

Bay Scallop Habitat Requirements

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Restoration Needs Workshop**

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Bay Scallop Habitat Requirements

- Bay scallops need seagrass to recruit, survive, grow and spawn!
- Questions?

Bay Scallop *Environmental* Requirements

(Leverone, 1993, MML Tech Rpt 253;
Two articles in Fla. Sci. 58)

- **Water Quality**
 - Temperature, Salinity, DO,
- **Food**
 - Phytoplankton composition, chl, TSS
- **Reproduction**
- **Habitat**
- **Hydrodynamics**
- **Harmful Algal Blooms (i.e., red tides)**

Sources of Information

- Results from a 1992-3 field and laboratory study Tampa Bay.
- Requirements based on correlations of growth, mortality and reproduction with species-relevant measures of water quality
- Literature information most appropriate for Florida populations of bay scallop
- Technical Report “Literature Search and Data Synthesis on the Bay Scallop with Emphasis on Florida Populations”

References on relevant WQ and environmental conditions for the southern bay scallop

PARAMETER	REFERENCE
Temperature	Tettlebach & Rhodes, 81
Dissolved Oxygen	Van Dam, 54; Shumway & Sandifer, 91
Salinity	Tettlebach & Rhodes, 81
Food Supply	Fegley et al., 92; Calahan et al., 89
Macrophyte Abundance	Ambrose, 89; Prescott, 90; Eckman, 87
Current Speed	Eckman et al., 87
Turbidity	Stone & Palmer, 75
Suspended Solids	Dyer, 75
Predators	Peterson et al., 89

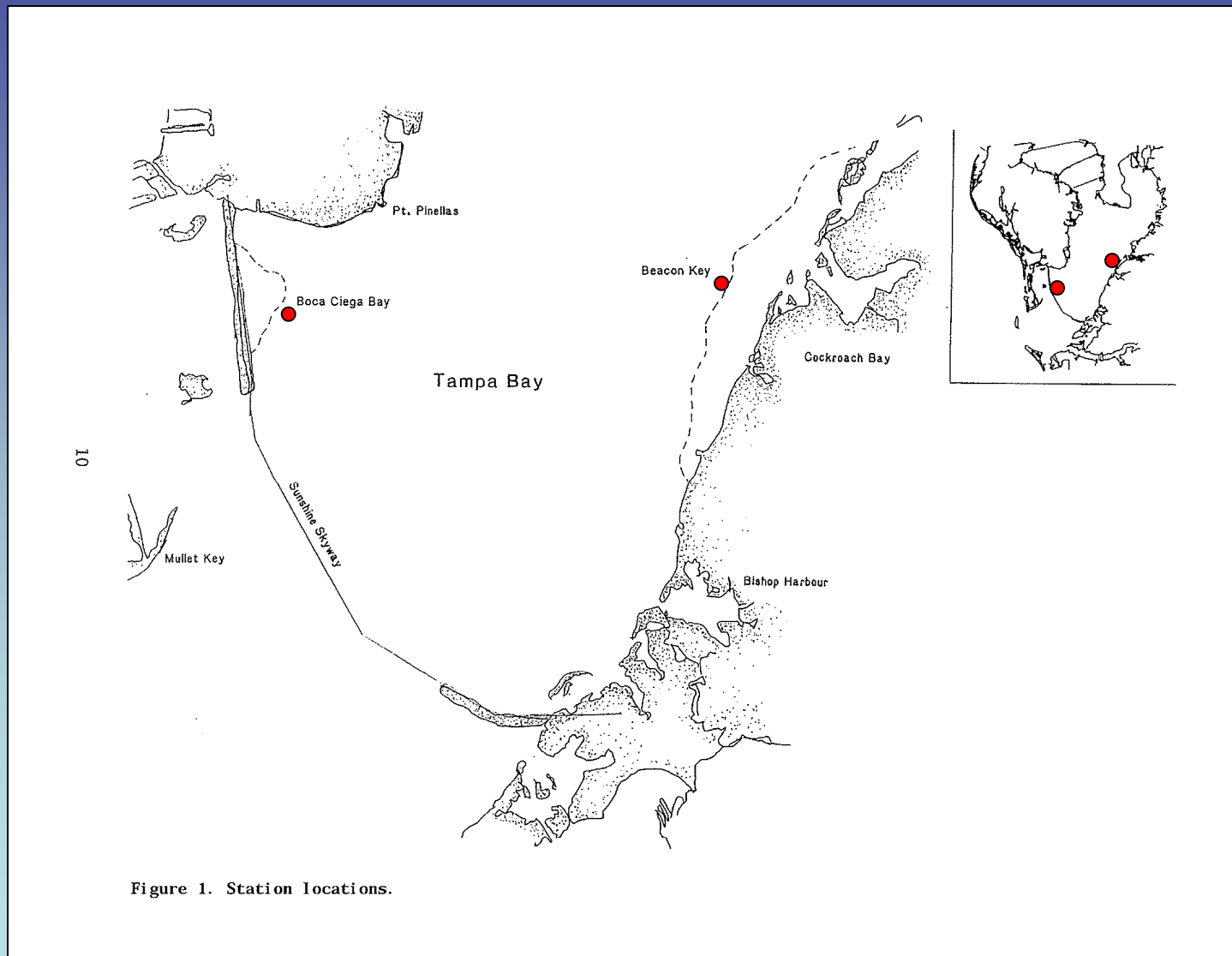
Unique Life History Differences for Florida Populations

- Shorter life expectancy
- Higher metabolic rates
- Reproductive cycle occurs later in the year
 - Lower fecundity
 - Smaller egg size
 - Higher energetic cost of reproduction
- Limits southern distribution and may accelerate senescence

