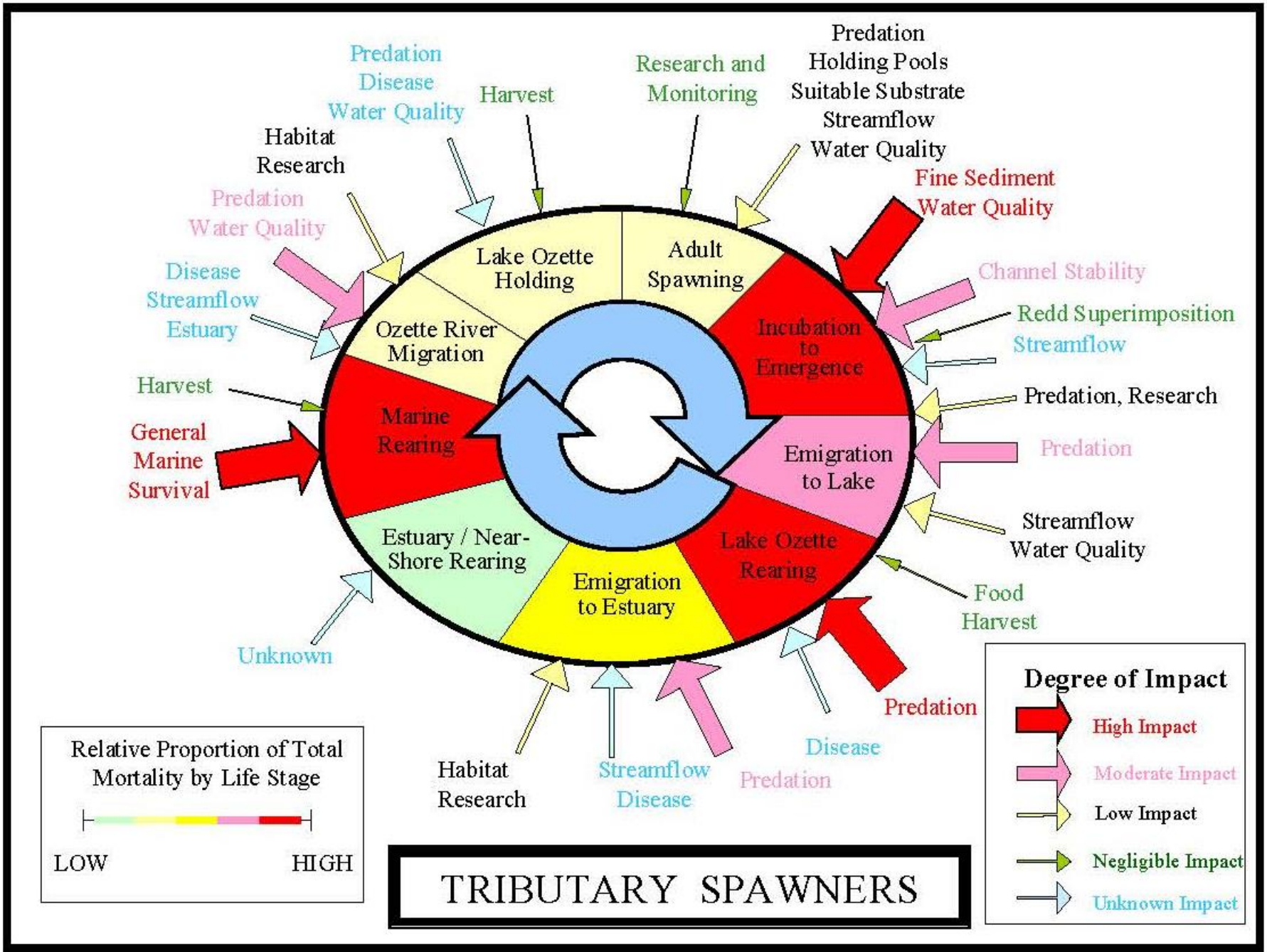
Predation of Sockeye Salmon Fry in the Cedar River: A Review of Past Studies

U.S. FISH & WILDLIFE SERVICE

King County

Washington Department of FISH and WILDLIFE

Recovery Plan for Lake Ozette Sockeye Salmon



Recovery Plan for Lake Ozette Sockeye Salmon

Estimates of post-release survival for the 1998 brood year Umbrella Creek Hatchery released fingerlings moving downstream from RM 4.8 to RM 0.8 ranged from 74 percent to 40 percent.

Burgner (1991) reviewed several studies conducted to determine fry predation rates for riverine spawned sockeye fry emigrating to nursery lakes and found widely ranging values: 63 to 84 percent (Lake Lakelse), 66 percent (Babine Lake), 13 to 91 percent (Karymaiskiy Spring, Kamchatka Peninsula), and 25 to 69 percent (Cedar River, Lake Washington).

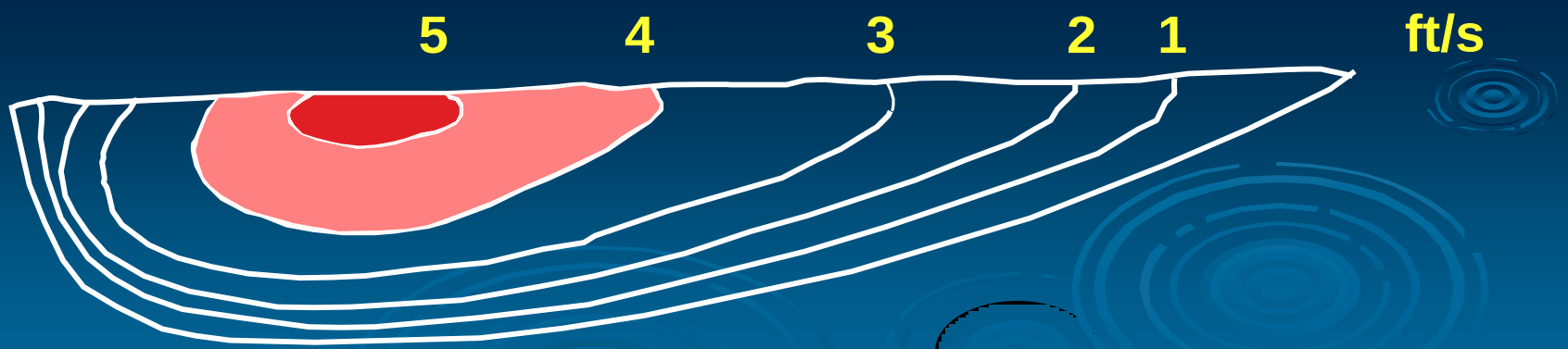
Cedar River Fry Predation Studies

- Predation by steelhead smolts - 1985
  (UW – D. Beauchamp)
- Survival of Hatchery Fry (WDFW) – 1995-1997
- Lower River sampling – 1995-2000
  (USFWS) USACOE dredging project
- Habitat based sampling - 1998-99
  (USFWS)
- Predation by resident trout – 2008, 2010
  (USFWS, King County, WDFW)


Lake Washington Basin
Lake Washington
Bear Creek
Lake Sammamish
Issaquah Creek
Cedar River
Cedar Falls
Landsburg Dam

Background

- Primarily migrate at night
- One or two nights to reach the lake
- Select channel areas with high velocities



