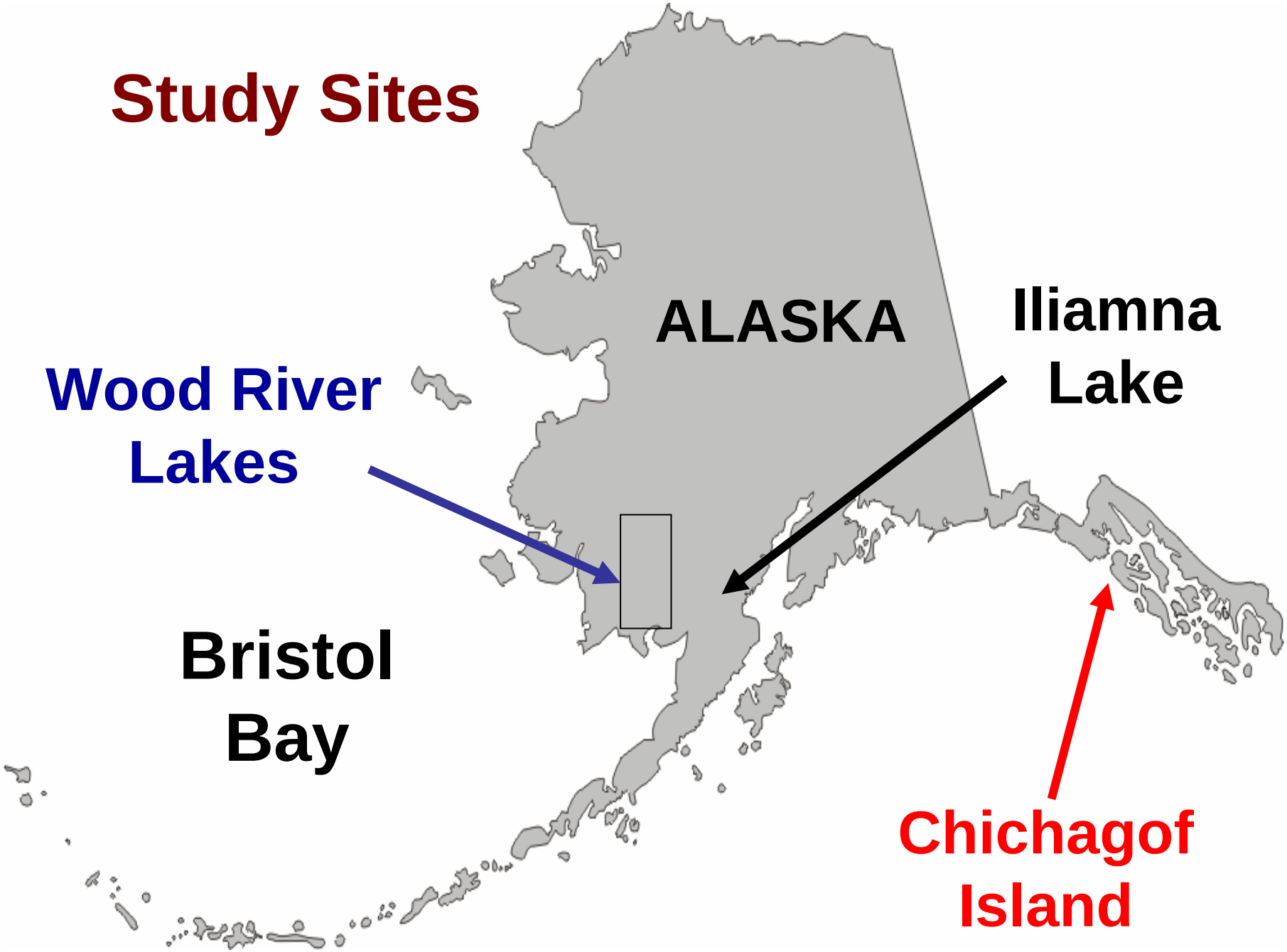
Stream size mediates the ecological effects of bear predation on salmon

“One can walk along almost any Alaska salmon stream in bear country during the summer spawning season and see jaws, heads, and other parts of salmon left by bears.”