Tampa Bay: Field Study

- **Deploy and maintain scallops at two sites**
 - Beacon Key
 - Boca Ciega Bay
- **Two deployments**
 - June (laboratory spawned)
 - August (wild scallops from Steinhatchee)
- **Collect relevant WQ data (biweekly)**
 - Temperature, salinity, DO, turbidity, TSS, chl a, phytoplankton composition
- **Measure biological responses (biweekly)**
 - Growth, mortality, reproductive development, fouling potential

Tampa Bay Stations



Scallop Growth

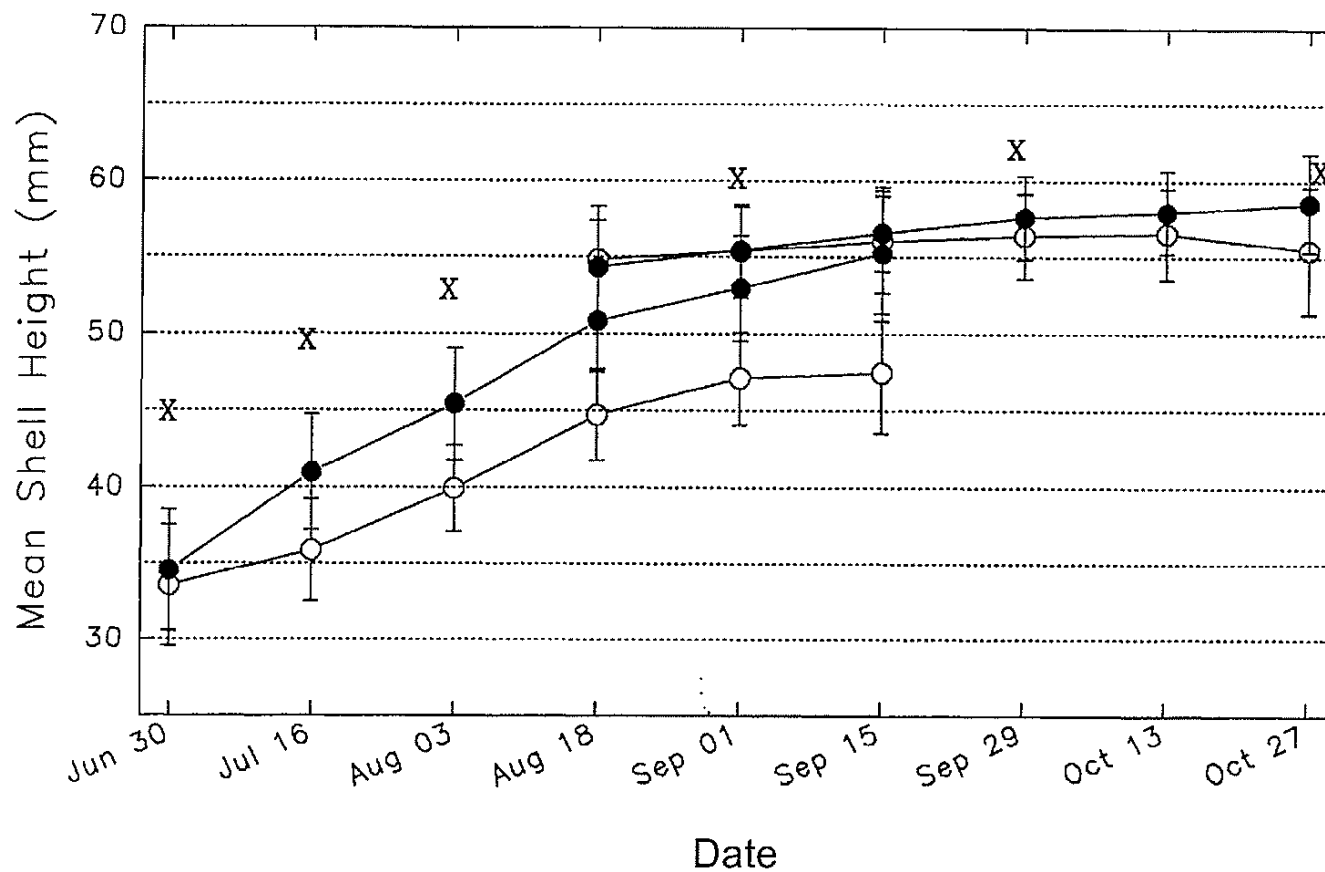
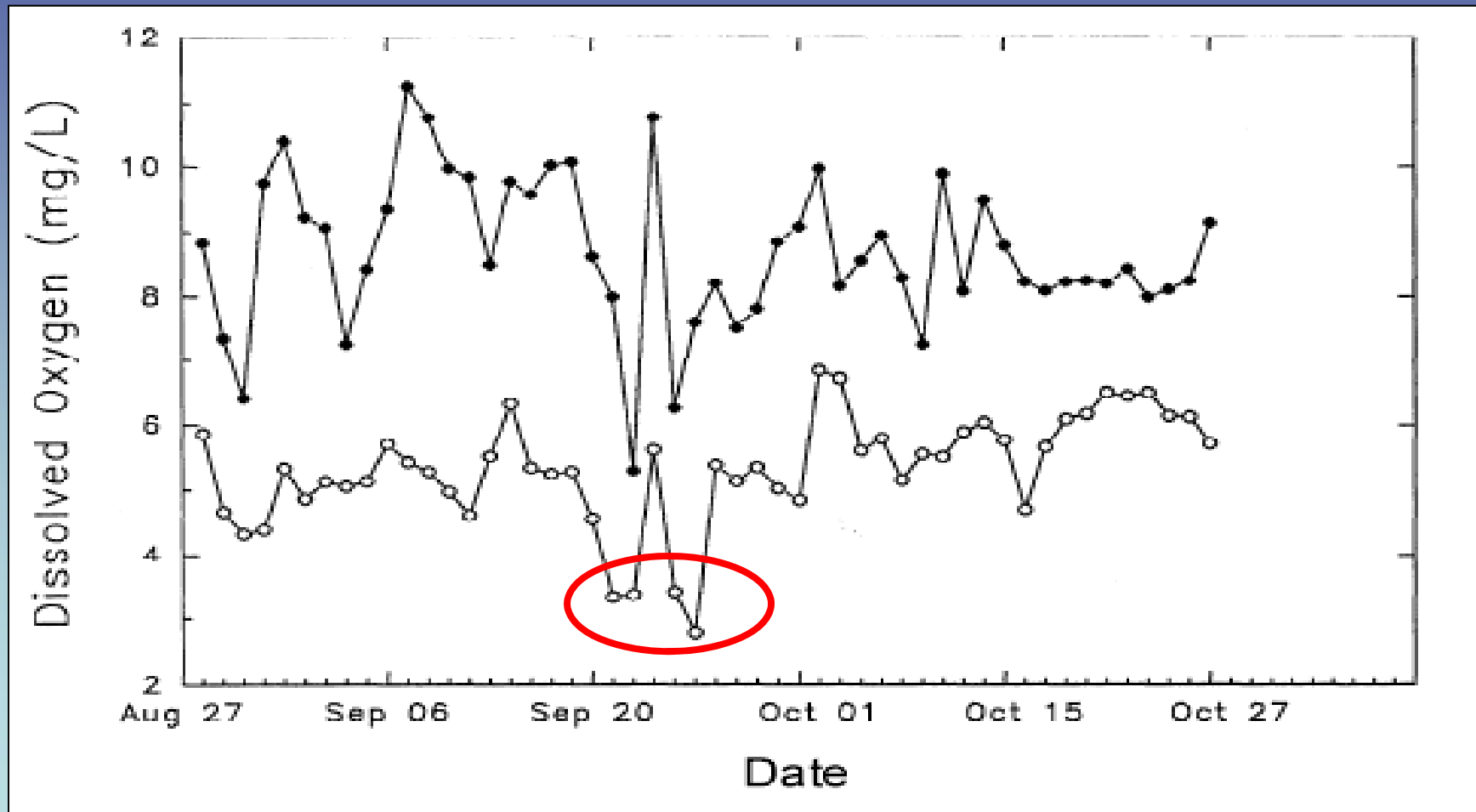


