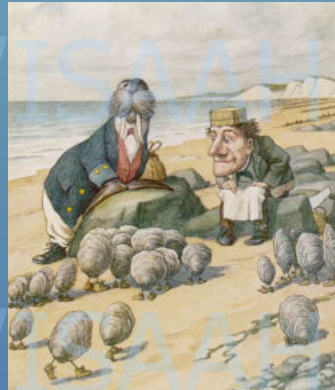


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Haplosporidiosis in Bivalve Molluscs: New Perspectives on *Haplosporidium* *costale*, Agent of SSO Disease in *Crassostrea virginica*

Nancy Stokes & Ryan Carnegie
Virginia Institute of Marine Science
Gloucester Point, VA USA

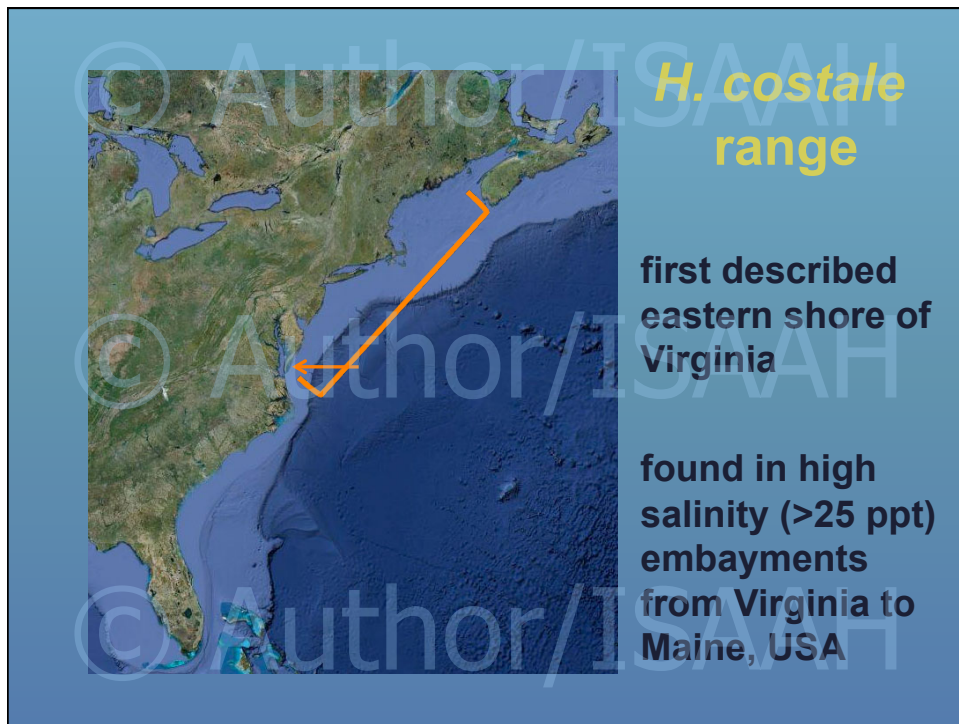


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Haplosporidium costale

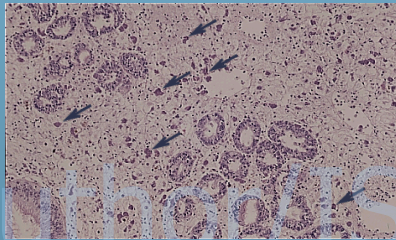
- protozoan of phylum Haplosporidia
- causative agent of SSO disease in eastern oyster, *Crassostrea virginica*
- strong seasonality: peak infections in March – May, mortalities in May – June

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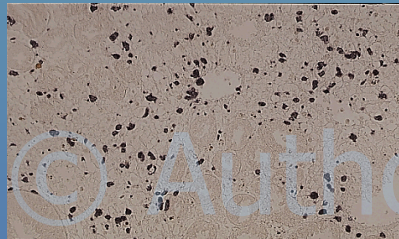
- Haplosporidium costale***
- protozoan of phylum Haplosporidia
 - causative agent of SSO disease in eastern oyster, *Crassostrea virginica*
 - strong seasonality: peak infections in March – May, mortalities in May – June
 - plasmodia indistinguishable from those of major oyster pathogen *H. nelsoni*
 - spores readily discernible between species
 - species-specific PCR primers and ISH probes

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Is it *H. costale* or *H. nelsoni*?