W. K. Clark (1959)


Study Sites
ALASKA
Iliamna Lake
Wood River Lakes
Bristol Bay
Chichagof Island

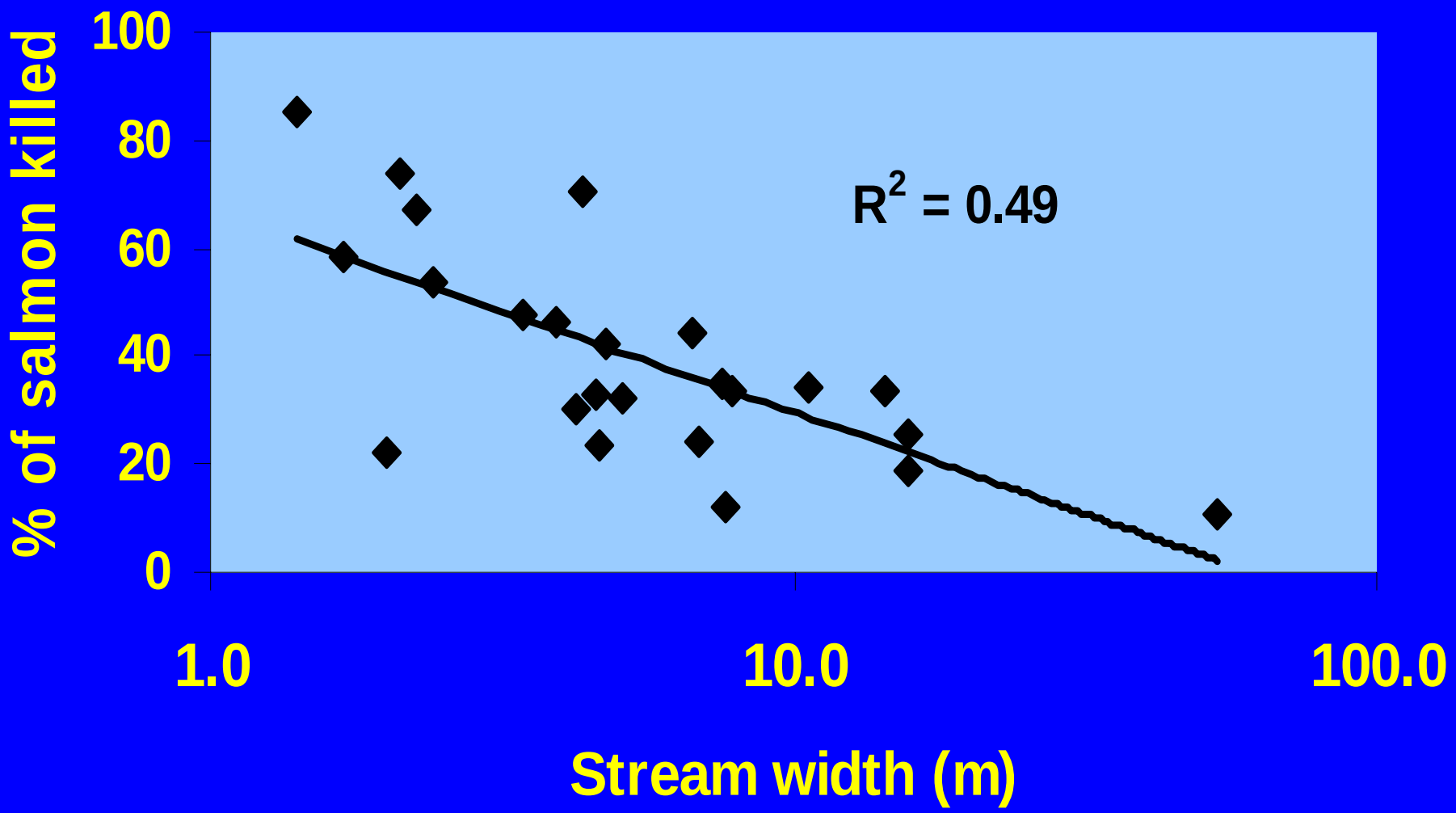
What controls the number and proportion of salmon killed in a creek each year?