Figure 4. Shell height (mean \pm 1 S.D.) of surviving bay scallops from Boca Ciega Bay (\bullet) and Beacon Bay (\circ) from June 30 through October 27, 1992. "X" represents growth data for natural populations of bay scallop from Anclote Anchorage, 1979-1981 (Barber and Blake, 1983)

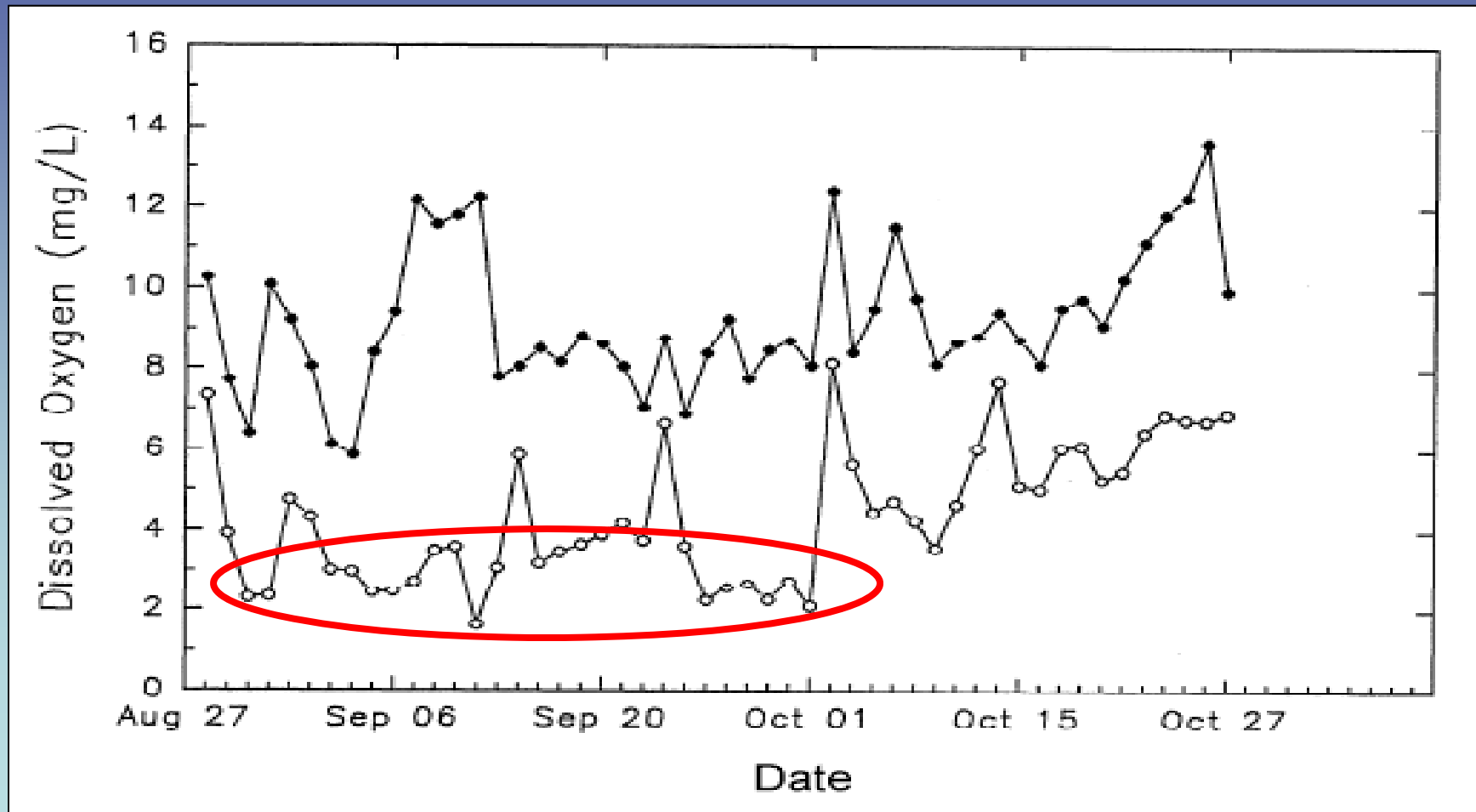
Temperature Ranges

