

Integrating Physiological and Demographic Parameters in NRDA

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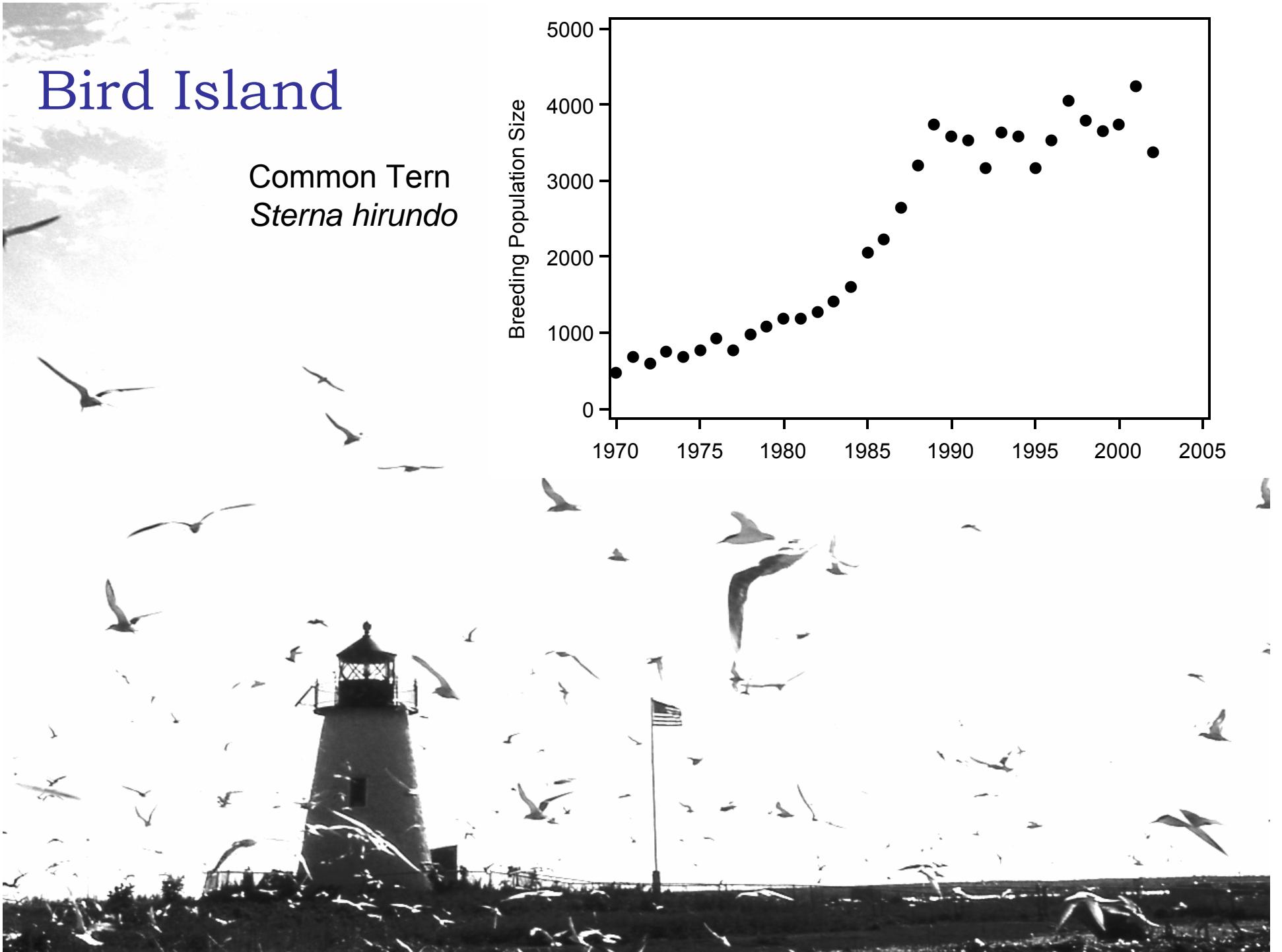
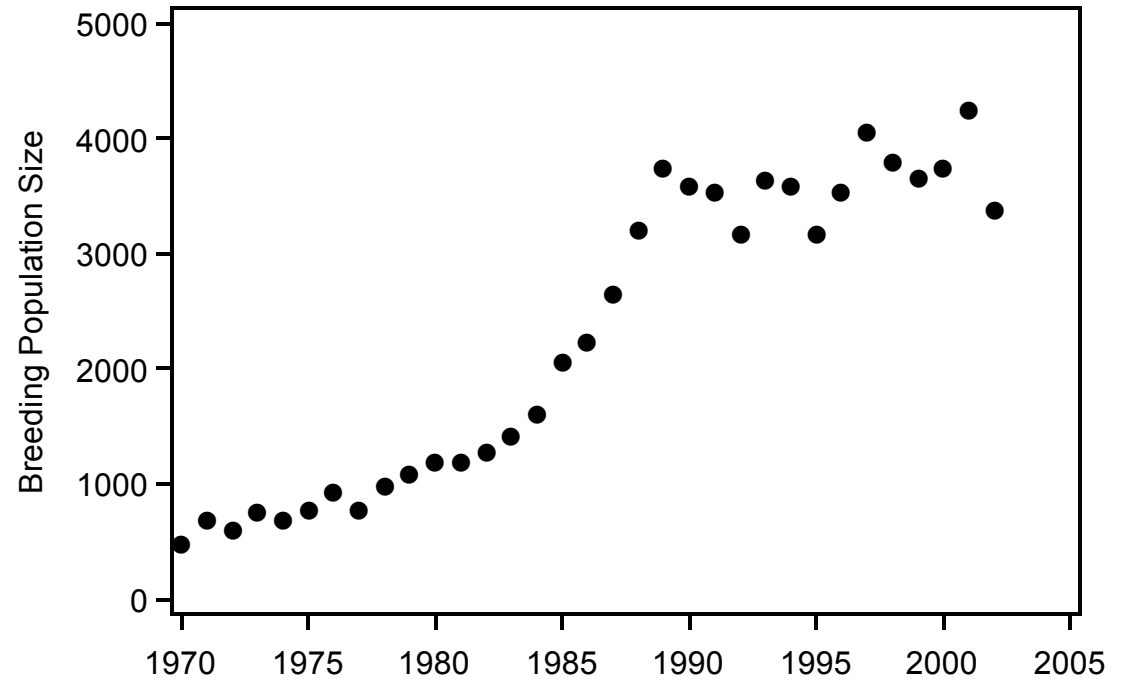
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Wake Forest University



