



Do Asian Pink Salmon Affect Survival of Bristol Bay Sockeye?

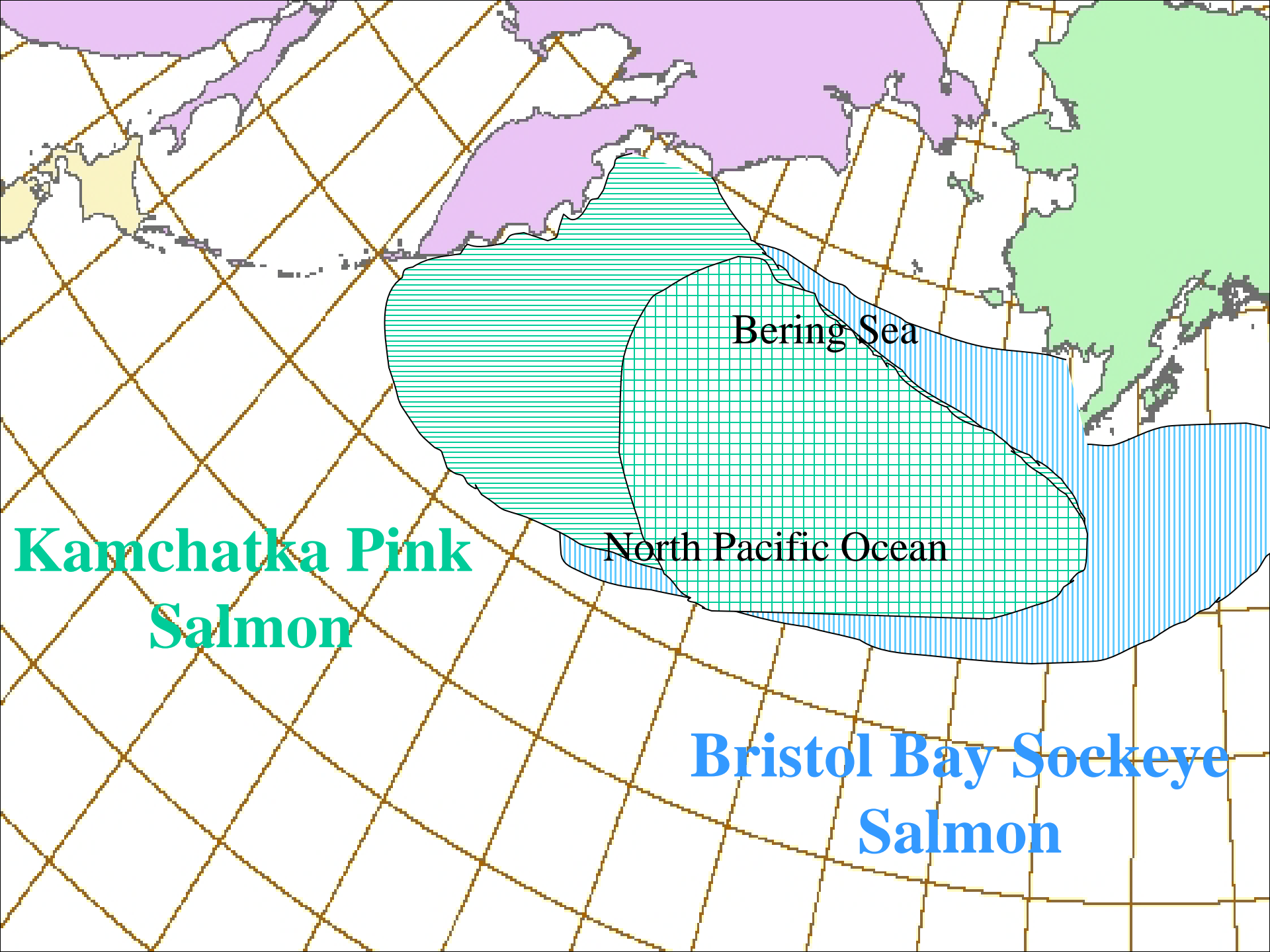
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And

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Ruggerone et al. (2003)

Fisheries Oceanography 12(3):

- Asian pink salmon abundance effects ocean growth of Bristol Bay sockeye salmon.
- Odd/even year differences in average Asian pink salmon abundance , Bristol Bay sockeye returns, and smolt -to-adult survival of three major sockeye salmon stocks: Kvichak, Egegik, and Ugashik.
- Density dependent interaction of sockeye salmon in their first year at sea and Asian pink salmon reduces survival of Bristol Bay sockeye salmon.