Piscivorous Fishes

- Cutthroat trout
- Rainbow trout/steelhead
- Juvenile coho salmon

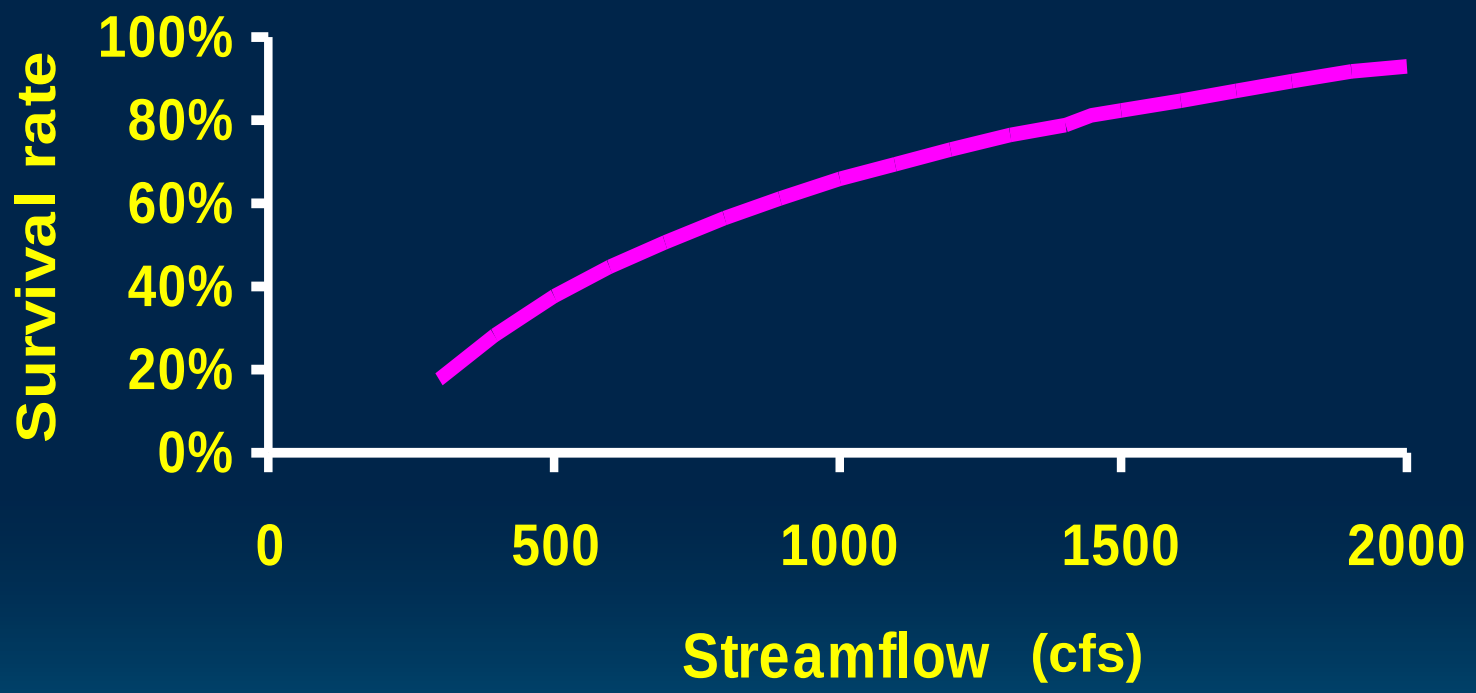
- Torrent sculpin
- Prickly sculpin
- Riffle sculpin
- Coastrange sculpin
- Shorthead sculpin

Predation by Steelhead Smolts

D. Beauchamp - 1985

- Objective – estimate predation losses of by fry by steelhead smolts (the major predator)
- Fry made up 3-72% of the diet
- Estimated 6.8 million fry consumed
- Estimated 15% of fry were lost to predation
- Concluded riverine predation is a significant source of fry mortality

Survival of Hatchery Fry – WDFW
Landsburg to Lake 1995-1997



Lower River sampling

- Objective – examine various factors that influence predation
- Sampling was part of flood control project – City of Renton, Corps of Engineers – 1995-2000
- Logistic regression model, GLIM analysis
- Factors examined
  - Streamflow
  - Fry abundance
  - Temperature
  - Light intensity
  - Habitat type
  - Predator size
- Analyses
  - Sculpin, n = 4,634
  - Salmonids < 130, n = 549
  - Salmonids > 130, n = 752

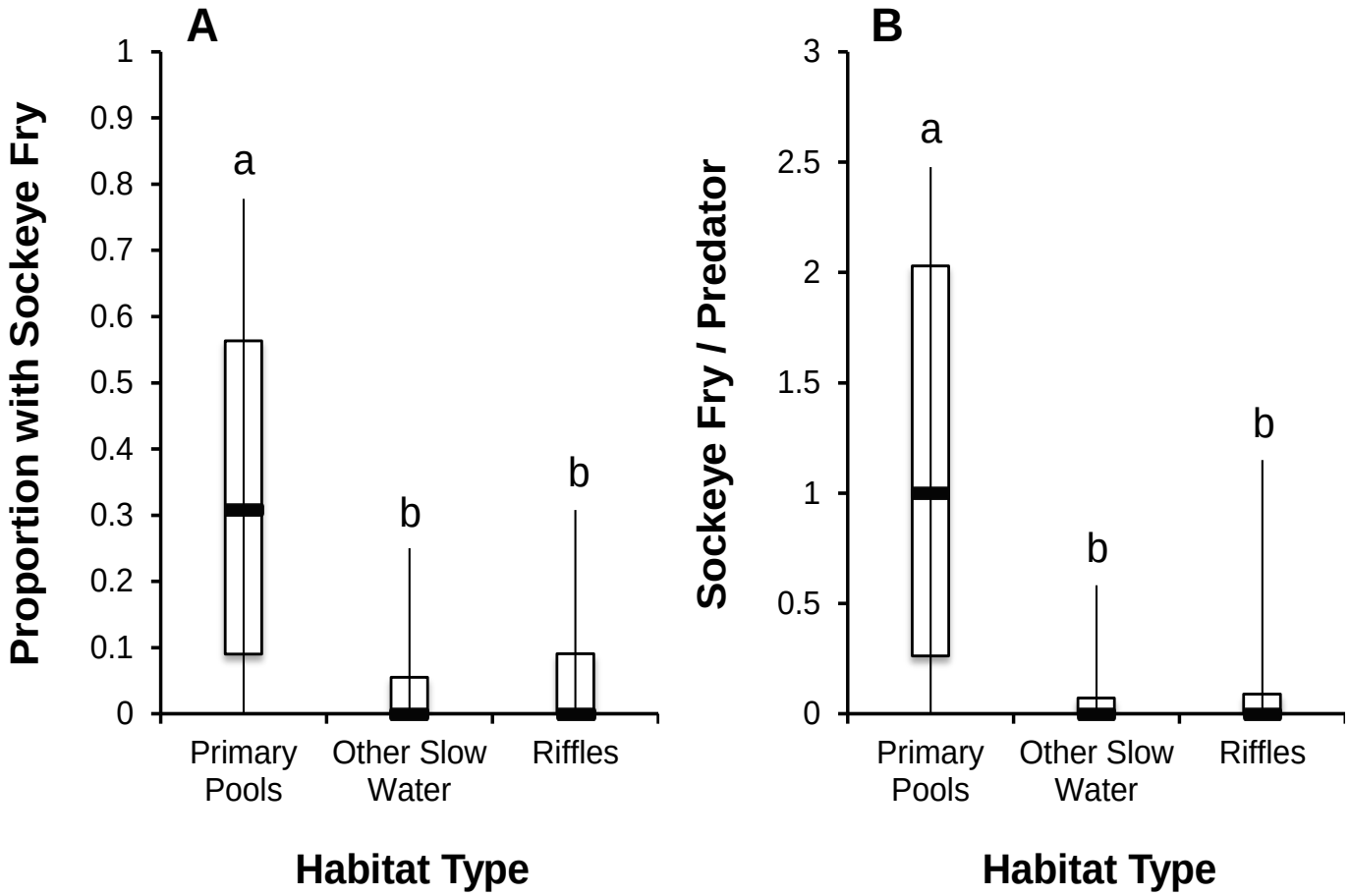
Logistic regression - Sculpin

- Best model
  - Log (fry abundance) - positive
  - Log (streamflow)- negative
  - Habitat type – primary and sec. pools only
  - Light intensity category – bright light only
  - Predator length – slight negative