Patterns:

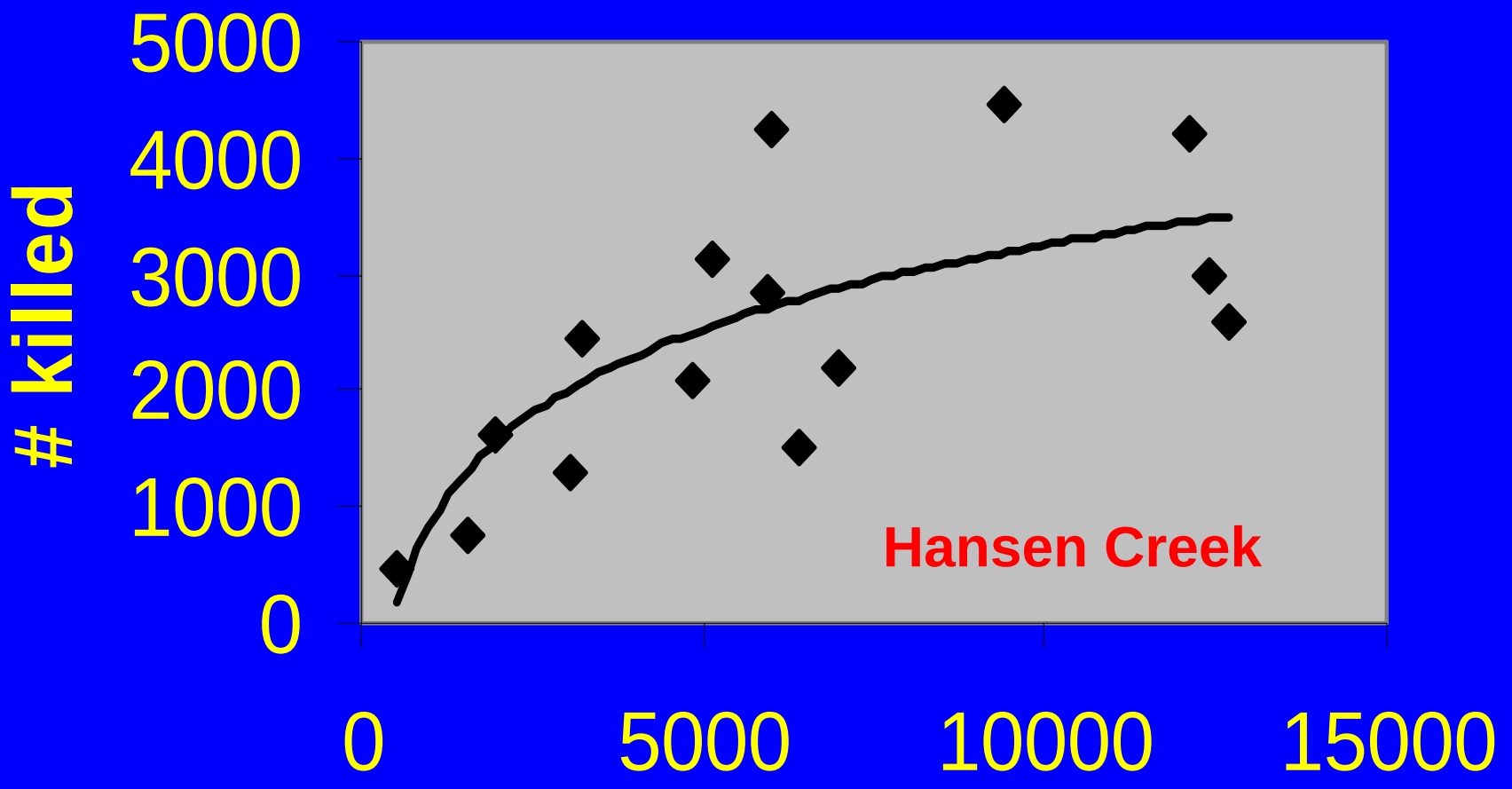
1. Bears kill a higher proportion of the salmon in narrow than wide streams
2. The number of salmon killed reaches an asymptote at high salmon density