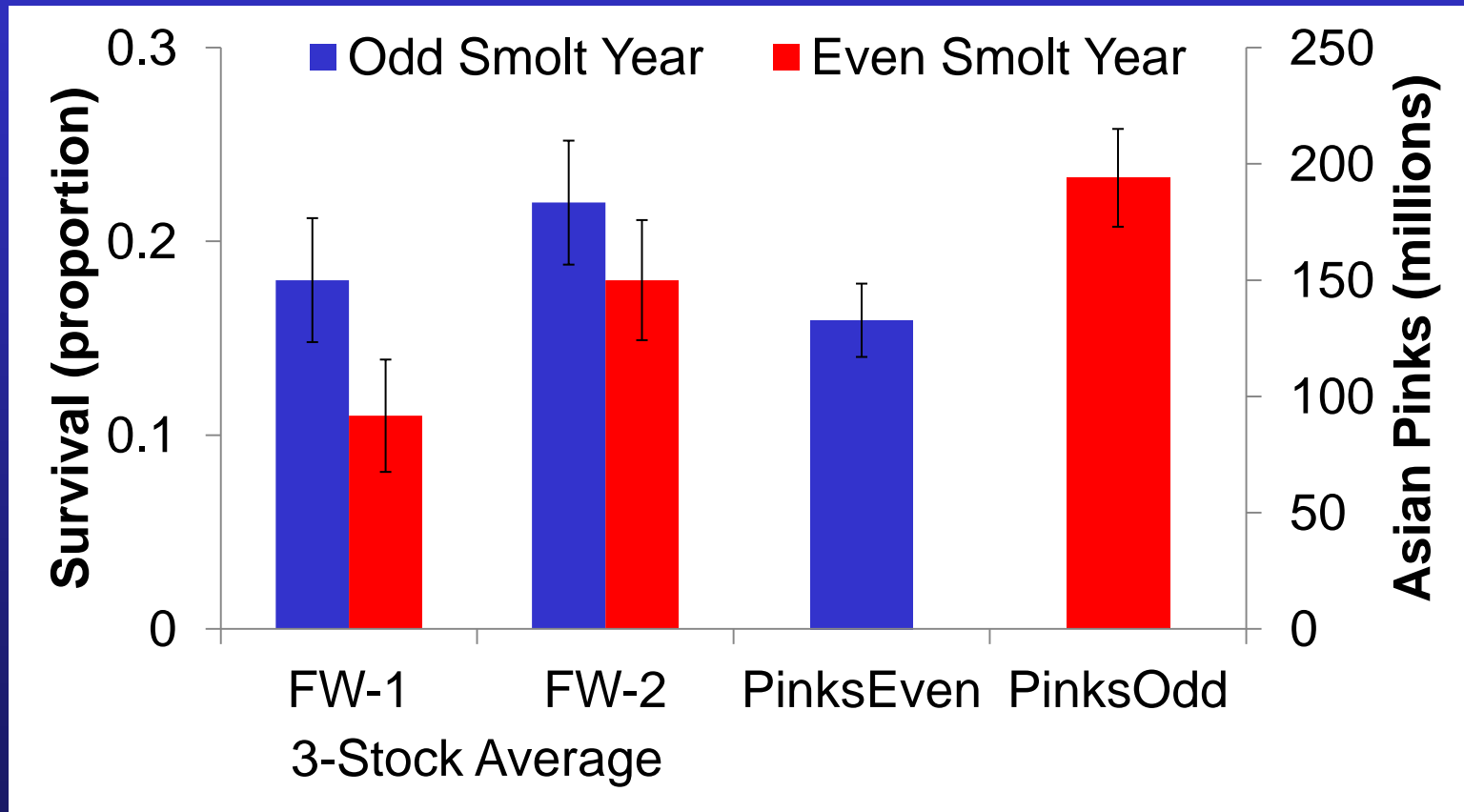
**Kamchatka Pink
Salmon**

**Bristol Bay Sockeye
Salmon**

Bering Sea

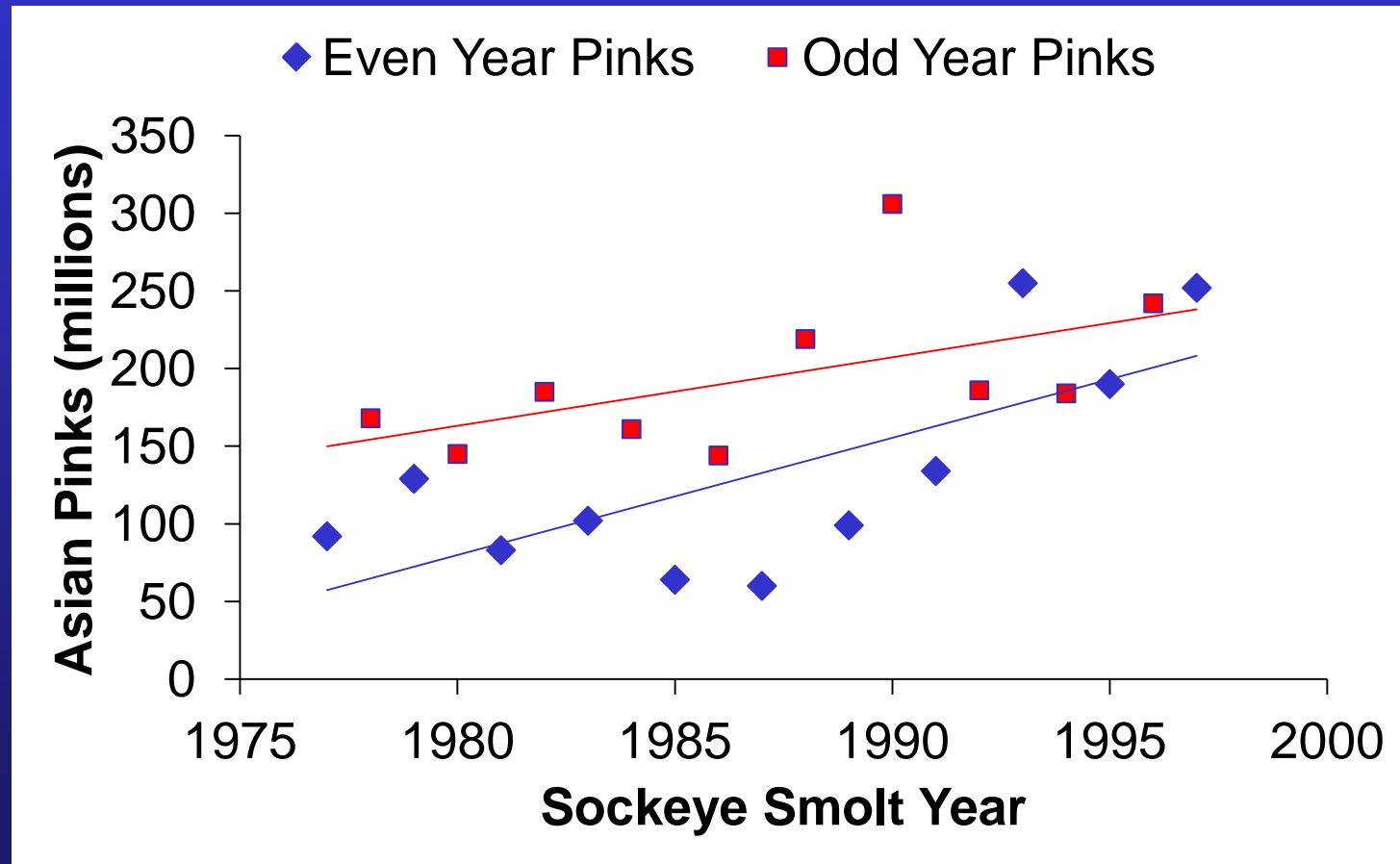
North Pacific Ocean