Habitat-based sampling 1998-99

- Objective – examine spatial differences in predation
- Sampled after hatchery releases
- Sampled 6 nights in 1998 and 2 in 1999
- Streamflows were between 530 to 700 cfs
- Habitat types
  - Primary Pools
  - Other slow-water habitats
  - Riffles

Predation by Torrent Sculpin



Predation by Resident Trout 2008, 2010

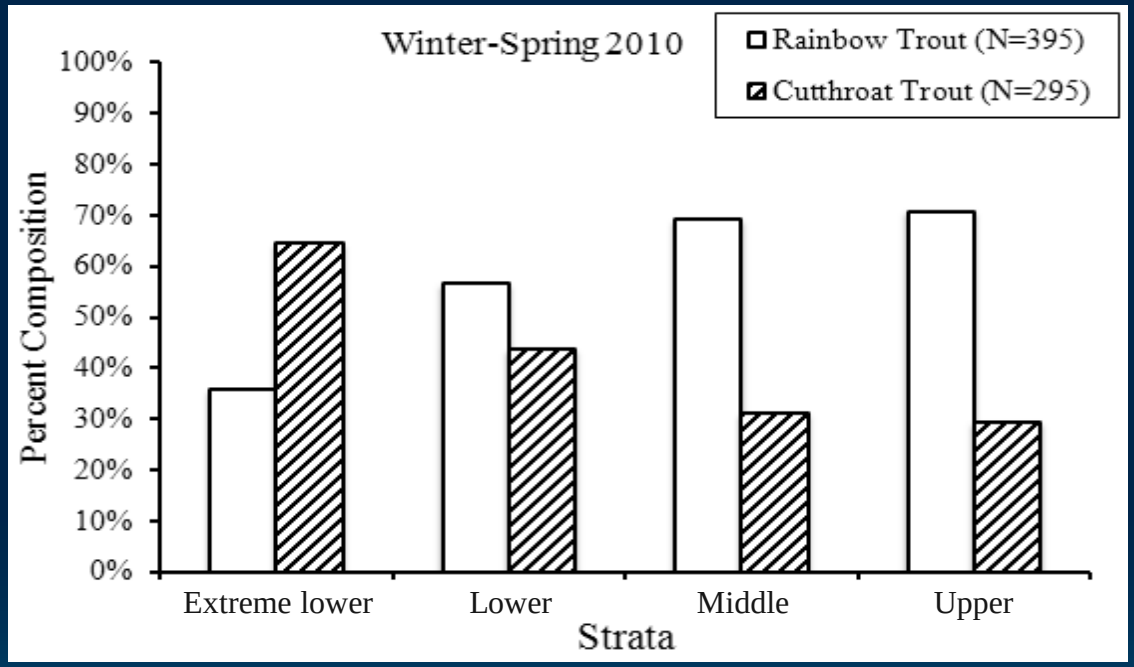
Summer

Winter-Spring

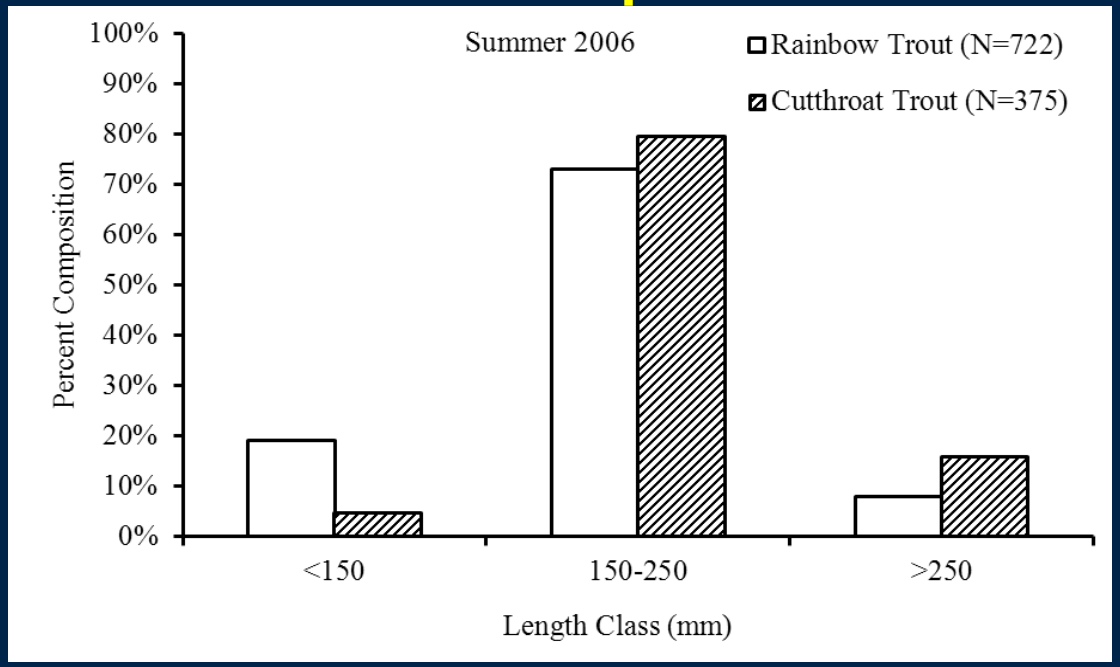
Diet and Predation Estimation

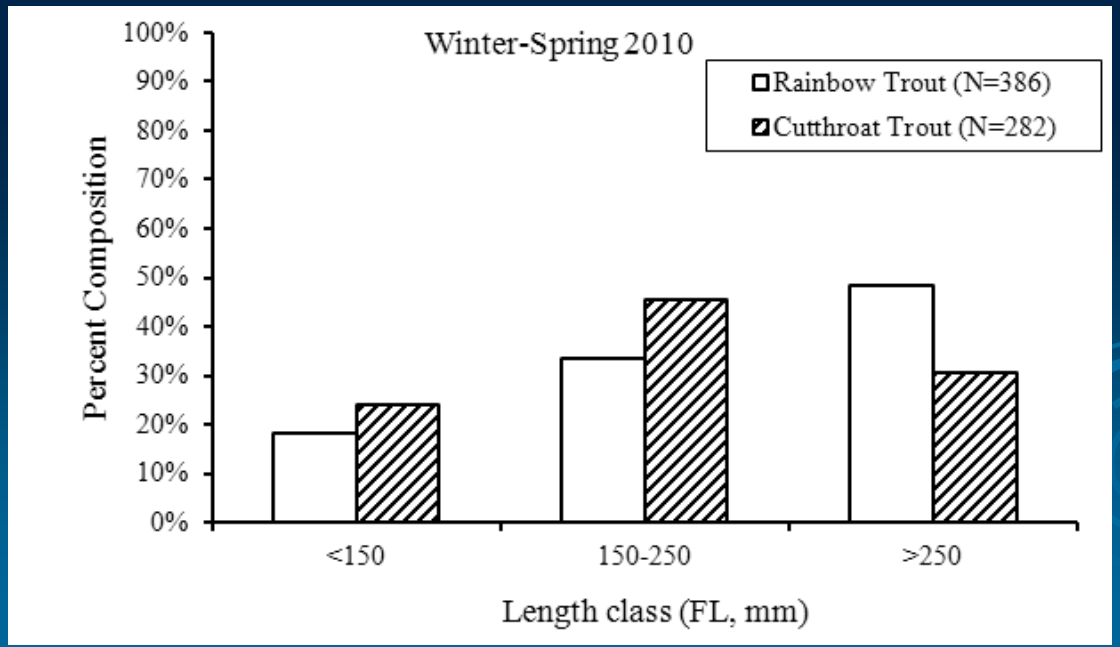
- Gastric lavage
- Identify stomach contents
  - including DNA analysis
- Predation estimation
  - Direct consumption model
  - Population estimate used to estimate total consumption