Coastal Response Research Center

Bird Island

Common Tern
Sterna hirundo

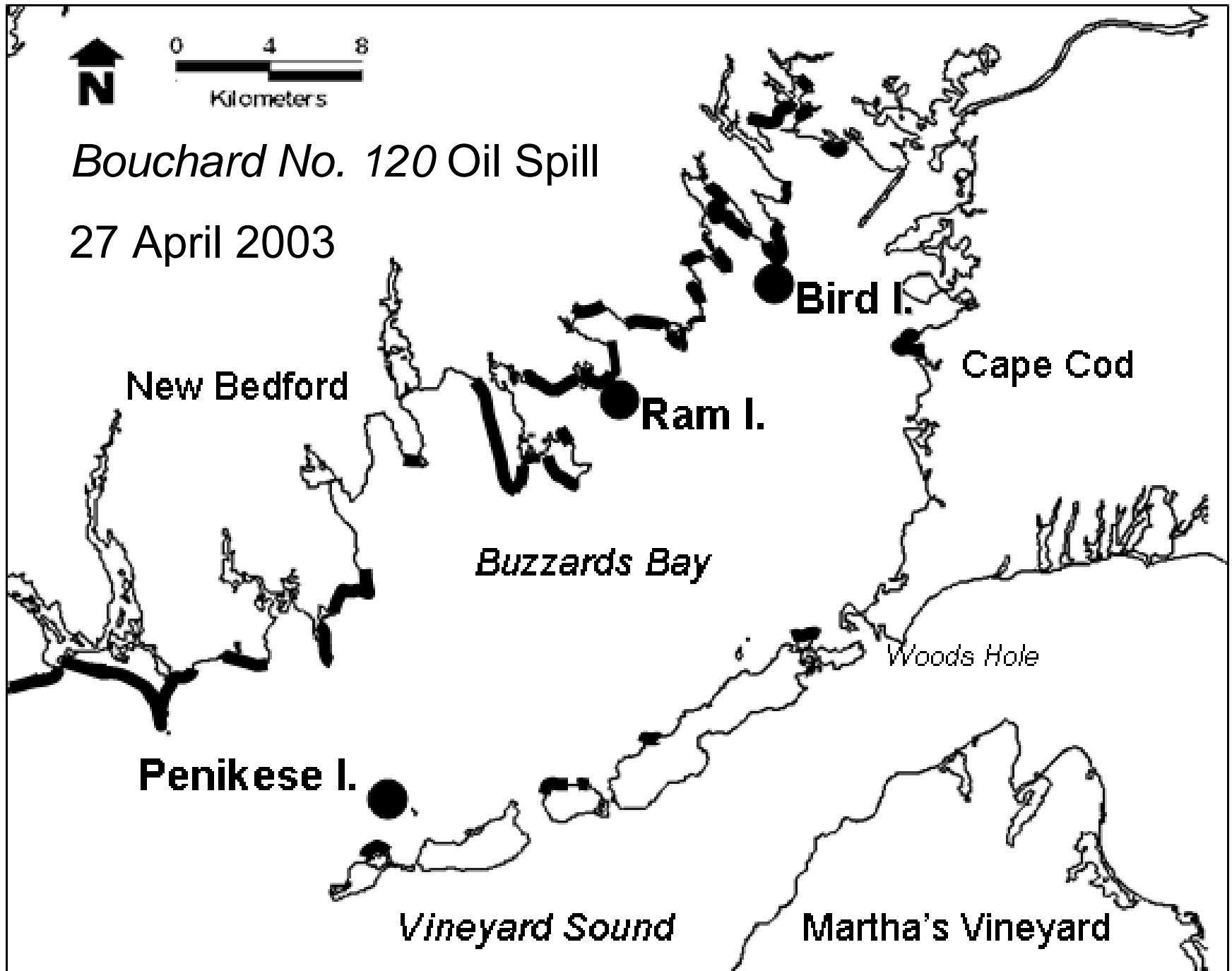




0 4 8
Kilometers

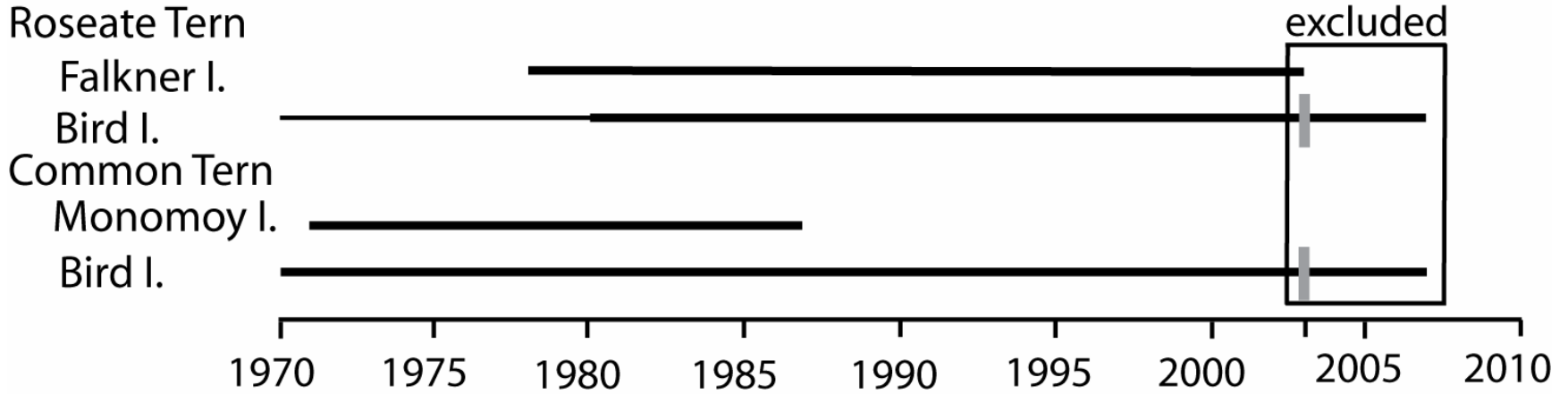
Bouchard No. 120 Oil Spill

27 April 2003

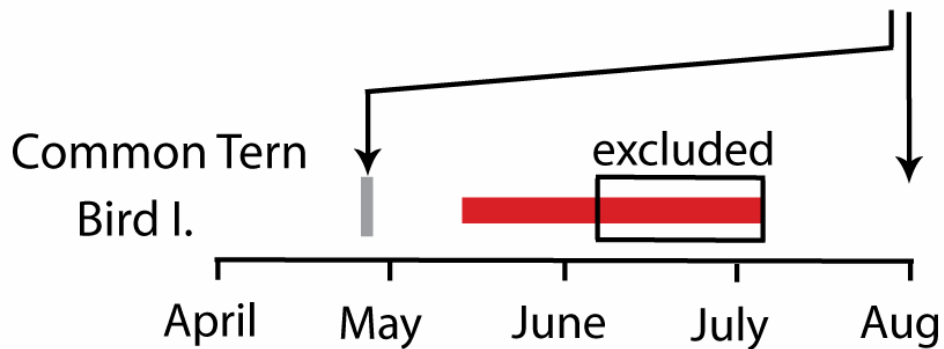
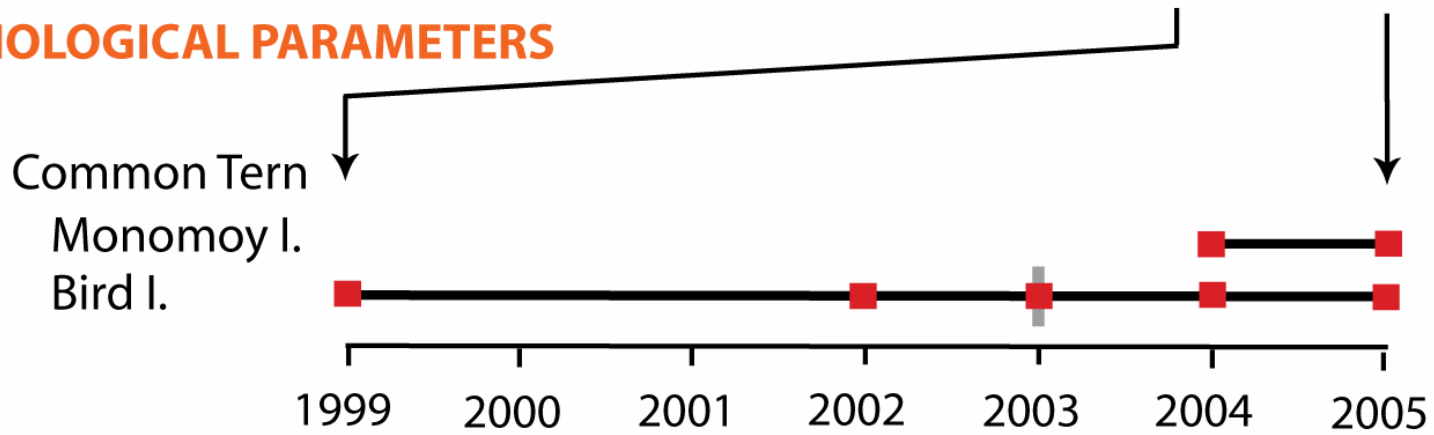