3-Stock Average Bristol Bay Sockeye Smolt Survival and Asian Pink Salmon Abundance 1977-1997



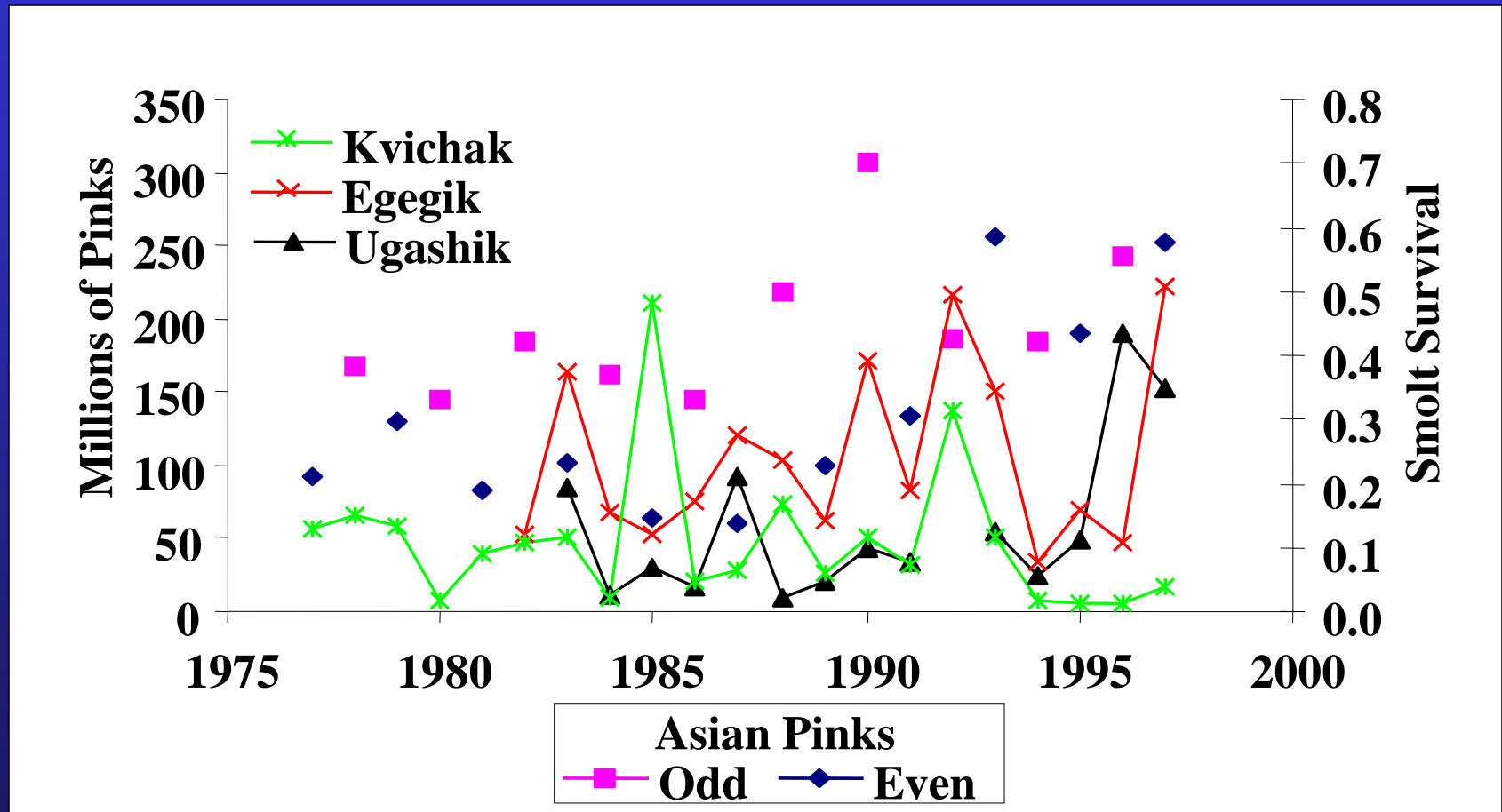
From Ruggerone et al. (2003), Rogers (2001)

