good for forecast while winter ones are more appropriate to study fundamental issues
• Russia made a great contribution into salmon ocean research=
• 2019 GoA survey gave interesting and comparable data showing spatial differentiation in winter habitat
Thank you!!

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