Striped Bass Health Indicator Development

Presentation to the Fisheries Goal Implementation Team

Brock Center – Chesapeake Bay Foundation
Virginia Beach, VA

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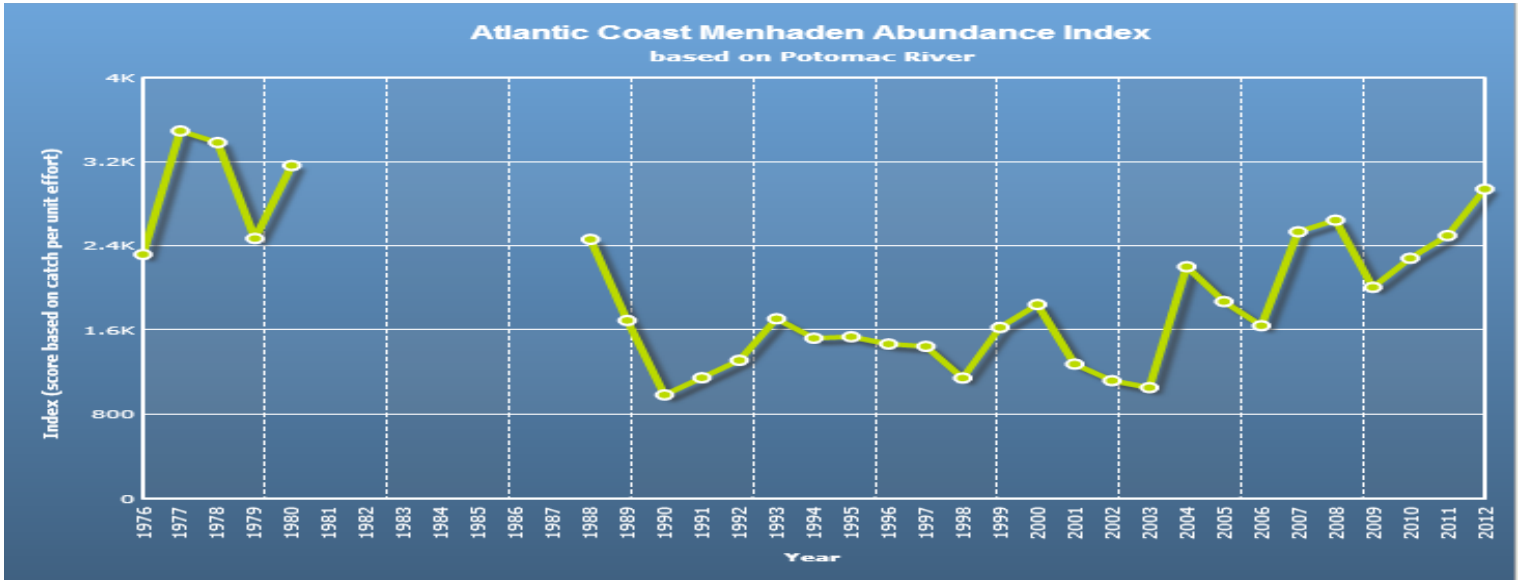
Outline

- Background on CBP Fish indicators
- Overview of Indicator development - Striped Bass Mycobacteriosis
- Potential Indicators
- Data and Methodology
- Connecting Indicators to Environmental Variables
- Conclusions and Next Steps

Chesapeake Bay Fish Indicators

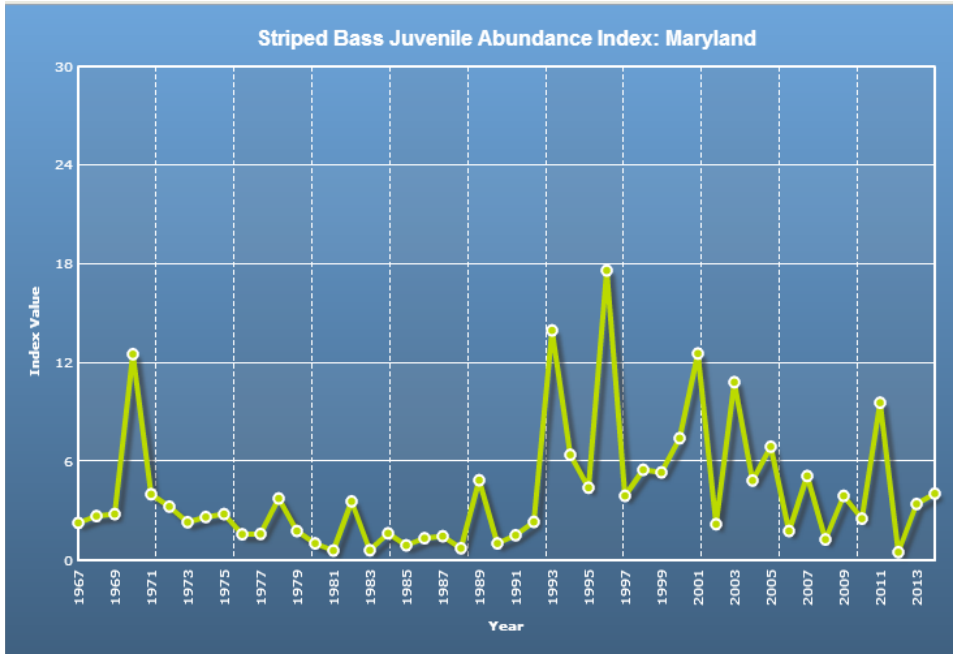
- Currently the CBP tracks the bay's health through a variety of indicators. The fish indicators tend to be based on coast-wide stock assessments or beach seine survey (e.g., Striped Bass and Atlantic Menhaden Abundance and Juvenile Indices)



http://www.chesapeakebay.net/indicators/indicator/atlantic_menhaden_abundance

Utility of Chesapeake Bay Fish Indicators

- These indicators are generally useful for publicly communicating basic patterns in key stocks, but they are not necessarily providing much information on how the bay's health is influencing fisheries stocks.



Trends in Biomass or Juvenile abundance indices can be influenced by many factors external to the Chesapeake.

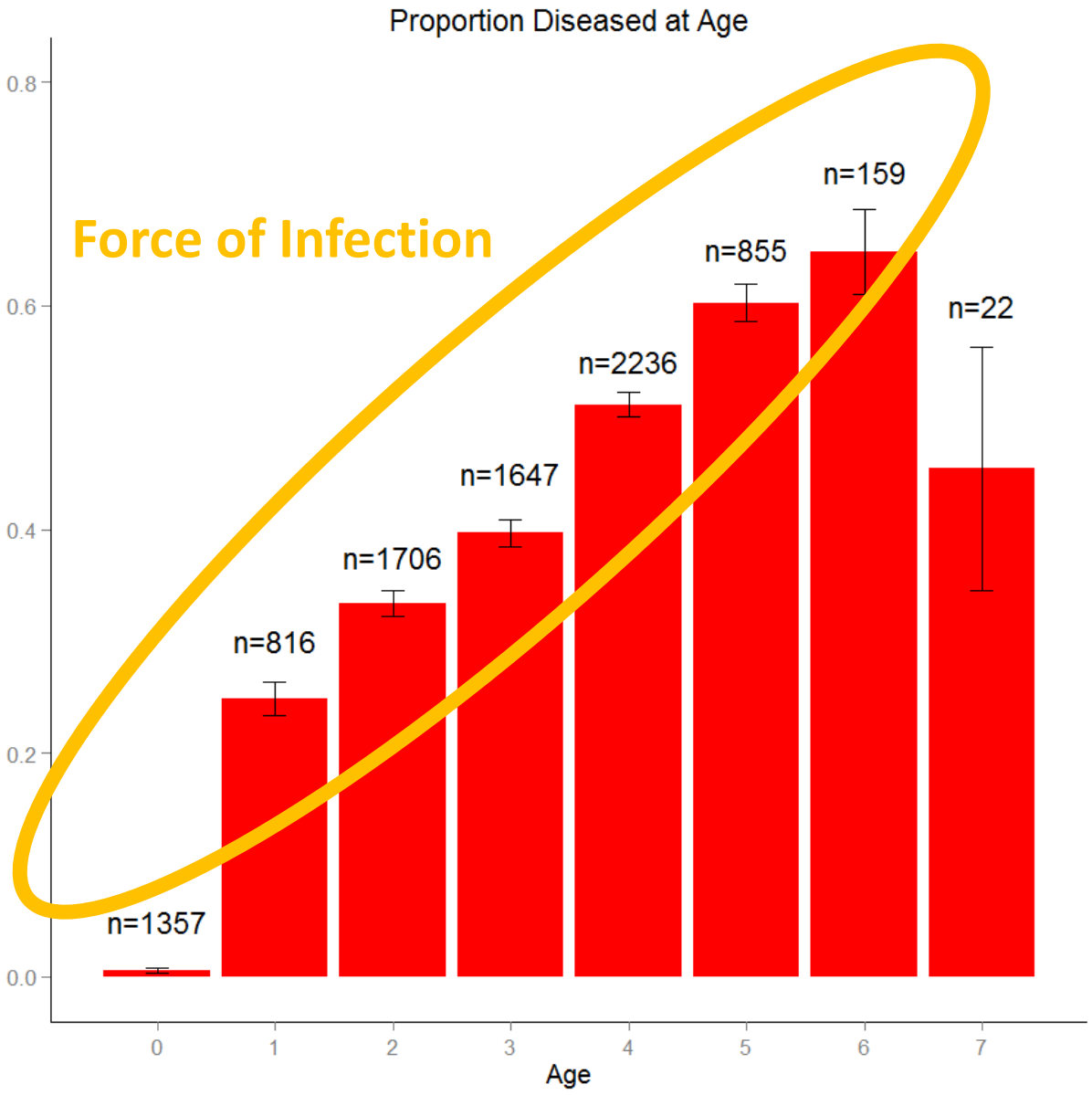
http://www.chesapeakebay.net/indicators/indicator/striped_bass_juvenile_abundance_index