Trends in Asian Pink Salmon Abundance 1977-1997



From Rogers (2001)

Bristol Bay Smolt Survival: Time Series By Stock



From ADFG (2003)

Objectives Of This Presentation

- Use regression and time-series models to examine the relationship between the abundance of Asian pink salmon and marine survival of 3 major Bristol Bay sockeye salmon stocks :
Kvichak 1977-1997
Egegik 1982-1997
Ugashik 1983-1997
- Use BASIS index of juvenile Bristol Bay sockeye salmon (2002-2007) in the Bering Sea to examine relationship of subsequent survival and returns to the abundance of Asian pink salmon.

Time Series Analysis

Model 1: Regression Model

(no trend to survival)

$$Survival = \alpha + \beta * PA + error$$

Model 2: AR(1) Model

(Add annual trend to survival)

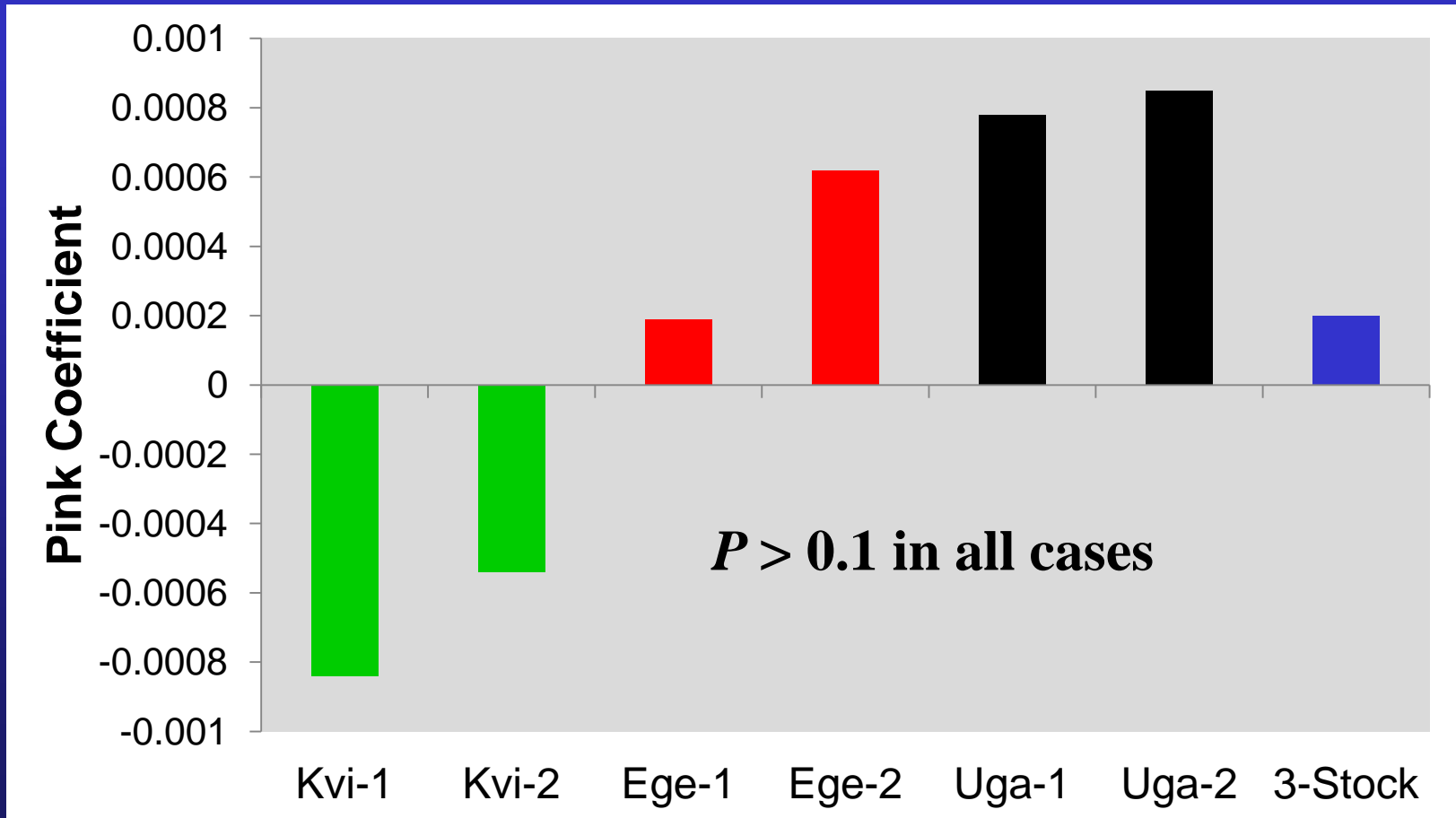
Model 3: AR(2) Model

(Add biennial trend to survival)