- Alligator Harbor populations: 9 – 32°C (Sastry, 1965)
- Anclote Harbor populations: 21 – 32°C (Barber and Blake, 1985).
- Tampa Bay populations: 23 – 31°C

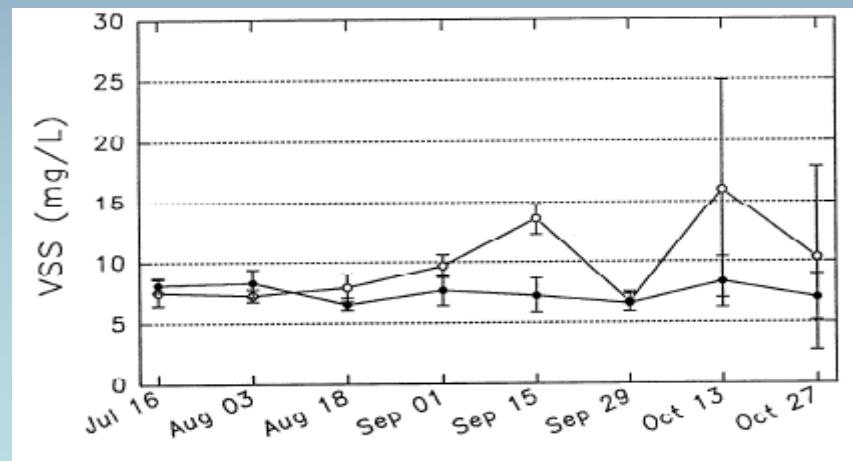
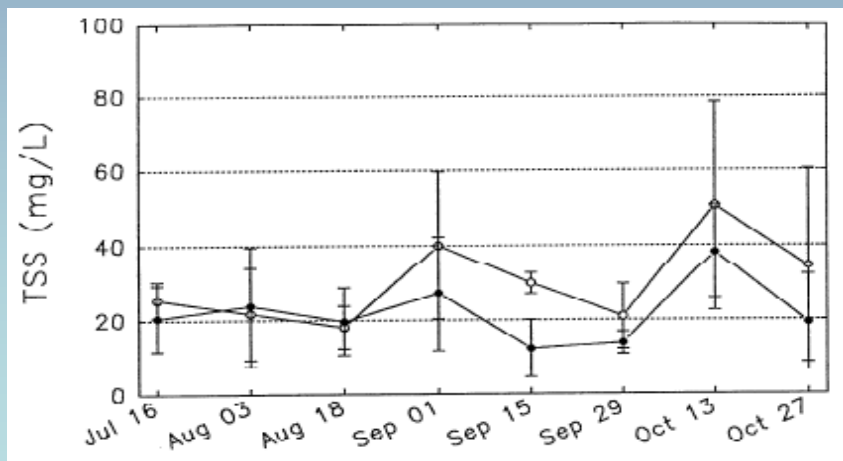
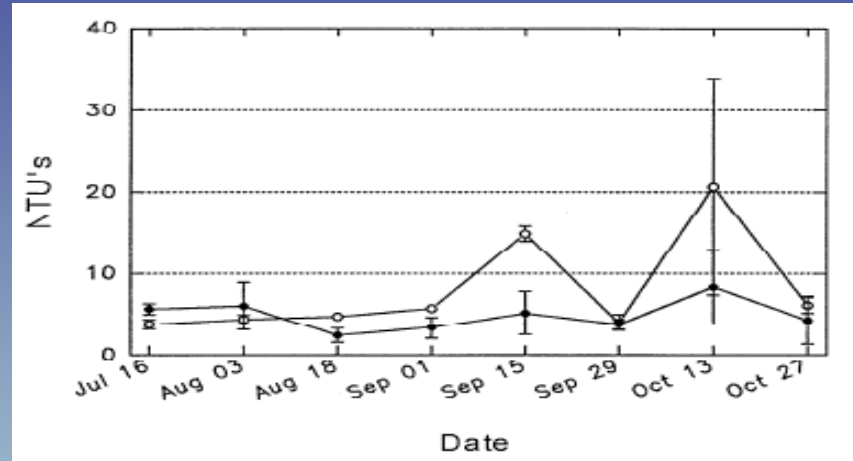
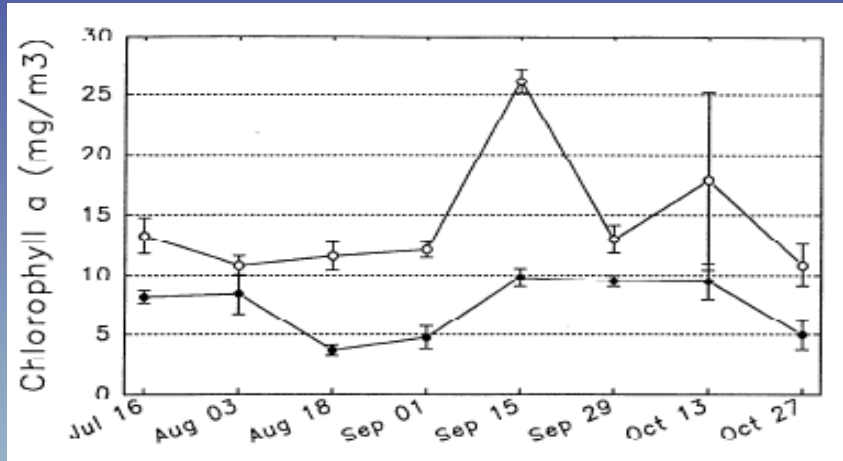
DO Record at Boca Ciega Bay (8/27 – 10/27/1992)