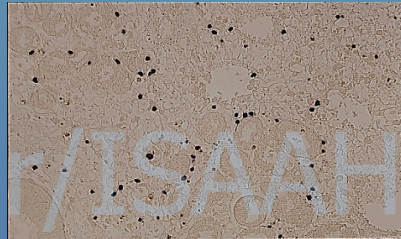


H&E

ISH with SSO probe



ISH with MSX probe



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Who cares about *H. costale*?

***Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo) are the major oyster pathogens**



Who cares about *H. costale*?

Haplosporidium nelsoni (MSX) and *Perkinus marinus* (Dermo) are the major oyster pathogens

H. costale infections of cultured stocks caused 20-70% mortalities in Massachusetts in late spring 1998



Recent Observations of *H. costale*

Location	% Prev	Oyster Host	Collection Date	Detection Method	
Long Island Sound, USA	0.2%	<i>C. virginica</i>	Oct-Dec, 1997-99	Histology, ISH, PCR	Sunila et al., 2002
Atlantic Canada	"low"	<i>C. virginica</i>	spring 2003	Histology, ISH, PCR	Stephenson et al., 2005

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Bohai Sea, China	3%	<i>C. gigas</i>	spring 2006, summer 2007	Histology, ISH, PCR	Wang et al., 2010

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New South Wales, Australia	32% - 68%	<i>Saccostrea glomerata</i>	austral winter, 2006-07	PCR	(in progress)

Recent Observations of *H. costale*



infections in several oyster species

infections in all seasons

Oyster Restoration



Size-specific study of disease impacts on reproduction



Oysters more abundant than expected



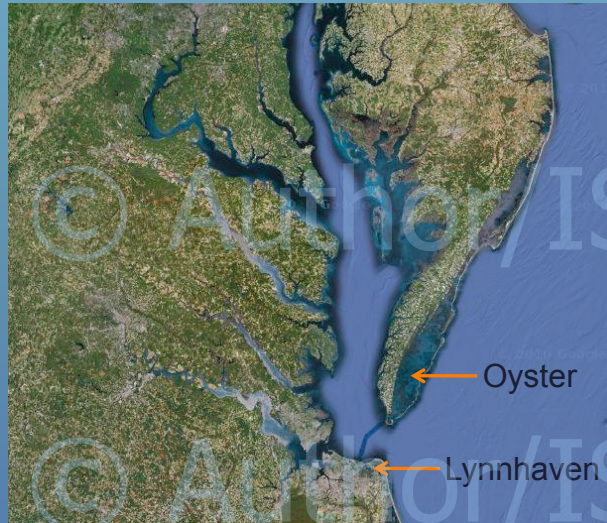
Oyster Sampling

Shell height size classes

- A = <50 mm
- B = 50 - 76.1 mm
- C = 76.2 - 100 mm
- D = >100 mm

25 oysters/size class/site
April – October, 2008

© Author/ISAAH Sampling Sites: Diseases



Oyster
SSO pos
MSX irreg

Lynnhaven
SSO neg
MSX pos

© Author/ISAAH Size-Specific Infection Profile

Oyster

	MSX				SSO			
	A	B	C	D	A	B	C	D
April	1-0-0-0	0-0-0-0	0-0-1-1	0-1-0-0	0-1-2-0	2-1-7-0	1-1-7-1	0-1-9-4
May	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-1-0	1-0-0-0	1-1-0-1	1-0-0-0
June	2-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0
July	0-0-0-0	1-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0
August	0-1-0-0	0-0-0-0	0-0-0-0	1-0-1-1	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0
October	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0