Chesapeake Bay Fish Health Indicator

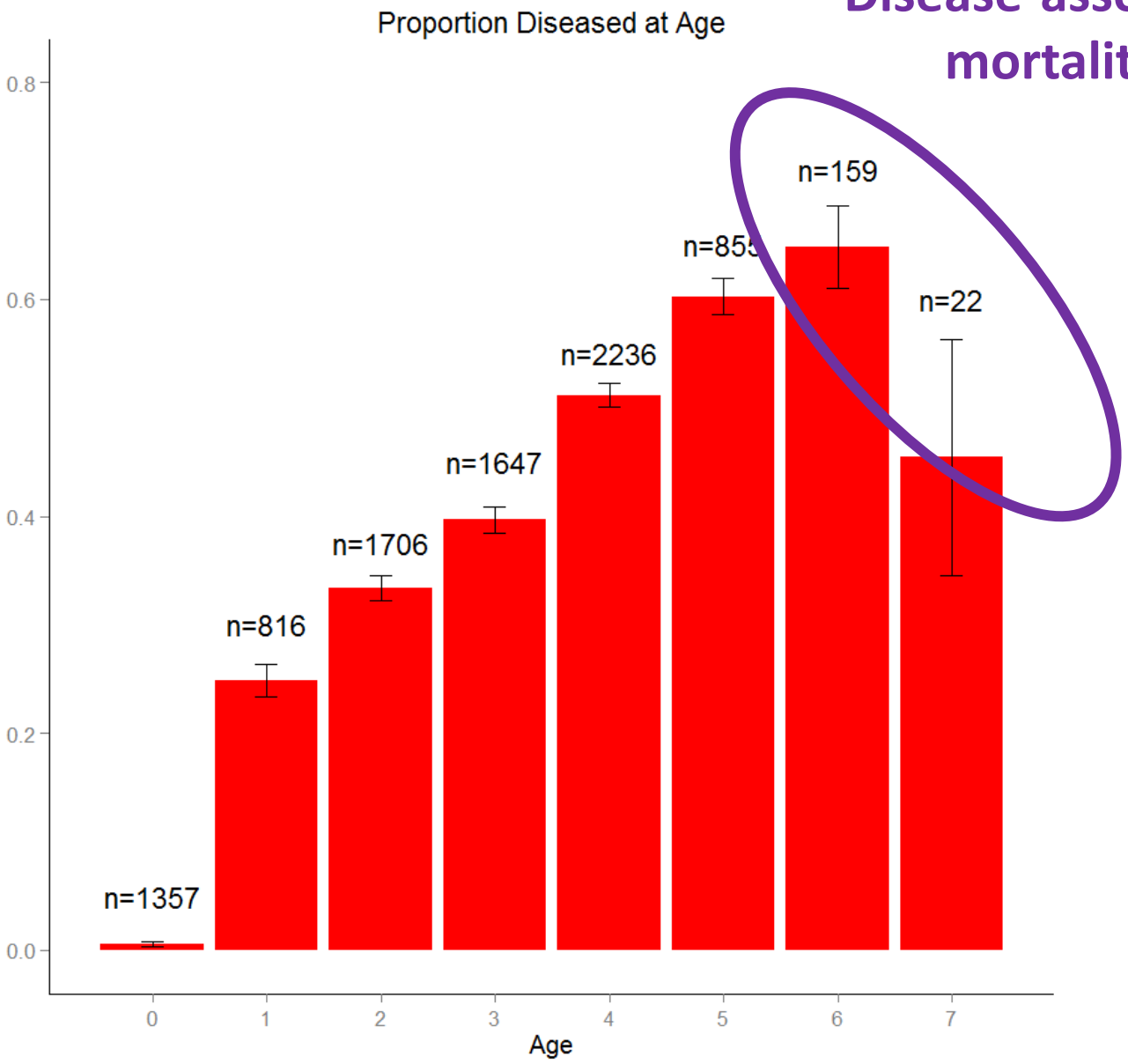
- The purpose of this project is to develop an indicator of striped bass health that may be useful for fisheries and water quality managers.
- Using MD DNR – Fish Health Team's data on Mycobacterial infection (16-year time series)
- Exploring connections between myco infection and environmental variables (water temp, hypoxia, forage fish, etc.)

Potential Fish Health Indicators

- Disease associated mortality
  - the increase in probability of death resulting from becoming infected relative to an animal that remains disease-free
- Force-of-Infection
  - the rate at which disease-free animals become infected
- Apparent Prevalence
  - the proportion of animals that have a positive test (or external indicator) for infection by the focal disease.
- Severity
  - extent of disease process


Proportion Diseased at Age
Force of Infection
n=1357
n=816
n=1706
n=1647
n=2236
n=855
n=159
n=22
0.0
0.2
0.4
0.6
0.8
0
1
2
3
4
5
6
7
Age

Disease-associated mortality



Striped Bass Disease Survey
1998-present

Striped Bass Disease Survey 1998-present

- Awareness of disease in CB striped bass, mid 1990s
  - High frequency of skin lesions, emaciation
- Identified as Mycobacteriosis in 1997
- Annual survey began in 1998
  - *Basic description of pathology*
  - *How many fish have disease*
  - *What species of bacteria are involved*
- *Current goals*
  - *Monitoring*
  - *Disease modeling*
  - *Fish health indicator*

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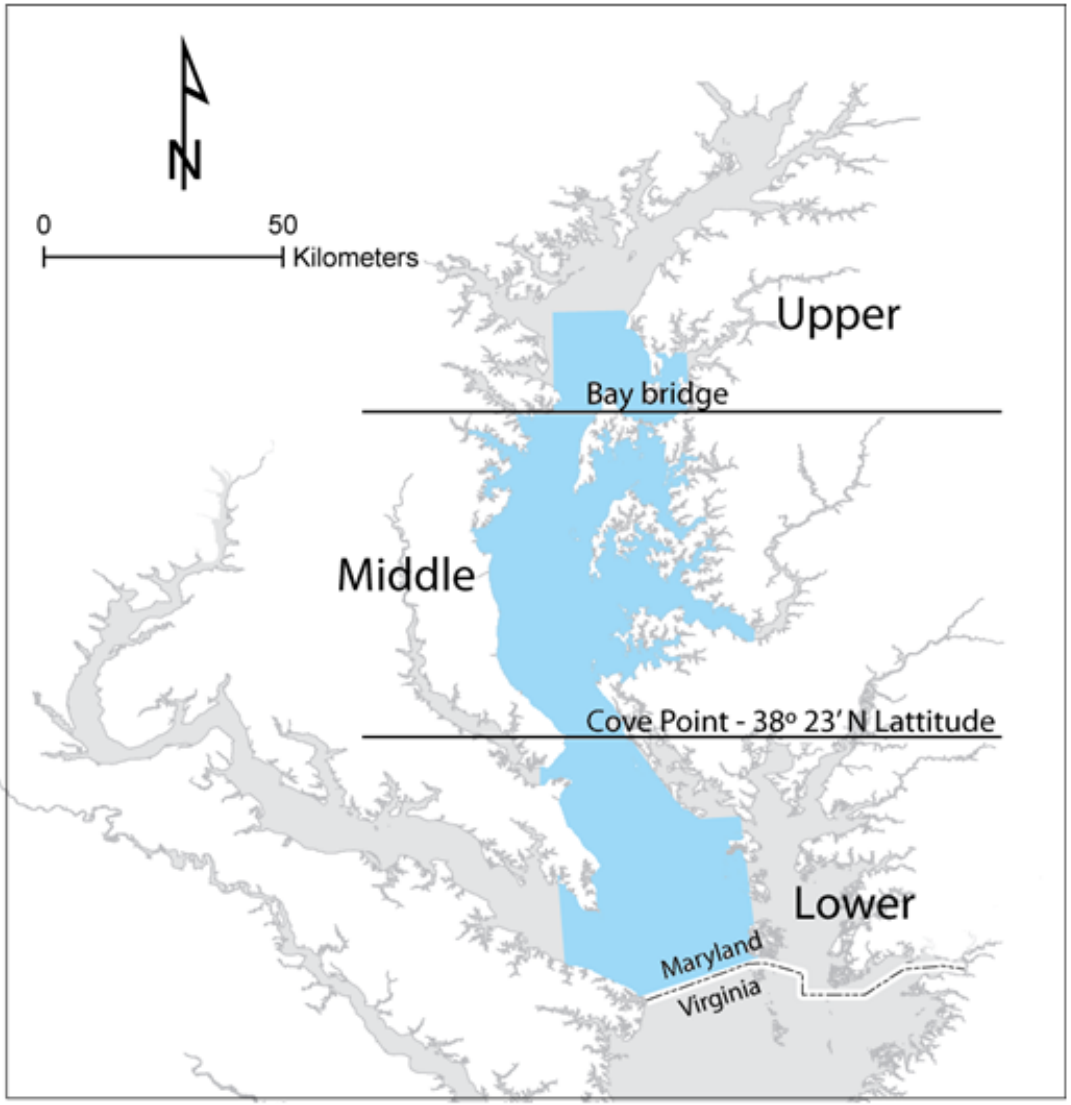
Striped Bass Disease Survey 1998-present



