WINGS, FINS, AND THE 'BLACK BOX': MANAGEMENT IMPLICATIONS OF MARINE BIRD AND FISH TROPHIC SIMILARITIES

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Overview

- Introduce basic conceptual model for use of marine birds as ecosystem indicators for fish (during the marine phase of their life cycle)
- Provide 3 case histories on the use of “ecological equivalents” and “ecological indicators”
  - Herring
  - Rockfish
  - Salmon (chinook)
- Discuss potential for a network of marine bird “monitoring stations” in the NPO

Case Study 1

Can Ecological Indicators (of Oceanic Foraging Conditions) be Used to Understand Herring Recruitment/Body Condition in the San Francisco Bay Estuary?

Herring Spawn in Bay → **Herring Feed at Sea** → **Herring Enter Bay** → **Herring Spawn in Bay**

Seabird Productivity on SE Farallon Island

WINTER SPRING SUMMER FALL WINTER

Productivity (number of offspring/female) = an integrated measurement of foraging conditions for marine birds, from egg-laying through offspring rearing in spring/summer each year.

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DIET OF HERRING AND PLANKTIVOROUS SEABIRDS IN THE GULF OF THE FARALLONES, CENTRAL-NORTHERN CALIFORNIA CURRENT SYSTEM

Pacific Herring

Common Murre

*Cassin's Auklet – Obligate planktivore

Western Gull

Macrozooplankton (**euphausiids: *E. pacifica, T. spinifera***)

