

A survey for potential endocrine disruption effects in bivalves in Maryland's Chesapeake Bay

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Recent described locations and effects of endocrine disruption in bivalve molluscs



Target Species in Chesapeake Bay

Crassostrea virginica



Mya arenaria



Tagelus plebeius



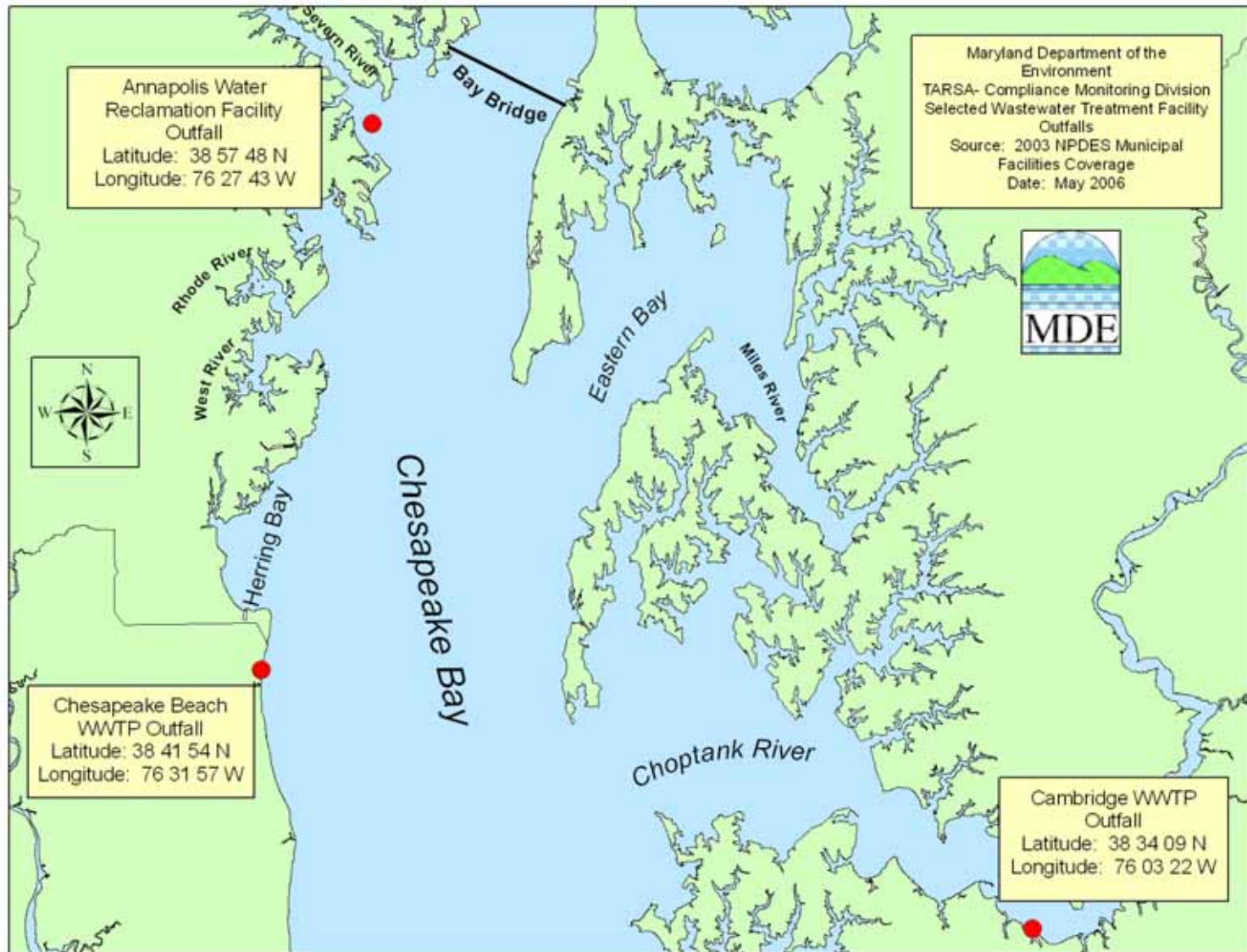
Ischadium recurvum



Rangia cuneata



Locations of wastewater treatment plant outfalls where bivalve samples were collected