Sampling Area

Striped Bass Disease Survey 1998-present

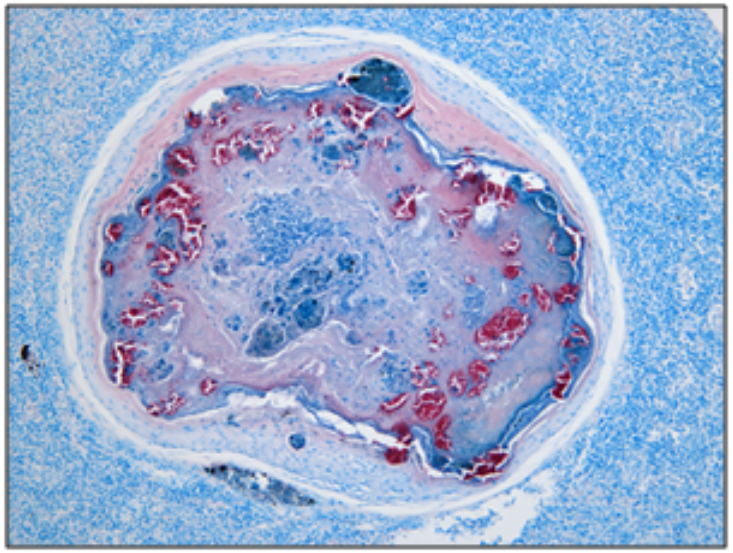
Types of data collected:

- Total length, weight, eviscerated weight, body condition, body fat index: all years
- Skin lesion severity
  - General: all years
  - Ulcer/Pigmented Foci: 2008-present
- Parasite indices (gill, skin, mesentary, intestine): all years
- Spleen
  - Granuloma severity/density: all years
  - Parasite severity/density: all years

Striped Bass Disease Survey 1998-present

Histopathology

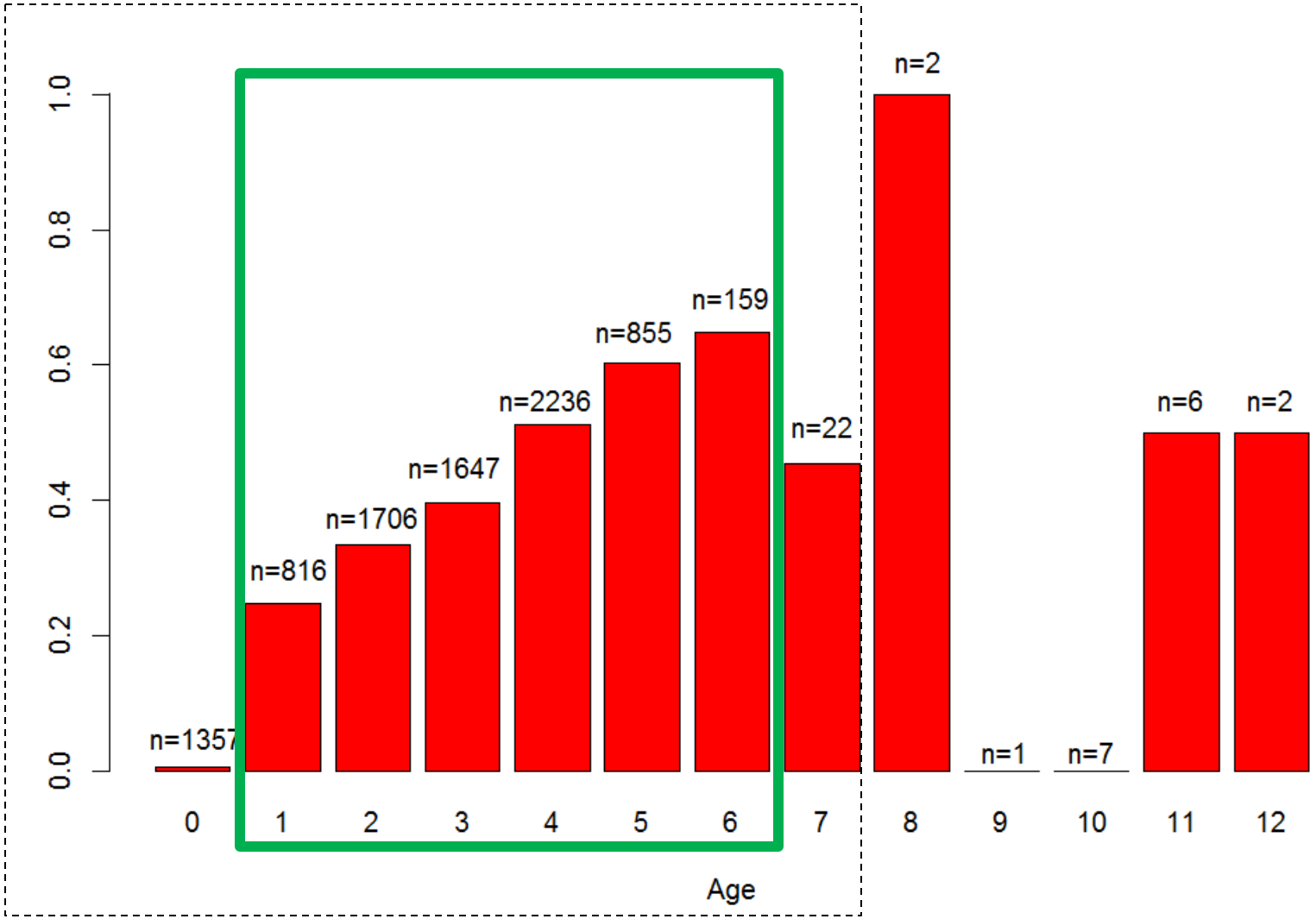
- Presence of granulomatous inflammation/lesions
- Detection of acid-fast bacteria
- Spleen is target organ



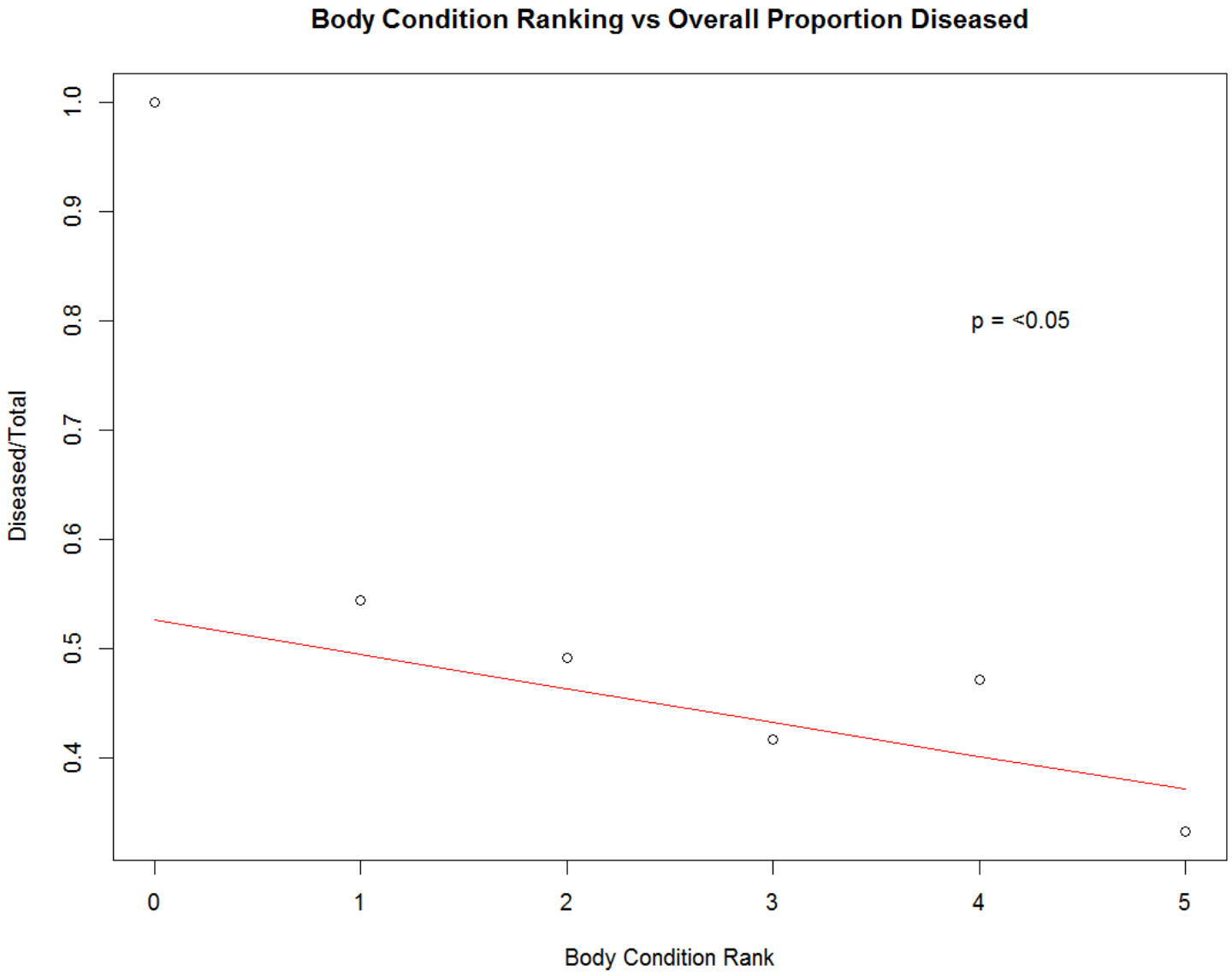
Confirmation

- Bacterial isolation
- Molecular (Genus)
- Gas chromatography (species)