Species composition by strata



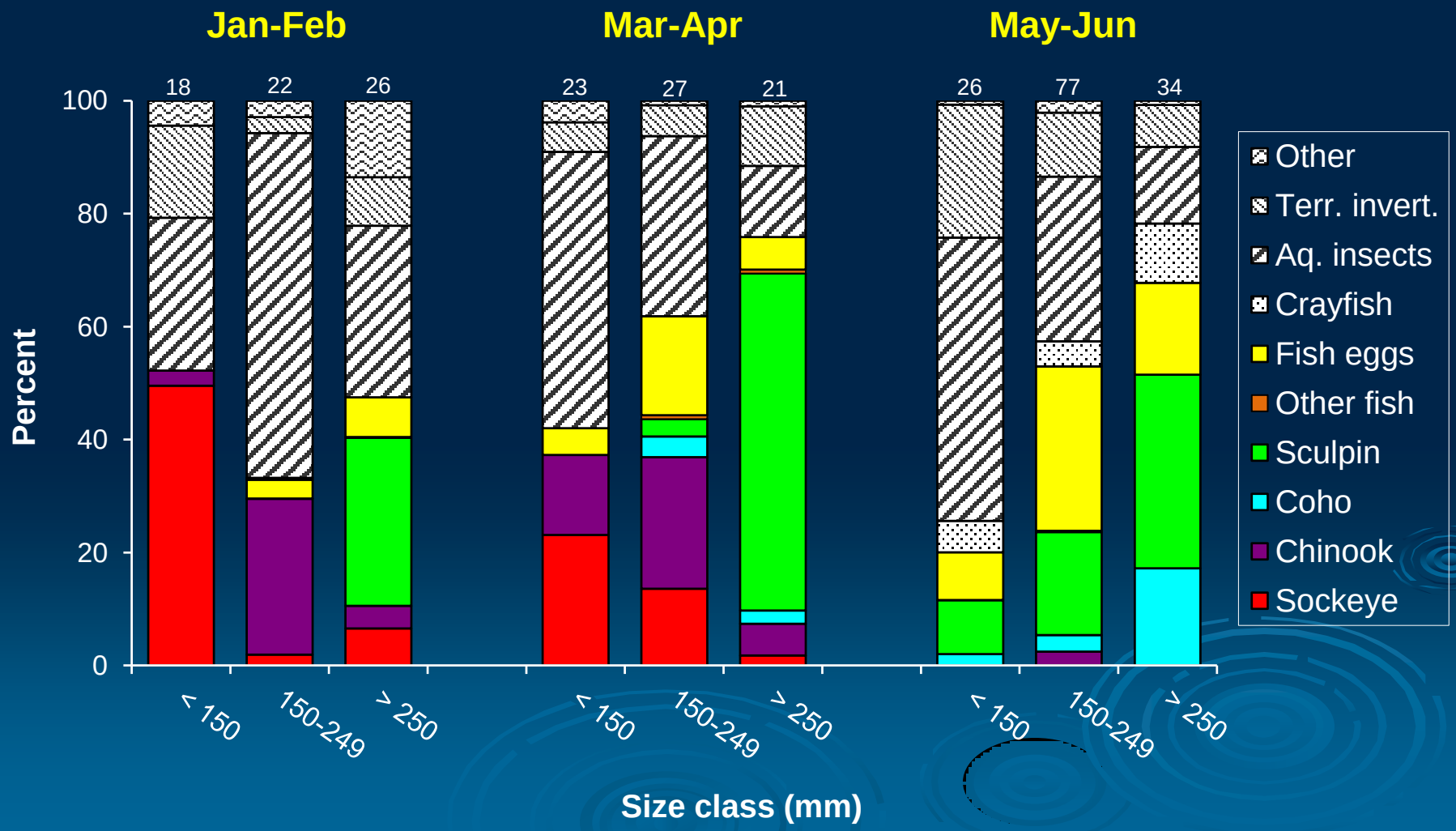
Size composition





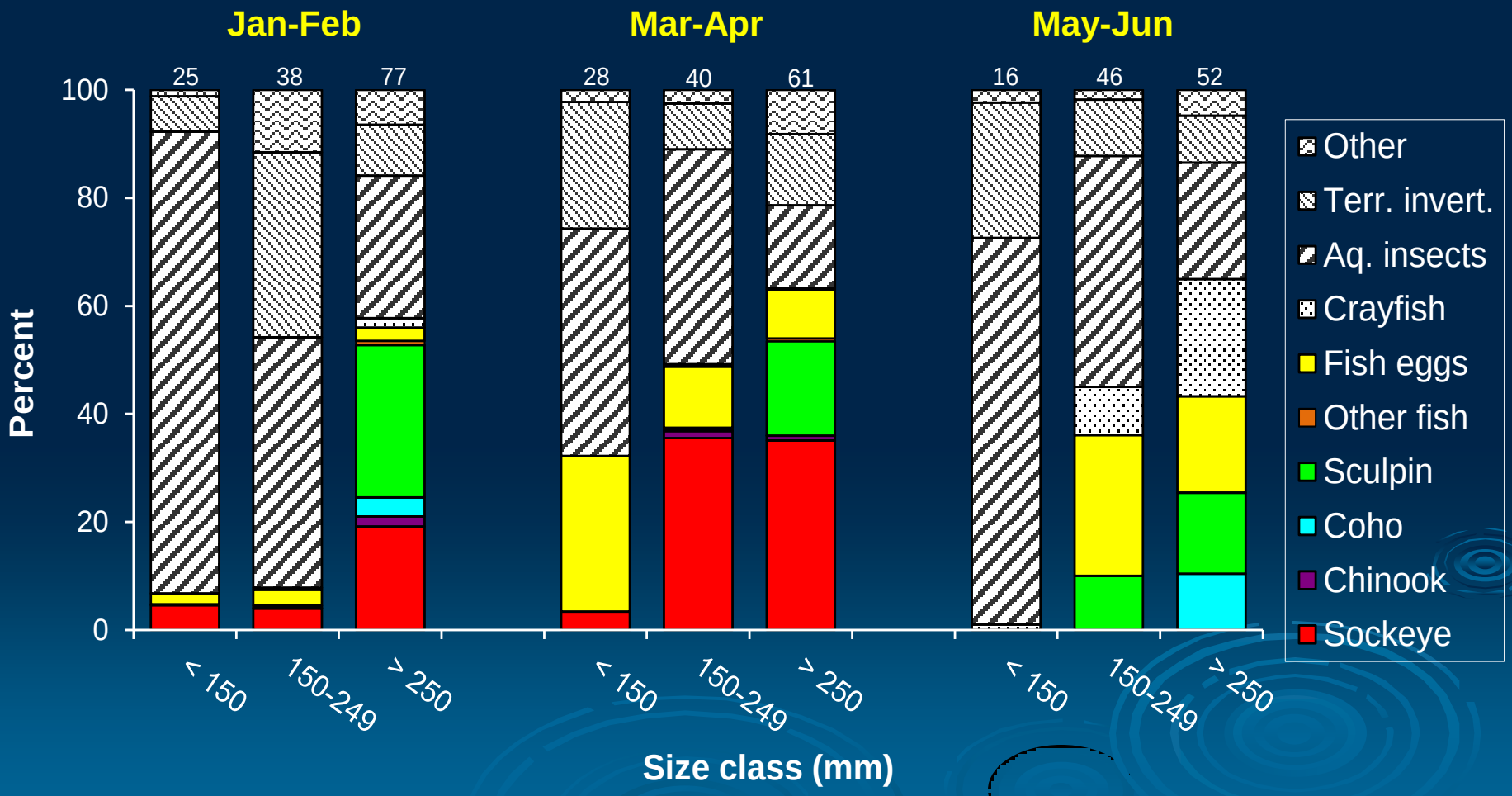
Cutthroat trout - 2010