Significance of Autoregressive Parameters for Smolt Survival

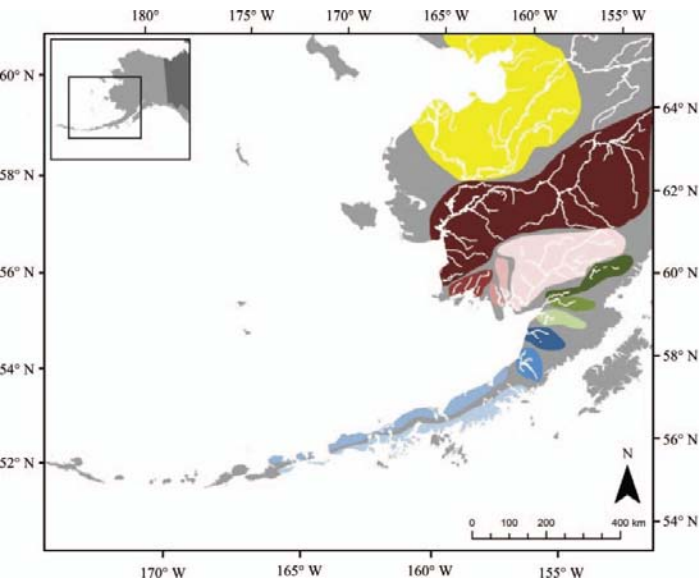
Stock/Age	Model 2 : AR(1)		Model 3: AR(2)	
	Coefficient	<i>P</i> -value	Coefficient	<i>P</i> -value
Kvichak-1	-0.267	0.231	0.131	0.596
Kvichak-2	0.102	0.665	-0.249	0.303
Egegik-1	-0.354	0.185	0.153	0.545
Egegik-2	-0.064	0.821	-0.267	0.367
Ugashik-1	0.149	0.632	0.247	0.625
Ugashik-2	-0.476	0.113	0.294	0.460
3-Stock Avg.	-0.421	0.115	0.472	0.098

Regression of Smolt Survival by Stock/Age with Pink Abundance

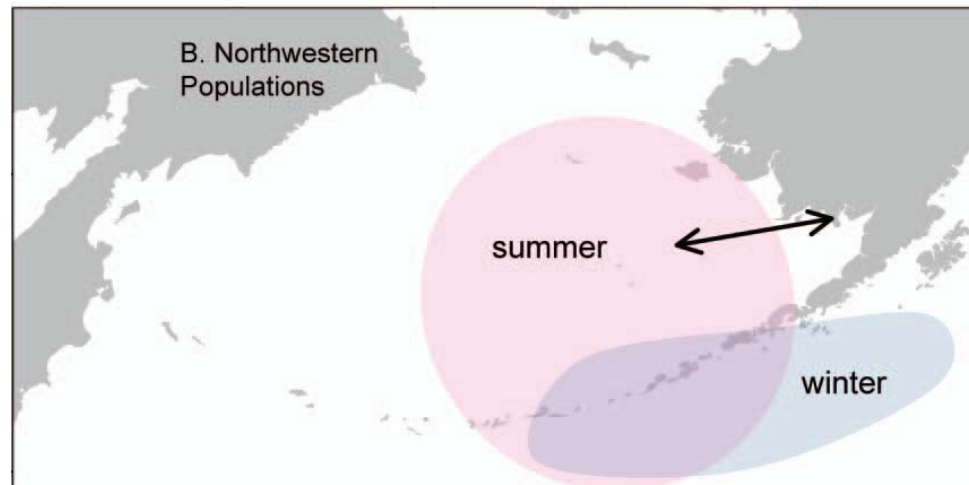
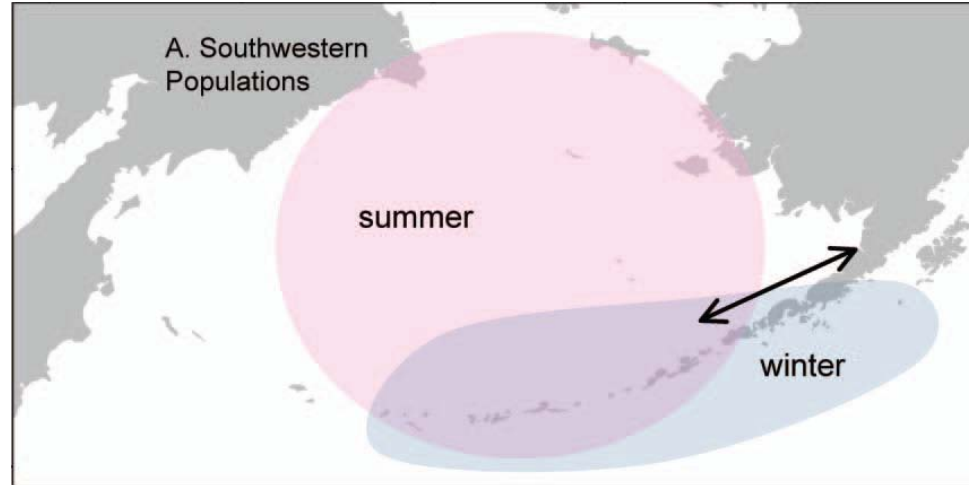




Bristol Bay Sockeye Salmon Seasonal Migration



- Yukon / Norton
- Kuskokwim Bay
- Togiak
- Igushik
- Wood
- Nushagak
- Kvichak
- Alagnak
- Naknek
- Egegik
- Ugashik
- North Pen
- South Pen



Conclusions: 1977-1997 Smolt Years

- No consistency among stocks in survival response over time or in relation to pink salmon abundance
- **COMPLEX:** Density interactions with Asian pinks are stock specific and compensatory (competition vs. predator sheltering)
- **SIMPLE:** Relationships between smolt survival and Asian pinks are artifacts of increasing pink abundance and stock-specific patterns in sockeye smolt survivals
- Regardless of mechanism, we do not see any relationship between BB smolt survival and Asian pink salmon abundance

