Session Summary 3-4:

Production Trends and Carrying Capacity of Salmon

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Topics

1. Temporal change in abundance, carrying capacity relating to long-term climate change
2. Interaction between wild & hatchery salmon
3. Global warming effect and future prediction
4. Population density-dependent effect
5. Juvenile biology

Temporal change in abundance, carrying capacity relating to long-term climate change

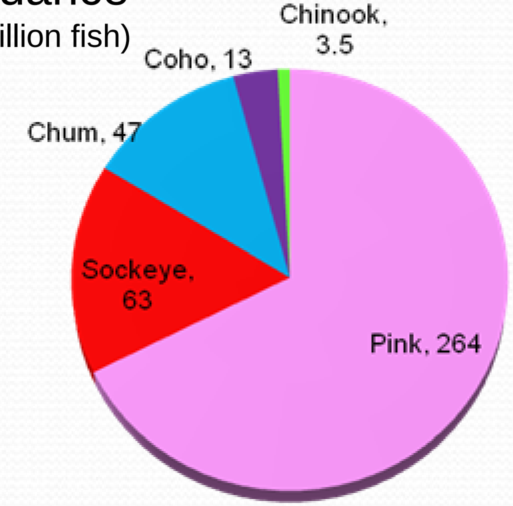
- Abundance in 1952-2000 (Wild salmon)
  Pink 70%
  Sockeye 17%
  Chum 13% (Ruggerone et al.)

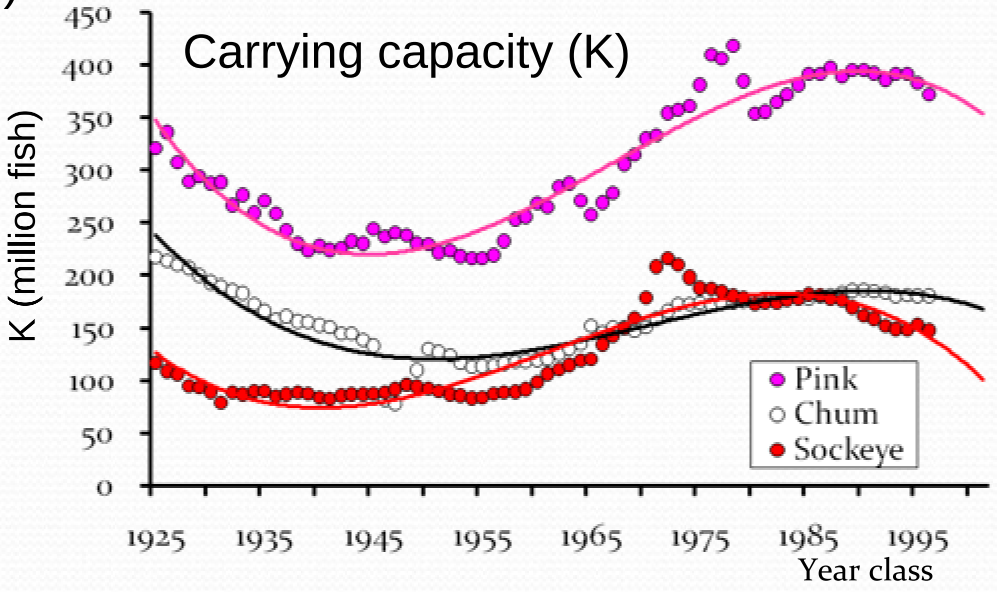
- Carrying capacity since 1975 (mean)
  Pink: 386 million fish
  Sockeye: 171 million fish
  Chum: 179 million fish
  (Kaeriyama et al.)

- Carrying capacity / productivety is shynchronized with long-term claimate change (Kaeriyama et al., Klyashtorin & Lyubushin, Mantua et al.)

- Carrying capacity for chum salmon is enough in the Bering Sea (Asumaya et al., Session 2)

Abundance
(Unit: million fish)