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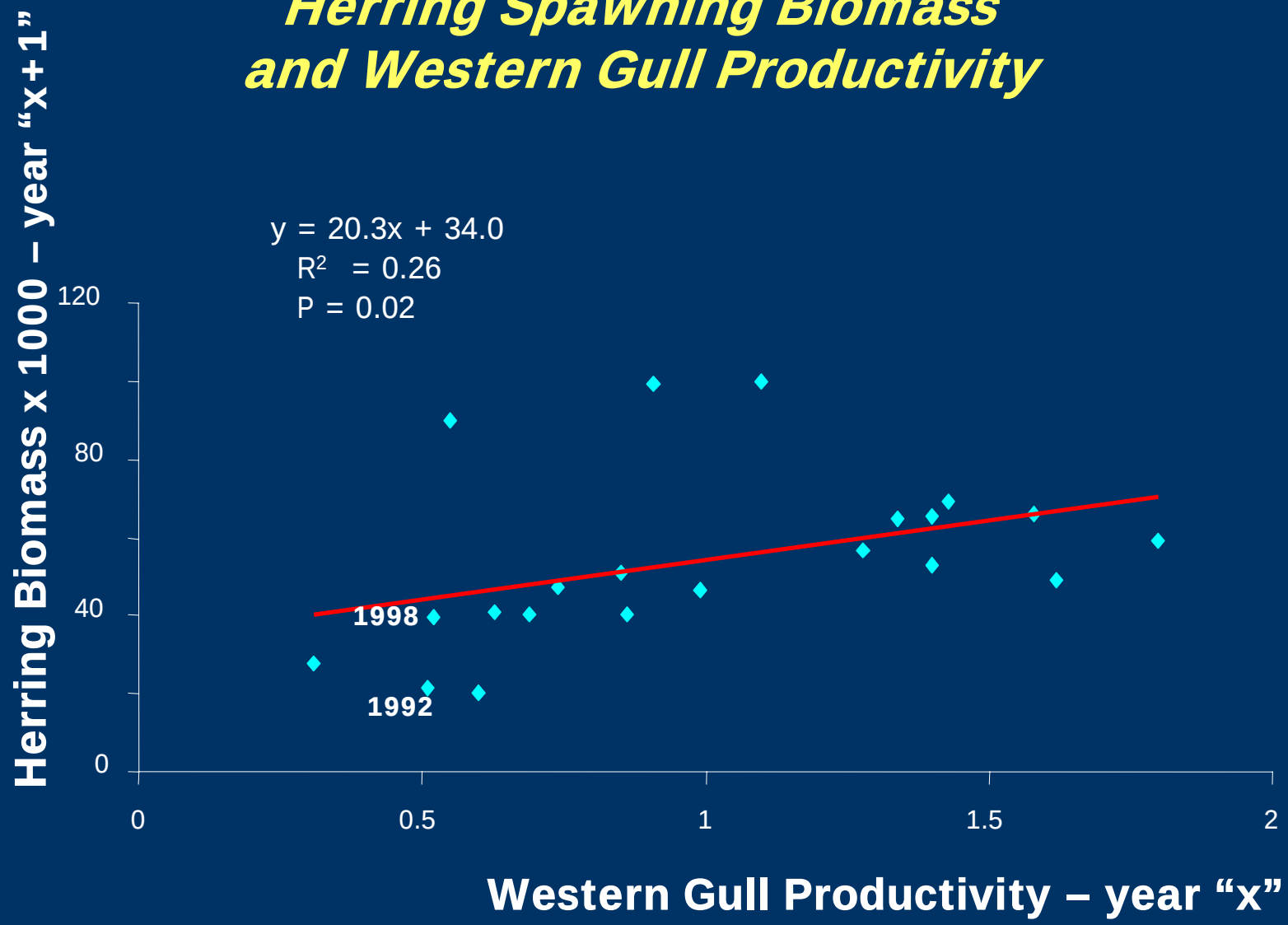
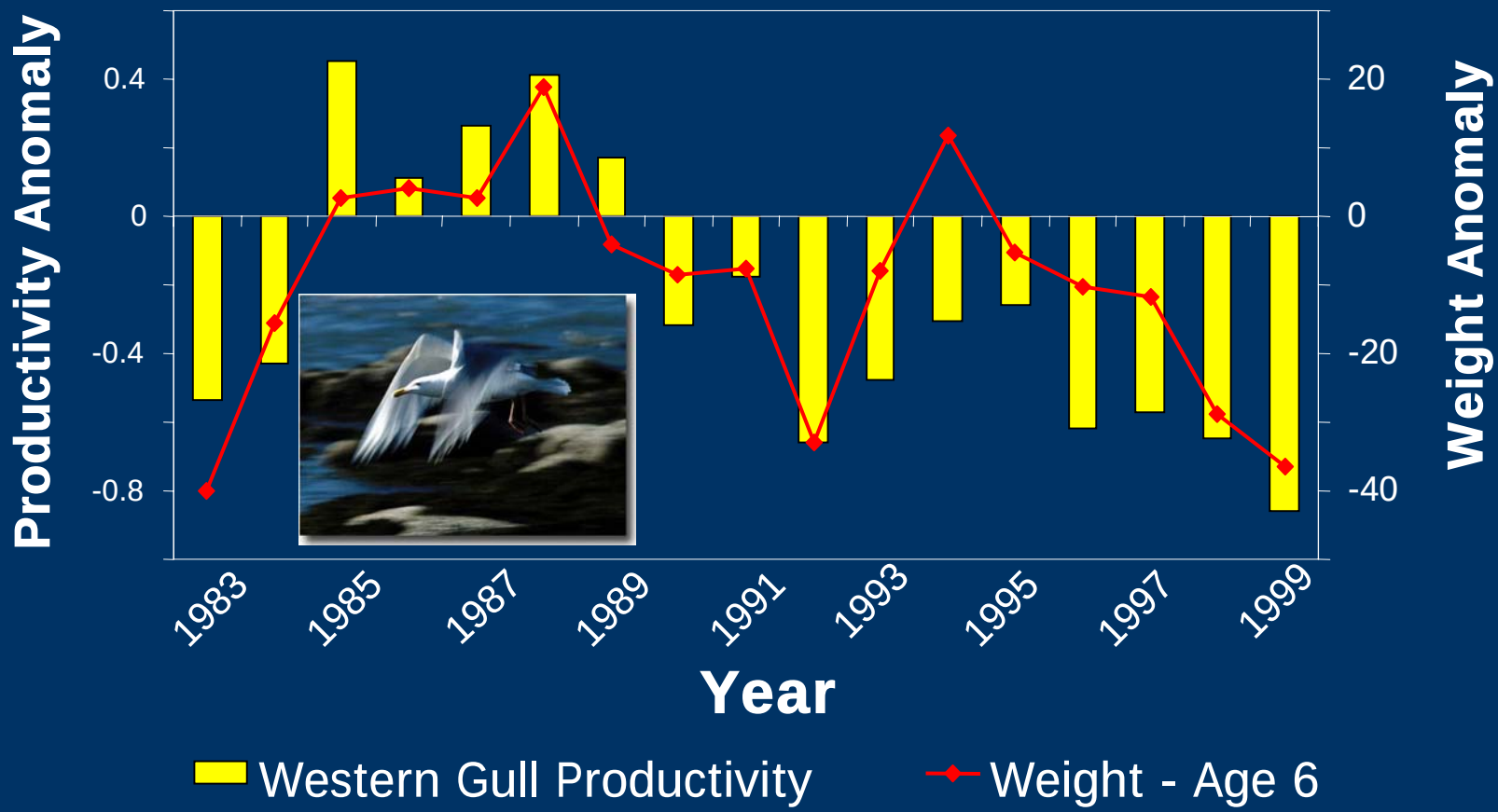
Herring Spawning Biomass and Western Gull Productivity