A = <50 mm
B = 50 - 76.1 mm
C = 76.2 - 100 mm
D = >100 mm

Heavy - Moderate - Light - Rare

Size-Specific Infection Profile

Lynnhaven

	MSX				SSO			
	A	B	C	D	A	B	C	D
April	2-0-0-0	1-1-0-0	0-1-1-1	1-0-0-0	0-0-2-0	1-0-3-0	1-0-3-0	0-3-5-3
May	0-0-1-1	1-0-2-0	1-0-0-0	1-1-0-0	0-1-1-1	1-2-0-0	2-0-1-1	1-1-1-2
June	0-0-0-0	0-0-0-0	0-0-0-0	0-0-1-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0
July	0-0-0-0	0-0-0-1	0-2-1-0	0-0-1-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0
August	0-0-0-0	0-0-1-0	0-0-0-0	0-0-1-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0
October	0-0-0-0	0-0-0-1	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0	0-0-0-0

A = <50 mm

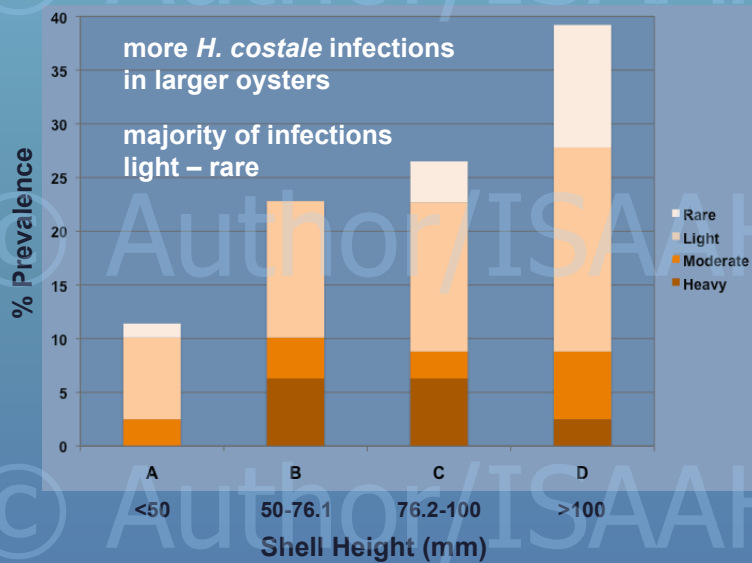
B = 50 - 76.1 mm

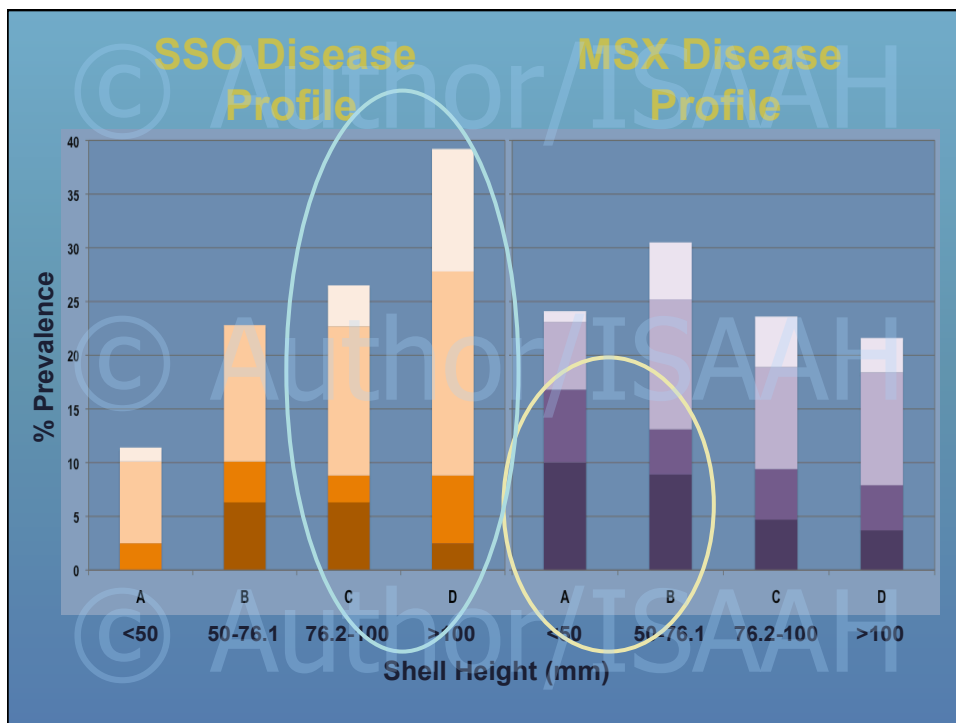