DEMOGRAPHIC PARAMETERS

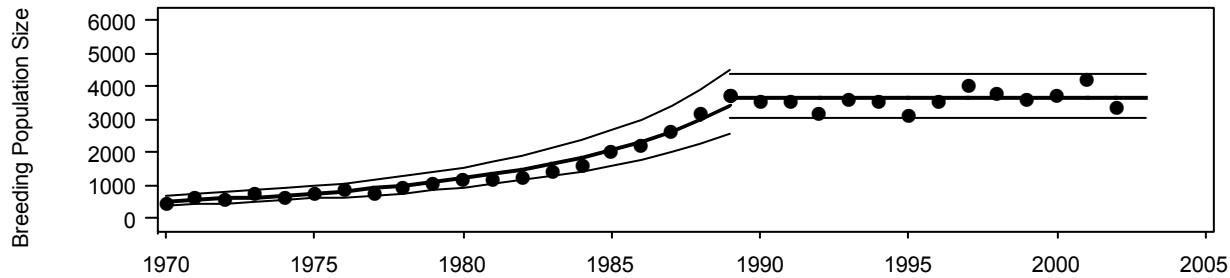
Bouchard No. 120



PHYSIOLOGICAL PARAMETERS



Demographic Parameters

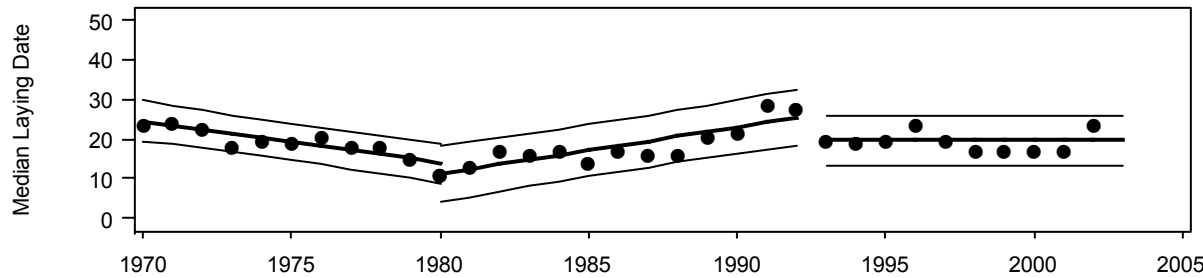


Breeding Population Size

RMSE

1970-1989 0.117

1989-2002 0.080

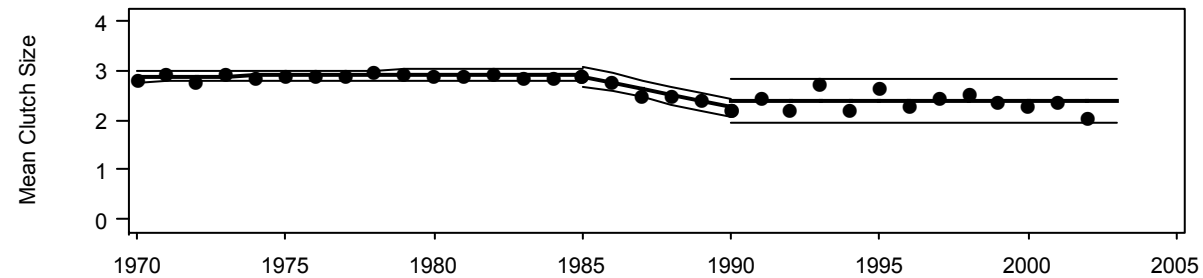


Median Egg-Laying Date

1970-1980 1.95

1980-1992 2.88

1993-2002 2.72

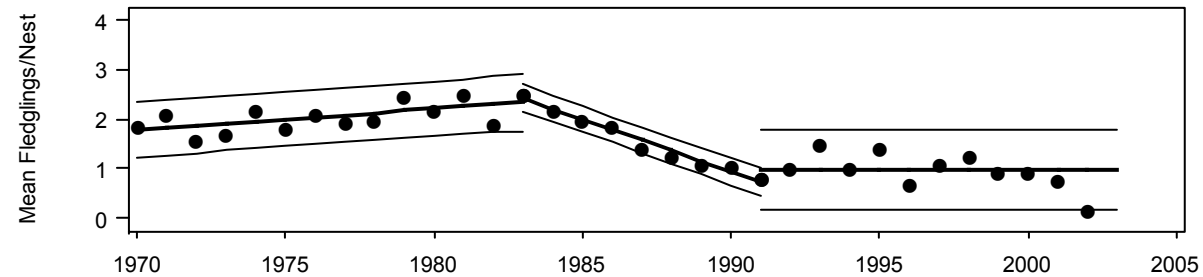


Mean Clutch Size

1970-1985 0.048

1985-1990 0.058

1990-2002 0.193



Productivity

1970-1983 0.236

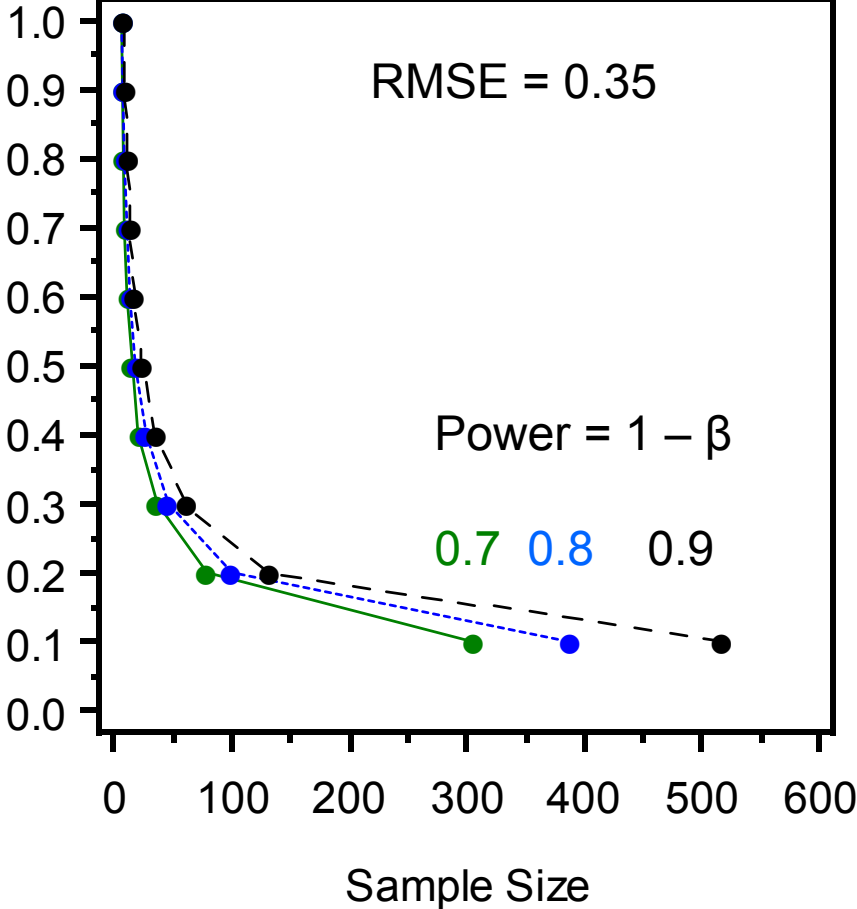
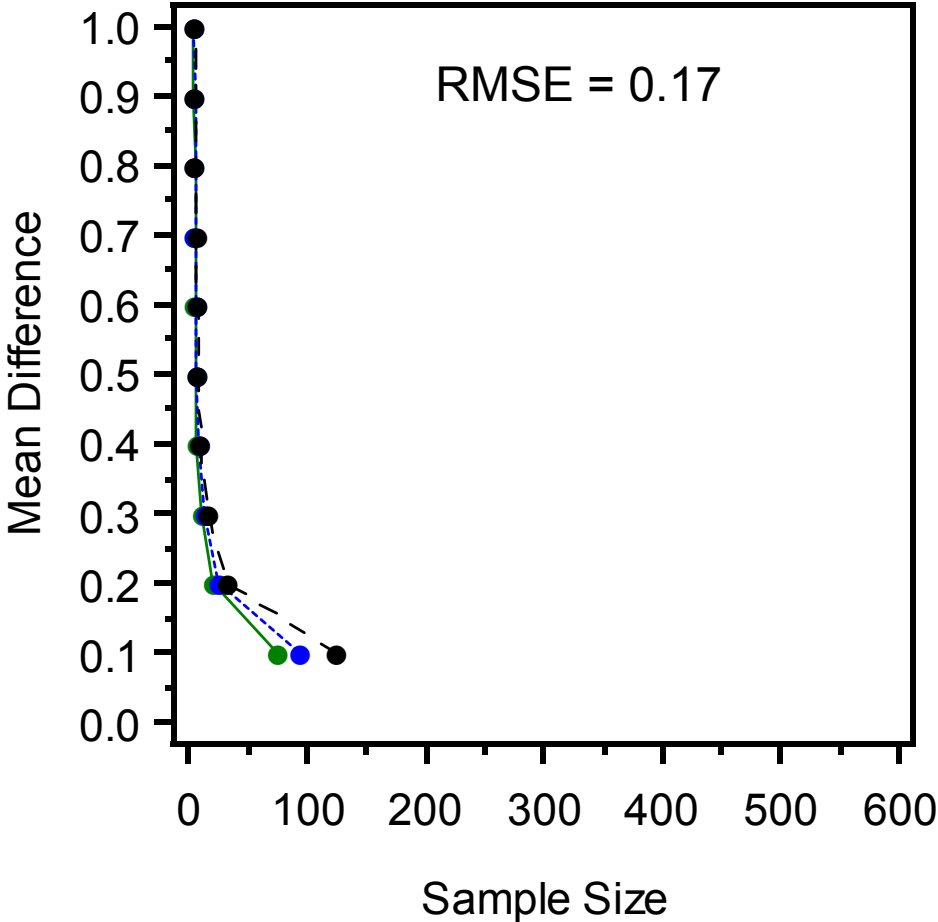
1983-1991 0.170