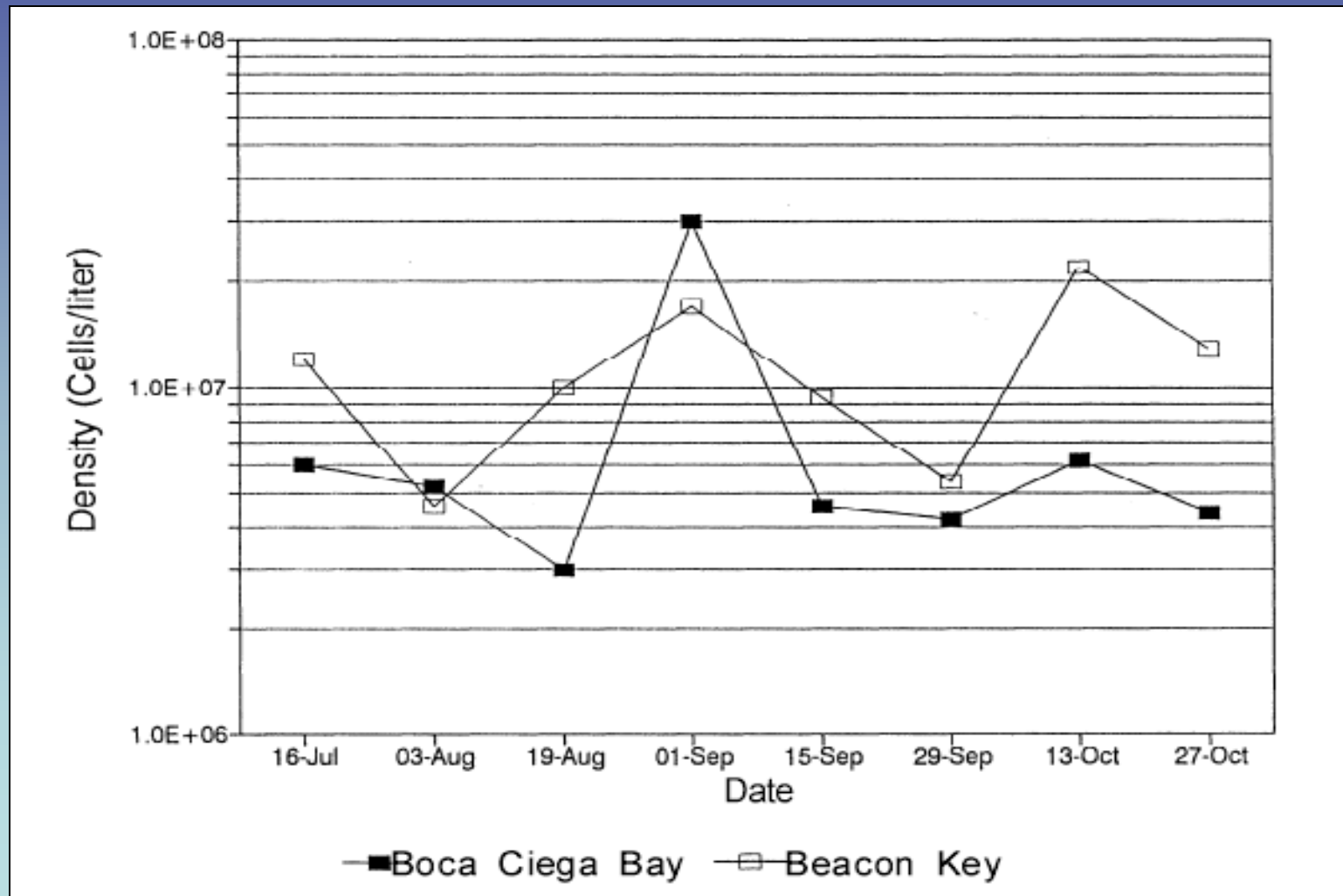
DO Record at Beacon Key (8/27 – 10/27/1992)