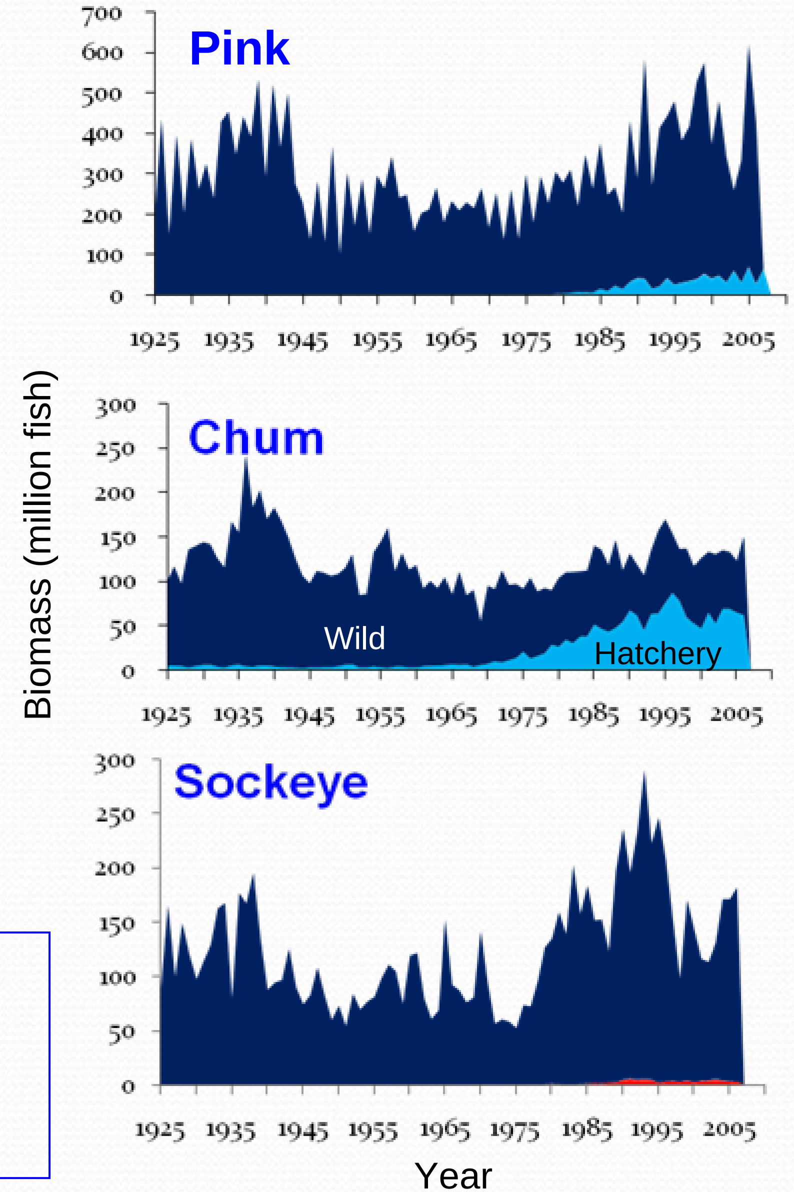


Interaction between wild & hatchery salmon

- Release of juvenile salmon from hatcheries in the 1970s and 1980s were 79 million in chum, 46 million in pink , 3.5 million in coho, 2.9 million in sockeye, and 2.2 million in Chinook salmon (Ruggerone et al.)

- Hatchery salmon occupied 60% in chum, less than 10% in pink and sockeye salmon for the biomass level since the 1990s (Kaeriyama et al.)

- MALBEC Modeling indicates that under scenarios of Pacific-wide reduced hatchery production the total of wild Alaskan chum salmon increase (Mantua et al.)



Hatchery salmon (Biomass)

Pink	<10%
Chum	60%
Sockeye	<10%

Population density-dependent effect

- Residual carrying capacity of Hokkaido chum salmon was positively correlated with body size and negatively correlated with mean age at maturity, being caused by the population density-dependent effect. (Kaeriyama et al., Seo et al.)

- Both ocean condition and population density have been shown to influence body size for chum salmon (Helle et al.).

- MALBEC Modeling results that density-dependent interaction in the ocean yields better fits to observed run-size data (Mantua et al.).

- Significant negative correlation was observed between total catches of Pacific salmon and fork lengths of Anadir River chum salmon (Zavolokina et al.)

- The fish bionergetic model resulted that body size reduction of Japanese chum salmon was caused by the prey density in the eastern North Pacific during winter and spring seasons (Aumaya et al., Session 2)

Juvenile biology

- Periodicity (7-8 years) of juvenile Pacific salmon abundance analogized the cycles of solar activity (11 years) (Koval).

- High abundance period of juvenile Pacific salmon coincided with it of Atka mackerel, despite antiphase of walley Pollock abundance in the western Bering Sea and North Pacific Ocean, and eastern Okhotsk Sea (Koval).

- According to the spatially explicit bioenergetics model (GRP) and spring sea surface temperature (SST), for juvenile chum salmon, energetic limitations negatively affect habitat quality and carrying capacity on the Bering Sea shelf during years with cool spring SSTs (Farley Jr & Moss)