Herring Mass (g, age 6) and Western Gull Productivity



Herring Condition (M/L^3)

	Herring Age (yrs)							
	1	2	3	4	5	6	7	8
Western Gull					*	*	*	
Common Murre		*			*	*	*	
Cassin's Auklet			*	*	*	*	*	

* = significant at the 0.05 level

Cassin's Auklet
Herring, Age 6

$R^2 = 0.71$

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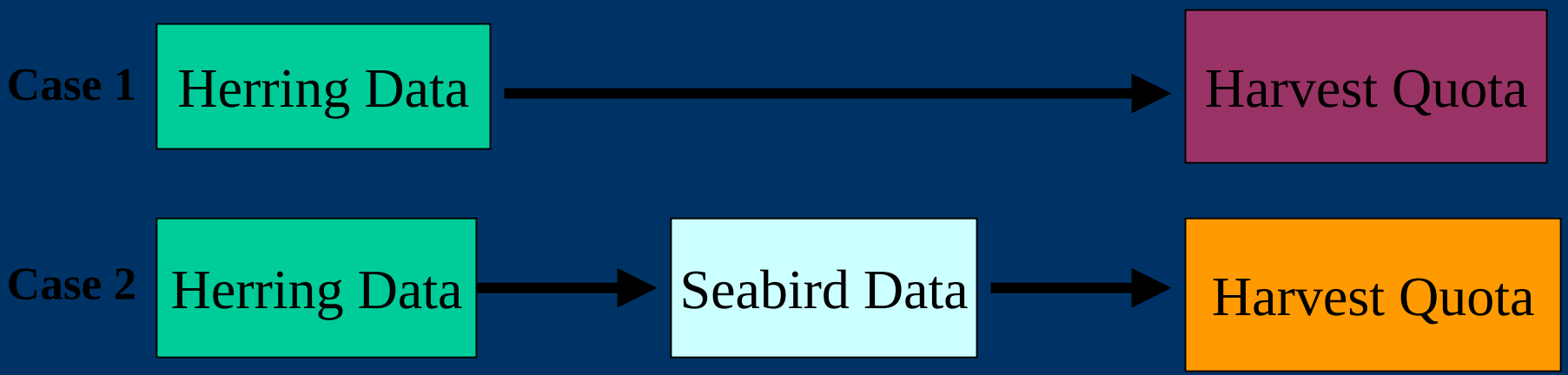
- *<u>Summary</u>: productivity of planktivorous seabirds, particularly auklets, may be a useful index to the oceanic feeding conditions for herring at sea during the spring and summer months.*

Potential Applications :

- adaptive management of herring fishery in SFB.
- contribute novel tool for understanding spawning biomass and other critical fishery statistics (condition).



Case Study 2

Can Top Predator (seabird and salmon) Diet be Used to Assess Rockfish (Sebastes spp.) Recruitment?

Chinook Salmon
(adult)

Common Murre

Pigeon Guillemot

Rhinoceros Auklet

Pelagic Juvenile Rockfish

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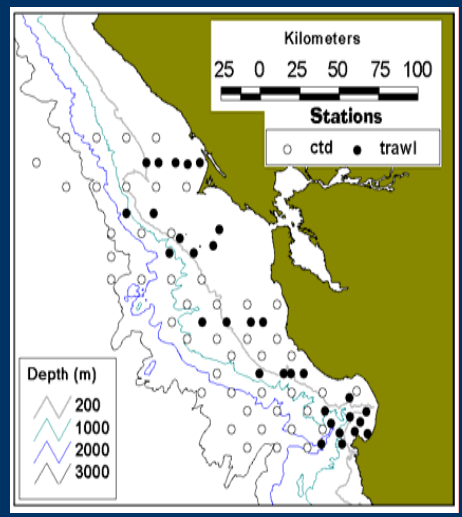
DATA SETS USED IN STUDY

1. **Rockfish Trawls (1983-2002):** The National Marine Fisheries Service (NMFS, Santa Cruz) conducts mid-water trawl surveys during May - June.