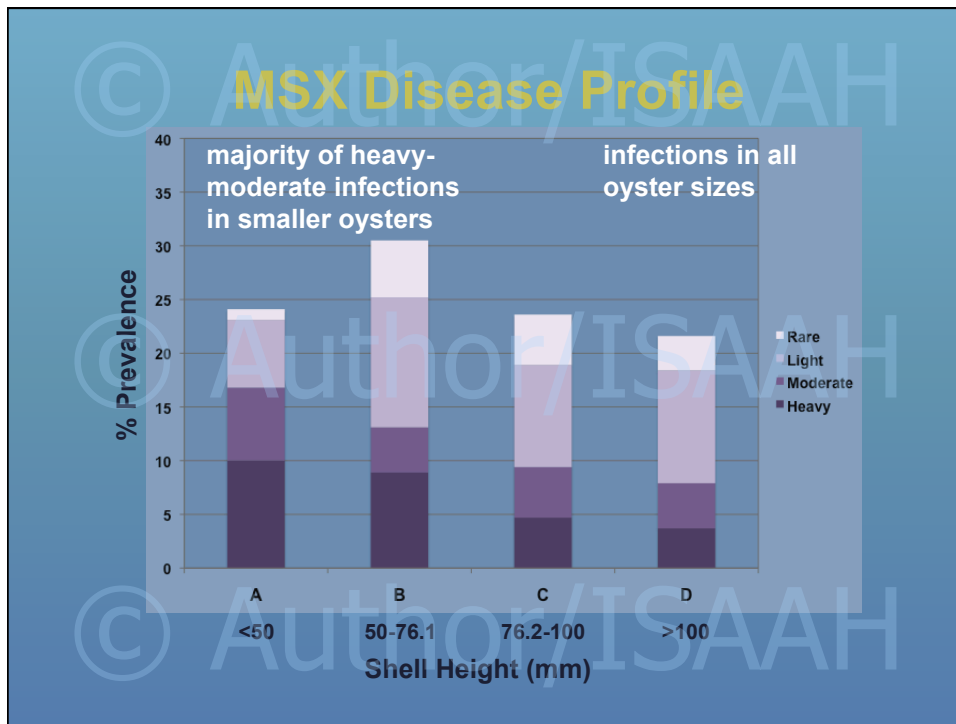
C = 76.2 - 100 mm

D = >100 mm

Heavy - Moderate - Light - Rare

SSO Disease Profile





Summary

- recent global observations of *H. costale* show expansions since its original description
 - range, host, seasonality
- recent impact of *H. costale* in Virginia appears to be greater than previously appreciated
 - colonization of Lynnhaven
 - higher prevalences and intensities than expected
- more *H. costale* infections in larger oysters, with majority rare - light intensity; *H. nelsoni* infections in all sizes, though smaller oysters have majority of moderate – heavy
 - acute (*H. nelsoni*) vs. chronic (*H. costale*) infection?

Acknowledgements



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Oyster Disease
Research Program**

Rita Crockett