Susan Johnson

Stream size controls variation in predation among creeks



In each creek, the number of salmon killed each year varies with density

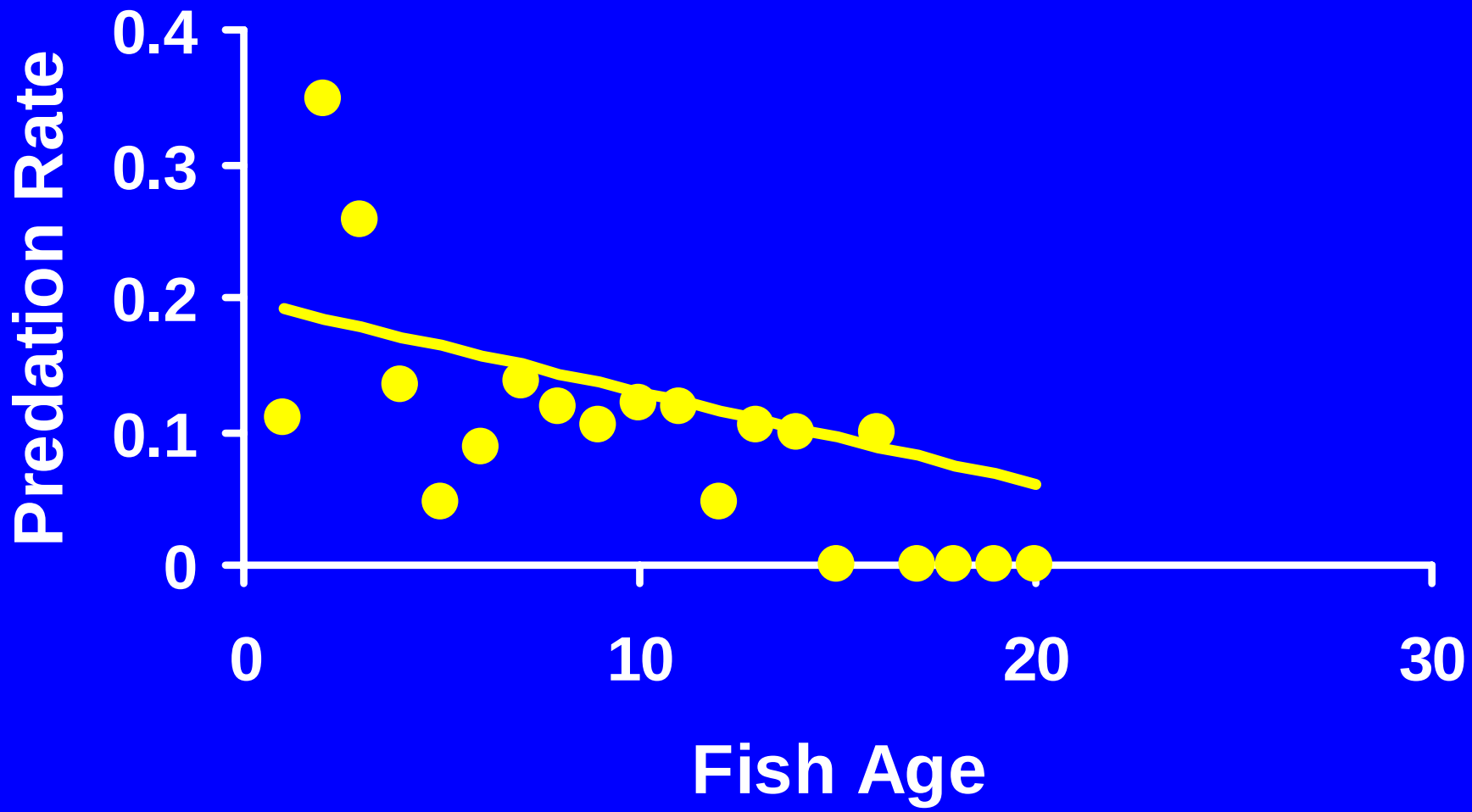


In shallow streams, bears can catch new arrived, energy-rich fish

Old fish are less nutritious…

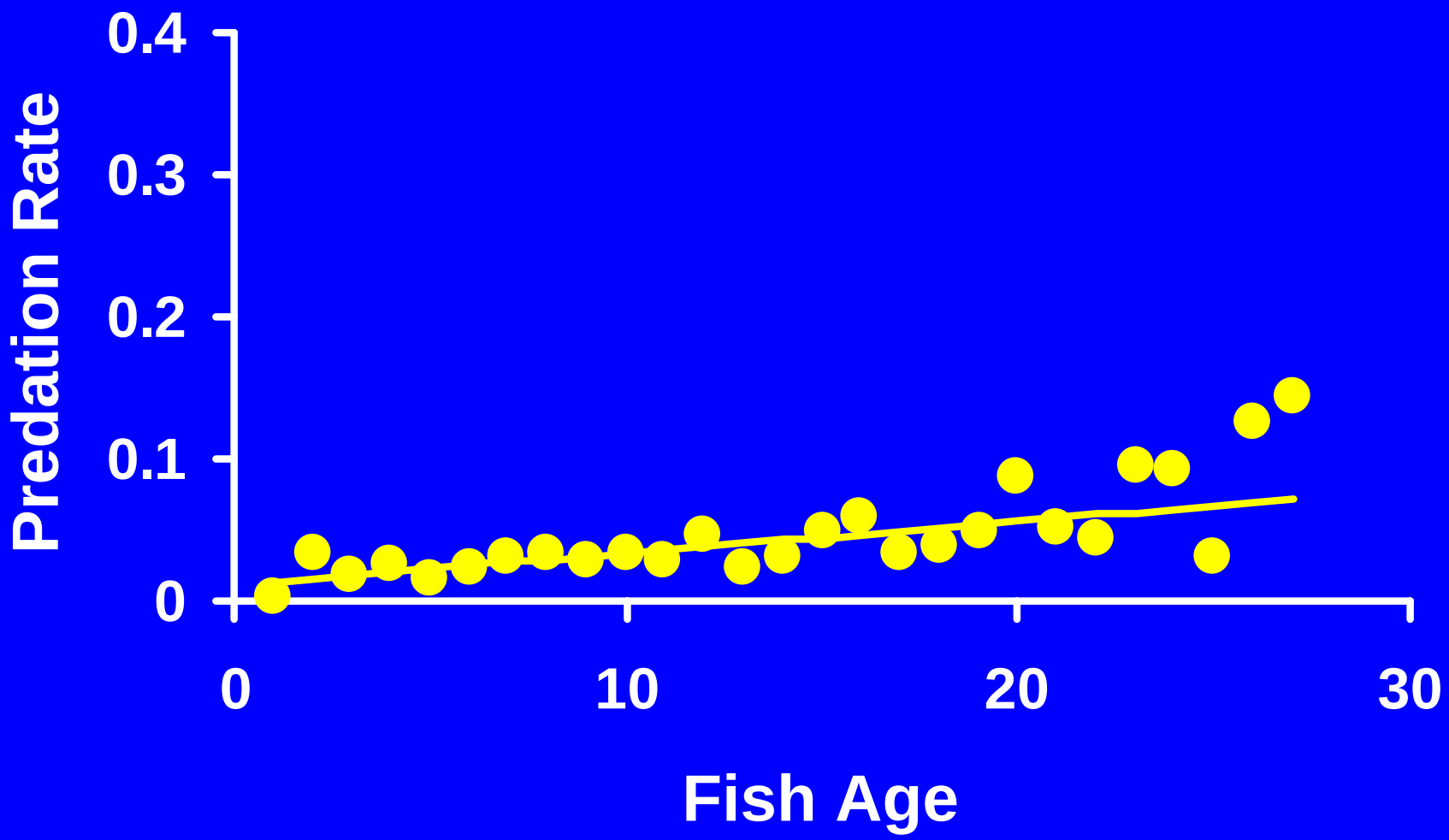
But easier to catch in larger creeks

Hansen Creek: Salmon are very easy to catch



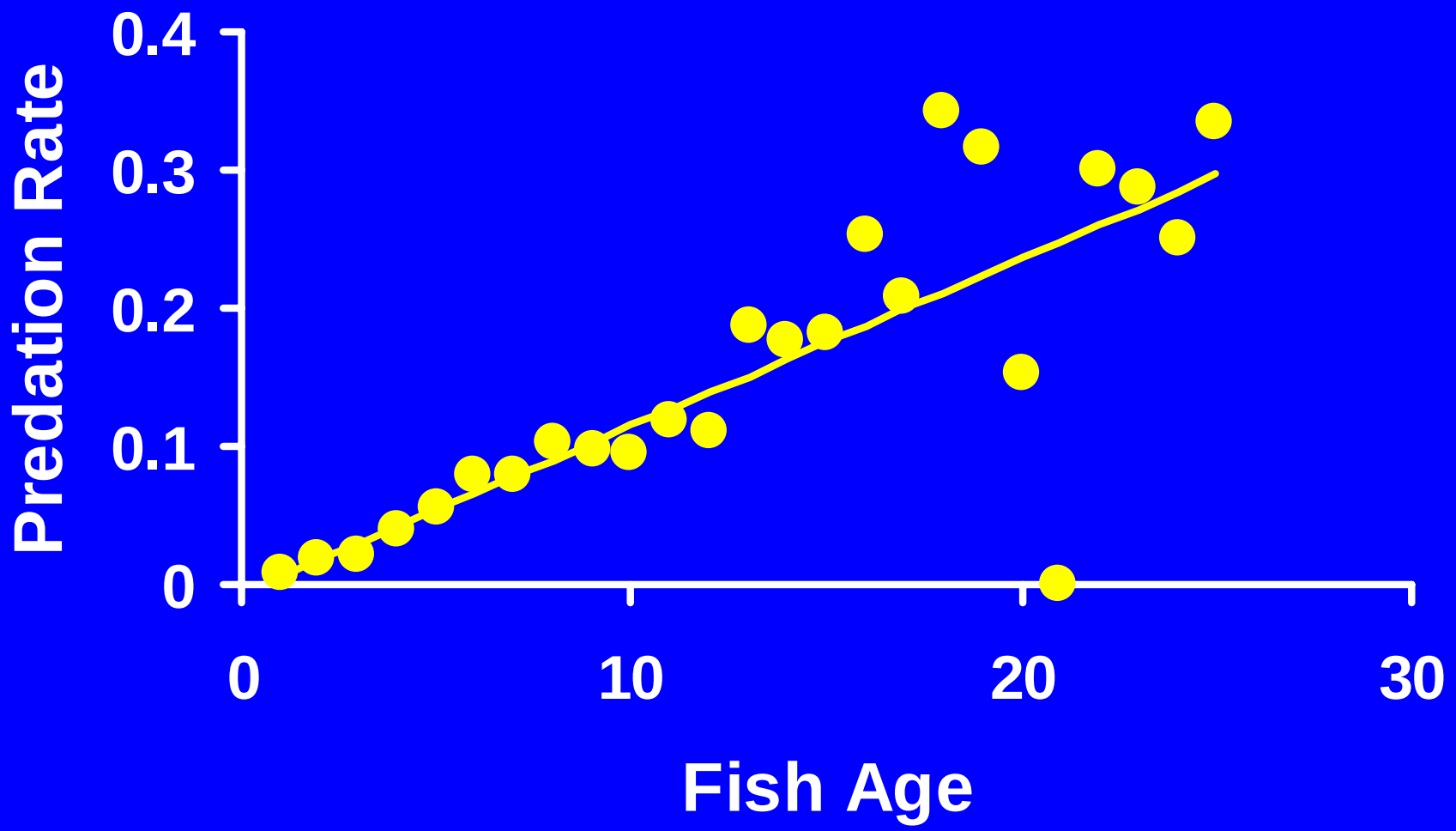