Incidence of hermaphroditism

Oyster

SPECIES	IMPACTED	H	TOTAL N BY SPECIES
Cv	Y	0	180
Cv	Y	0	
Cv	Y	0	
Cv	N	0	
Cv	N	0	
Cv	N	0	

Mussel

lr	Y	0	180
lr	N	0	
lr	N	0	
lr	Y	0	
lr	Y	1	
lr	Y	0	

Soft clam

Ma	N	0	113
Ma	N	0	
Ma	Y	0	
Ma	Y	0	

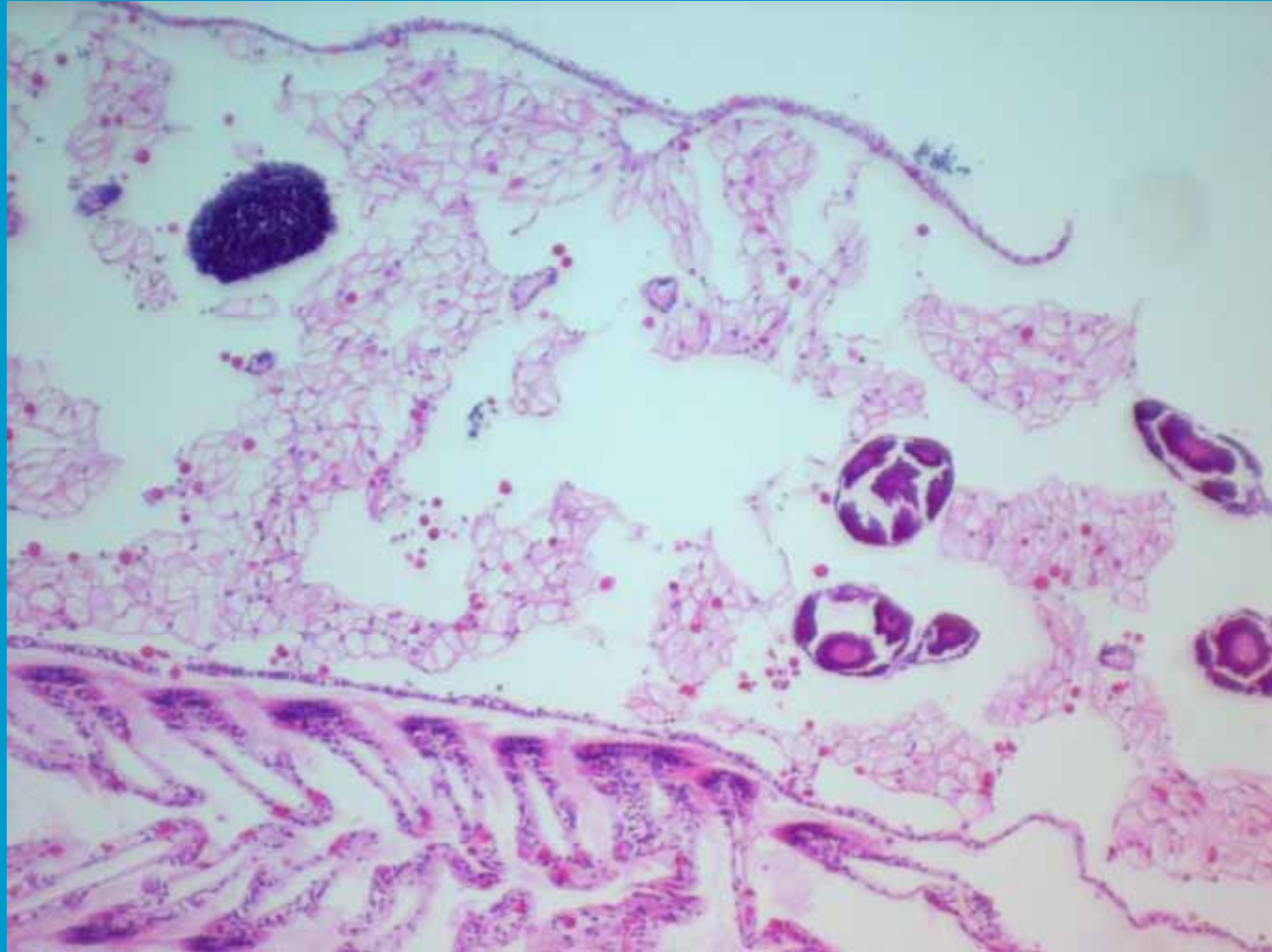
Razor clam

Tp	N	0	63
Tp	Y	0	
Tp	Y	0	

Rangia clam

Rc	Y	0	10
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Ischadium recurvum
hermaphrodite