Diet, percent by weight, all strata combined



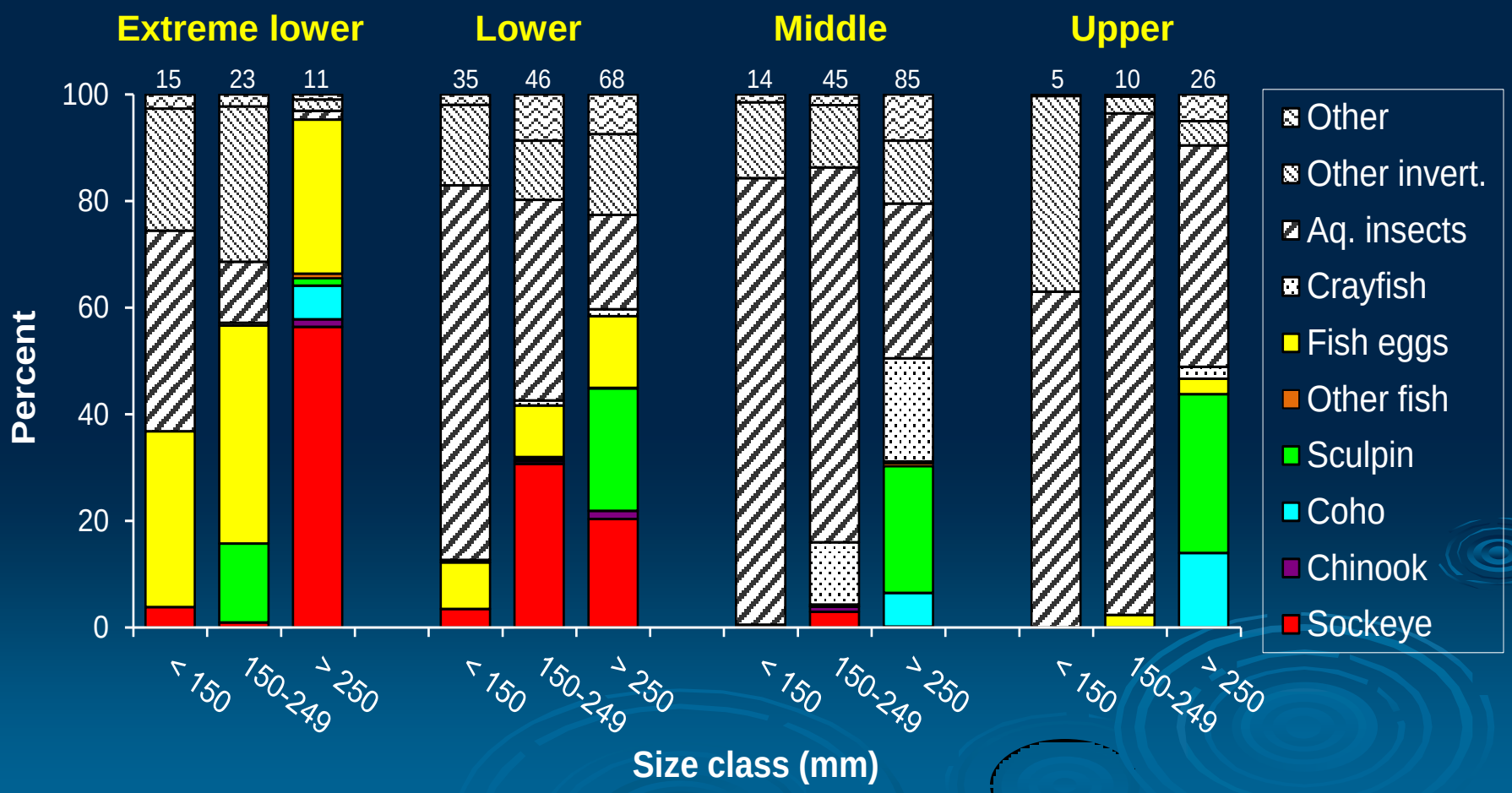
Rainbow trout - 2010

Diet, percent by weight, all strata combined