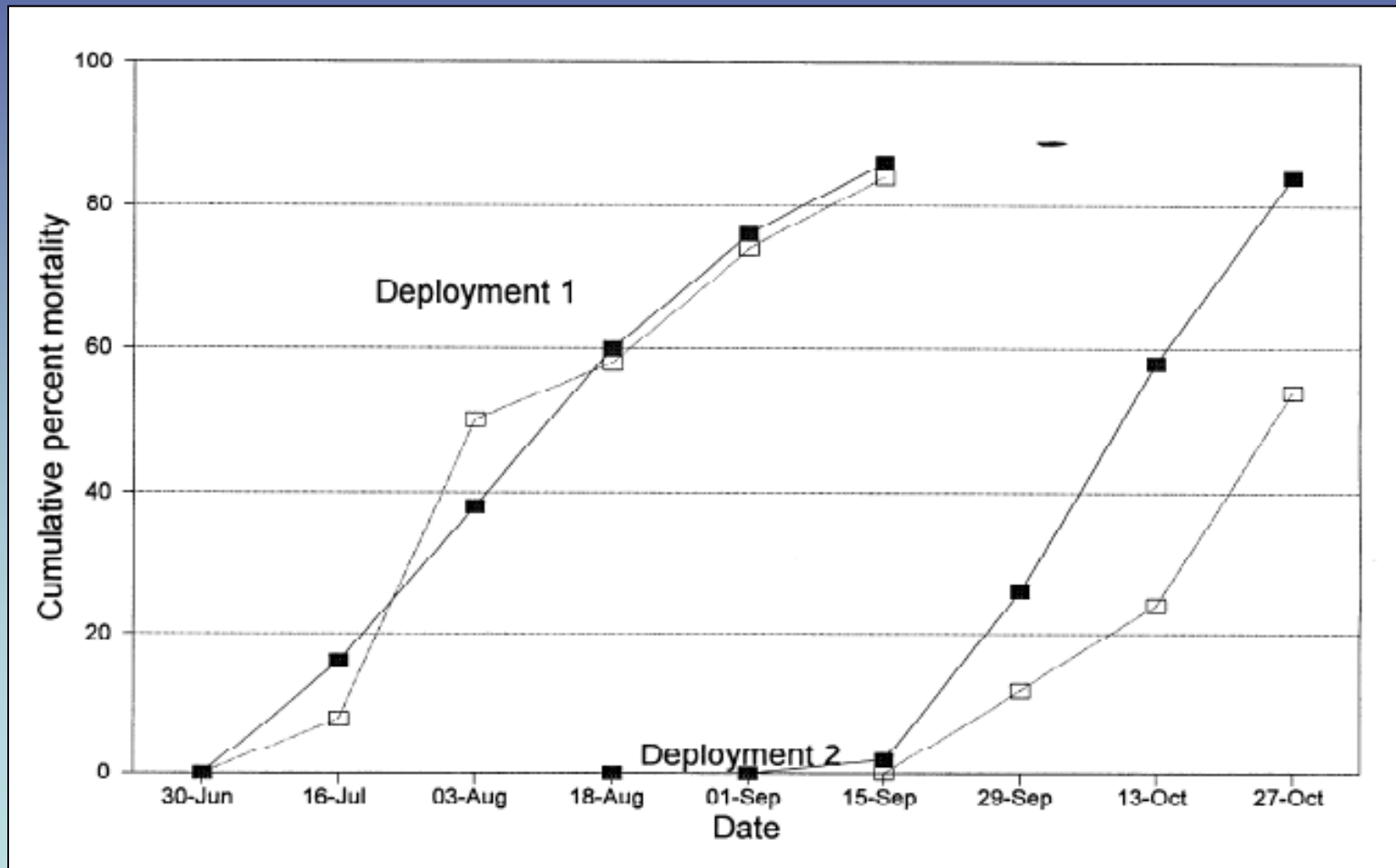
WQ at BCB (●) and BK (○)



Phytoplankton Densities (cells/L)



Cumulative Percent Mortality



Reproductive Condition from Both Deployments

STATION	DATE	GONAD SIZE	SPAWNING STATUS	MEAN OOCYTE DIAMETER(µm)
BCB-G	16-Jul	FULL		41.75
BCB-G	16-Jul	FULL		40.25
BCB-G	16-Jul	FULL		39.17
BCB-G	16-Jul	FULL		
BCB-G	16-Jul	FULL		
BCB-S	16-Jul	FULL		
BCB-S	16-Jul	FULL		
BCB-S	16-Jul	FULL		42.50
BCB-S	16-Jul	50%	SPAWNED	
BCB-S	16-Jul	FULL		
BK-G	16-Jul	75-50%	PARTIAL SPAWN	38.61
BK-G	16-Jul	75-50%	PARTIAL SPAWN	40.68
BK-G	16-Jul	75-50%	PARTIAL SPAWN	39.17
BK-G	16-Jul	90%		38.93
BK-G	16-Jul	FULL		
BK-S	16-Jul	90%		
BK-S	16-Jul	90%		37.67
BK-S	16-Jul	FULL-90%		
BK-S	16-Jul	FULL-75%		
BK-S	16-Jul	90%		40.00
BCB-G	03-Aug	FULL		39.17
BCB-G	03-Aug	FULL		
BCB-G	03-Aug	FULL		
BCB-G	03-Aug	90%		
BCB-G	03-Aug	90%		
BCB-S	03-Aug	90%		
BCB-S	03-Aug	90%		
BCB-S	03-Aug	75%		44.17
BCB-S	03-Aug	FULL		
BCB-S	03-Aug	50%		
BK-G	03-Aug	50-75%		
BK-G	03-Aug	50%		40.25
BK-G	03-Aug	FULL		
BK-G	03-Aug	75%		45.00
BK-G	03-Aug	75%		
BCB	15-Sep	75%		
BCB	15-Sep	50-75%		
BCB	15-Sep	50%		35.50
BCB	15-Sep	90%		45.63
BCB	15-Sep	50%		37.88
BCB	15-Sep	50%		43.21
BK	15-Sep	<25%	SPAWNED	29.79
BK	15-Sep	<25%	SPAWNED	32.12

