Size-selective mortality of Kvichak River, Bristol Bay, Alaska sockeye smolts in relation to smolt characteristics, ocean conditions, and sockeye productivity

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SCALE – Salmon Comparisons Across Large Ecosystems Project

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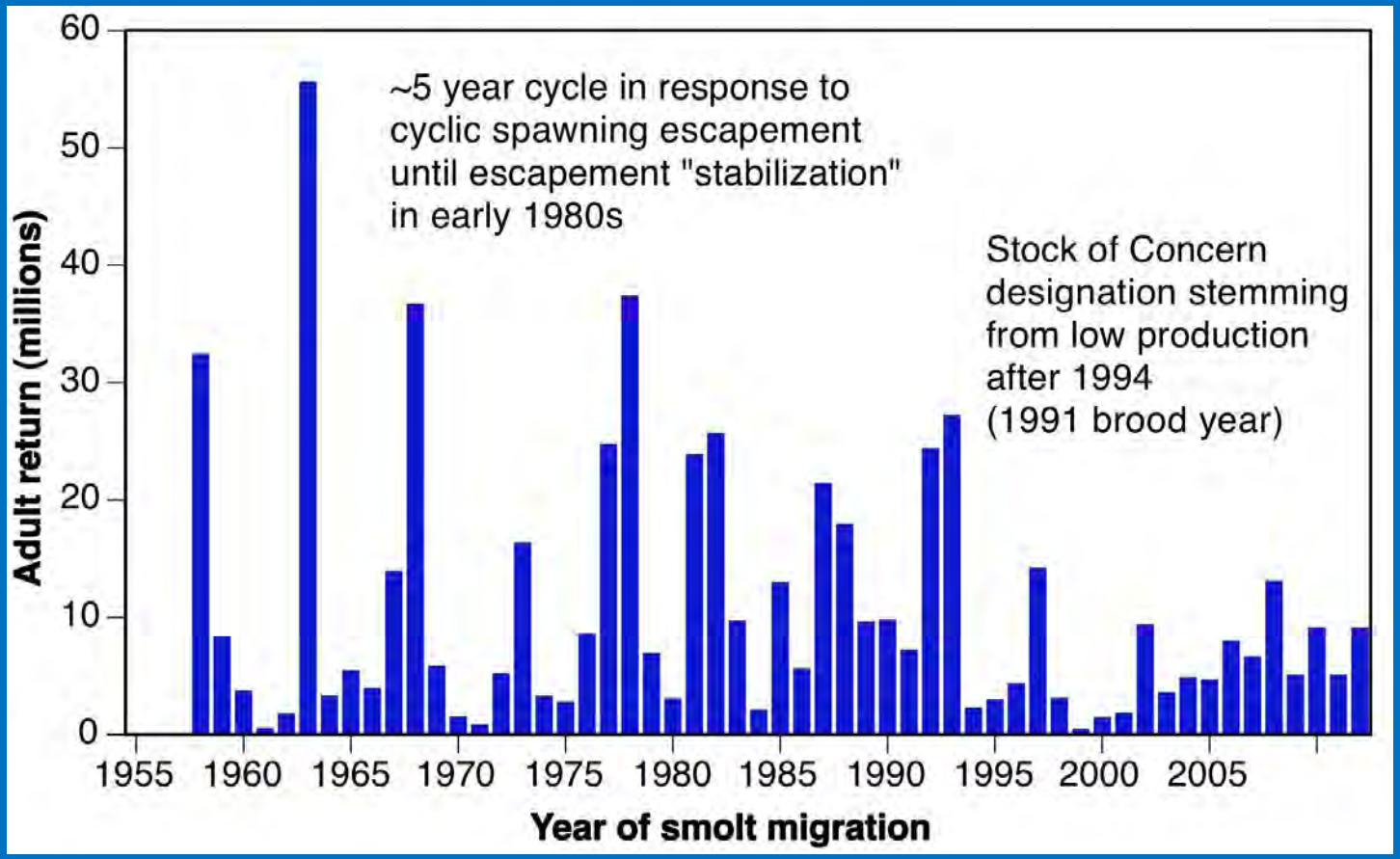
Alaska Sustainable Salmon Fund