1991-2002 0.348

Demographic Parameters

Power Analysis – Sample Size and Power to detect Differences between Two Means

$$\text{Mean Difference} = \mu_1 - \mu_2 = 1.0 - 0.8 = 0.2$$

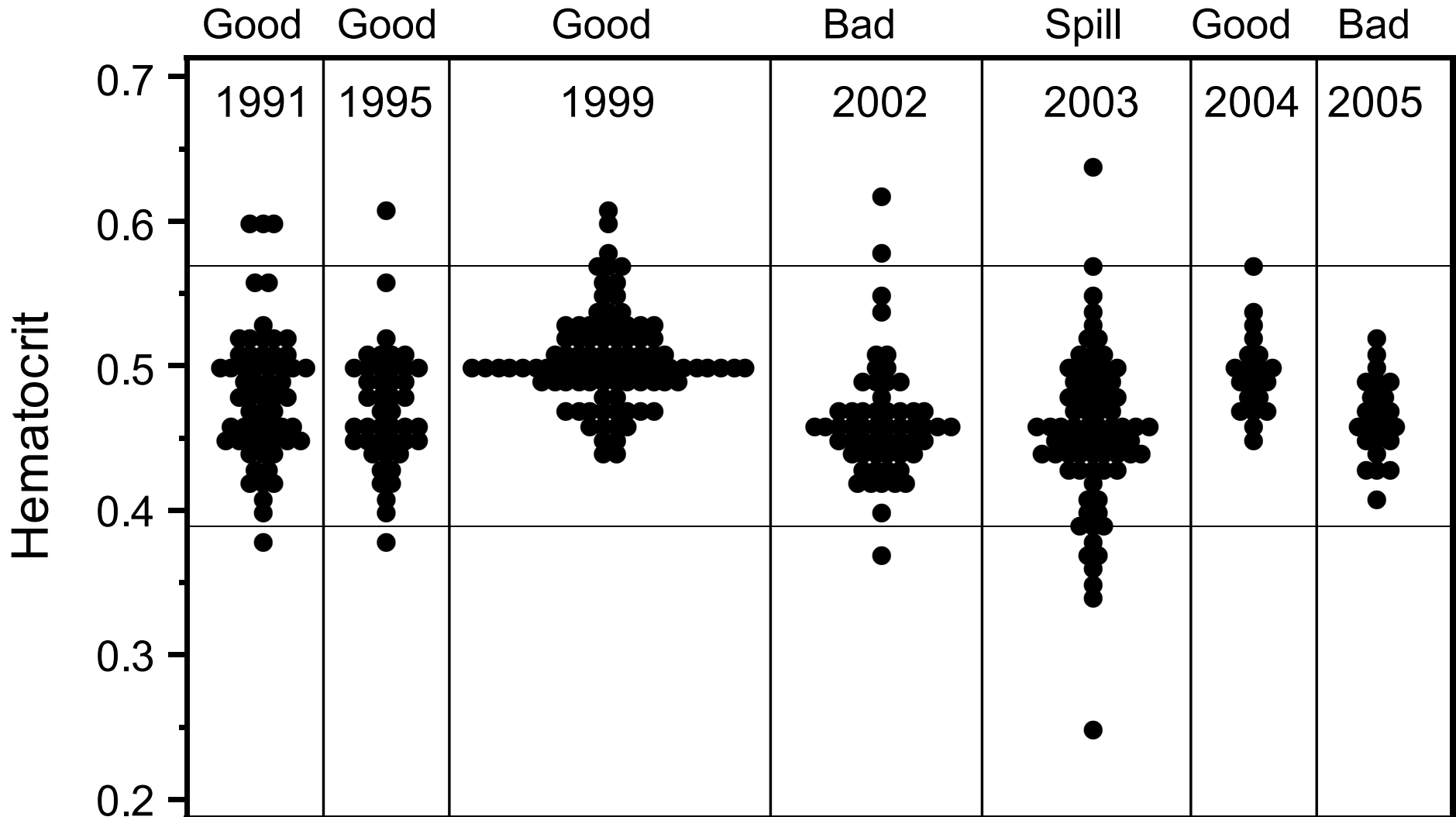


Physiological Parameters

	Response	
	Ecological	Pathological
Erythron Status		
Hematocrit (Packed Cell Volume)	dehydration	anemia
Nutritional Indicators		
Total Protein	protein availability	
Albumin	protein availability	
Uric Acid	protein digestion	
Blood Urea Nitrogen	protein digestion	