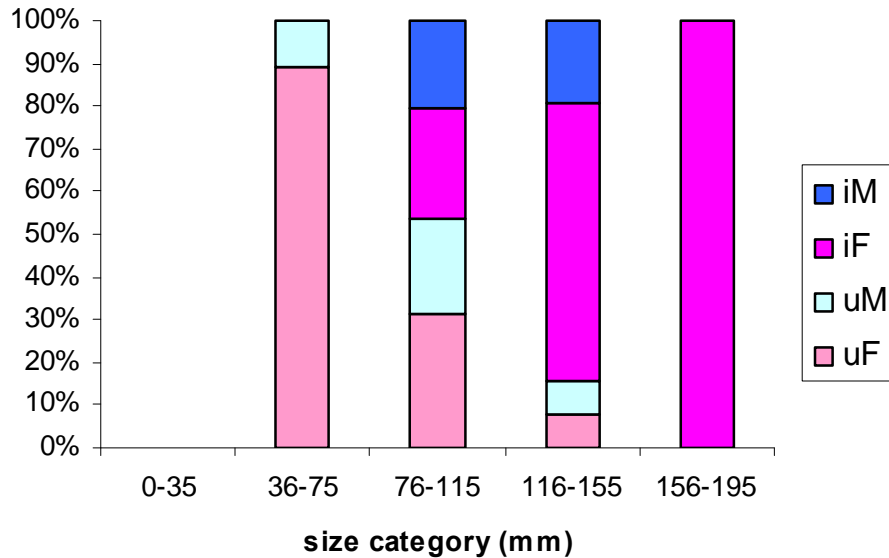
Oyster Sex Ratios

Size Effects

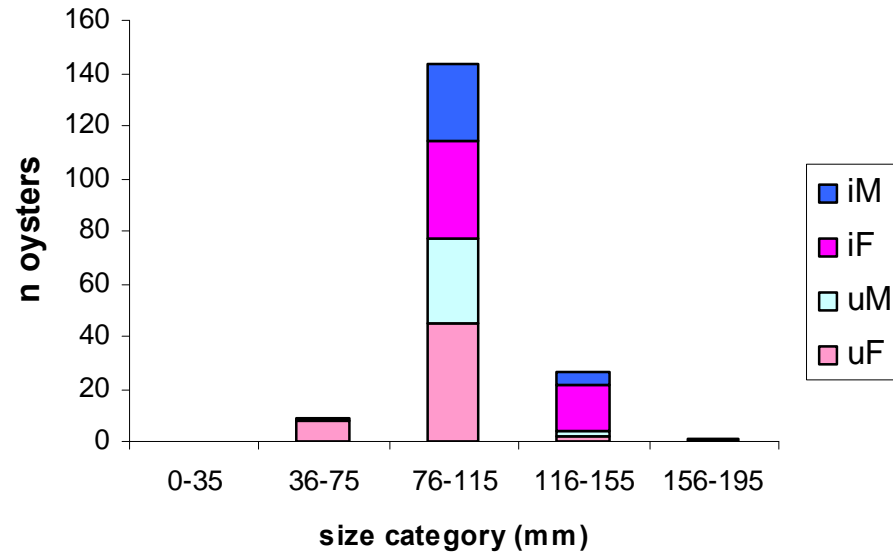
- **Oysters are protandric hermaphrodites, often changing from male to female with age.**
- **Therefore, the proportion of females is expected to be larger in larger (older) oysters.**
- **This may mask feminizing endocrine disruption effects, which also might be expected to have greater manifestations the longer oysters are exposed.**