Kvichak sockeye production from smolt

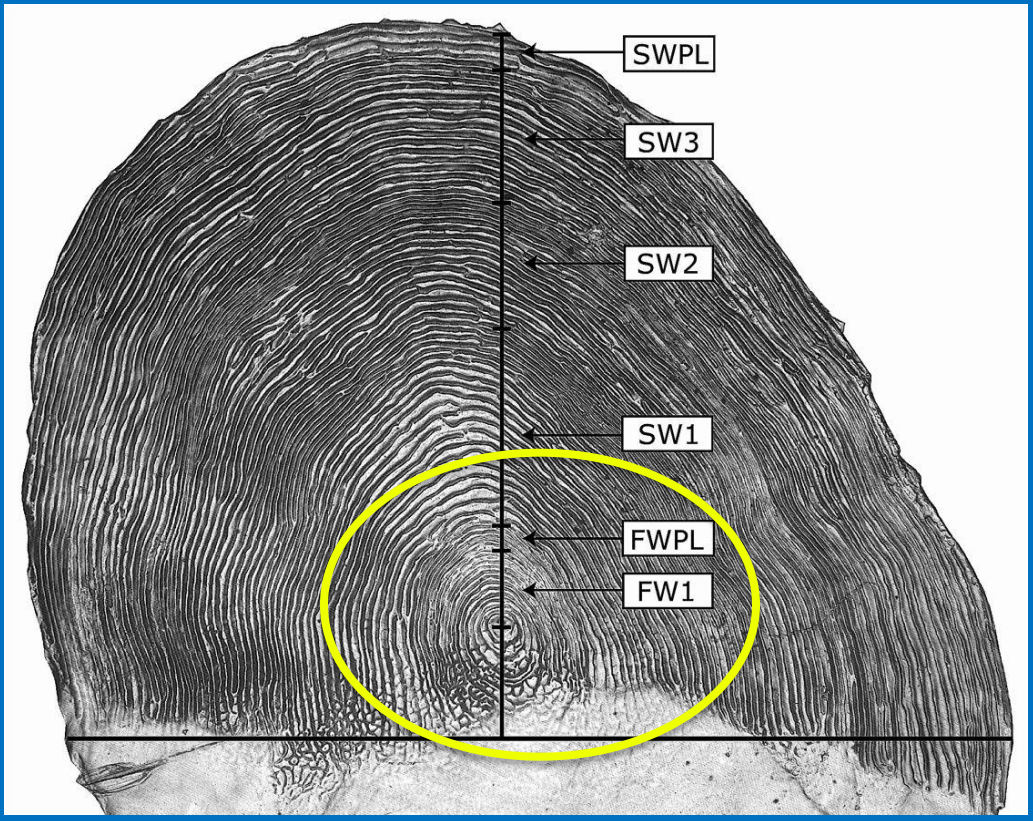


Size-selective mortality of salmon at sea

- Is salmon productivity related to size-selective mortality?
- Expect larger smolts to have higher survival at sea, but how much?
- Does selectivity & size of survivors vary over time?
  - Smolt size and age
  - Ocean regimes & ocean conditions
- Preliminary analyses

Adult Kvichak sockeye scales, 1957-2012

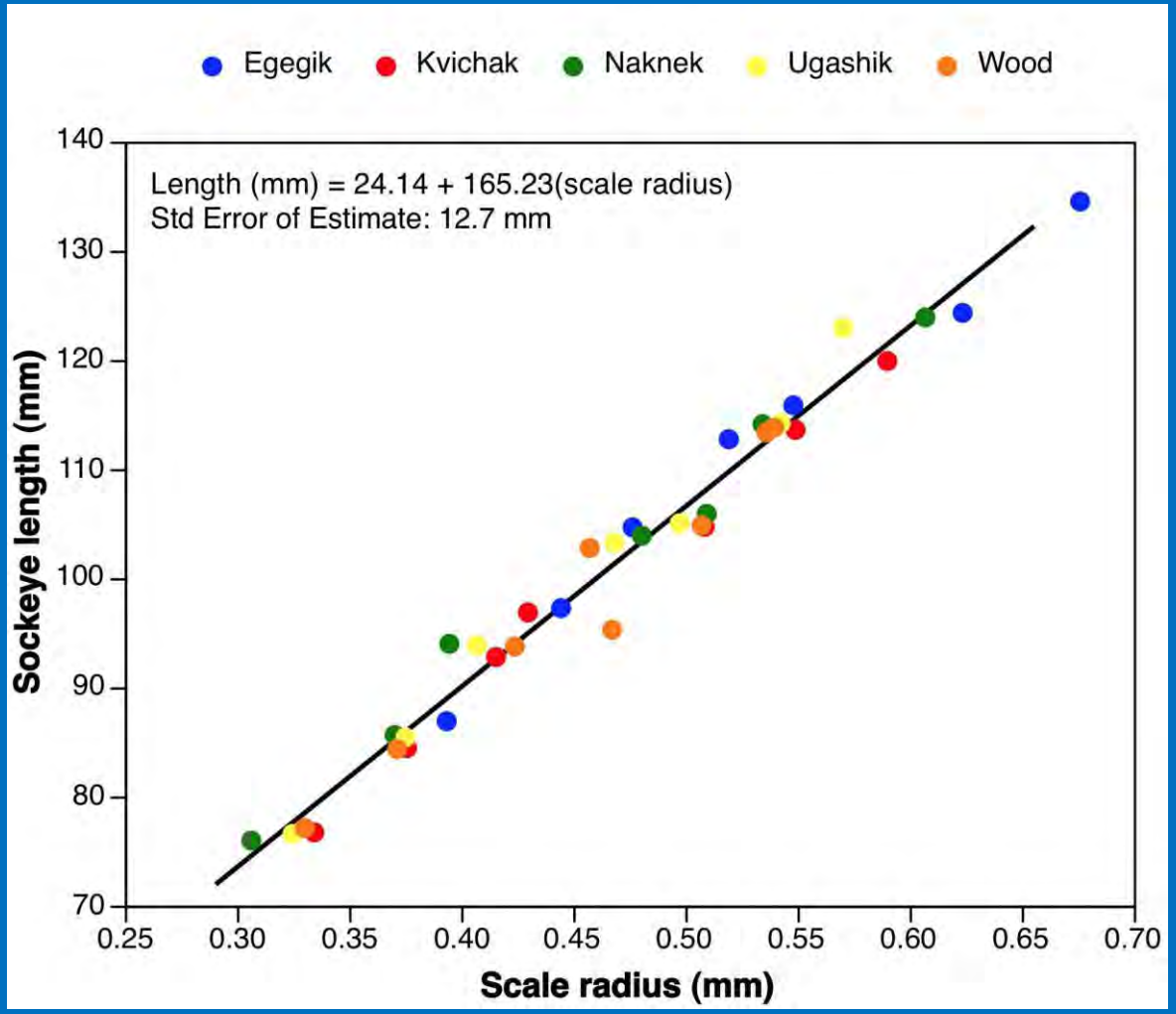
- Ages 1.2, 1.3, 2.2, 2.3
- 50 scales / age / yr
- 200 scales/yr
- ADF&G SCALE Lab
  (extensive measurement checks)