2. **Salmon Gut Contents (1980-1999):** NMFS examined Chinook Salmon caught in the vicinity of the Farallon Islands.

3. **Seabird Offspring Diet (1972-2002):** PRBO has conducted studies (May - July) from "RV Farallon Island".



***Common Murre (single fish, observed brought to colony)**

***Pigeon Guillemot (single fish, observed brought to colony)**

***Rhinoceros Auklet (multiple fish, collected)**

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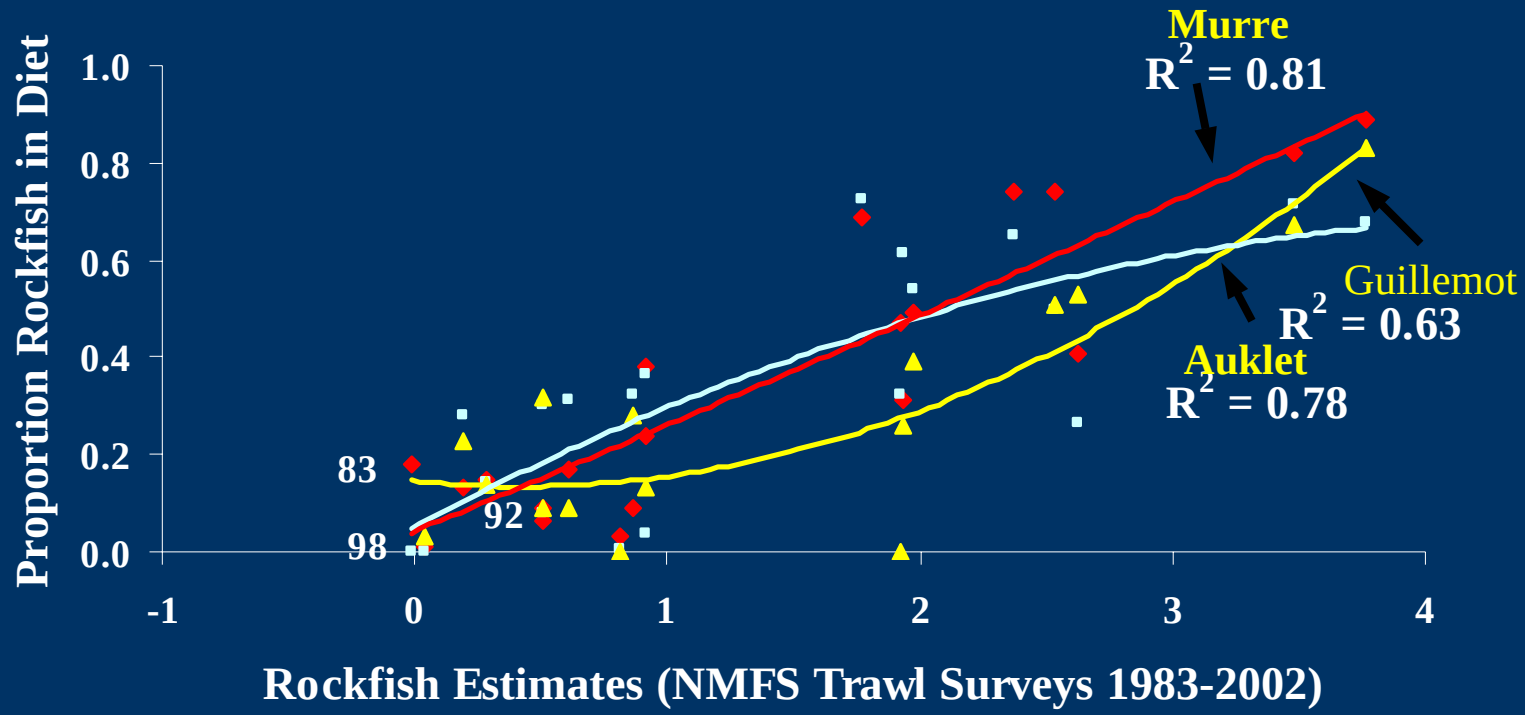
Trawls and Marine Bird Diet: 'Functional Response'