Oyster Size Distribution

Impacted vs Unimpacted (n=179)



Impacted vs Unimpacted (n=179)



Sex ratio comparisons for all oysters

SPECIES	OUTFALL	IMPACTED	F:M RATIO	MEAN SHELL HEIGHT	MEAN F SHELL HEIGHT	MEAN M SHELL HEIGHT
Cv	A	Y	0.67	100	99	100
Cv	A	N	1.73	88	86	92
Cv	C	Y	2.75	119	121	112
Cv	C	N	1.50	99	99	98
Cv	CB	Y	2.63	97	98	95
Cv	CB	N	1.50	87	86	89

- **ANOVA demonstrated that shell heights of impacted vs unimpacted samples at all sites are significantly different ($p < 0.05$).**

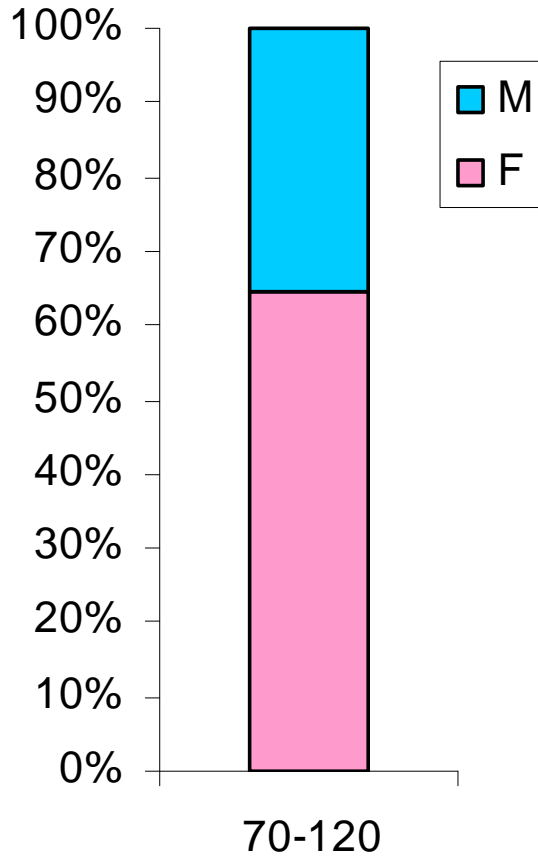
Sex ratio comparisons for oysters 76 – 115 mm

SPECIES	OUTFALL	IMPACTED	F:M RATIO	p VALUE BY SITE ($\alpha = 0.05$)	p VALUE POOLED ($\alpha = 0.05$)
Cv	A	Y	0.67	0.089	0.774
Cv	A	N	1.78		
Cv	C	Y	2.67		
Cv	C	N	1.27		
Cv	CB	Y	2.38		
Cv	CB	N	1.25		
Cv	pooled	Y	1.28		
Cv	pooled	N	1.41		

- All p values > 0.05; no significant differences in sex ratios

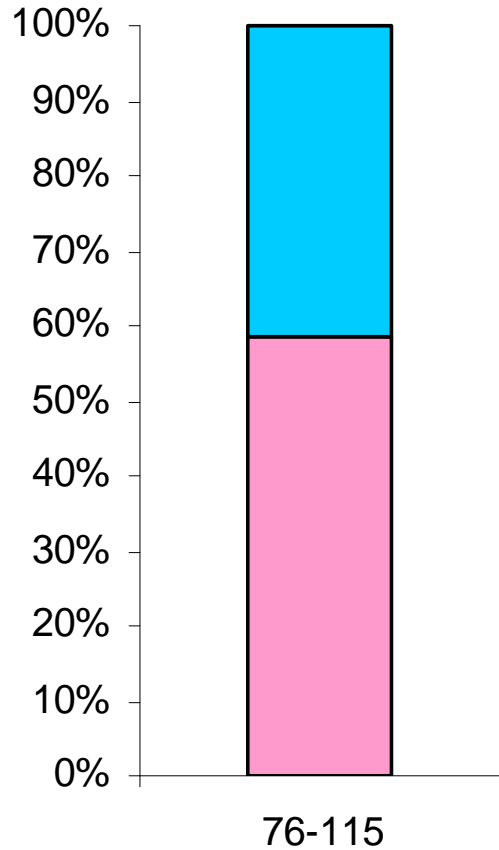
Sex ratio comparisons with historic oysters