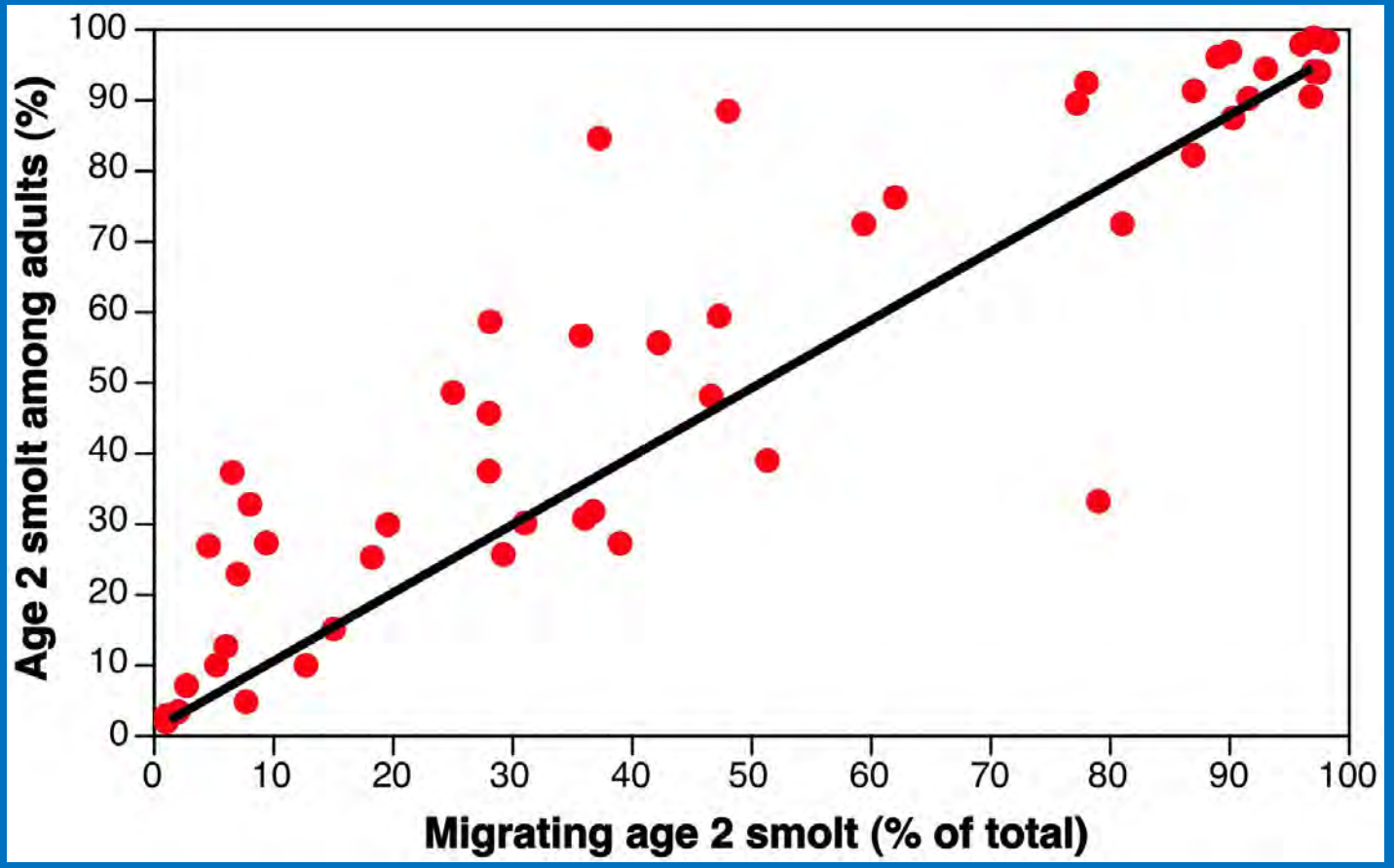
Selectivity (mm) =
Survivor smolt length – migrating smolt length

Regression to predict smolt length from adult scales (survivors)

- 5 stocks
- 5 years
- 10 smolts per 10 mm interval
- Corrected for smolt scale scrape sample