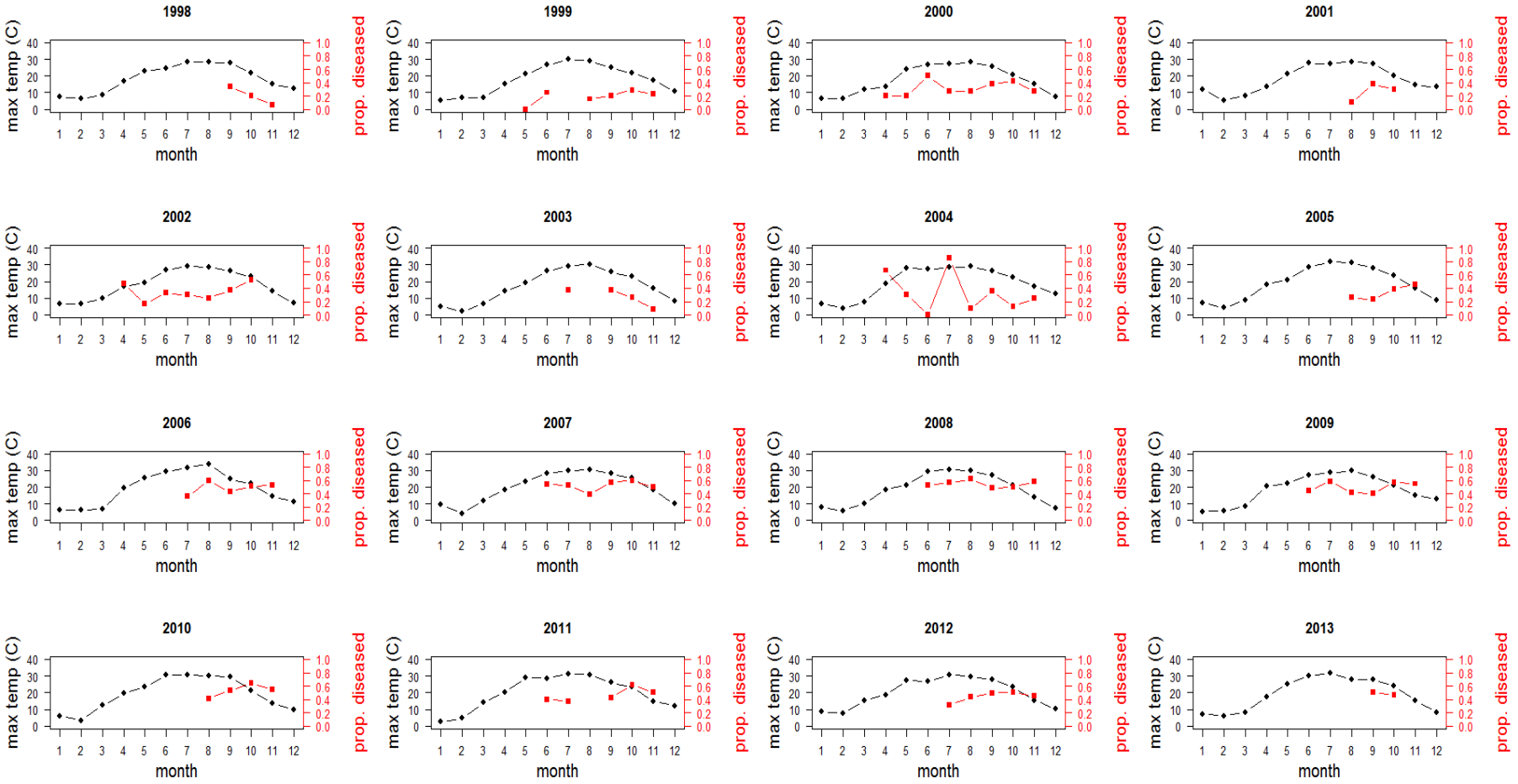
Proportion Diseased at Age

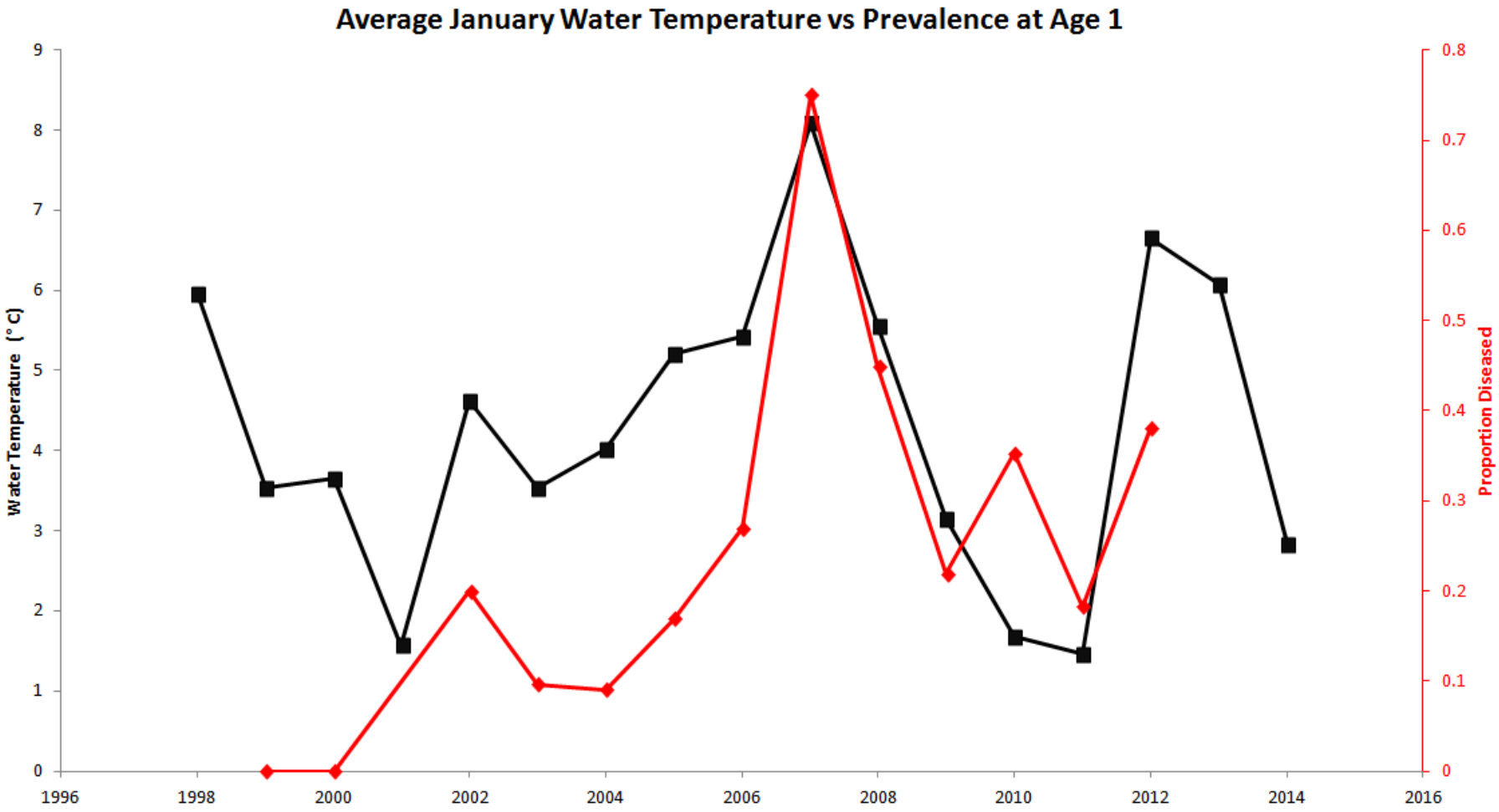


Analyses to Date: Connecting Indicators to Environmental Variables

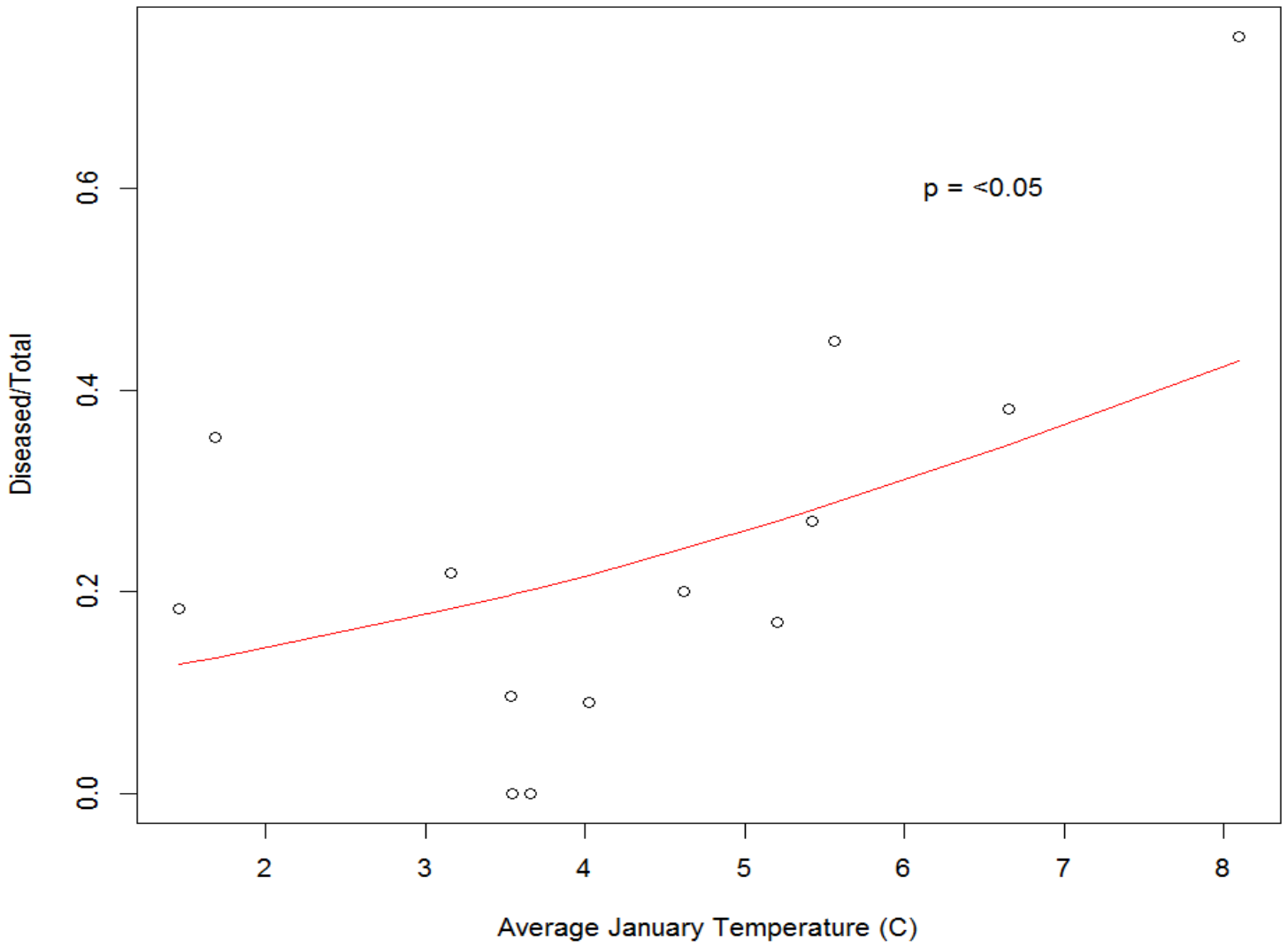

Body Condition Ranking vs Overall Proportion Diseased
Diseased/Total
0.4
0.5
0.6
0.7
0.8
0.9
1.0