Seabird data and trawl surveys are correlated

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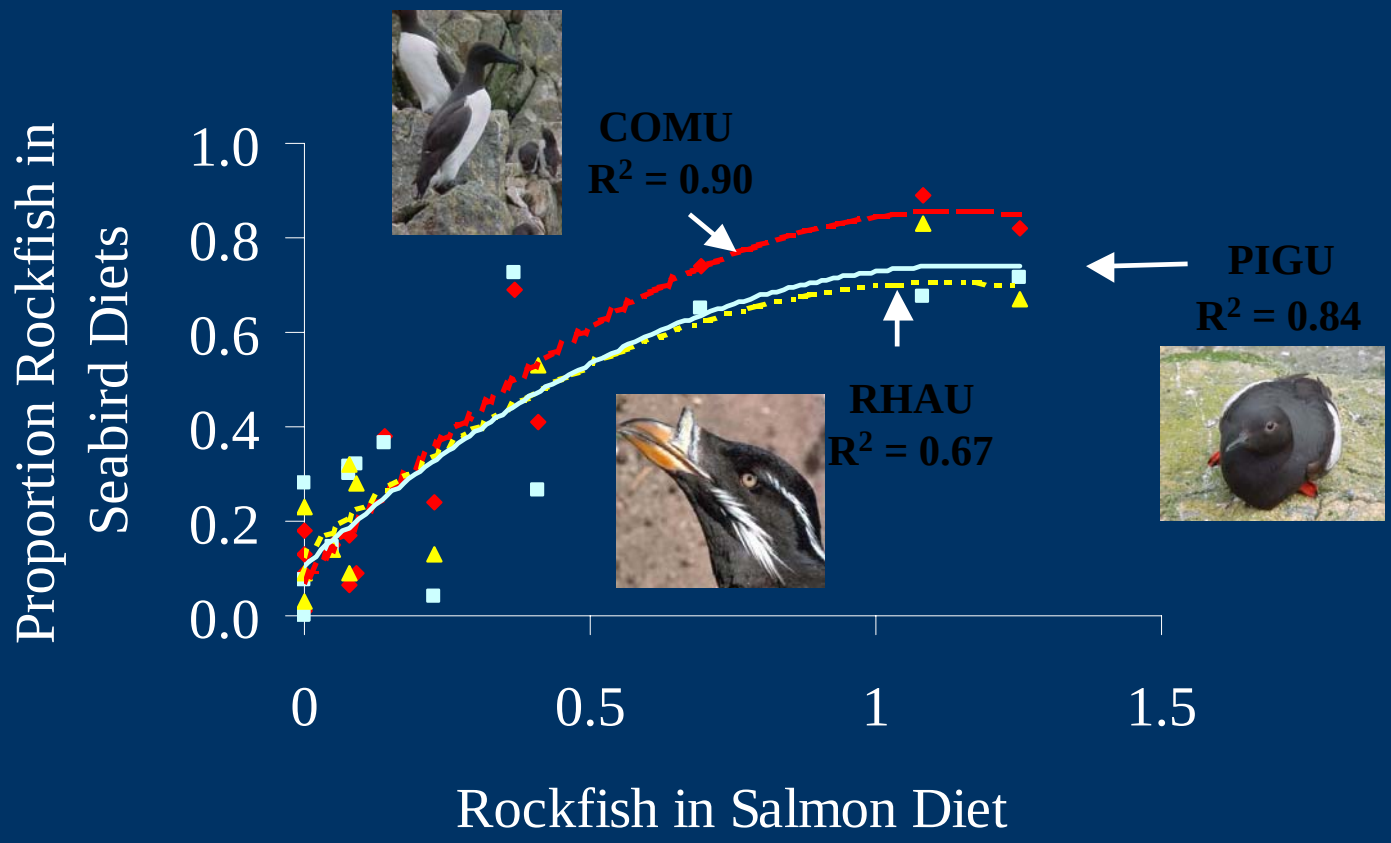
Correlation: Salmon and Seabird Diet

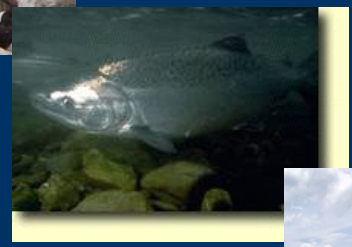


The Multivariate Rockfish Index (MRI)