Andrew Hendry

Pick Creek: Salmon are moderately easy to catch

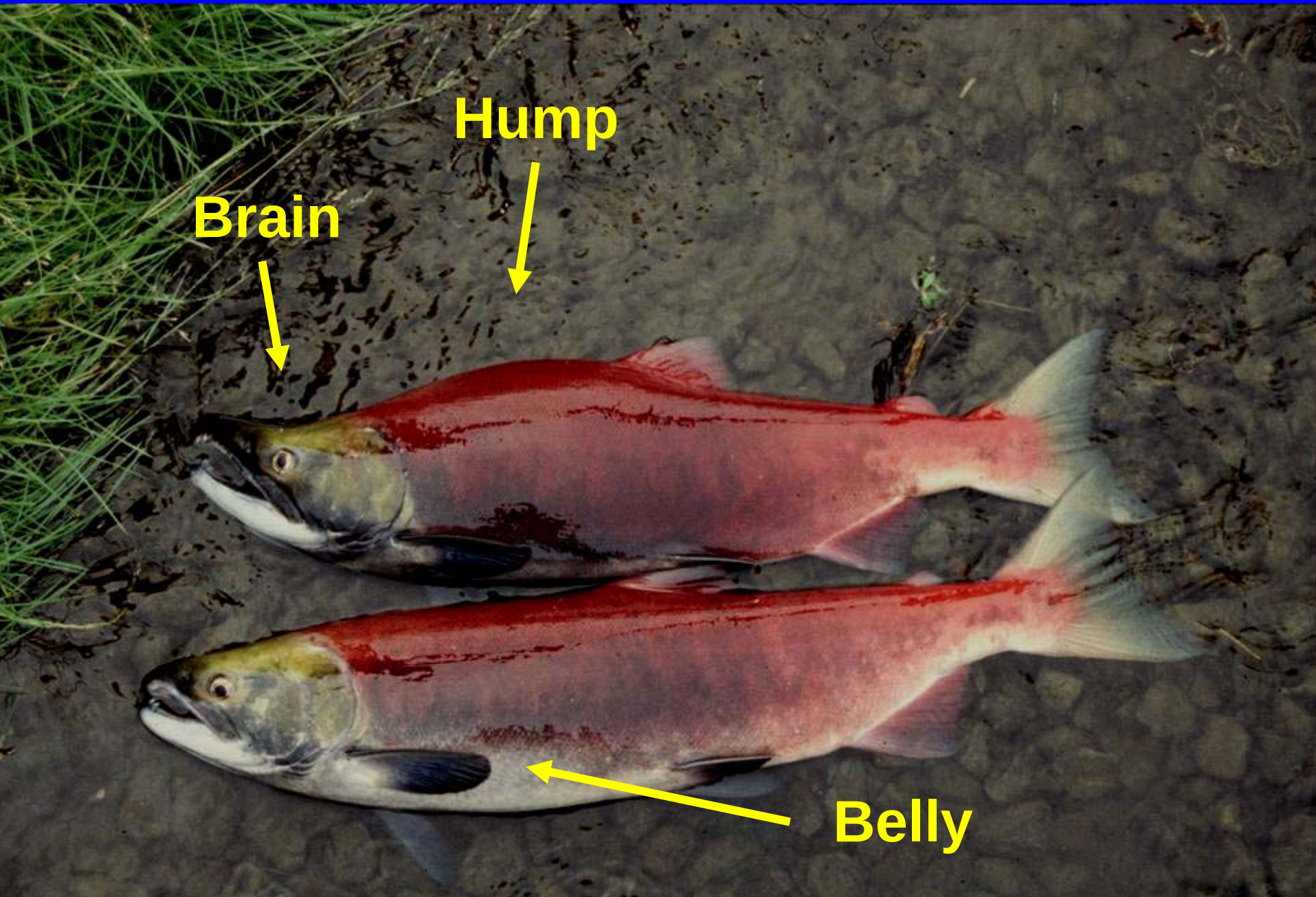



Bobette Dickerson

Himmel Creek: Salmon are hard to catch



Bears selectively consume body parts



Male Hansen Creek sockeye salmon

Consumption of the dorsal hump in males

Consumption of eggs from females

Hansen Creek sockeye - 2004

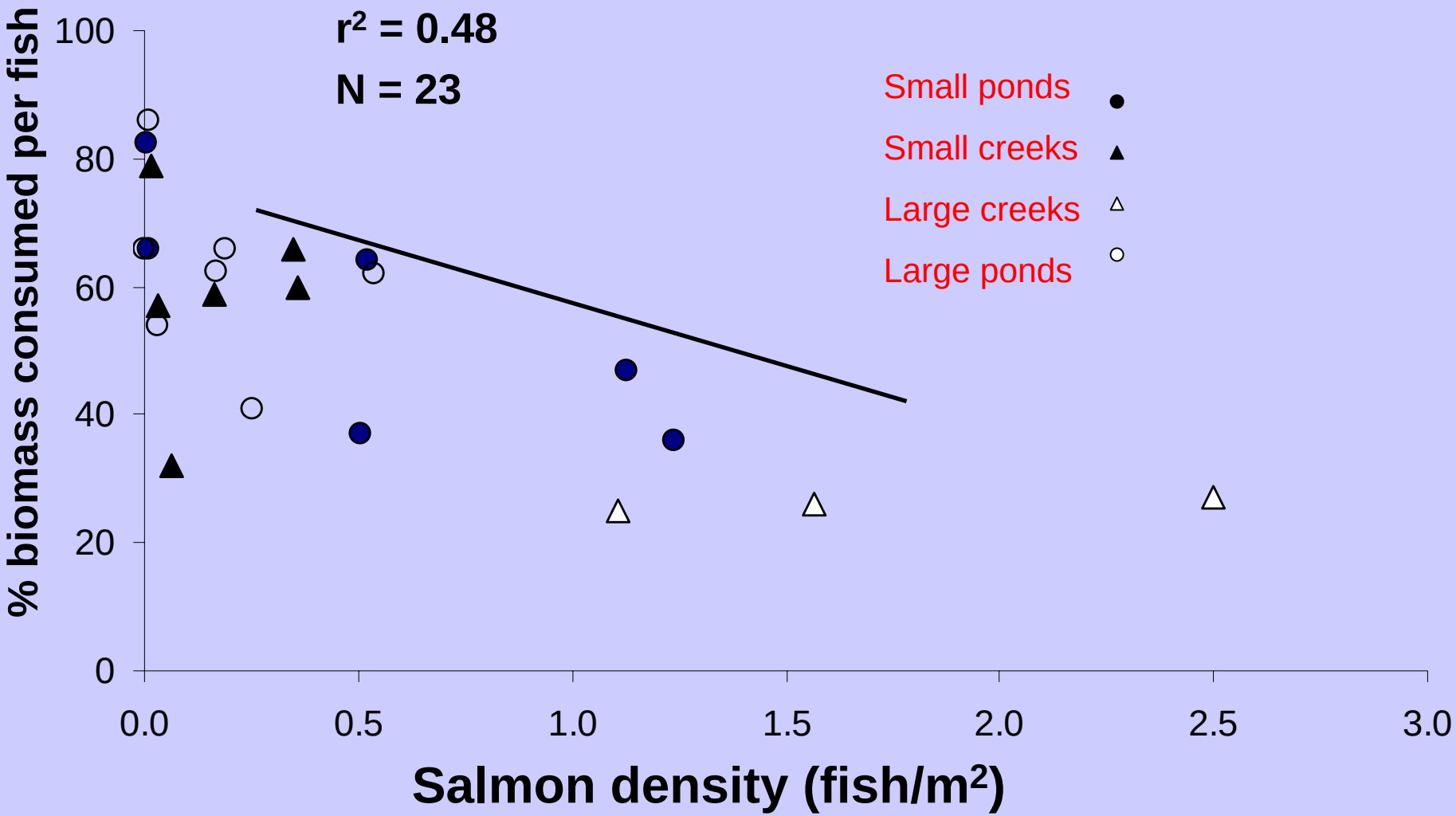
% of fish with different body parts eaten