p = <0.05
0
1
2
3
4
5
Body Condition Rank

Monthly Maximum Temperatures vs Overall Proportion Diseased

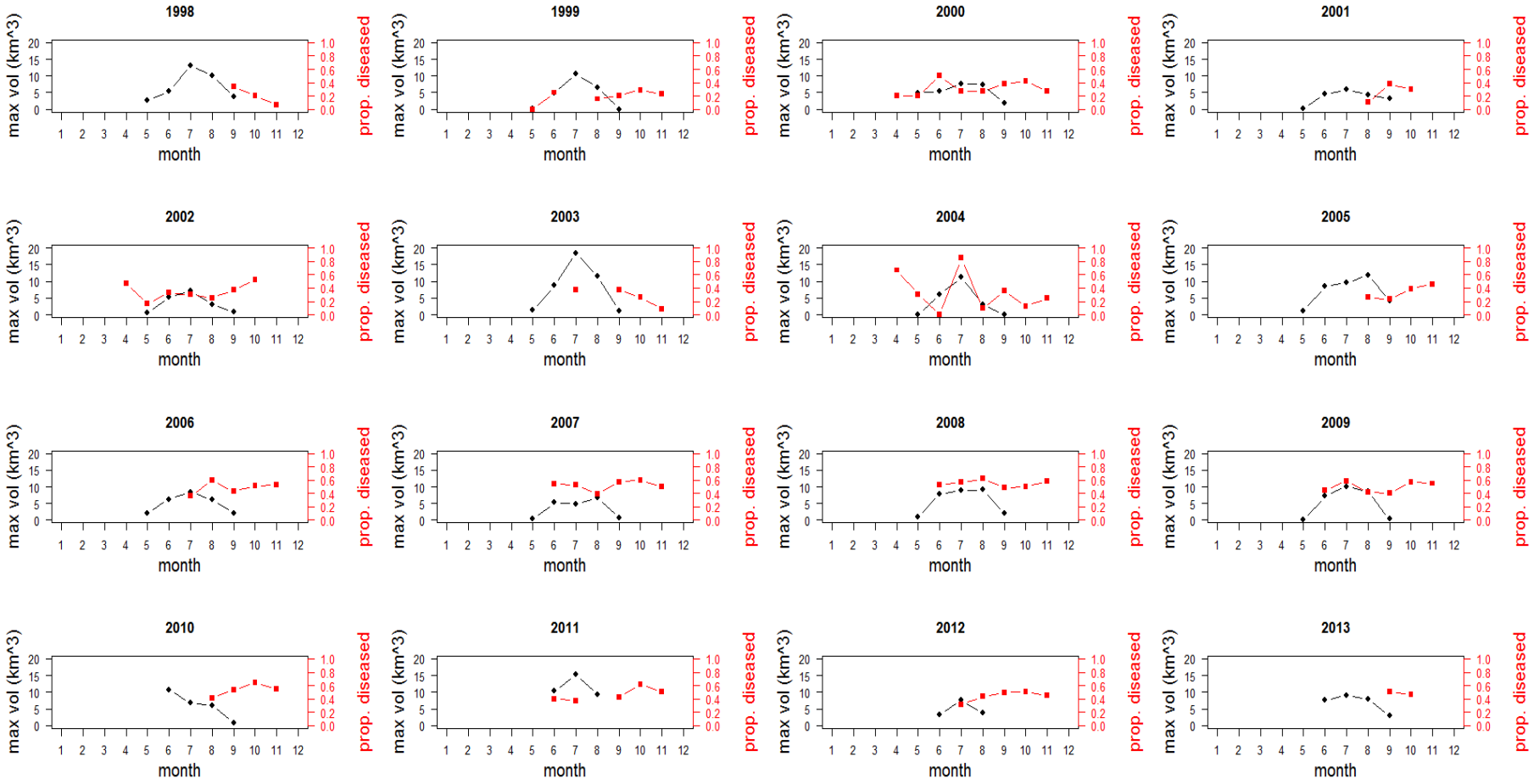



Average January Water Temperature vs Prevalence at Age 1
Water Temperature (° C)
Proportion Diseased
0
1
2
3
4
5
6
7
8
9
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016