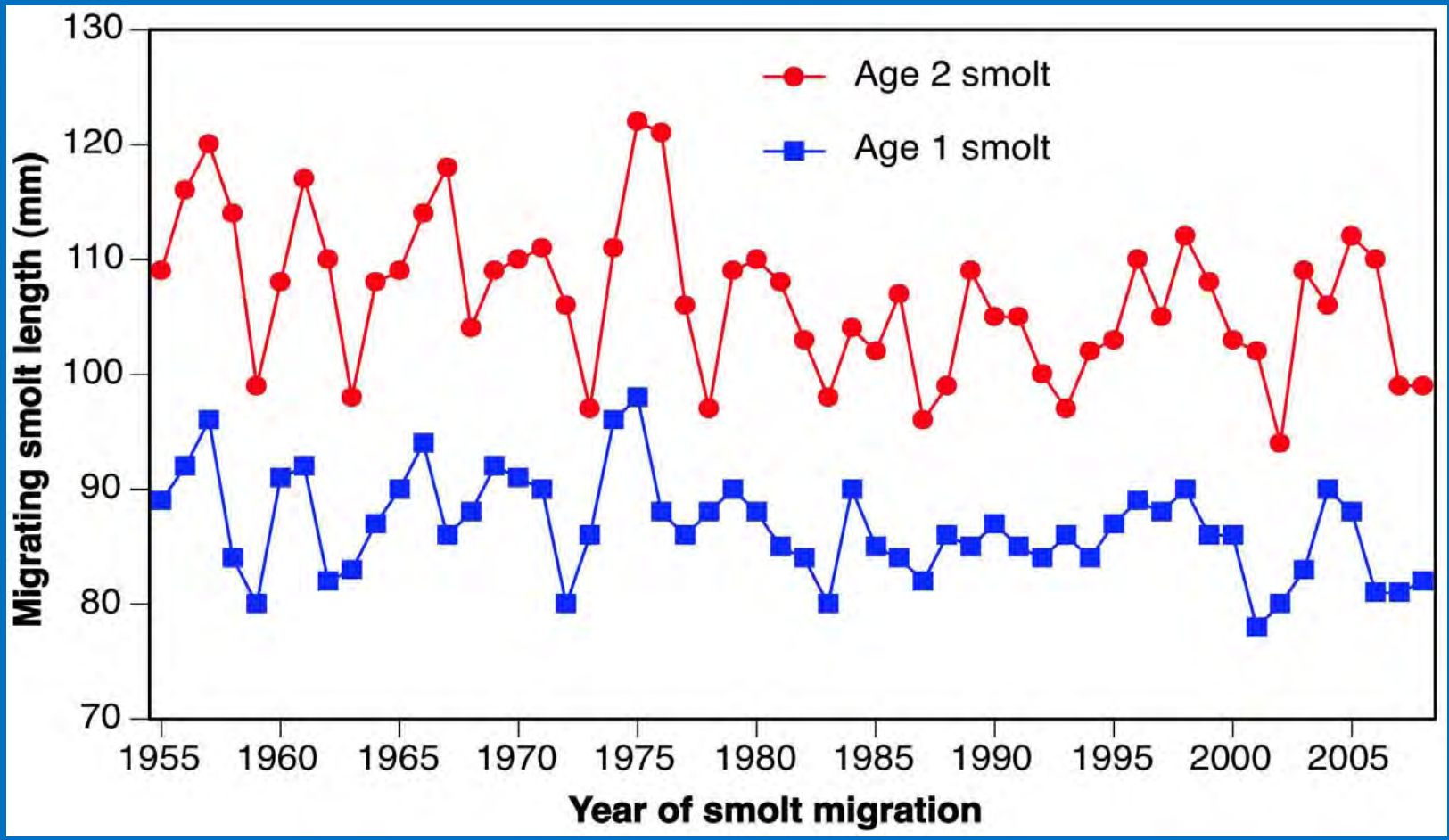


Adult freshwater age correlated with smolt age composition, 1955-2008



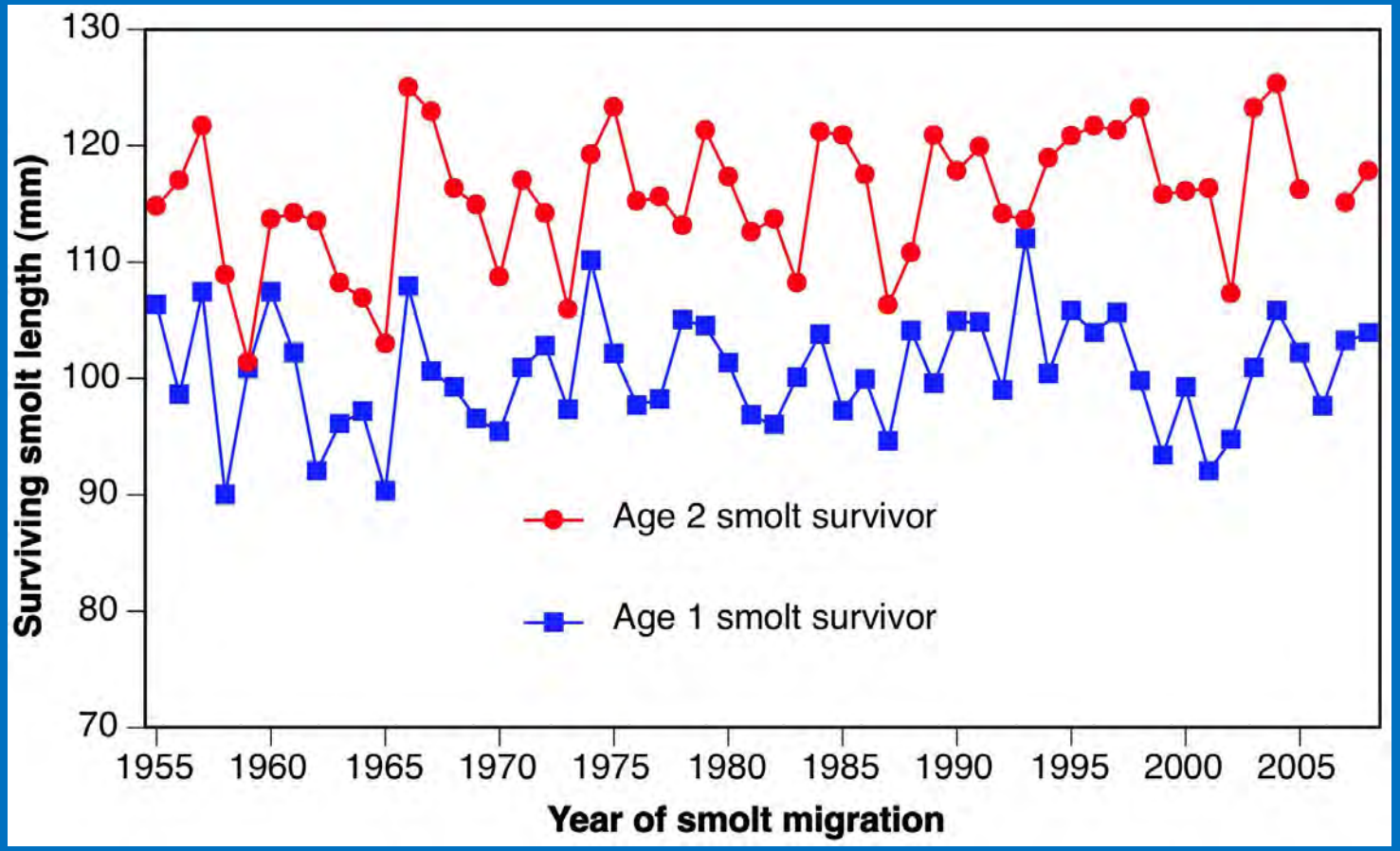
- Correlation suggests avoidance of fyke net by larger smolts is not high.
- Age-2 higher in adult return largely due to higher survival at sea.

Migrating Kvichak smolt length, 1955-2008



Smaller, less variable size after mid-1970s. Density-dependent growth in lakes, including brood interaction.