Principal Component Analysis

a. Eigenvalues:			
	Eigenvalue	**Proportion**	**Cumulative Proportion**
PC1	4.13	0.83	0.83
PC2	0.52	0.10	0.93
b. Factor Loadings:			
		PC1	**PC2**
Common Murre		0.47	-0.06
Pigeon Guillemot		0.44	0.11
Rhinoceros Auklet		0.42	0.71
Salmon Gut Contents		0.42	-0.70
Trawl Surveys		0.48	-0.04

Multivariate Rockfish Index (MRI) Reveals Decline in Rockfish Recruits



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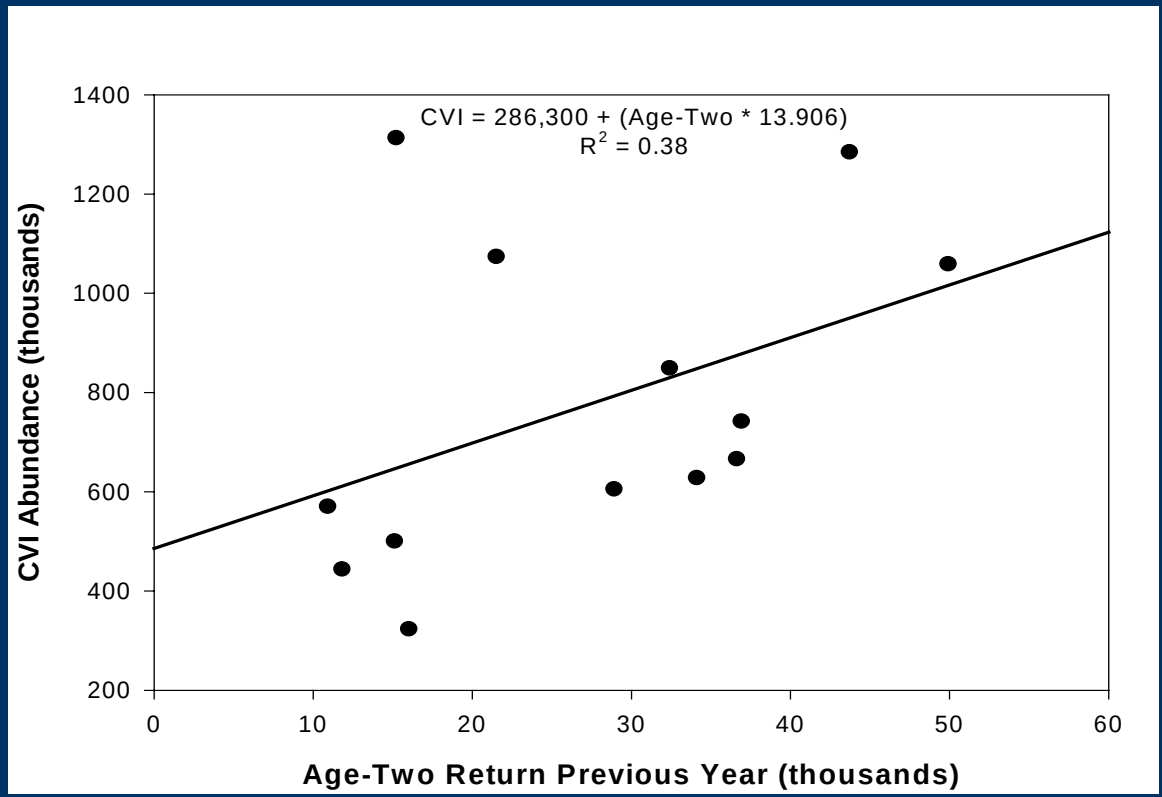
Case Study 3

Can Seabird Productivity be Used to Help Predict Central Valley (CA) Chinook Salmon Returns (hatchery fish)?



Current PFMC method uses jacks to forecast the Central Valley Index (CVI) for the following year

Results of Principle Components Analysis (PCA) that encompasses the reproductive success of 3 seabird species (Brandt's Cormorants, Common Murres, and Cassin's Auklets – 3-yr running average), and jack counts (1973-2002).