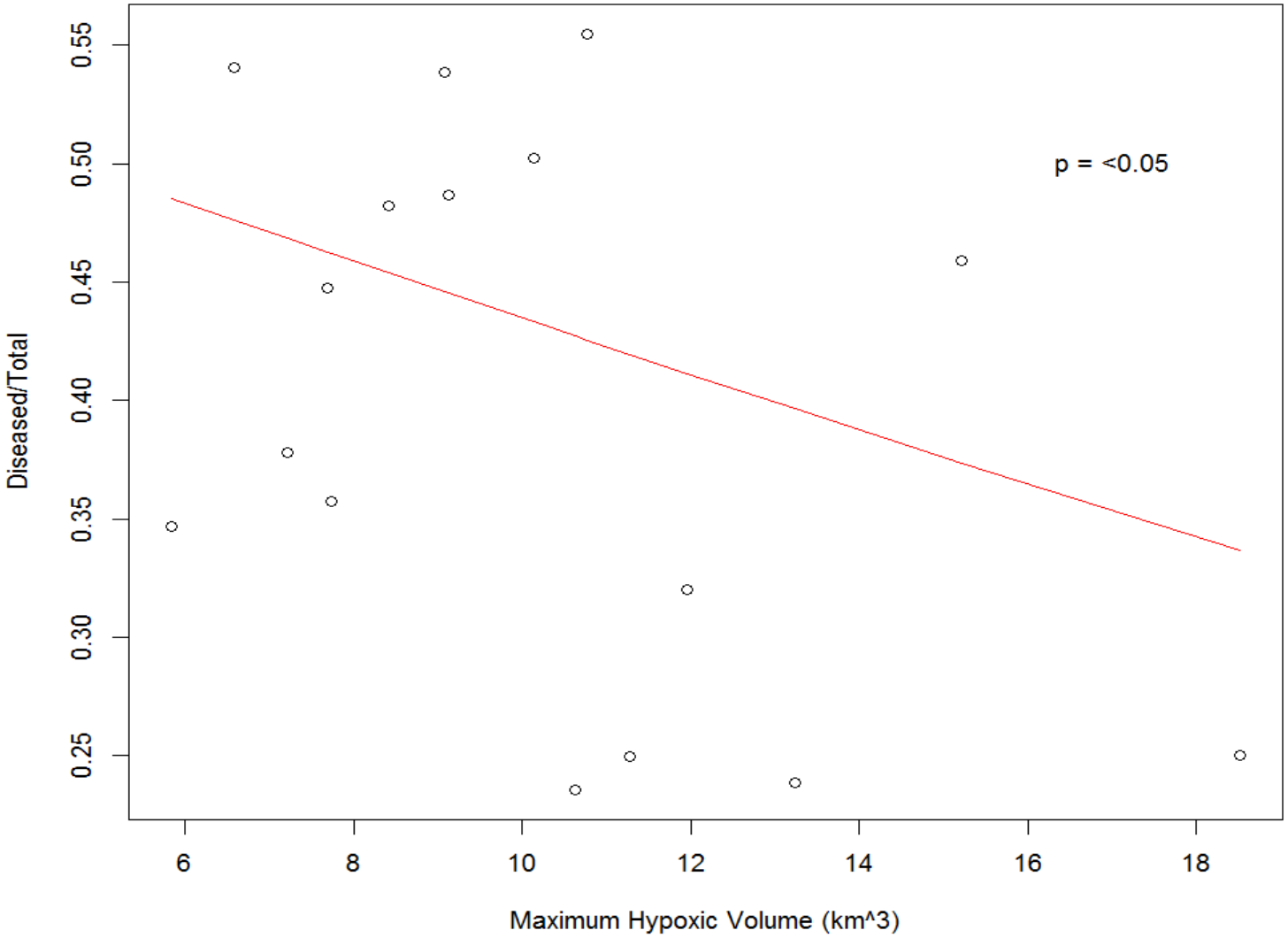
Average January Temperature vs Proportion Diseased at Age 1



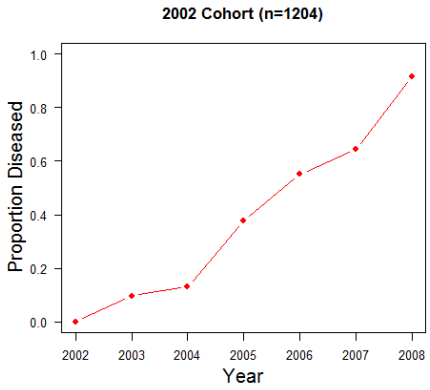
Monthly Maximum Hypoxic Volume vs Overall Proportion Diseased

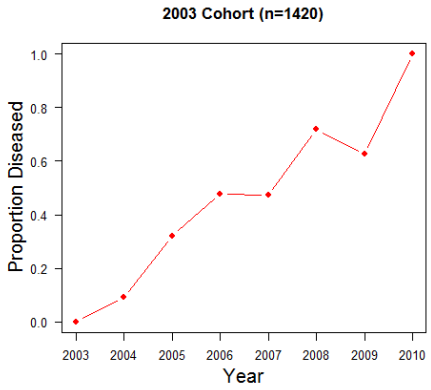


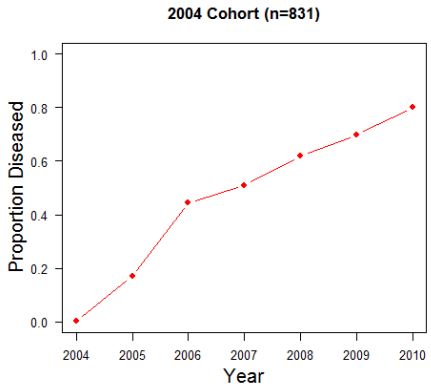
Maximum Annual Hypoxic Volume vs Overall Proportion Diseased

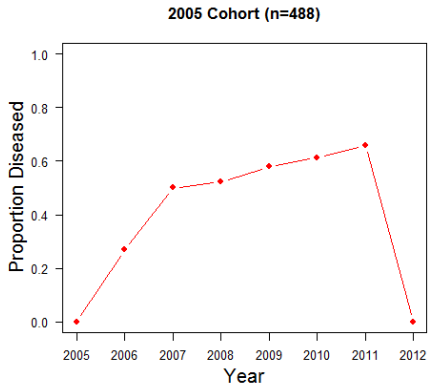


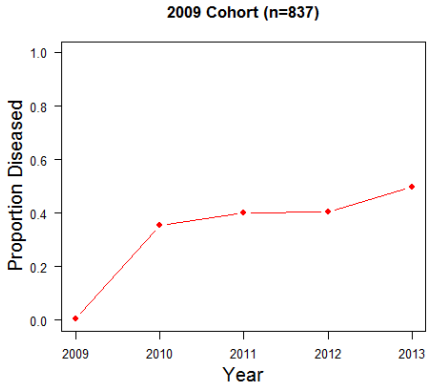
Prevalence Over Time (Cohorts)

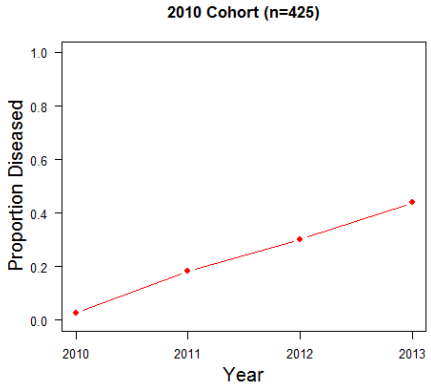


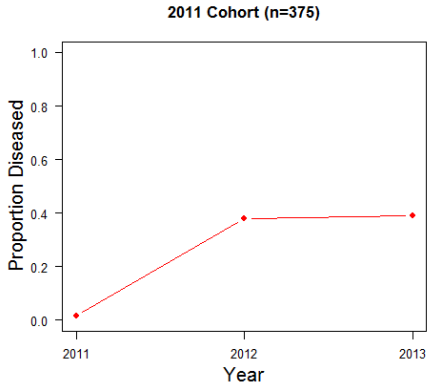




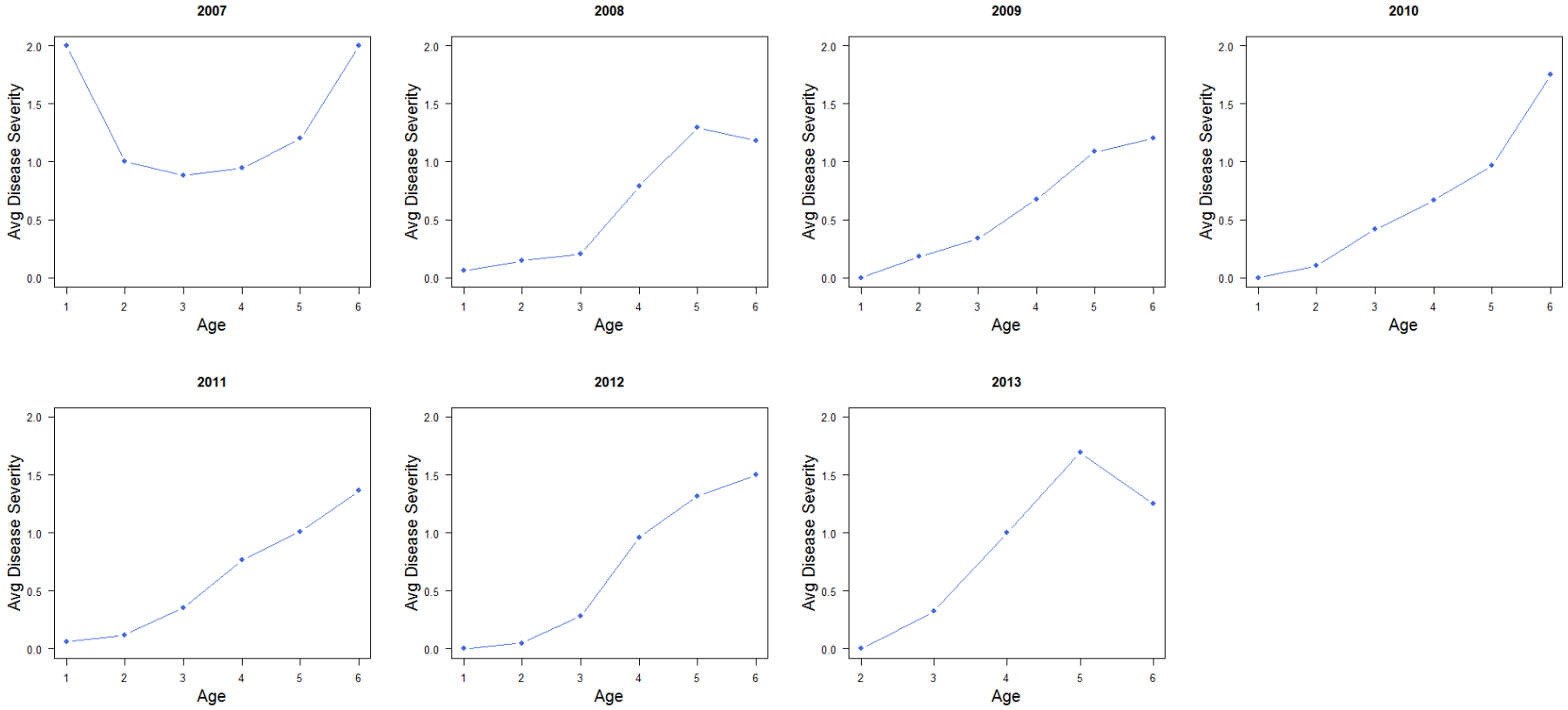








Overall Disease Severity at Age



Preliminary Conclusions

- With current data availability, apparent prevalence and disease severity are appropriate annual indicators
- Initial work shows that apparent prevalence is correlated with several external factors including body condition, seasonal water temperatures, and hypoxic volume
- With additional analyses examining the interaction of external factors, apparent prevalence will be a successful indicator of striped bass health in the Bay