Triglycerides	lipid ingestion	
Liver Function		
Bile Acids	lipid ingestion	cholestasis
Cholesterol		hepatocellulitis
GGT (γ - Glutamyl Transferase)		hepatocellulitis
Tissue Enzymes		
AST (Aspartate Amino Transferase)	muscle overexertion	hepatocellulitis
CK (Creatine Kinase)	muscle overexertion	hepatocellulitis
LDH (Lactate Dehydrogenase)	muscle overexertion	hepatocellulitis

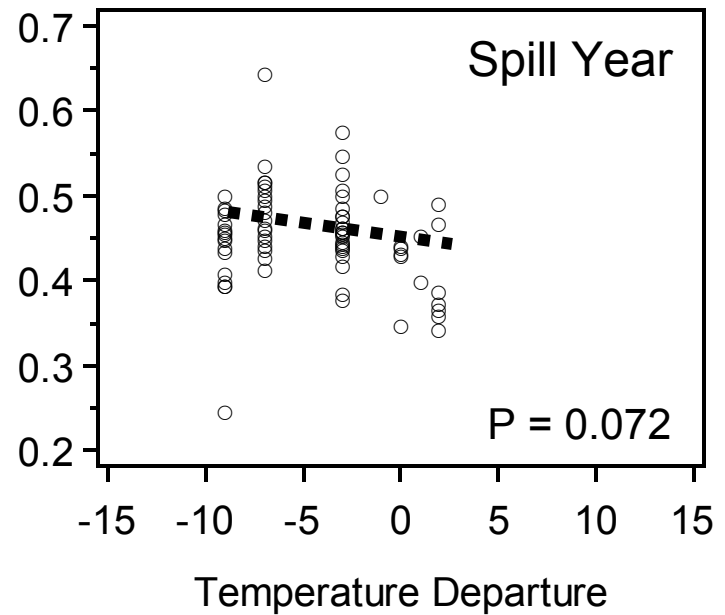
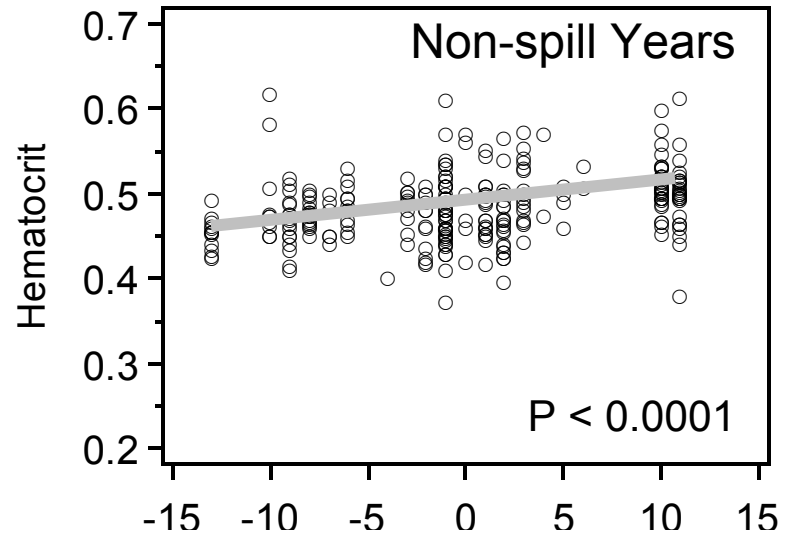
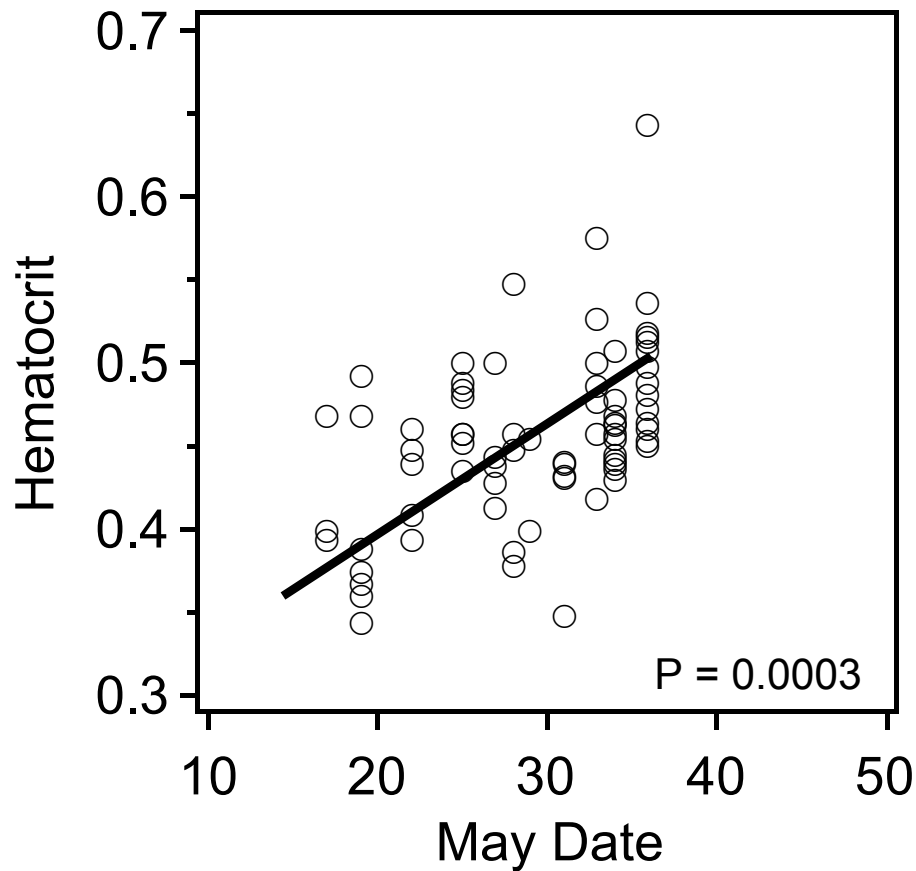
Physiological Parameters