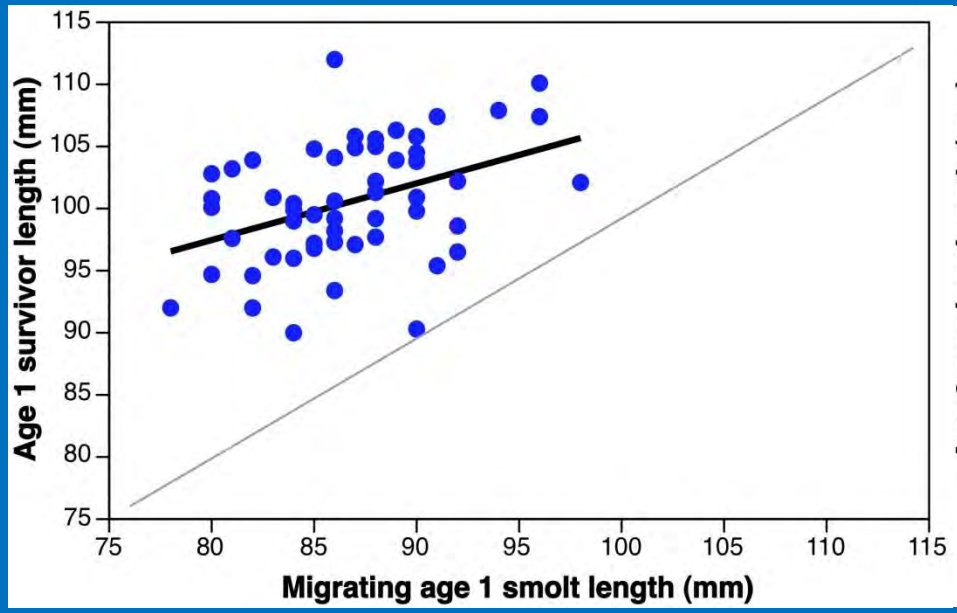
Length of surviving smolts after 2 or 3 years at sea, 1955-2008



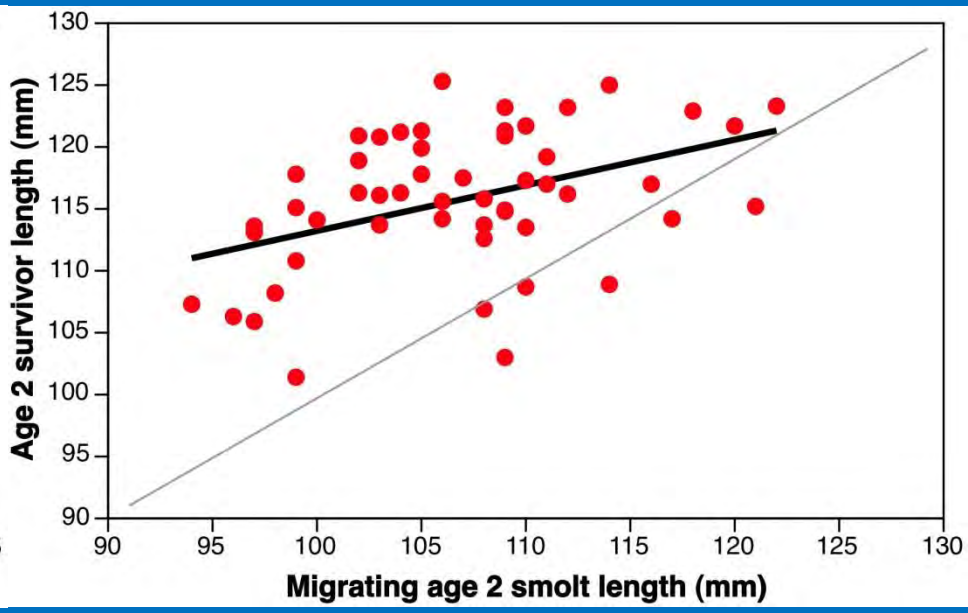
- Age 1 length: 101 mm Age 2 length: 116 mm
- No clear trend over time; small size in early period related to small smolt size