STATION	DATE	GONAD SIZE	SPAWNING STATUS	MEAN OOCYTE DIAMETER(µm)
BCB	01-Sep	>75%		44.38
BCB	01-Sep	FULL		
BCB	01-Sep	>75%		38.61
BCB	01-Sep	90%		46.25
BCB	01-Sep	FULL		
BCB	01-Sep	FULL-90%		
BCB	01-Sep	75%		
BK	01-Sep	75%		
BK	01-Sep	FULL		35.54
BK	01-Sep	75%		
BK	01-Sep	75%		41.43
BK	01-Sep	FULL		41.79
BK	01-Sep	75%		
BK	01-Sep	75-90%		
BCB	15-Sep	75%		
BCB	15-Sep	75%		41.79
BCB	15-Sep	FULL-90%		
BCB	15-Sep	75%		38.75
BCB	15-Sep	50-75%		
BCB	15-Sep	90%		33.57
BCB	15-Sep	50%		
BK	15-Sep	FULL-75%		38.13
BK	15-Sep	50%		
BK	15-Sep	FULL		39.26
BK	15-Sep	50-75%		
BK	15-Sep	90%		37.50
BK	15-Sep	50%	PARTIAL SPAWN	
BK	15-Sep	25-50%	PARTIAL SPAWN	26.41
BCB	24-Sep	25%	MOSTLY SPAWNED	
BCB	24-Sep	<25%	MOSTLY SPAWNED	
BCB	24-Sep	50%	SPERM INTACT	
BCB	24-Sep	< 2.5%	MOSTLY SPAWNED	25.95
BCB	24-Sep	50%		32.37
BCB	24-Sep	50-75%		
BK	24-Sep	50-75%		
BK	24-Sep	10%	SPAWNED	29.12
BK	24-Sep	10%	SPAWNED	30.83
BK	24-Sep	75%		41.39
BK	24-Sep	50%		32.64
BK	24-Sep	90%		
BK	24-Sep	50%		33.39
BCB	13-Oct	10%	SPAWNED	32.97
BCB	13-Oct	50%	PARTIAL SPAWN	

Tampa Bay: Laboratory Studies

- Bay scallop responses to low DO at several temperature : salinity combinations (for 2 days)
 - DO: 1 – 5 mg/L
 - Temp: 25 – 35° C
 - Salinity: 15 – 35 ppt
- Returned to normoxic conditions and observed latent mortality
- Measured “escape response”

Laboratory Results

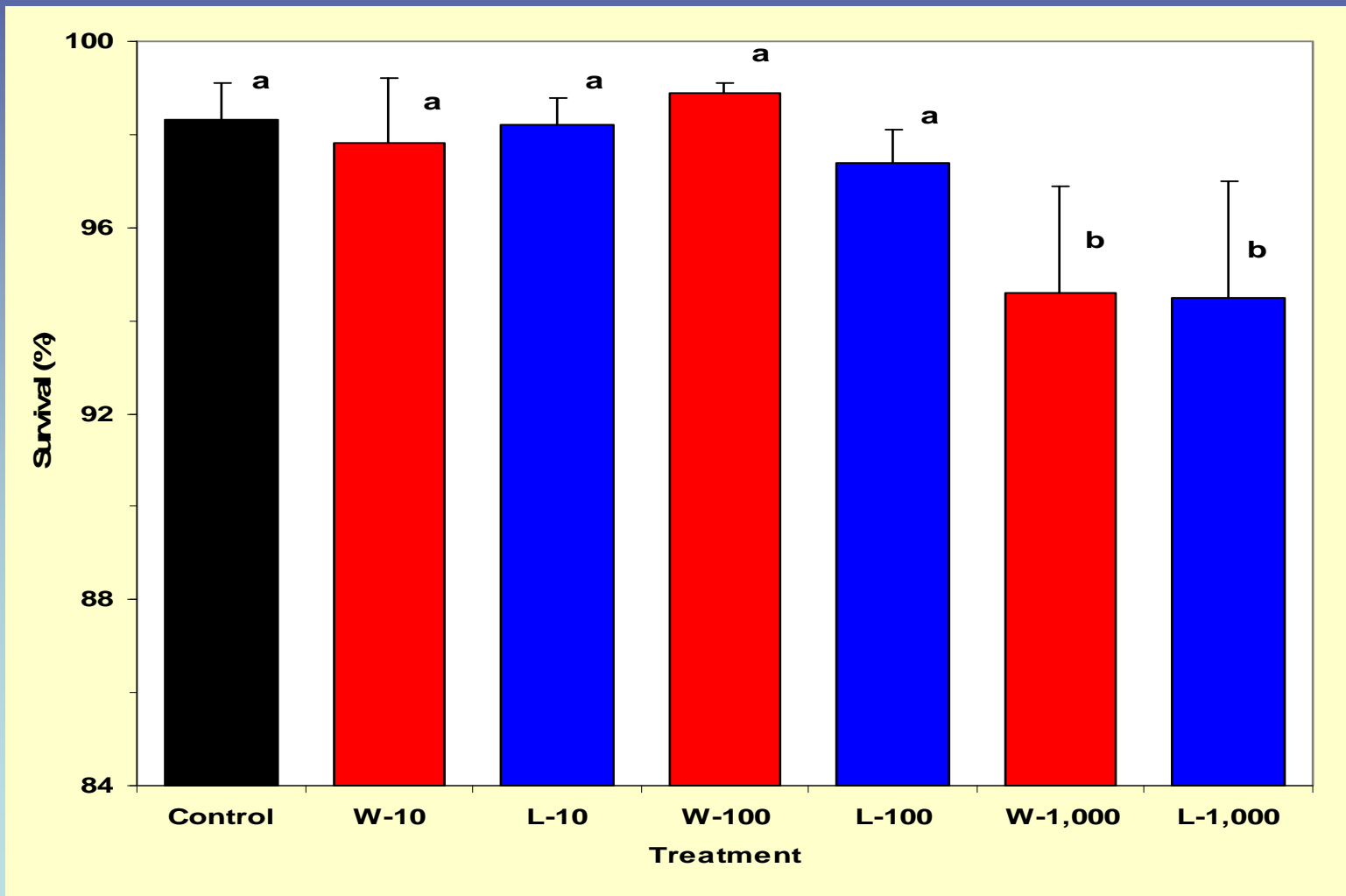
Table 8. Summary of laboratory trials exposing adult bay scallops to low dissolved oxygen levels, including exposure conditions, exposure duration, and observations (findings).