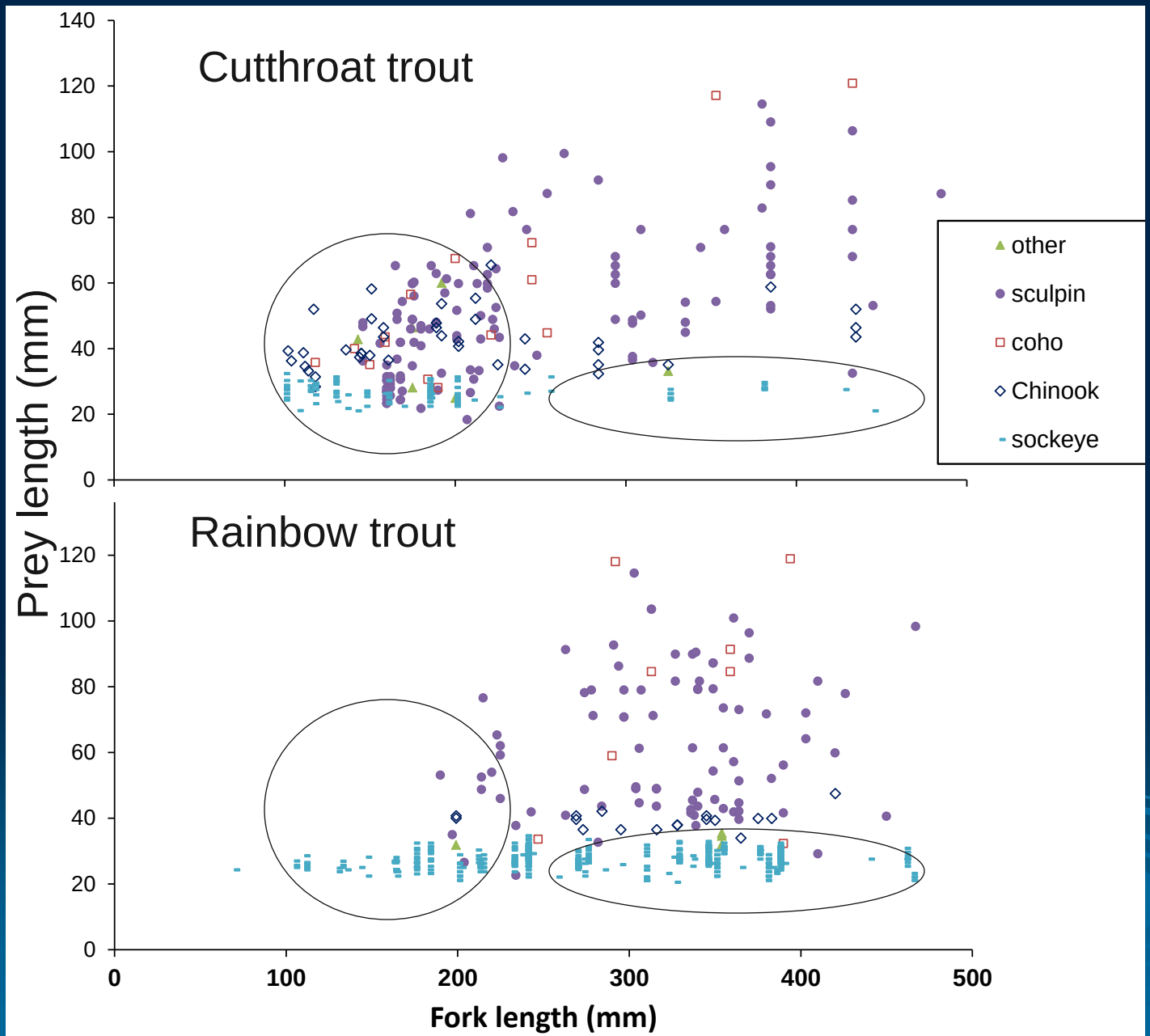


Rainbow trout - 2010

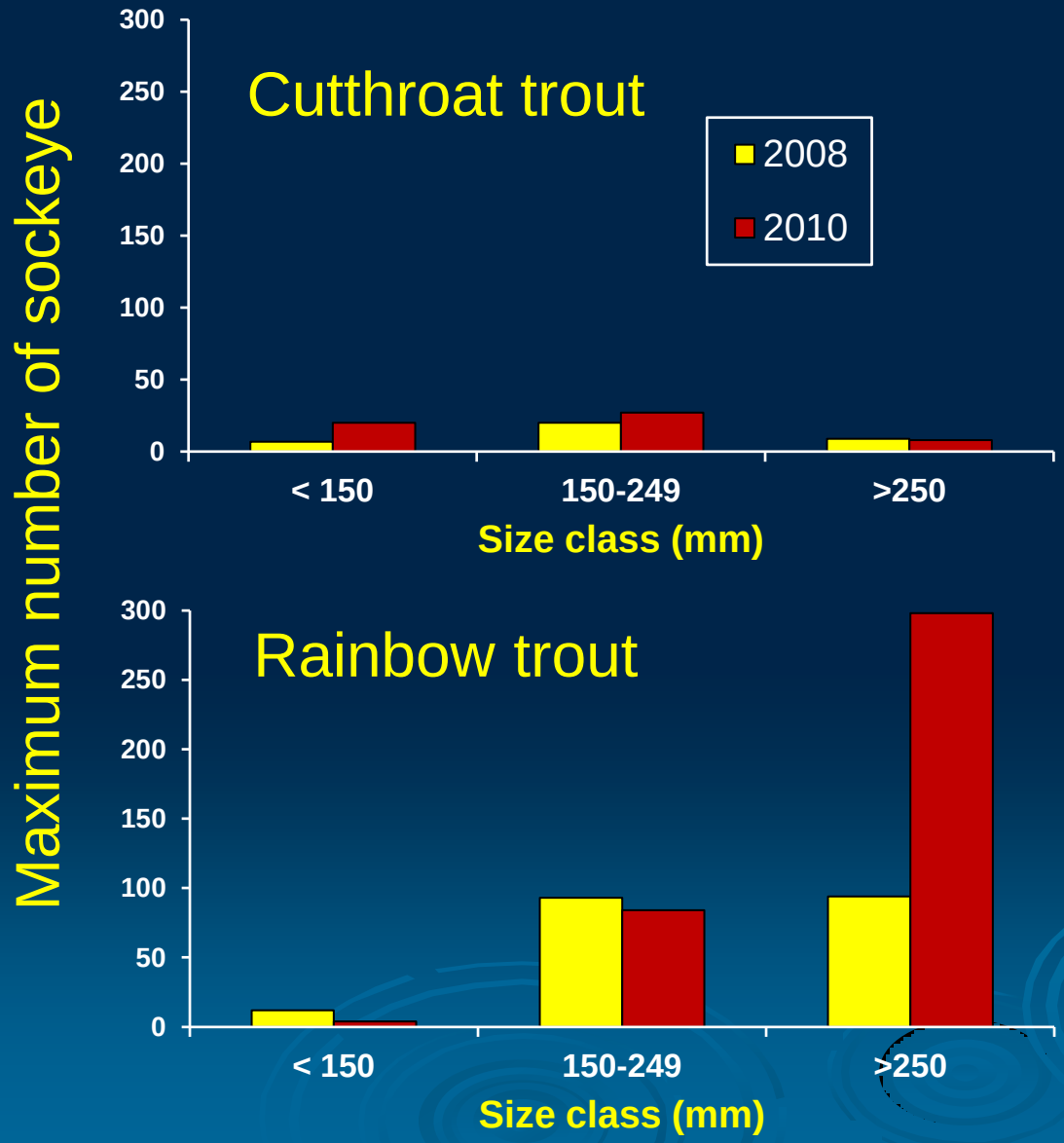
Diet, percent by weight, all dates combined