1960s oysters (n=1607)



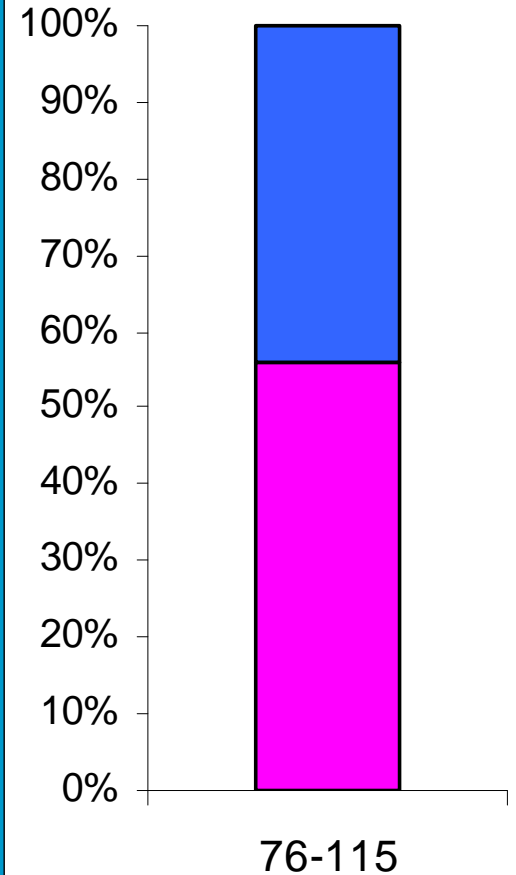
Kennedy, 1983

Unimpacted (n=77)



size category (mm)

Impacted (n=66)



Sex ratio comparisons with historic oysters

TYPE	IMPACTED	F:M RATIO	p VALUE ($\alpha = 0.05$)
I	Y	1.28	0.156
U	N	1.41	0.271
H	N	1.82	

- All p values > 0.05; no significant differences in sex ratios

Sex ratio comparisons for other species

SPECIES	OUTFALL	IMPACTED	F:M RATIO	p VALUE BY SITE ($\alpha = 0.05$)	p VALUE POOLED ($\alpha = 0.05$)
lr	A	Y	1.31		
lr	A	Y	1.73	0.60	
lr	A	N	1.31	0.76	
lr	C	Y	1.31		
lr	C	N	1.31	1.00	
lr	CB	Y	1.07		0.95
Ma	A	Y	0.80		
Ma	A	N	0.93	0.80	
Ma	C	Y	1.00		
Ma	C	N	0.81	0.70	0.90
Tp	A	Y	2.00		
Tp	C	Y	0.71		
Tp	C	N	1.00	0.51	0.62

Conclusions

- **No evidence of delayed gametogenesis in adults**
- **No evidence of endocrine disruption as reflected by the presence of hermaphrodites**
- **No differences in oyster sex ratios between impacted and unimpacted sites, or between contemporary and historic samples, in age 2 oysters.**
- **No evidence of endocrine disruption as reflected in sex ratios for the other 3 species examined**

Suggestions for further study

- **Identify and quantify endocrine disrupting compounds in outfalls, and their environmental concentrations over time and space, to better define and select control and treatment sites.**
 - **Dye studies**
 - **Monitoring concentrations of selected endocrine disruptors**
- **Caging studies at outfalls and control sites**
 - **Duration consistent with lifespan and reproductive cycle of the species tested**

Suggestions for further study

- **Laboratory exposures to environmentally relevant concentrations of effluents or cocktails.**
- **Examine biomarkers of gametogenic activity**
- **Investigation of multiple generations**
 - **Gamete viability and fertilization success**
 - **Larval survival**

Acknowledgments

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