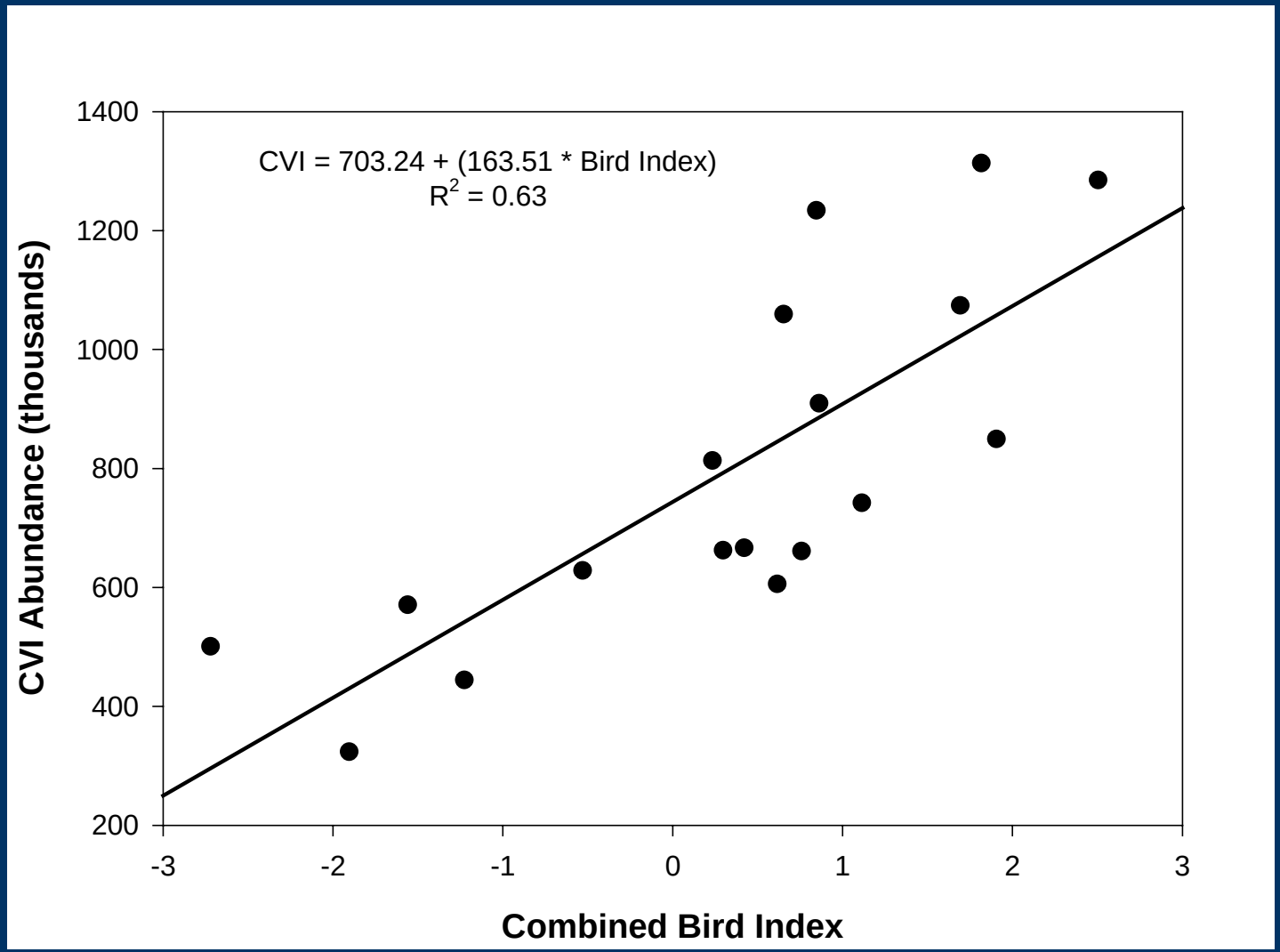
a. Eigenvalues:

	Eigenvalue	Proportion	Cumulative Proportion
PC1	2.06	0.51	0.51
PC2	1.10	0.27	0.79

b. Factor Loadings:

	PC1	PC2
Brandt's Cormorant	0.59	0.15
Common Murre	0.51	-0.39
Cassin's Auklet	0.62	0.08
Total Jacks	0.07	0.90