	Body	Belly	Hump	Brain	Bite	Sample
Males	52.2	1.8	15.8	77.9	5.5	897
Females	32.0	42.0	4.4	35.5	13.0	1286

Bears consume body parts to maximize energy density, not volume. They are most selective when salmon are most available:

1) **In small creeks**
2) **When salmon are numerous**

Bears consume a greater proportion of biomass per captured fish when salmon density is low



Flow of nutrients

- Lots of salmon tissue is not eaten on bear-killed fish, and many fish die of senescence
- The pathway (aquatic or terrestrial) for the nutrients depends on creek morphology and bear predation

Terrestrial pathway: maggots, birds, mammals

Sue Johnson

Aquatic pathway: bacteria, insects, fish

Carcass deposition

- ***Shallow, narrow streams:*** High bear predation and deposition on gravel bars make carcasses available to maggots and other terrestrial organisms.
- ***Deep, wide streams:*** Low bear predation and deposition in pools make carcasses available to fishes and aquatic insects


Photo: Susan Johnson

Conclusion: Stream size plays a key direct and indirect role in the ecology of salmon and bears

- In small streams:
  - Bears kill a larger fraction of the salmon
  - Bears kill more salmon prior to spawning
  - Bears get more nutrition from each fish
  - Predation is more size – selective
  - Carcasses are available to terrestrial scavengers


Questions?