Prey length – all trout

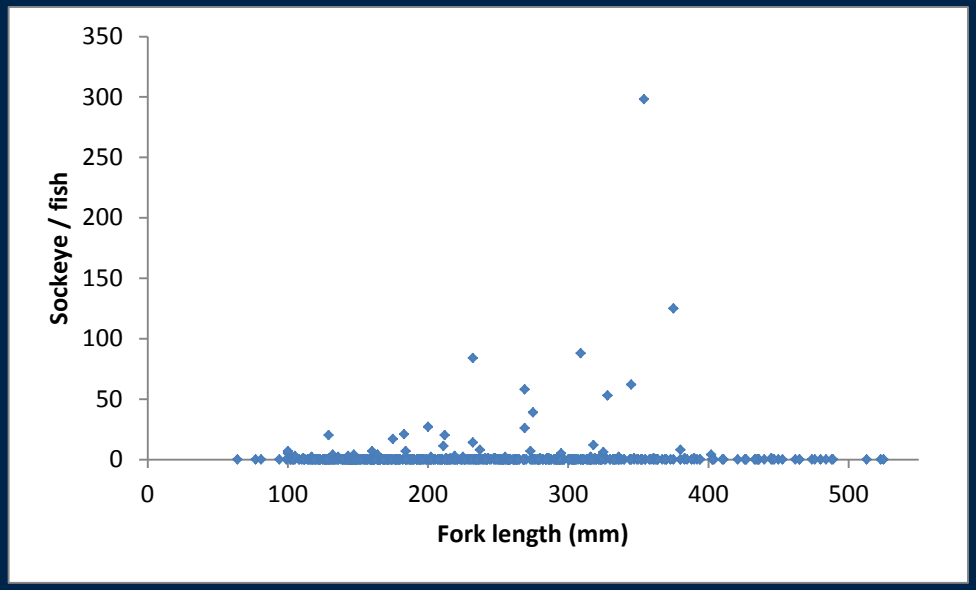


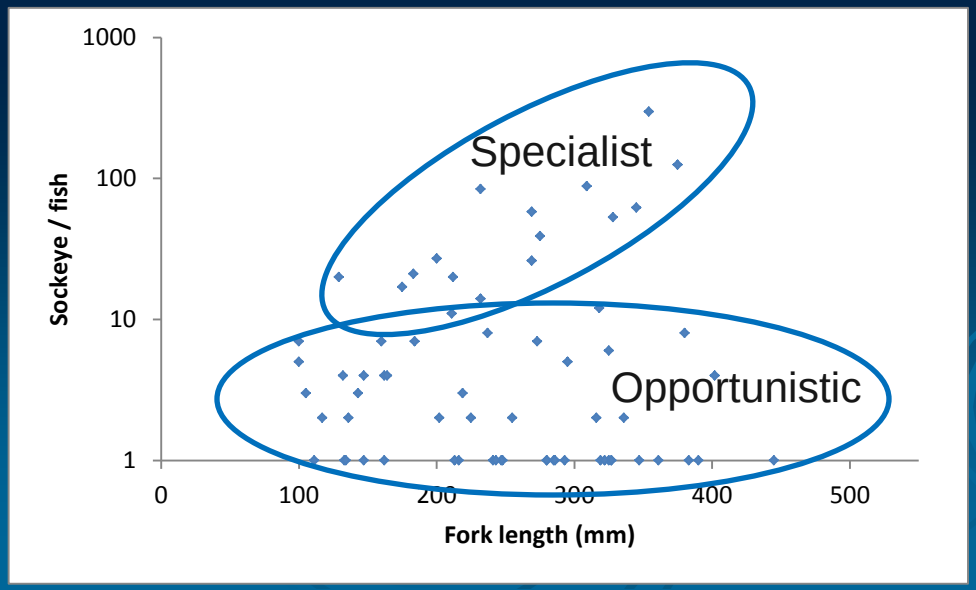
Maximum number of sockeye



Trout - 2010

Number of sockeye for each fish





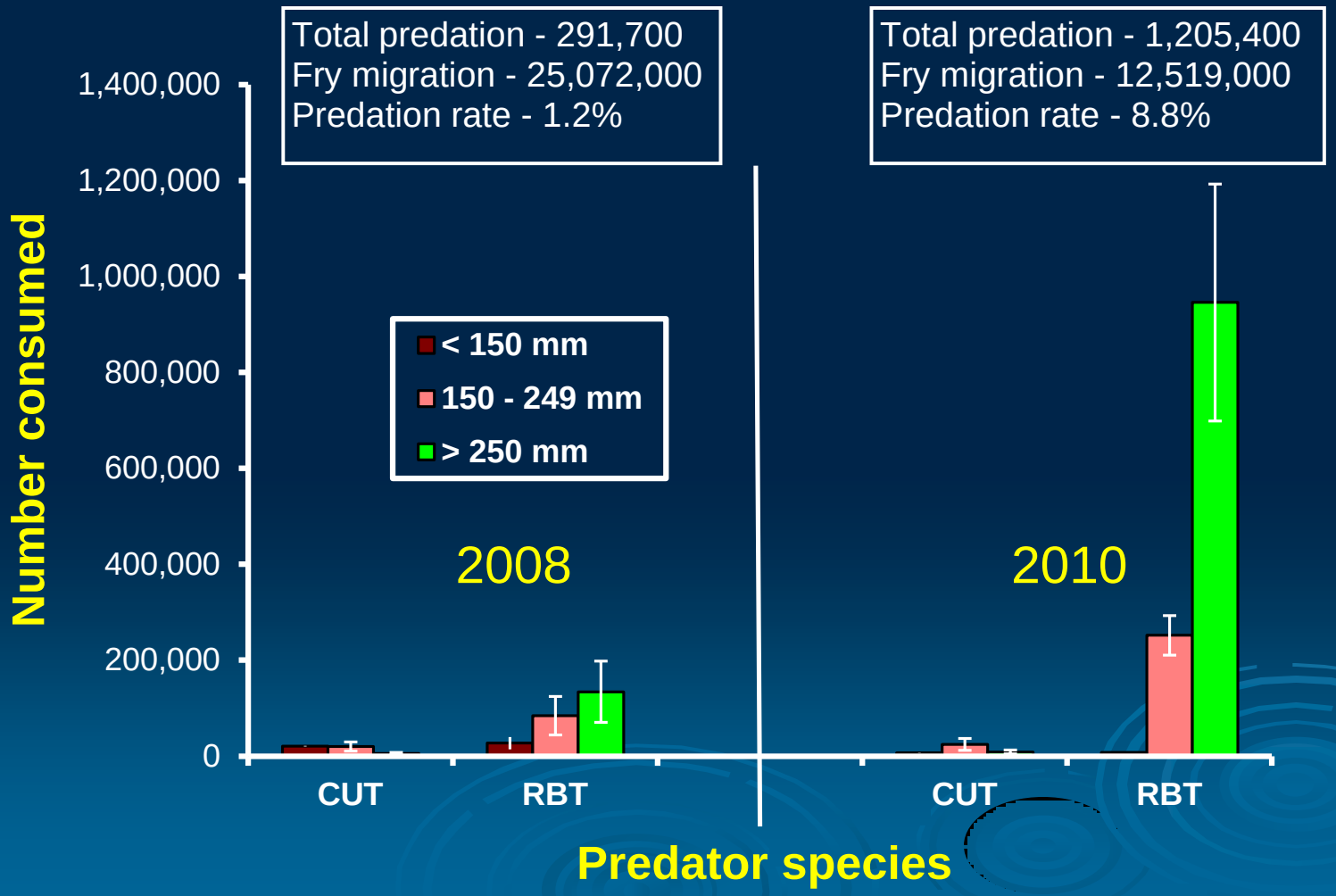
Food Specialization by Individual Trout

(Bryan and Larkin 1972)