Length of surviving smolt increases with greater length of migrating smolt

Age-1 smolt

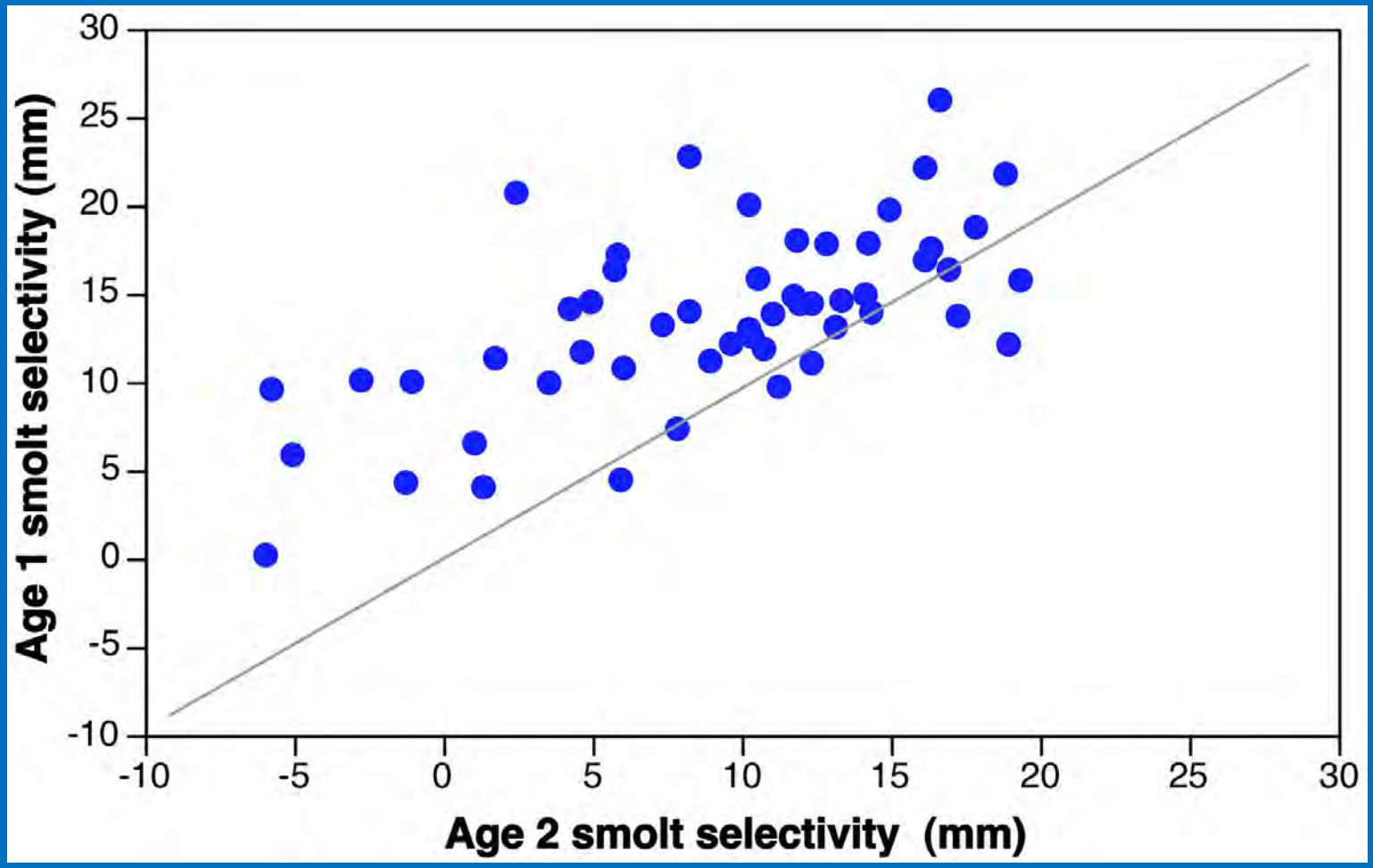


Age-2 smolt



- Note that slope is <1, suggesting less benefit of greater size at higher end of length range.

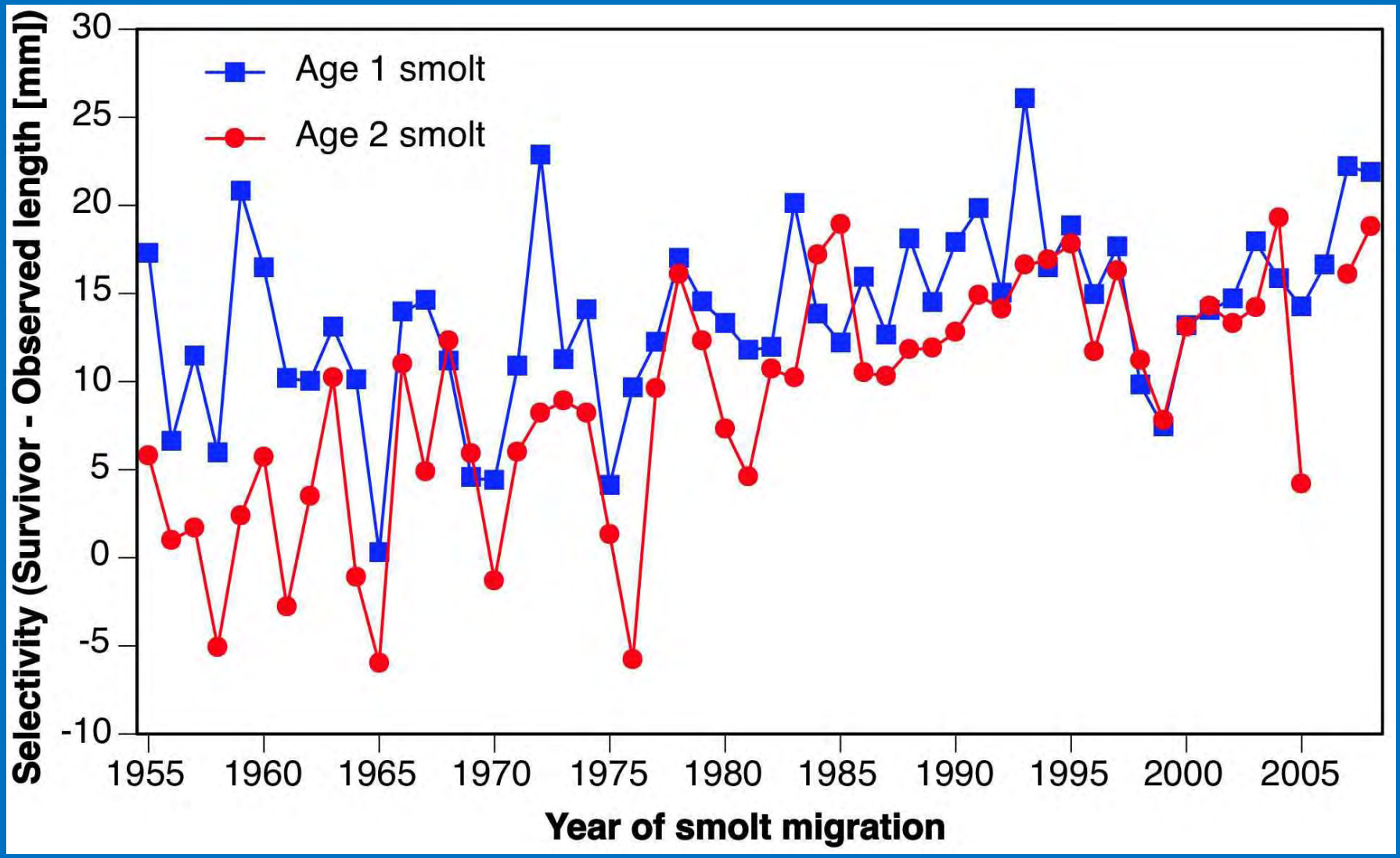
Selectivity of age 1 & age 2 smolts correlated