Hematocrit resolved oil-spill and naturally adverse conditions



Physiological Parameters

Hematocrit improved after oil-spill and was not related to weather as in non-spill years

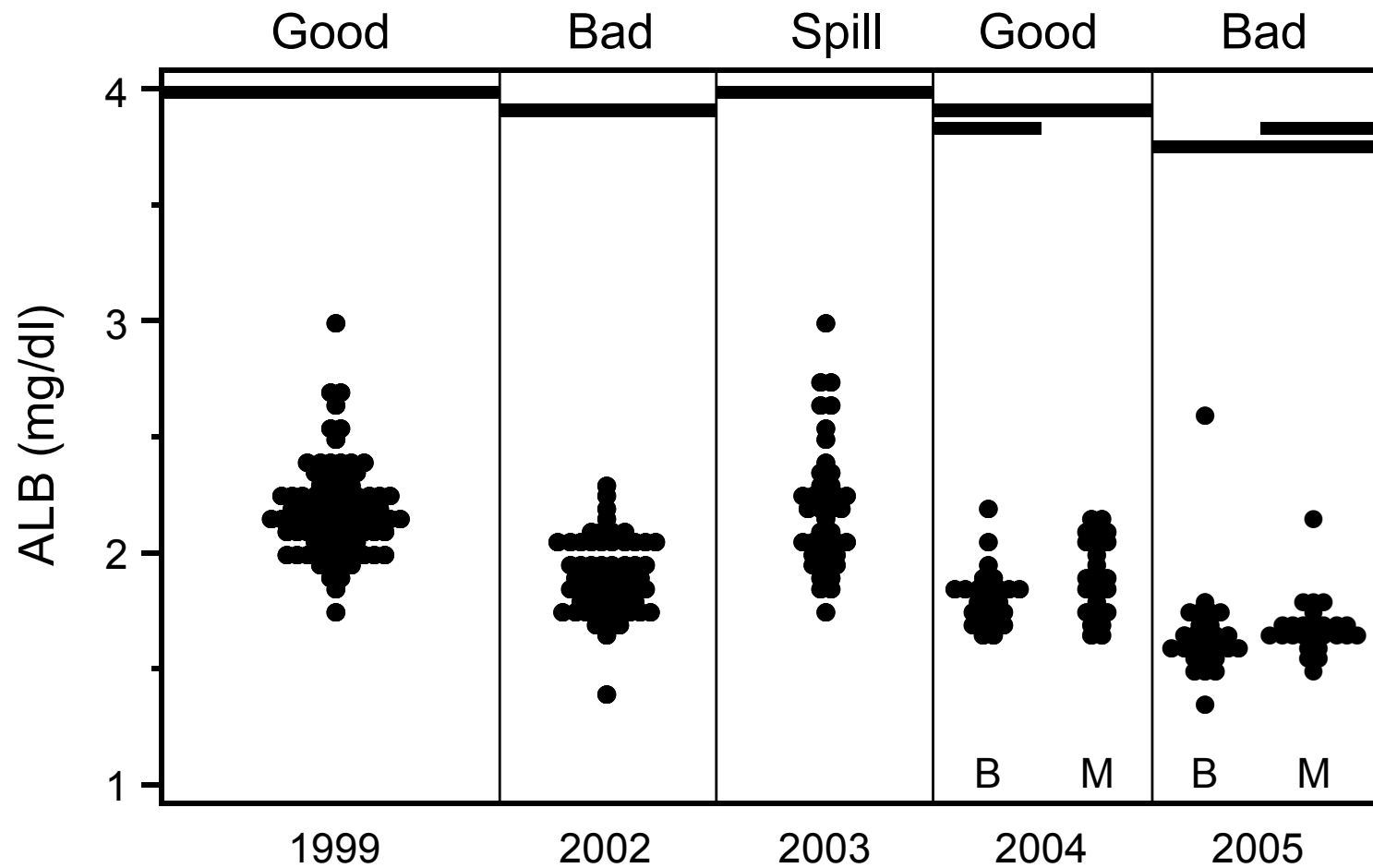


Year x Temp Interaction $P = 0.0004$

Physiological Parameters

Albumin – long-term protein availability

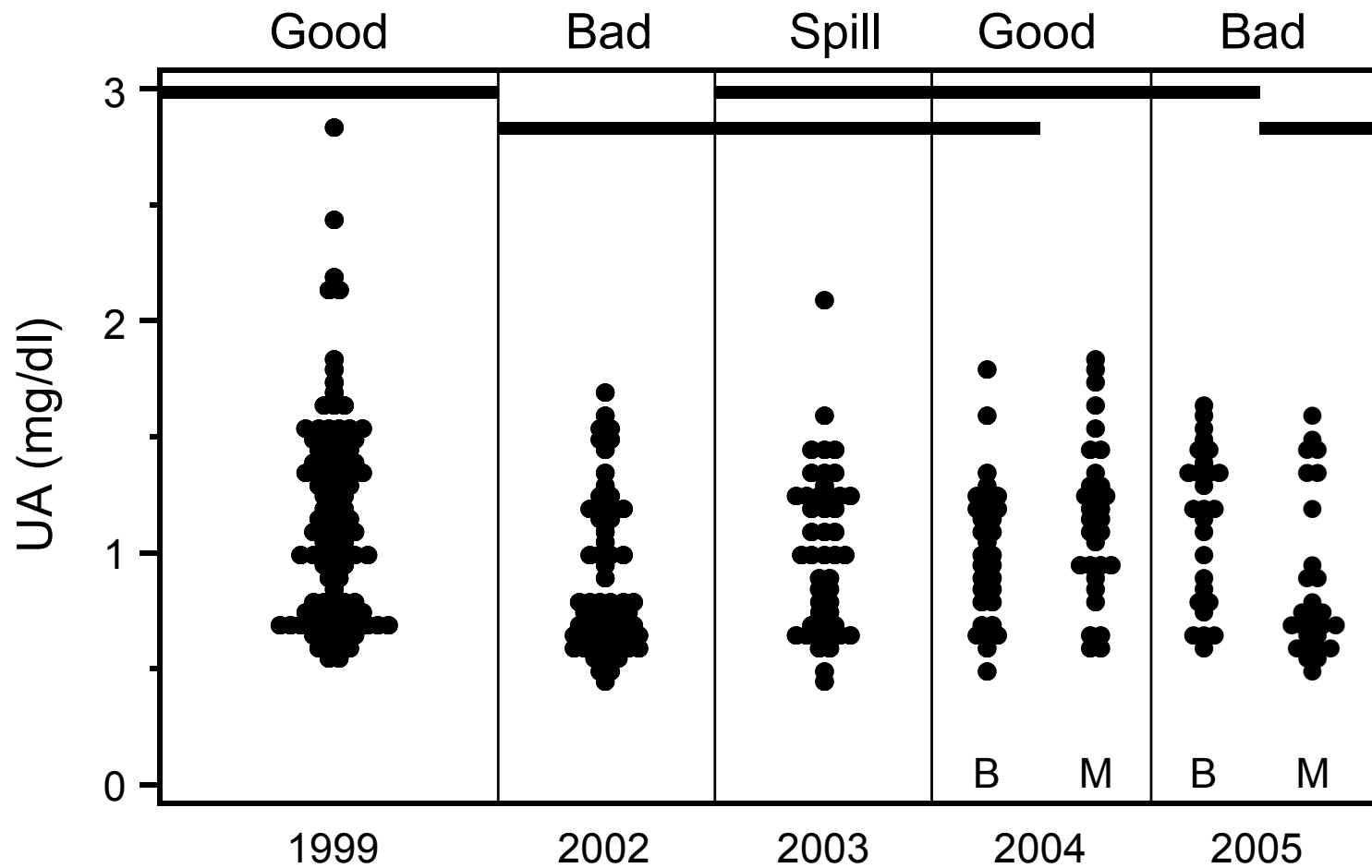