Four Rainbow Trout stomach samples

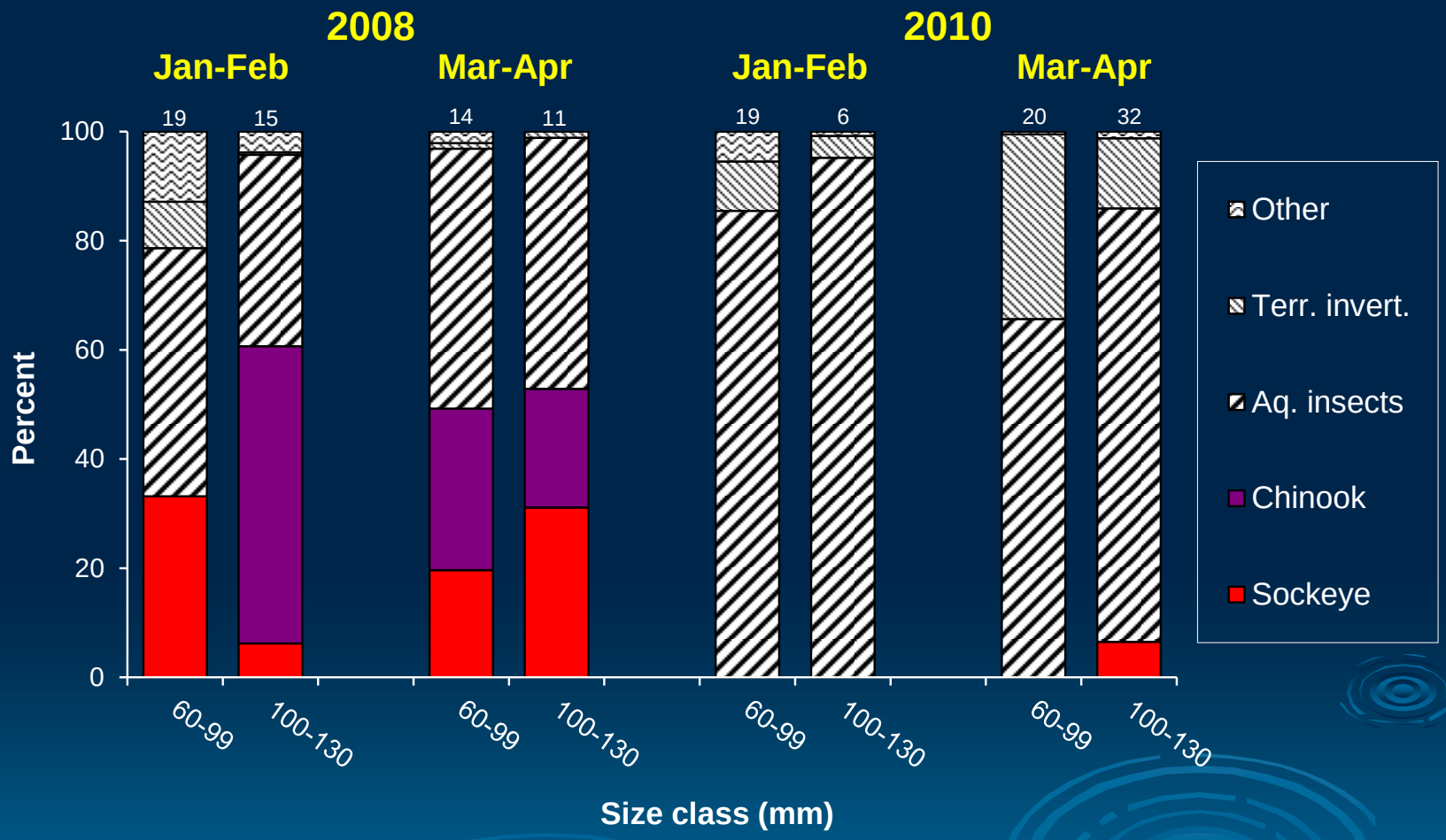
Trout Consumption Estimates of Sockeye

Direct Consumption Model



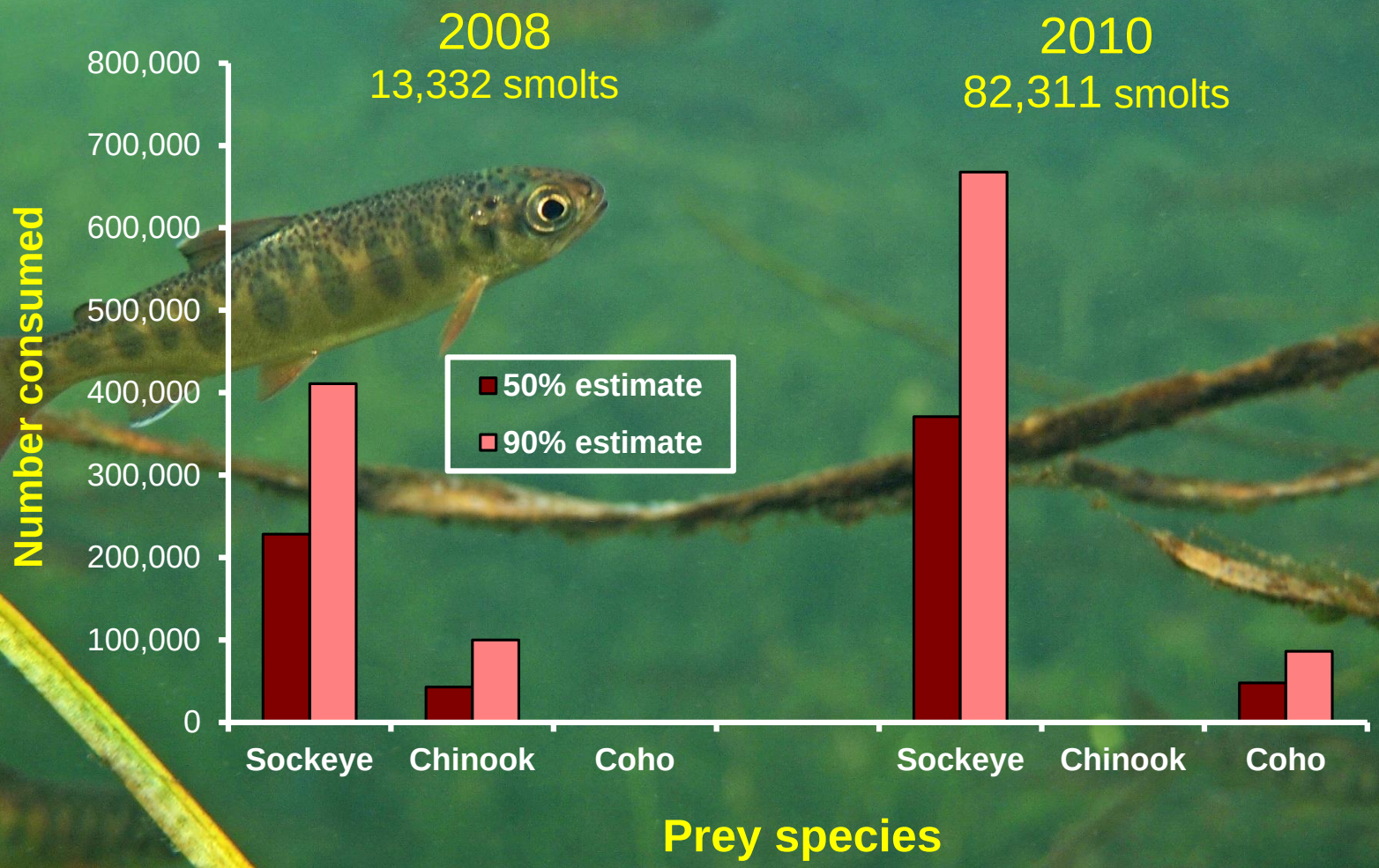
Juvenile Coho Salmon

Diet, percent by weight, all strata combined



Juvenile Coho Salmon Consumption Estimates

Two population estimate scenarios



Summary

- Riverine predation of sockeye fry can be an important source of mortality
- Most important factor appears to be streamflow (coarse scale) or velocity (fine scale)
- Predation rates appear to be highest in low-velocity habitats such as primary pools
- Predation of sockeye fry varies widely between species, size, river section, month, and individuals

Summary

- Predation of sockeye was most evident in small cutthroat trout and large rainbow trout
- Total consumption of sockeye was highest in rainbow trout > 250 mm
- Predation of juvenile Chinook was observed primarily in cutthroat trout
- Predation levels were highest in the lower sections of the river

Questions