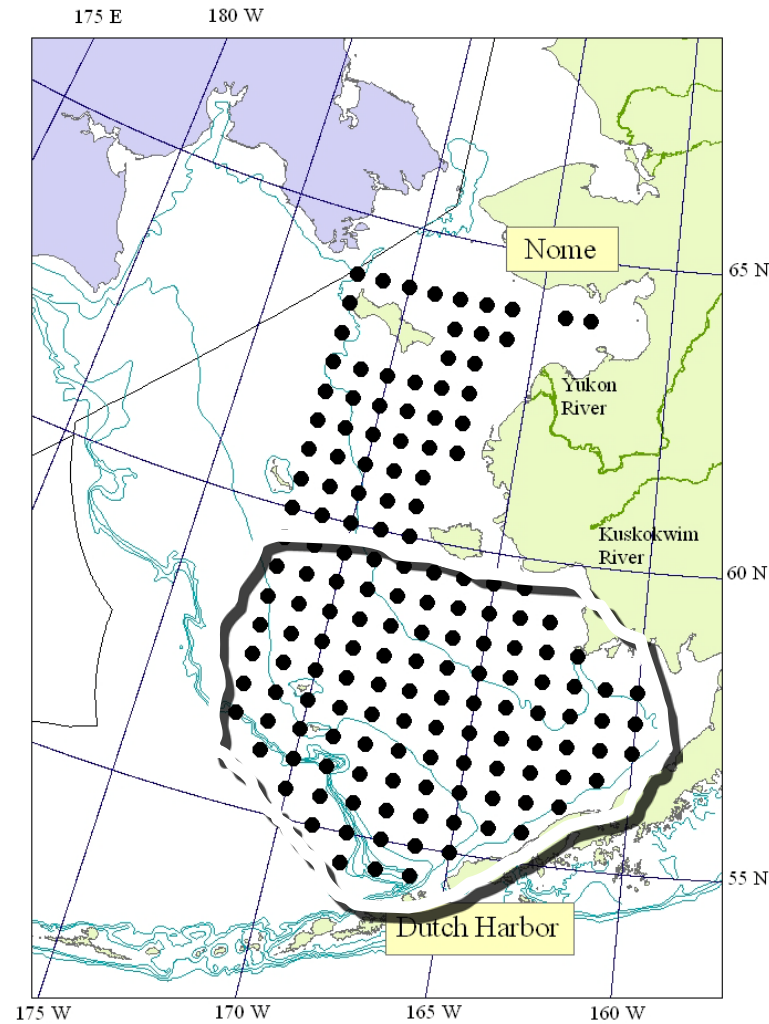
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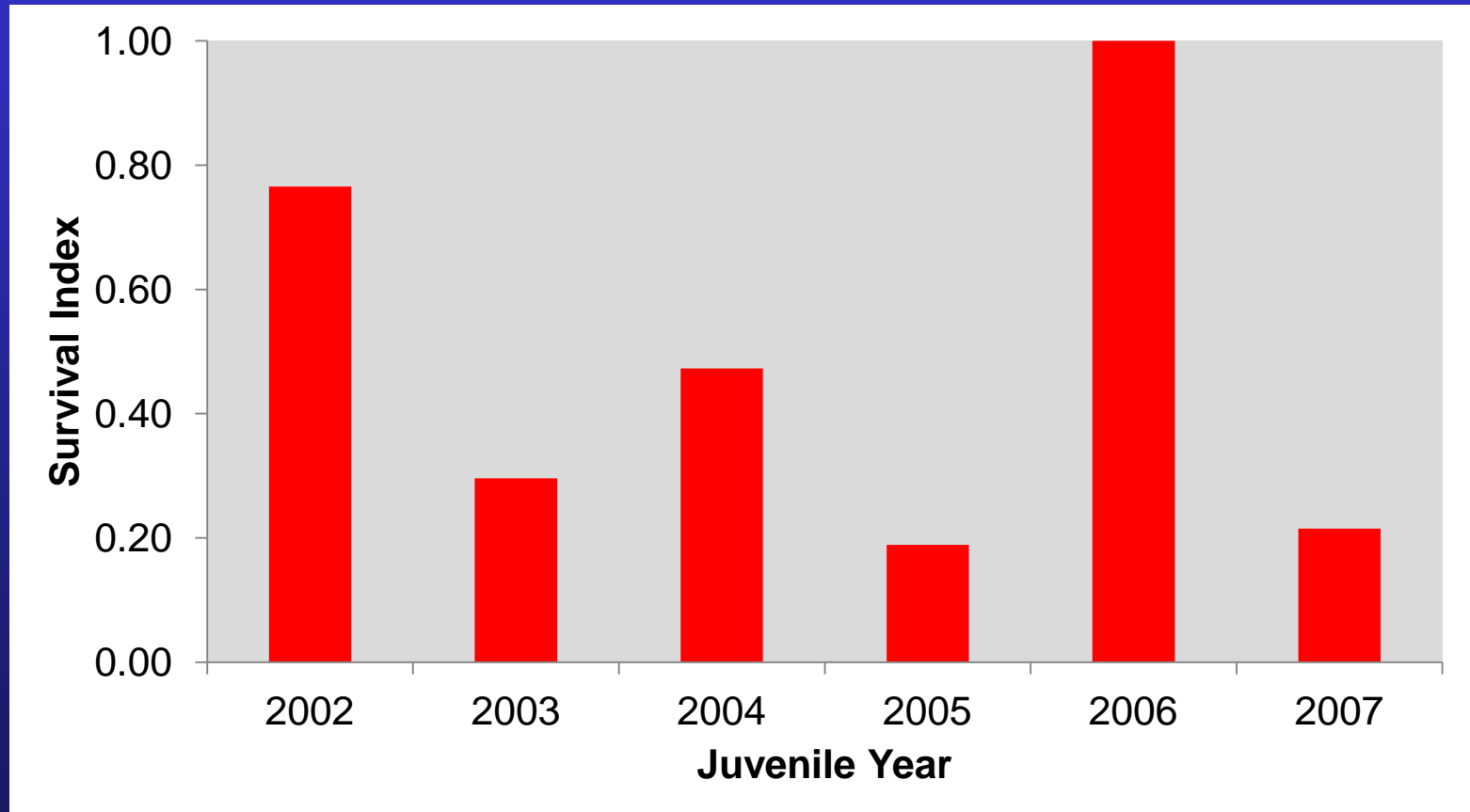


BASIS Survey

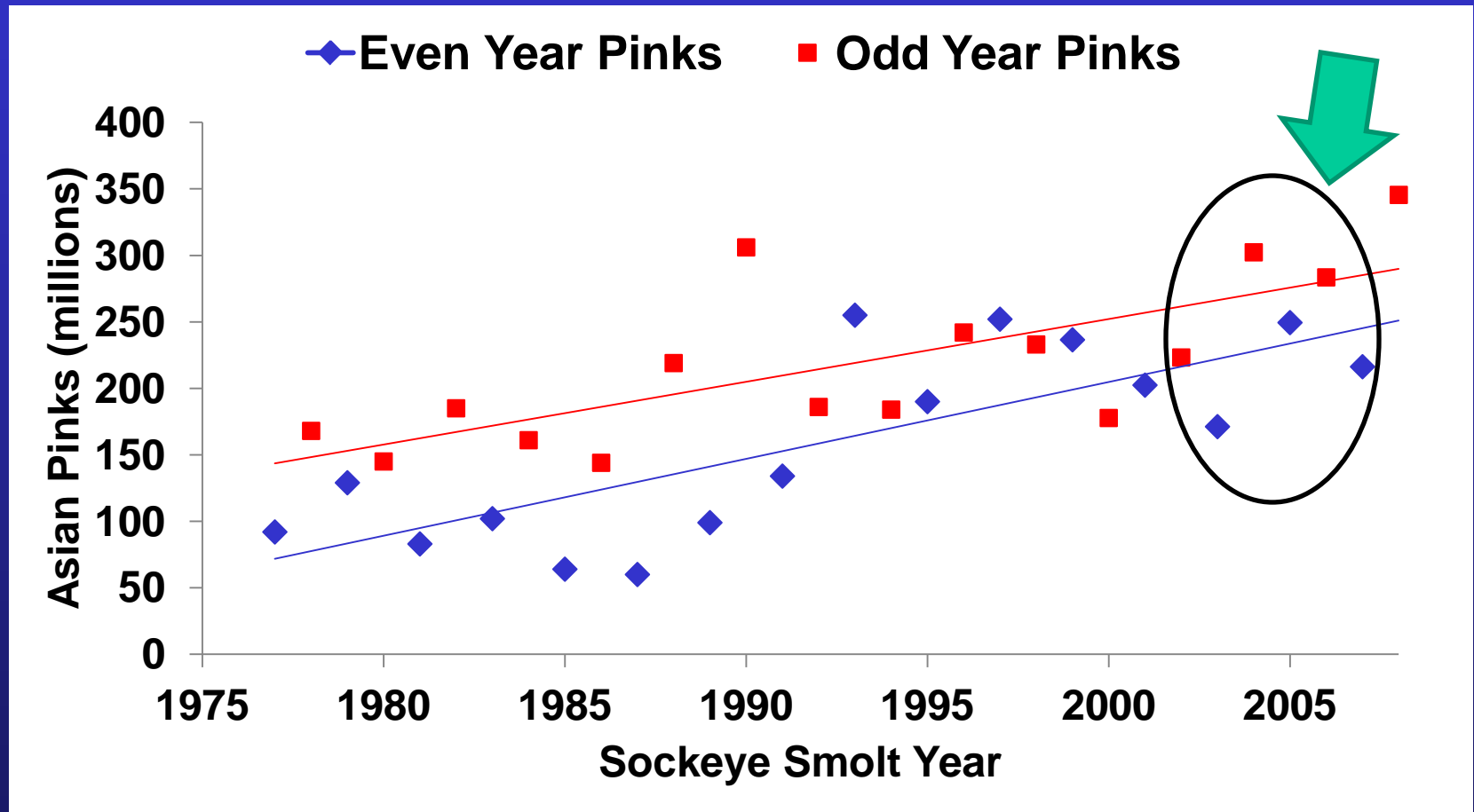
Southeast
and Northeast Bering Sea
mid August – September
2002 - 2007