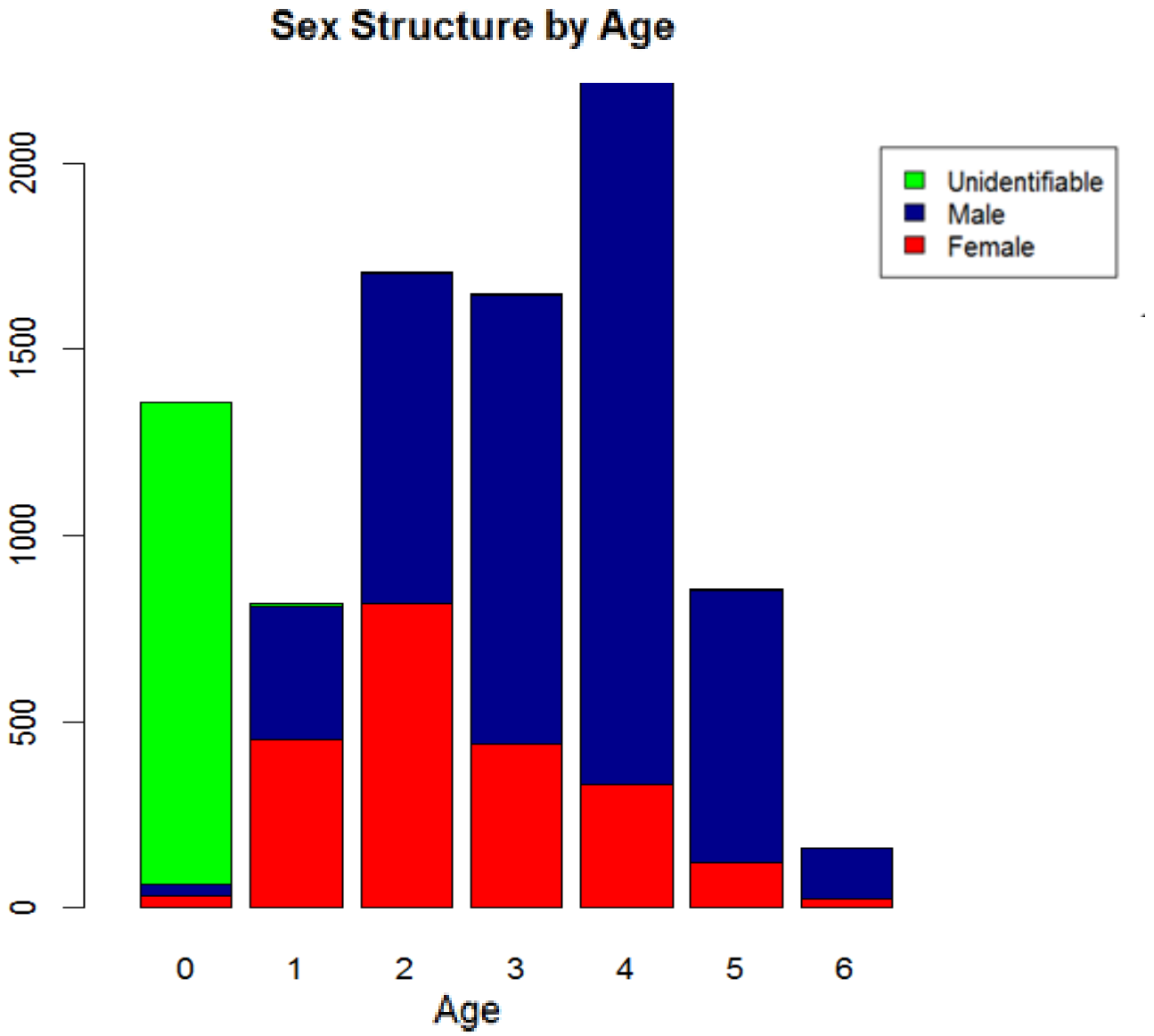
Future Steps

- Estimates of disease-associated mortality and force of infection can be attained for complete data set (one value)
- Future surveys should focus efforts on acquiring older age classes in order to more effectively capture annual trends in disease-associated mortality
- Interactions between external factors and their relationship with disease status will continue to be examined (i.e. temperature and hypoxia)

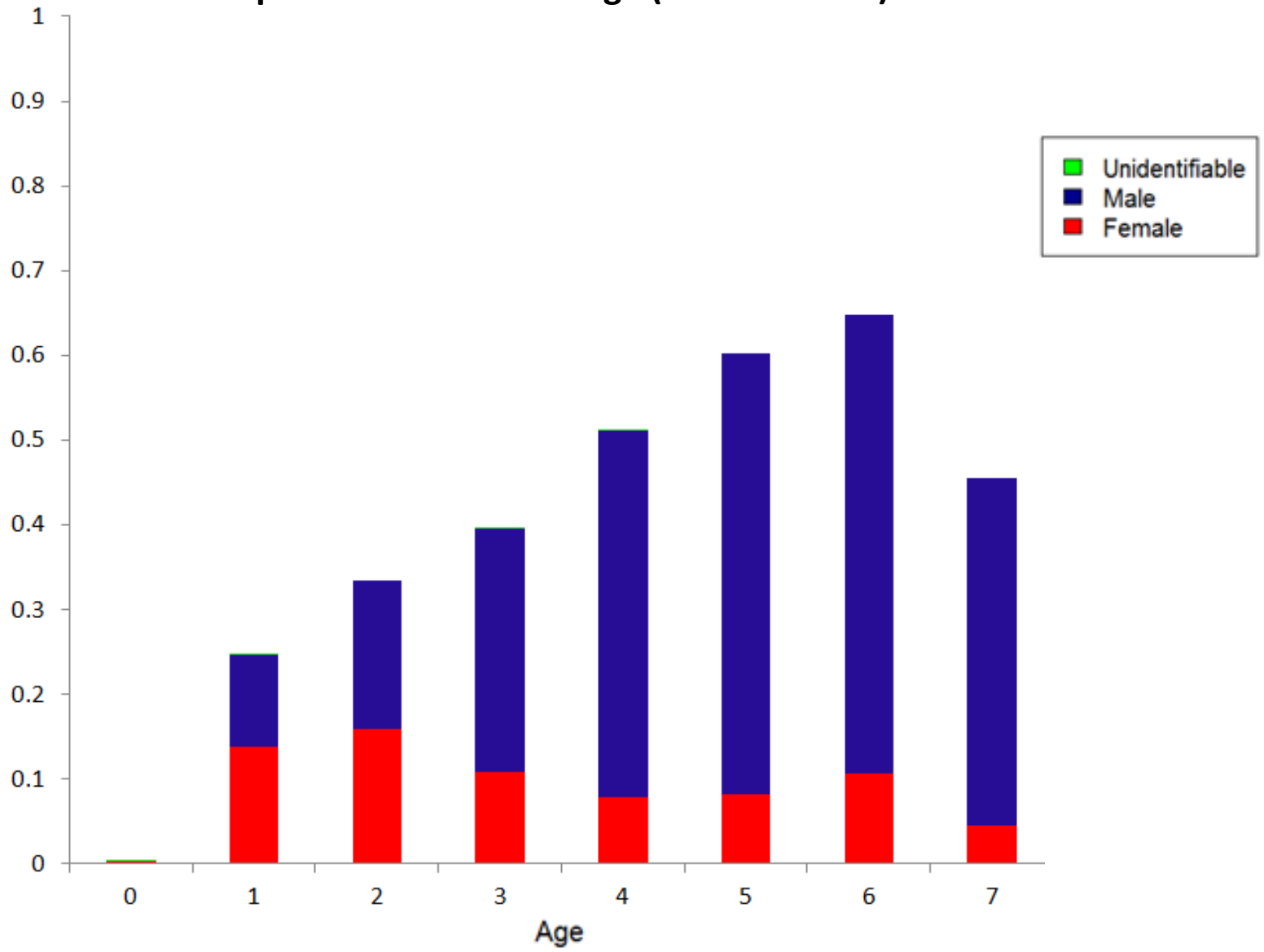
Acknowledgments

Chesapeake Bay Program

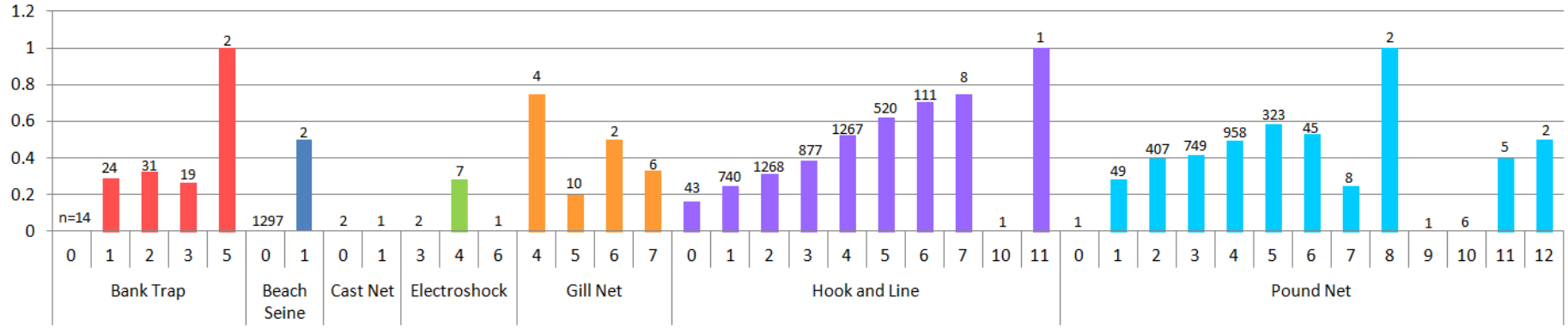
A Watershed Partnership


Sex Structure by Age
Unidentifiable
Male
Female
0
500
1000
1500
2000
0
1
2
3
4
5
6
Age