Lines connect populations with means that are not significantly different



Physiological Parameters

Uric Acid – post-prandial protein digestion

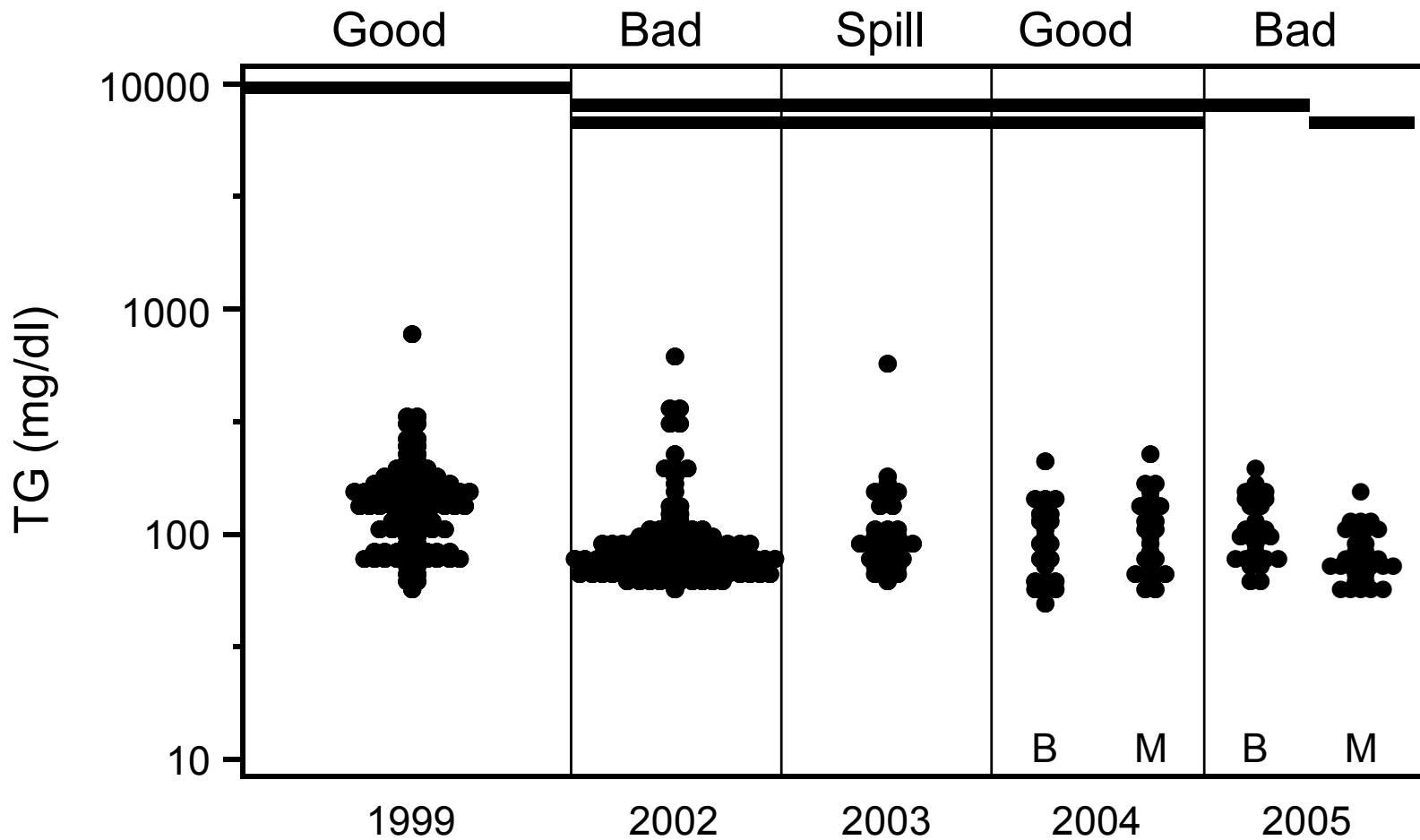
Lines connect populations with means that are not significantly different



Physiological Parameters

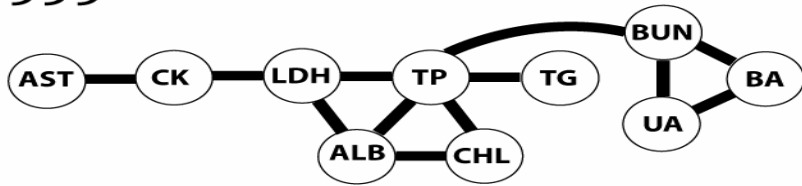
Triglycerides – post-prandial lipid assimilation