- **Selectivity is higher for age-1 smolts (14 mm) than age-2 smolts (9 mm)**

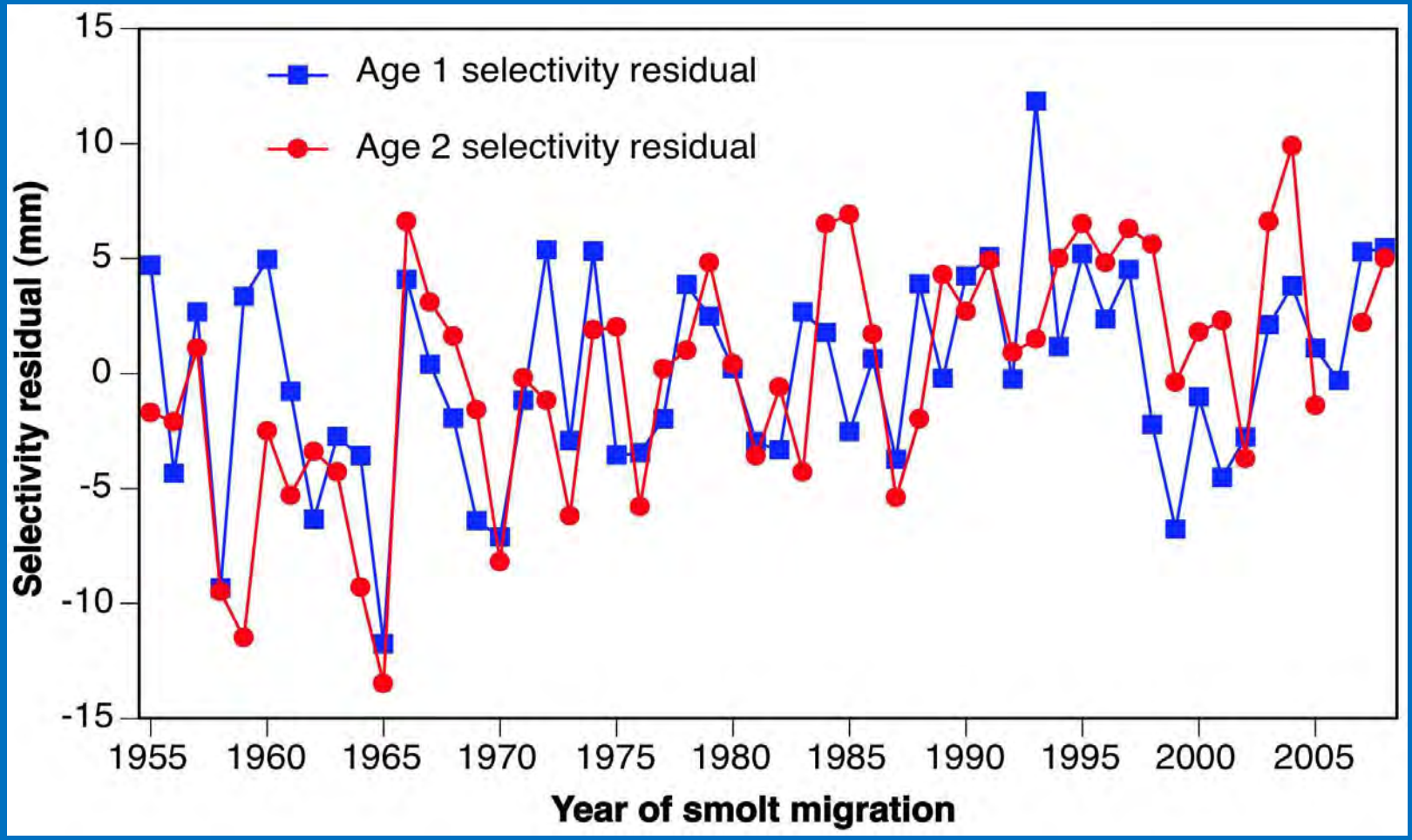
Selectivity (mm) = Survivor smolt length – migrating smolt length

Selectivity of Kvichak Smolts, 1955-2008



Why did selectivity increase after mid-1970s regime shift, a period with "better" ocean conditions?

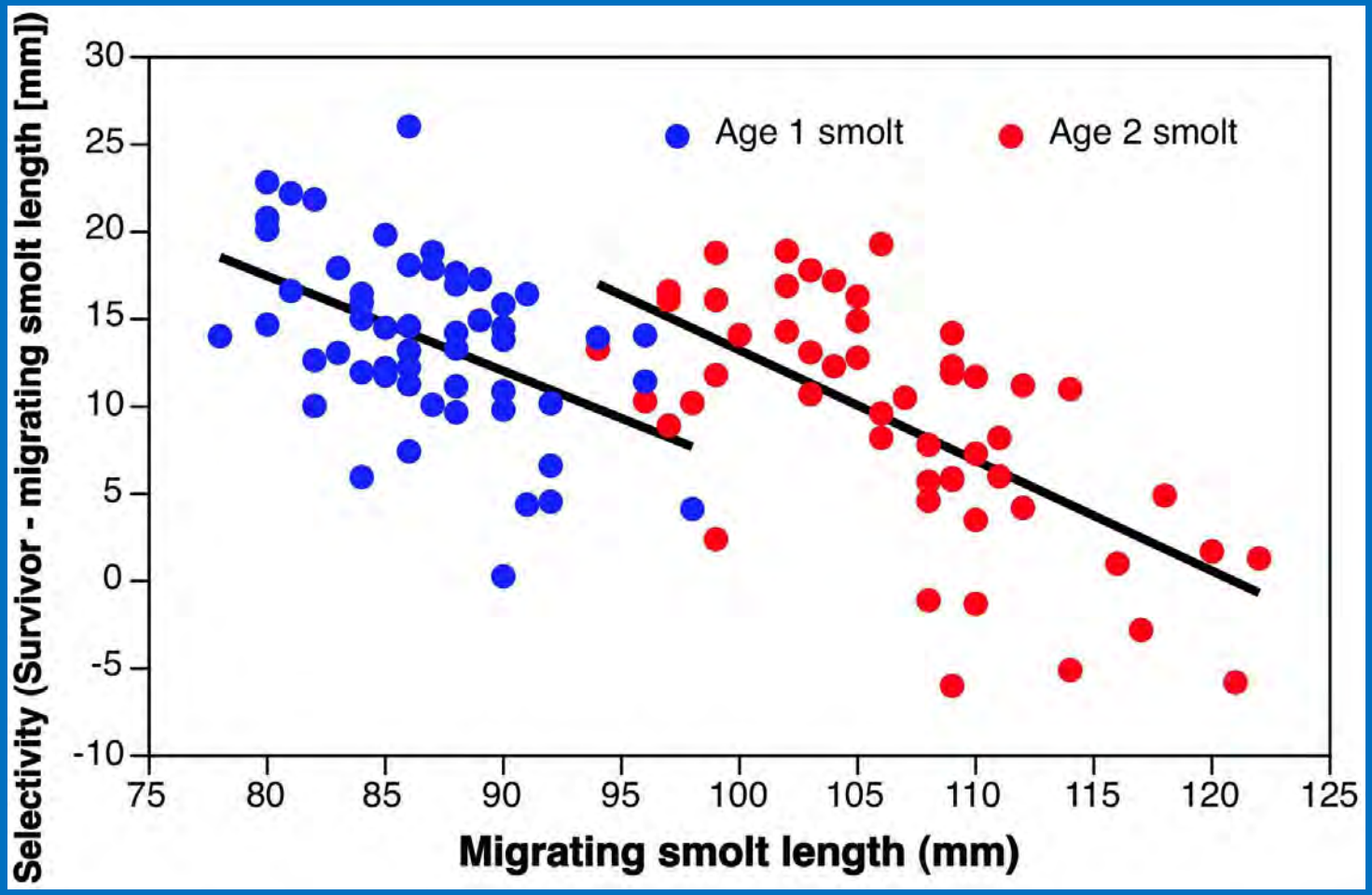
Selectivity after standardizing for length of migrating smolts