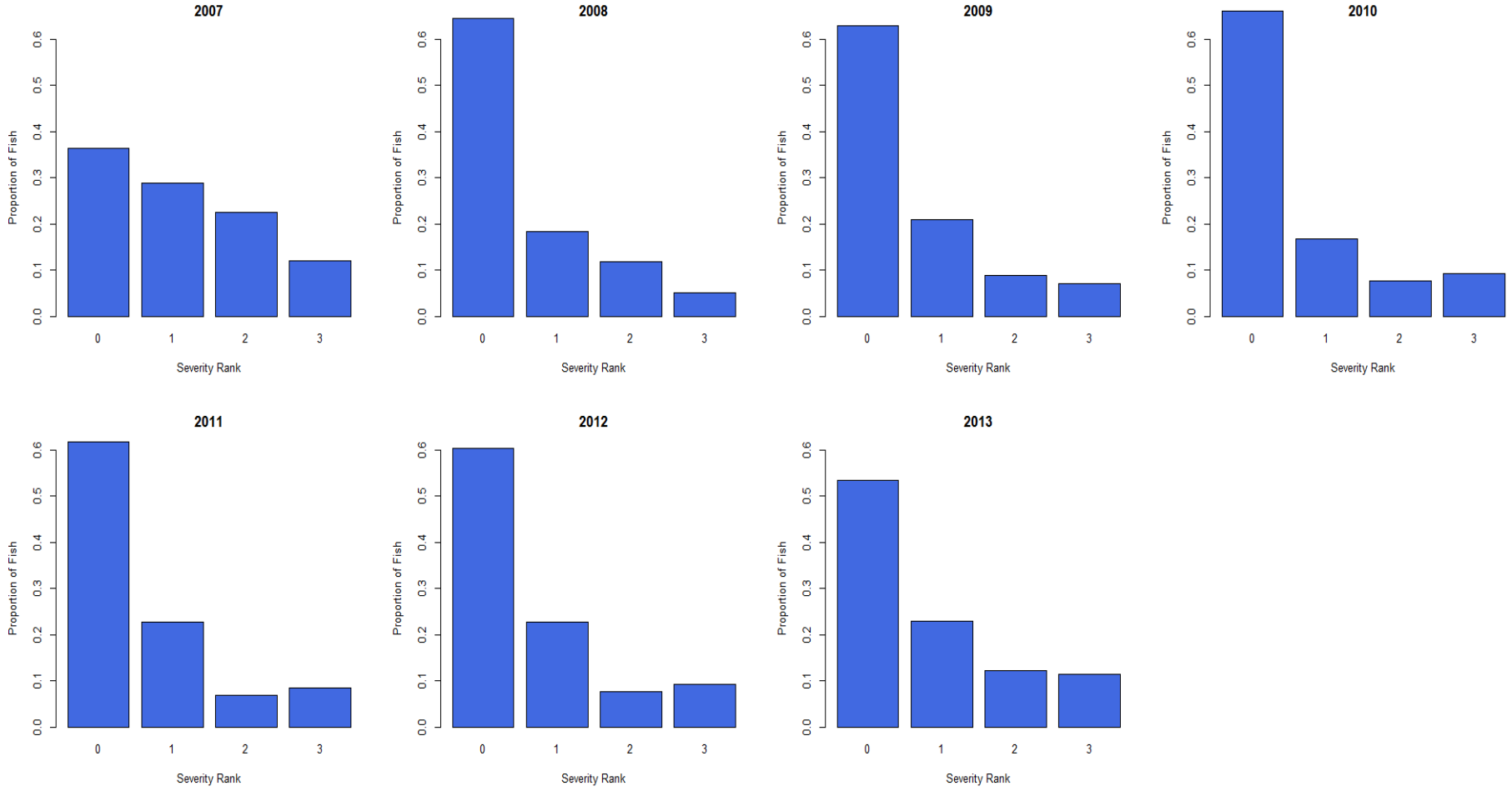
Proportion Diseased at Age (Sex Structure)

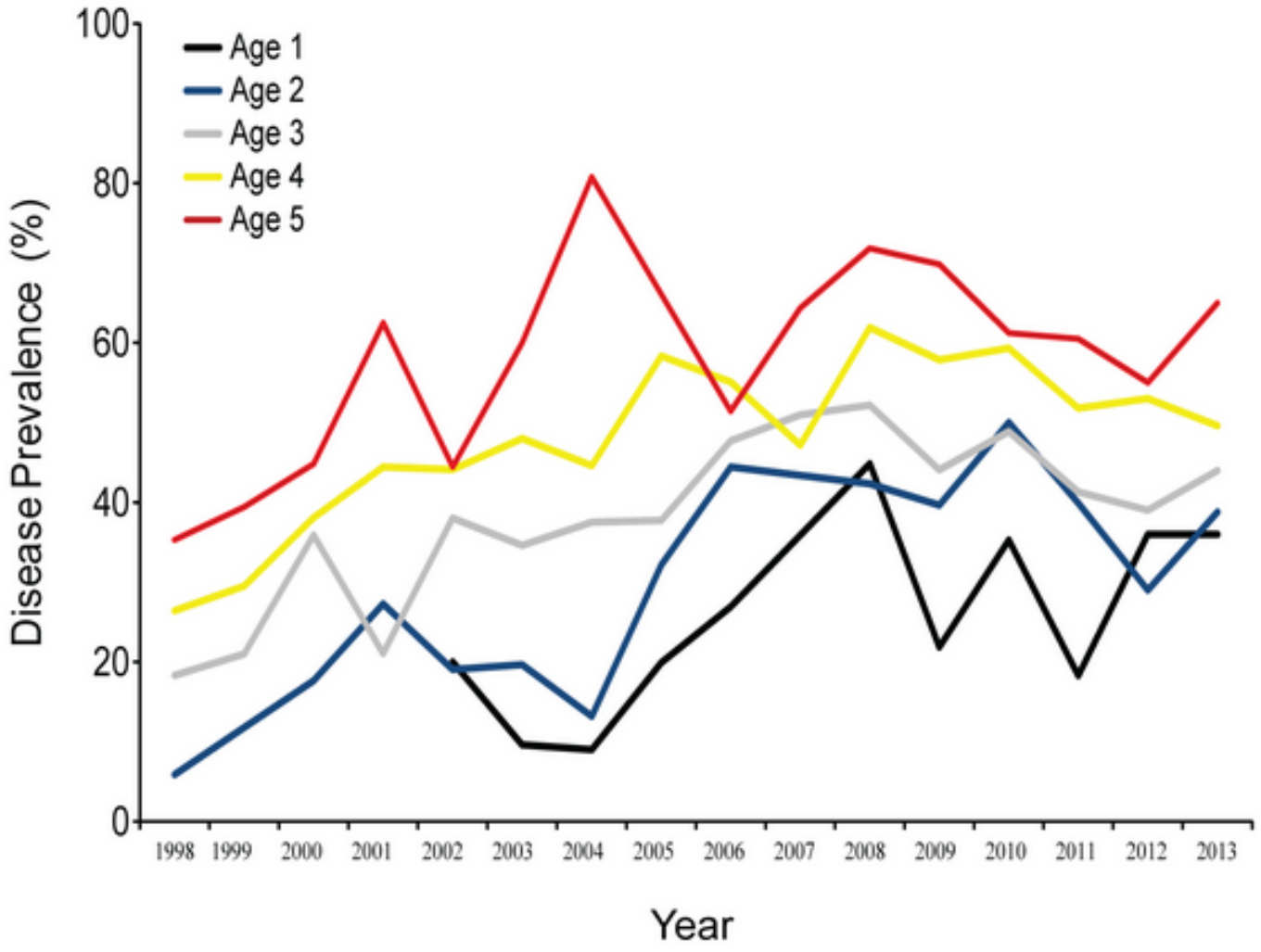


Proportion Diseased (Sample Gear Type)



Annual Compostition of Severity Rankings




Age 1
Age 2
Age 3
Age 4
Age 5
Disease Prevalence (%)
100
80
60
40
20
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year