Lines connect populations with means that are not significantly different

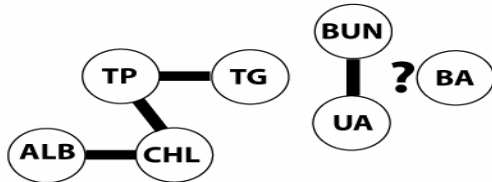


Physiological Parameters

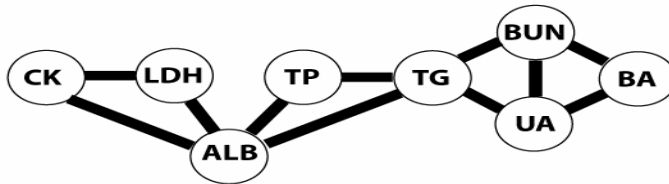
1999



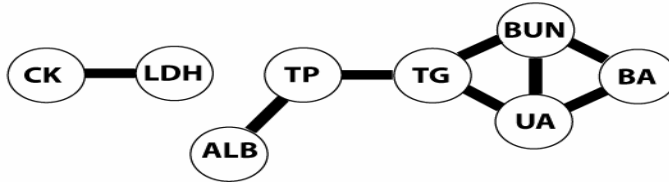
2002



2004

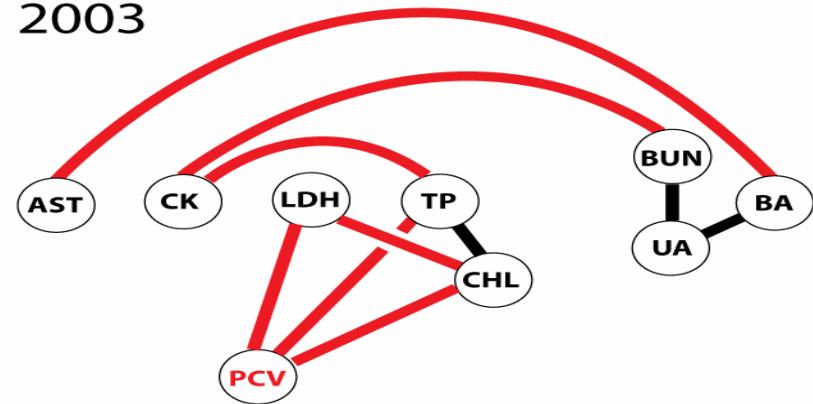


2005



Correlation Structure Differed Between Natural and Post-Spill Conditions

2003



Conclusions

Demographic Parameters

Natural Variability of Pre-Spill and Reference Site
Seabird Demographic Parameters:

Most Variable:

Breeding Population Size
Productivity

Least Variable:

Clutch Size
Egg Mass

Magnitude of Variation varies on Decadal Timescale

Natural Variation limits Resolution of Demographic Impacts,
especially in Small Populations (small sample sizes)

Conclusions

Physiological Parameters

Decreased Hematocrit (anemia) was associated with post-spill, but not adverse natural conditions

Decreased ALB, UA, and TG was associated with adverse natural, but not post-spill conditions

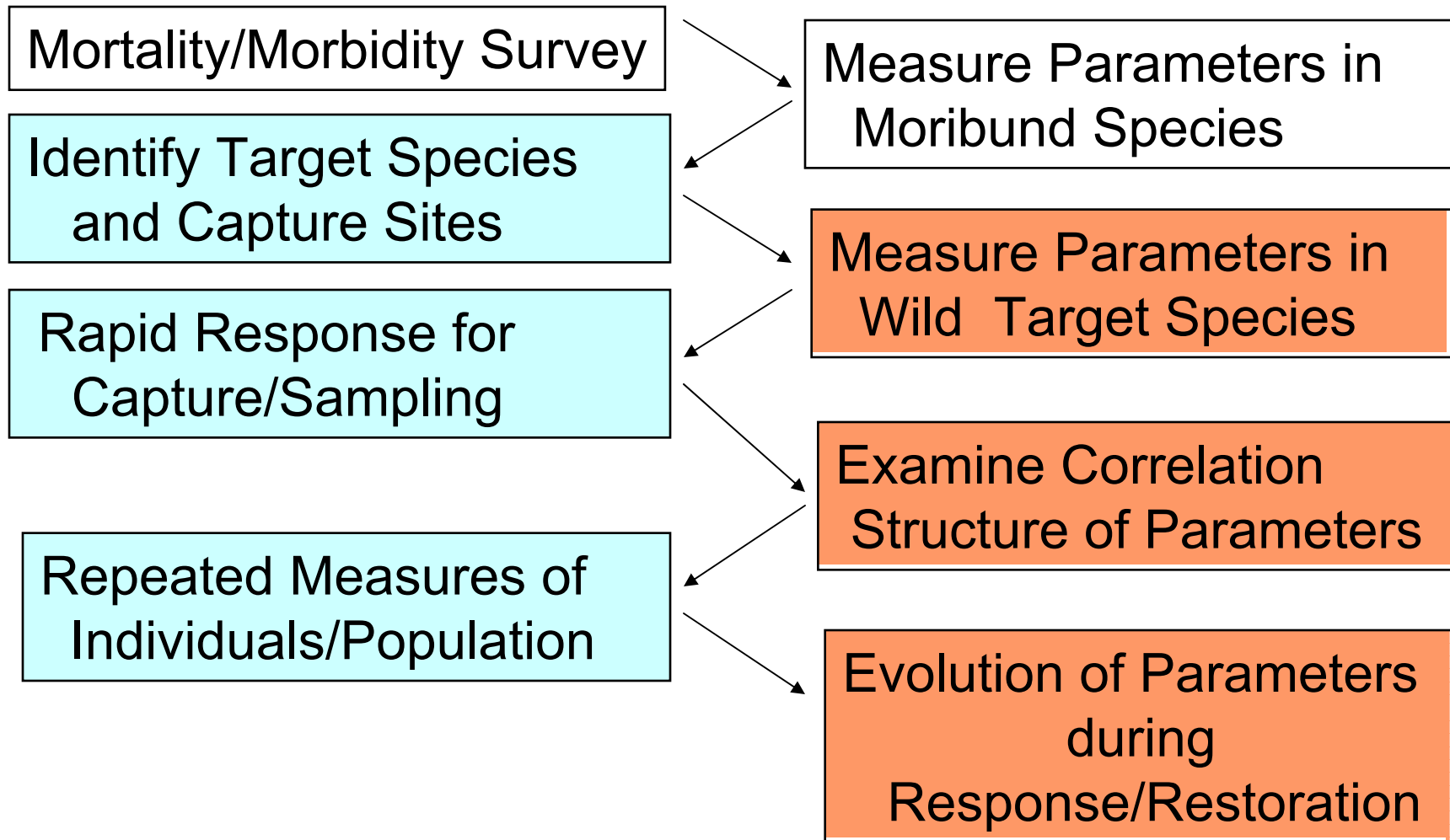
Indications of tissue damage were not observed using physiological parameters

Application:

Integrating

Demographic Parameters

Physiological Parameters



Acknowledgement

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Coastal Response Research Center