- Standardized selectivity by age is correlated.
- Higher selectivity 1977-1996, lower 1998-2002.

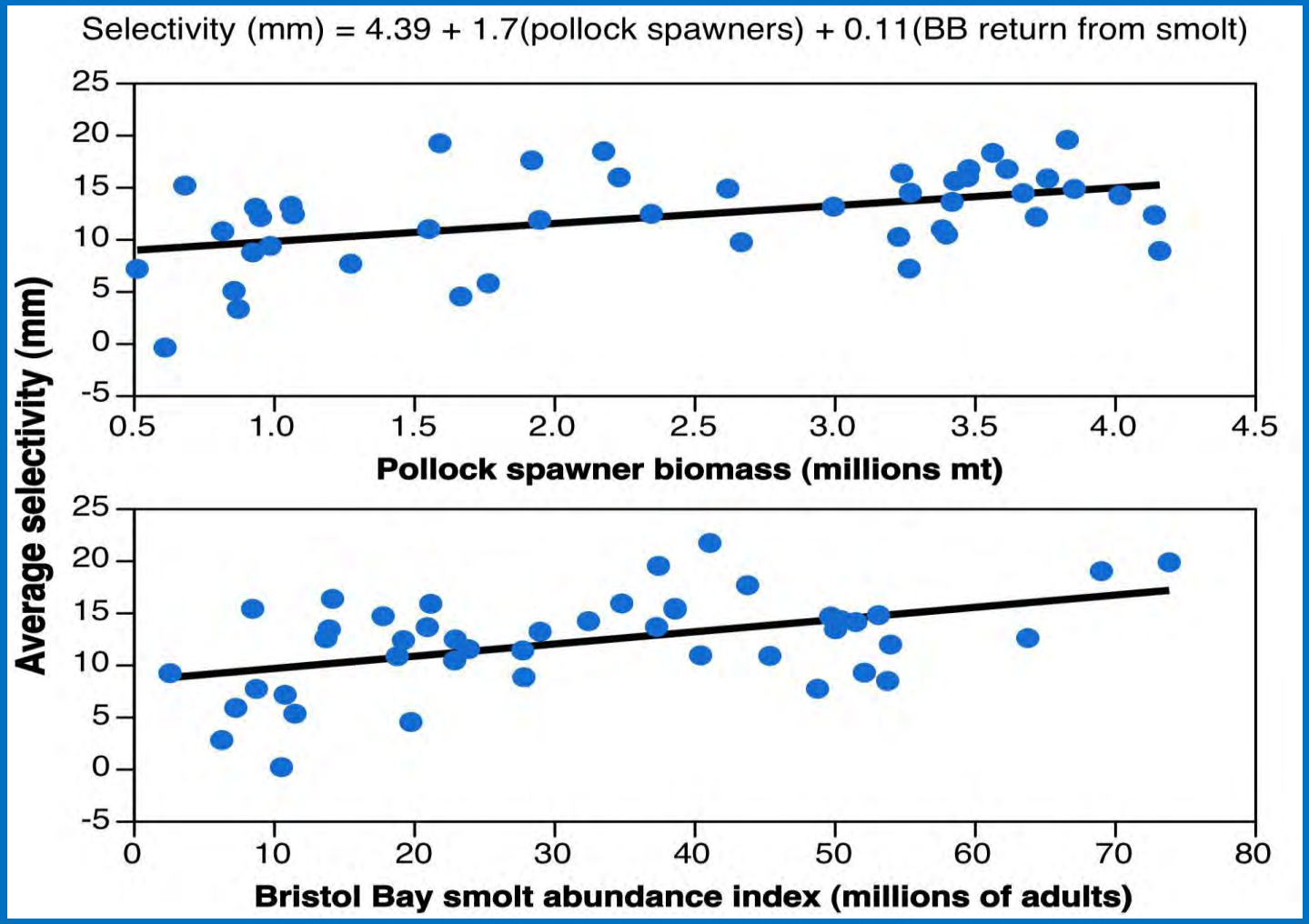
Selectivity declines with larger smolt size

(higher selectivity when smolts are smaller)



- Selectivity of age-1 is less than age-2 at same size.
- Age-1 smolts grow faster, perhaps more fit.

Do pollock larvae & density-dependent growth affect selectivity?



- Preliminary analysis

Summary

- Size of surviving smolts after 2-3 years at sea did not shift over time, but selectivity was greater after the mid-1970s regime shift.
- Density-dependent growth in lakes influenced size-selective mortality at sea: greater size needed for high survival at sea.
- High selectivity in recent decades may be related to YOY pollock & density-dependent growth and survival.
- All analyses are preliminary!

THE END