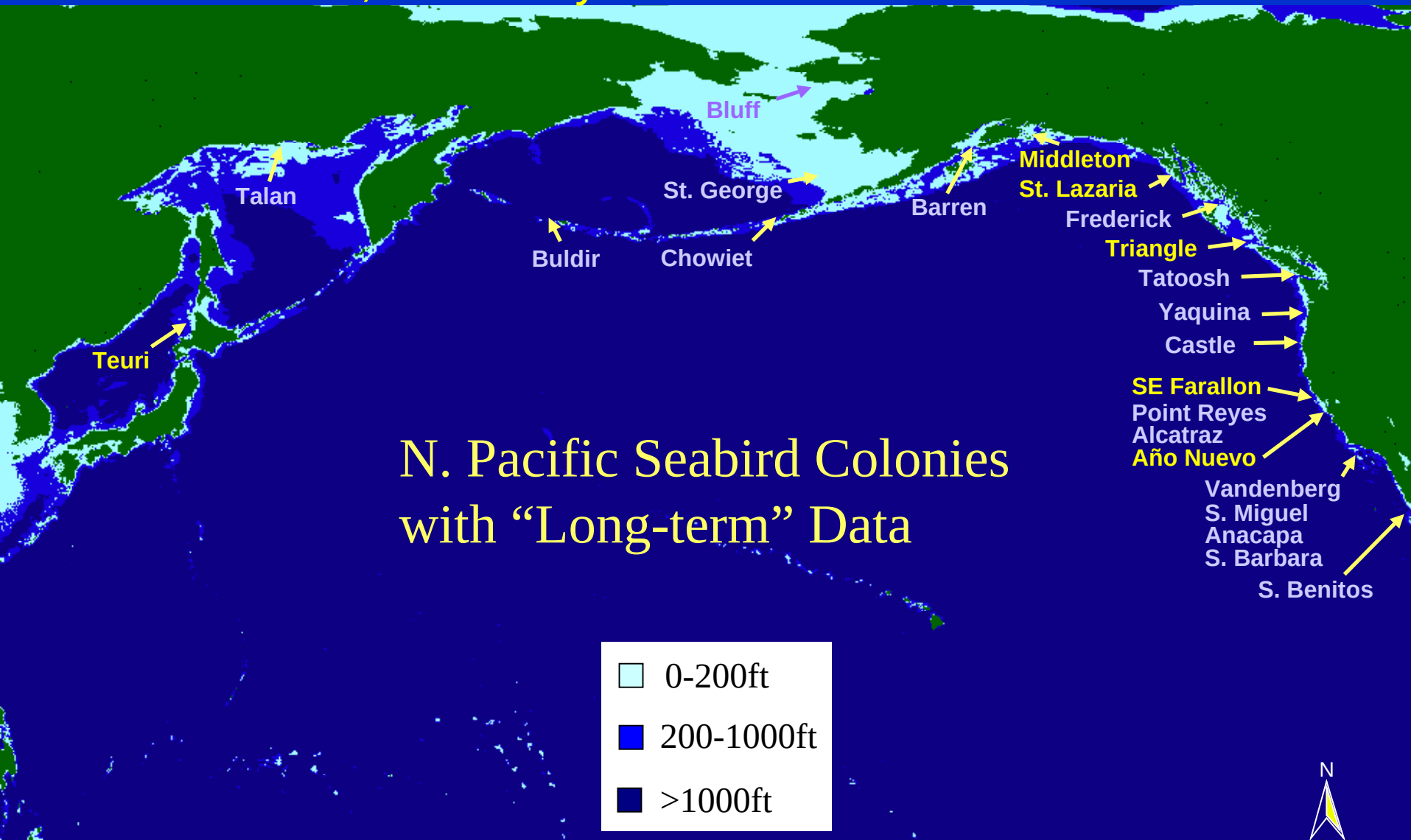
Regression estimator based on combined seabird/jack index



Comparison of Predictions (1985 – 2002)

	JACK Index	JACK/BIRD Index
average	-8.7%	-2.1%
range	-50% to +67%	-37% to +45%

Conclusion: (1) Seabird data may be useful to understanding marine fish population and life history fluctuations, with possible management applications. (2) More studies (on calibration) are needed, but luckily we have much to work with.




Thank you

Potential Use of the "MRI" in Rockfish Stock Assessments

Landings by Gear Type

Life History Information

Age/Length Compositions

Stock Assessment

Fishery Independent:
ROV
Trawl Surveys
Seabird Diet
Salmon Diet
} ***MRI***

Fishery Dependent:
logbook data, etc.

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