BASIS Juvenile BB Sockeye Survival Index (Adult Return/Juvenile Abundance)

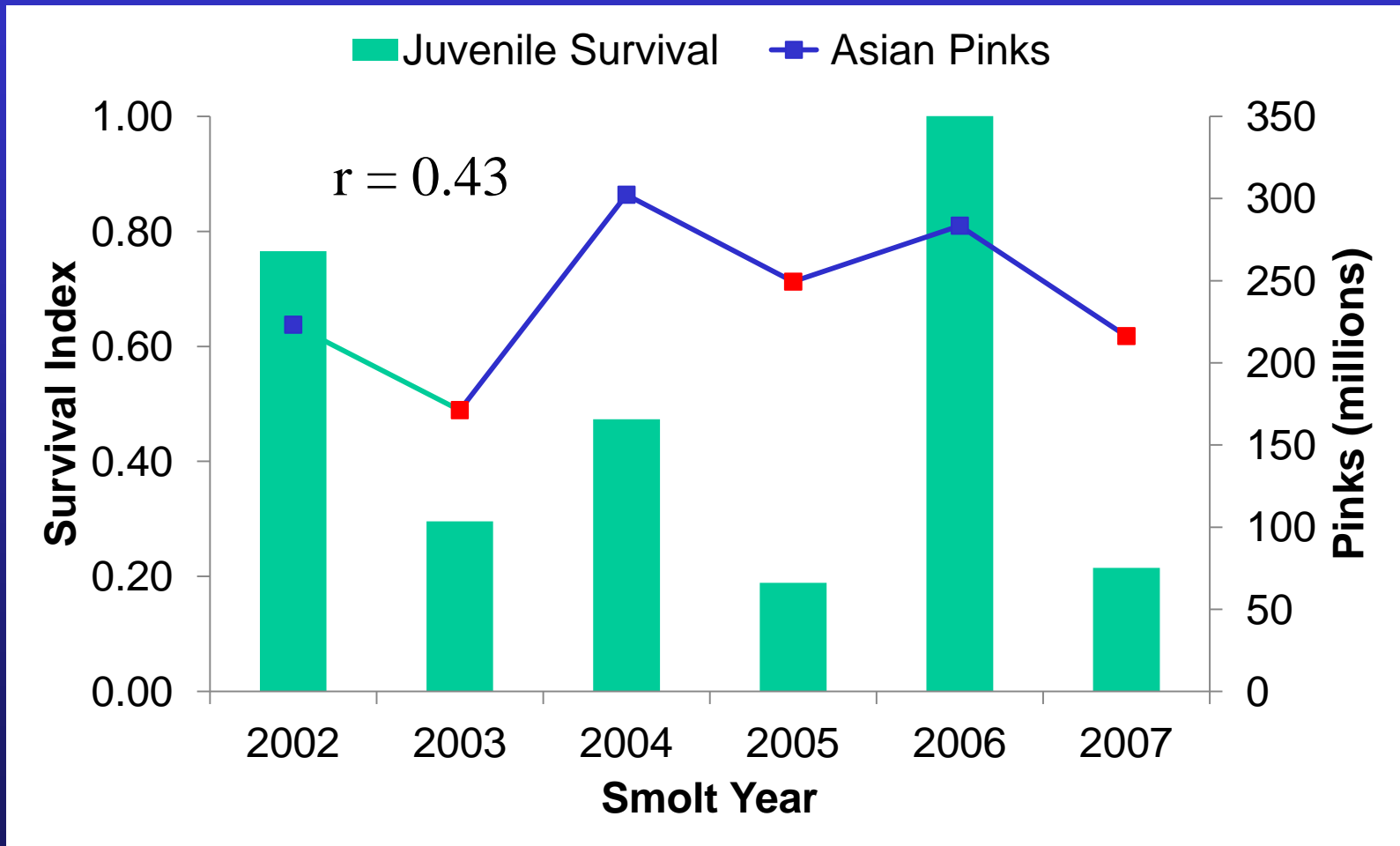


Trends in Asian Pink Salmon Abundance 1977-2008

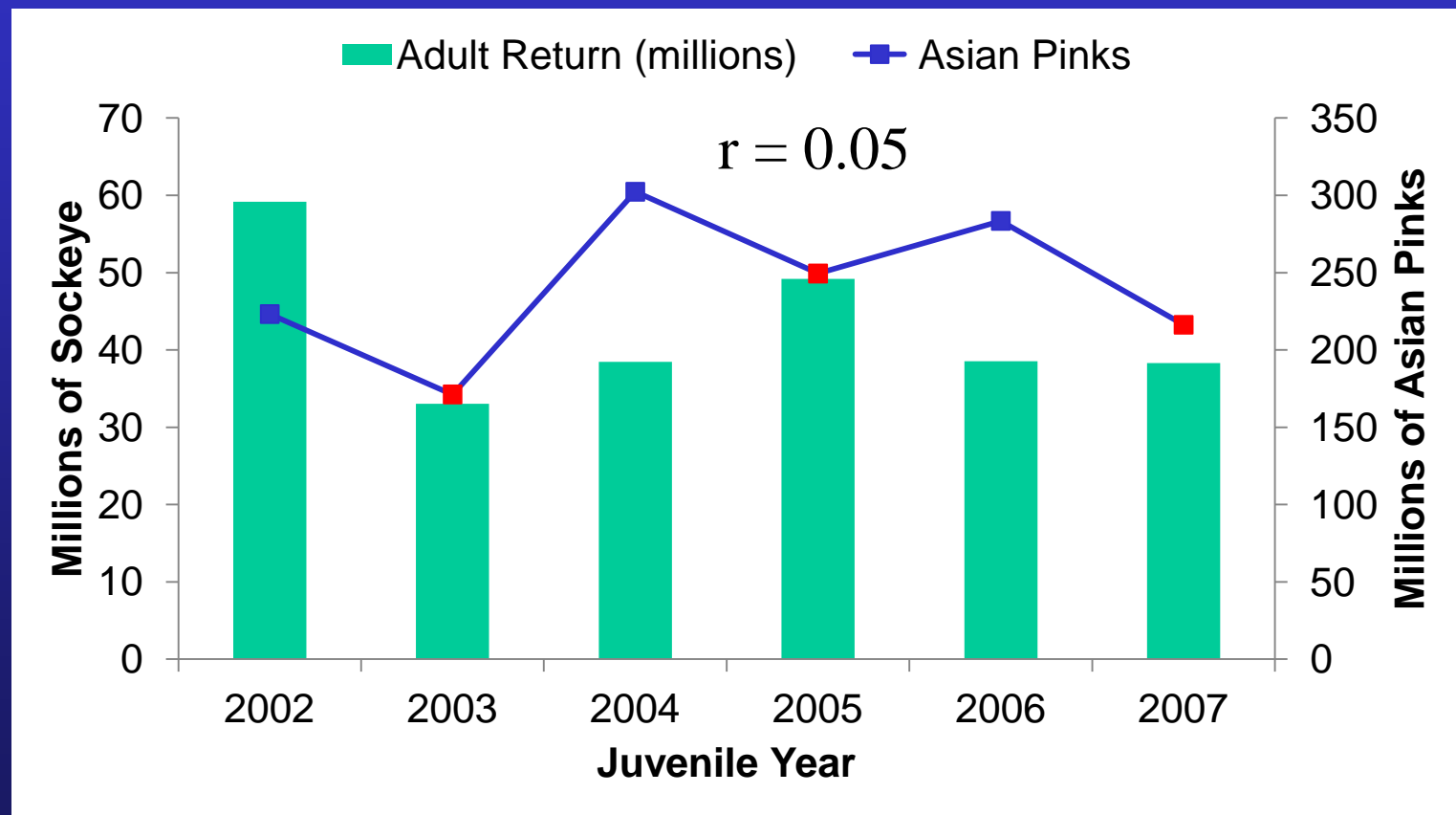


From Ruggerone et al. (2010), Rogers (2001)

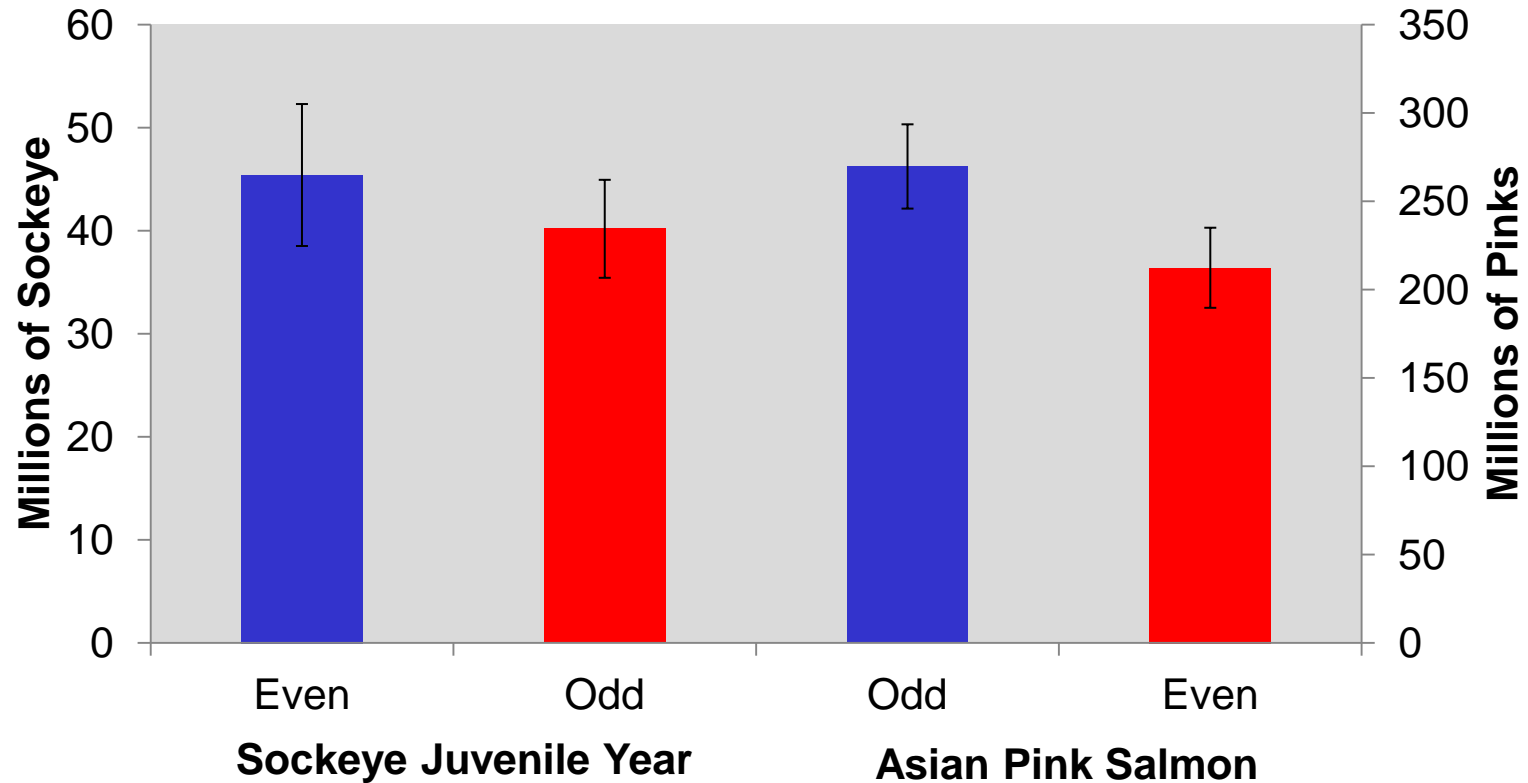
Sockeye Juvenile Survival Index and Associated Asian Pink Abundance



Bristol Bay Sockeye Returns and Asian Pink Salmon for 2002-7 Juvenile Years



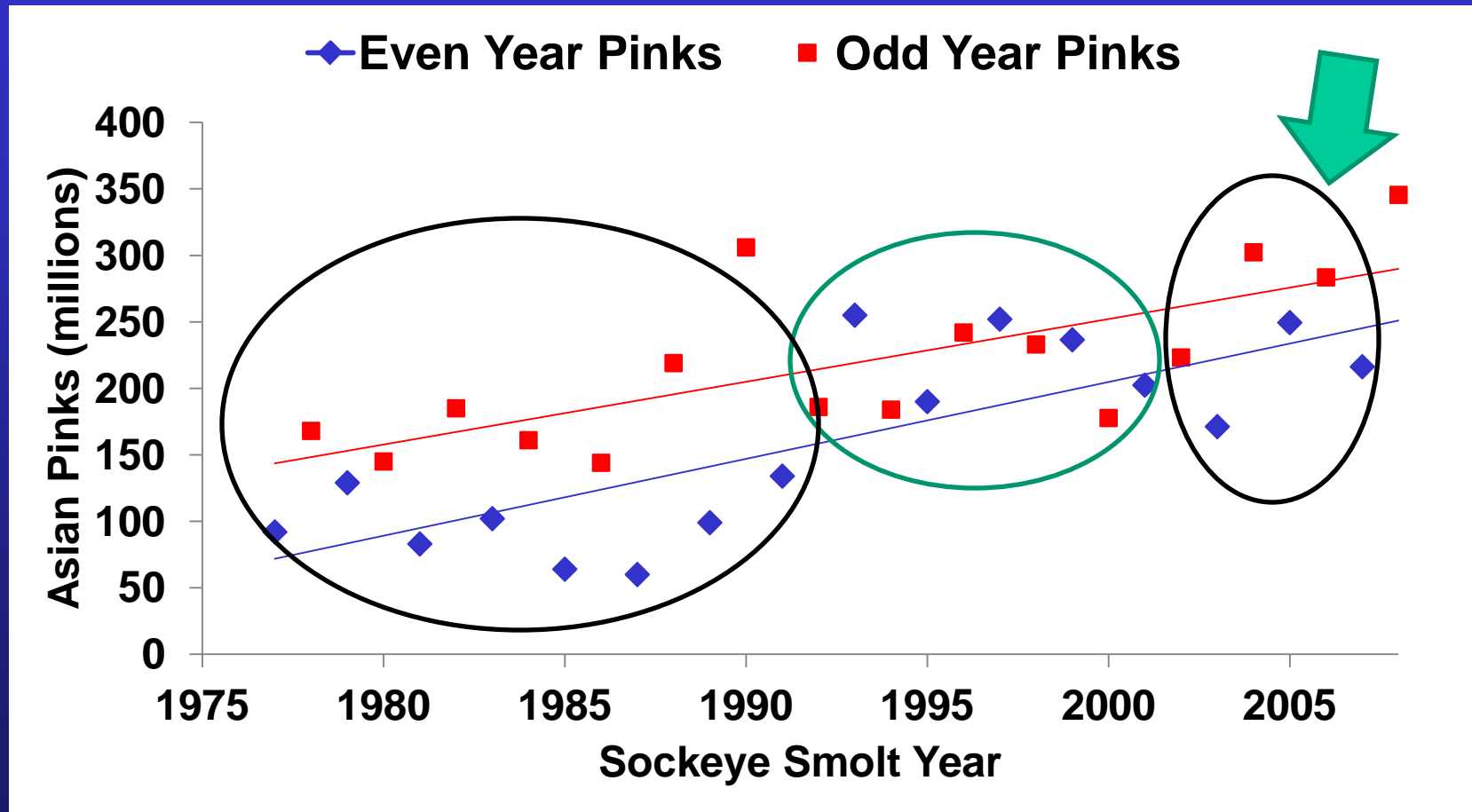
Average Odd/Even Returns of Bristol Bay Sockeye and Asian Pink Salmon, 2002-7 Juvenile Years



Conclusions: 2002-2007 Juvenile Years

- Juvenile survival index was positively correlated with Asian pink salmon abundance
- Adult returns and juvenile survival index were HIGHER for even year juveniles
- Results consistent with conclusions from Part 1 (1977-97) smolt data: no cumulative negative impact of Asian pink salmon abundance on Bristol Bay sockeye salmon survival

Trends in Asian Pink Salmon Abundance 1977-2008



From Ruggerone et al. (2010), Rogers (2001)

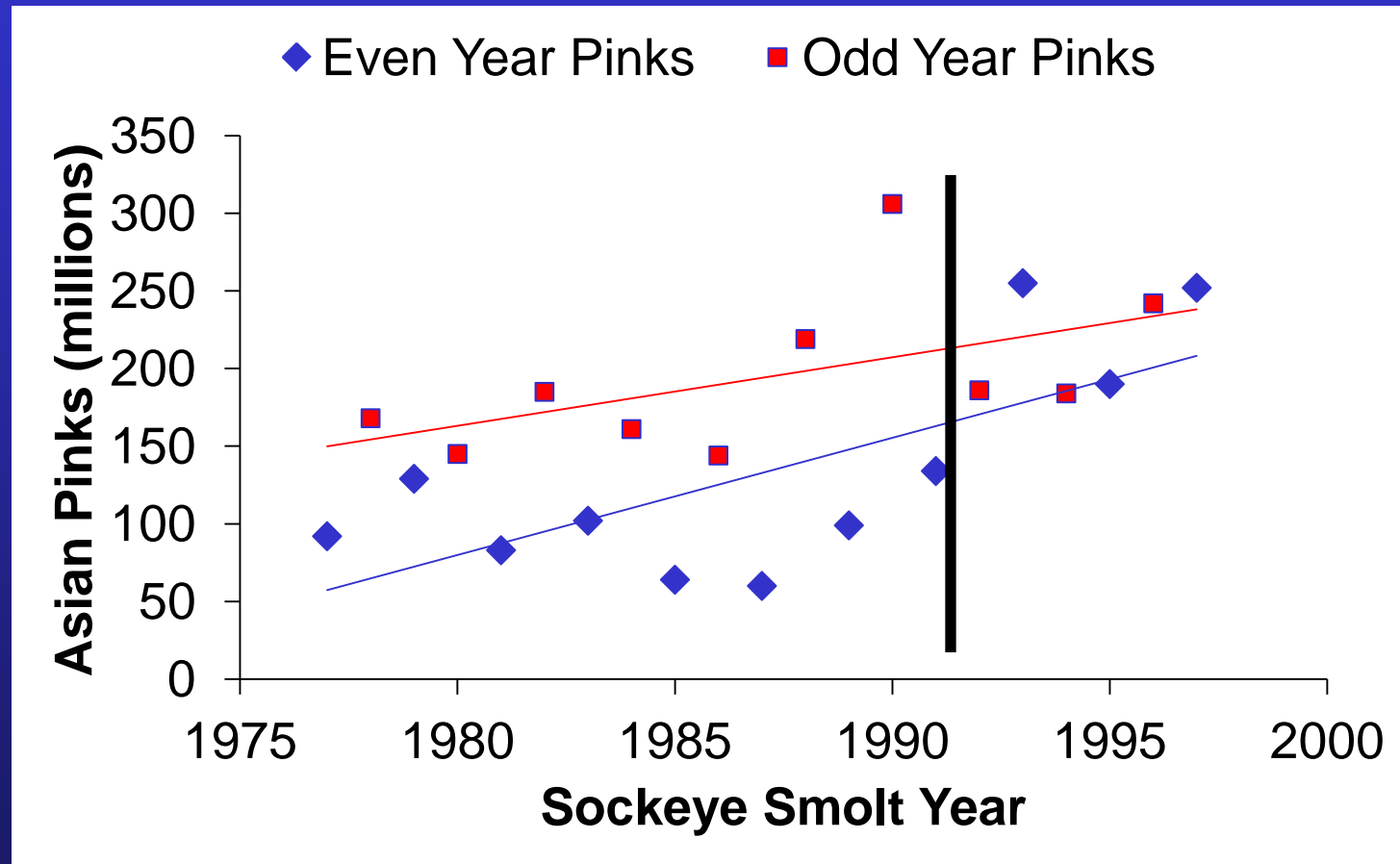
Acknowledgements

- **Lowell Fair and Tim Sands, ADFG for sockeye salmon smolt and adult return data**
- **Ellen Martinson, NOAA Fisheries, for help running time series analyses**
- **Joe Orsi for inviting us to speak at the Pink and Chum salmon workshop**

A large school of salmon swimming in the water, viewed from above. The fish are densely packed and moving in a coordinated manner. The water is a light, slightly hazy blue-grey color. The fish have silvery scales and some have a reddish tint on their heads.

Questions?

Trends in Asian Pink Salmon Abundance 1977-1997



From Rogers (2001)