<u>TRIAL</u>	<u>TEMP</u> (°C)	<u>SALINITY</u> (o/oo)	<u>DISSOLVED</u> <u>OXYGEN</u> (mg/l)	<u>DURATION</u> (h)	<u>FINDINGS</u>
1	25	27-29	7.5	48	Positive tactile response; no mortality.
2	24	32	2-4	2.5	Positive tactile response; no mortality.
3	24	30	<2	6	Positive tactile response; no mortality.
4	30	30	<2	6	One test organism → broken hinge → died.
5	30	25	<2	3	Two controls died; one test died; negative tactile response.
6	24	33	1-3	24	Two test organisms died within three days; negative tactile response; curled mantles.
	30	33	<2	24	One test organism died; another died three days later. Negative tactile response; curled mantles.

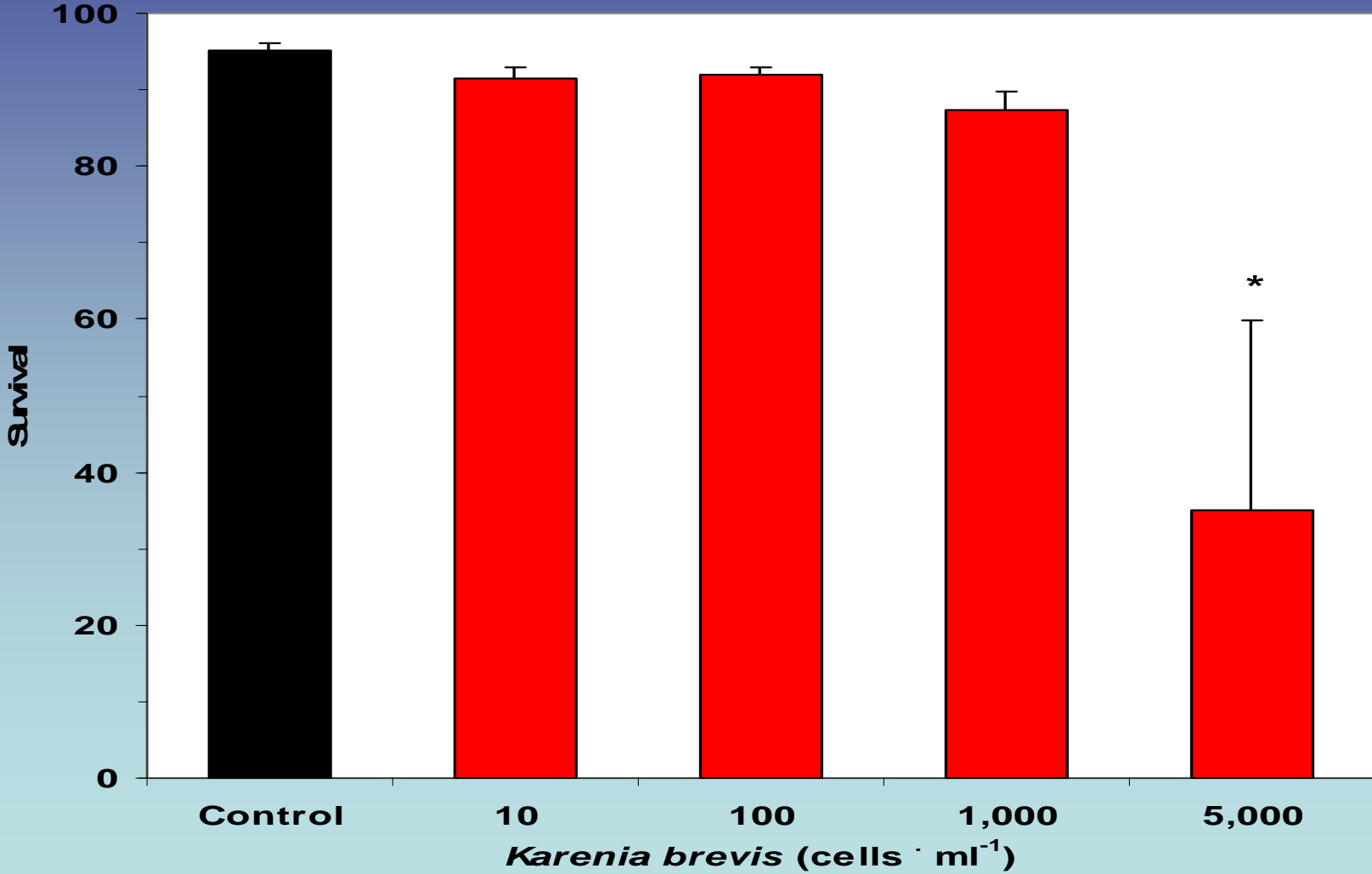
**Impacts of *Karenia brevis* on
early life stages of Florida
populations of bay scallop**

Bay scallop larvae

Survival of 3-day old bay scallop larvae exposed to *K. brevis* and its toxins



Survival of 7-day old bay scallop larvae exposed to *K. brevis* and its toxins

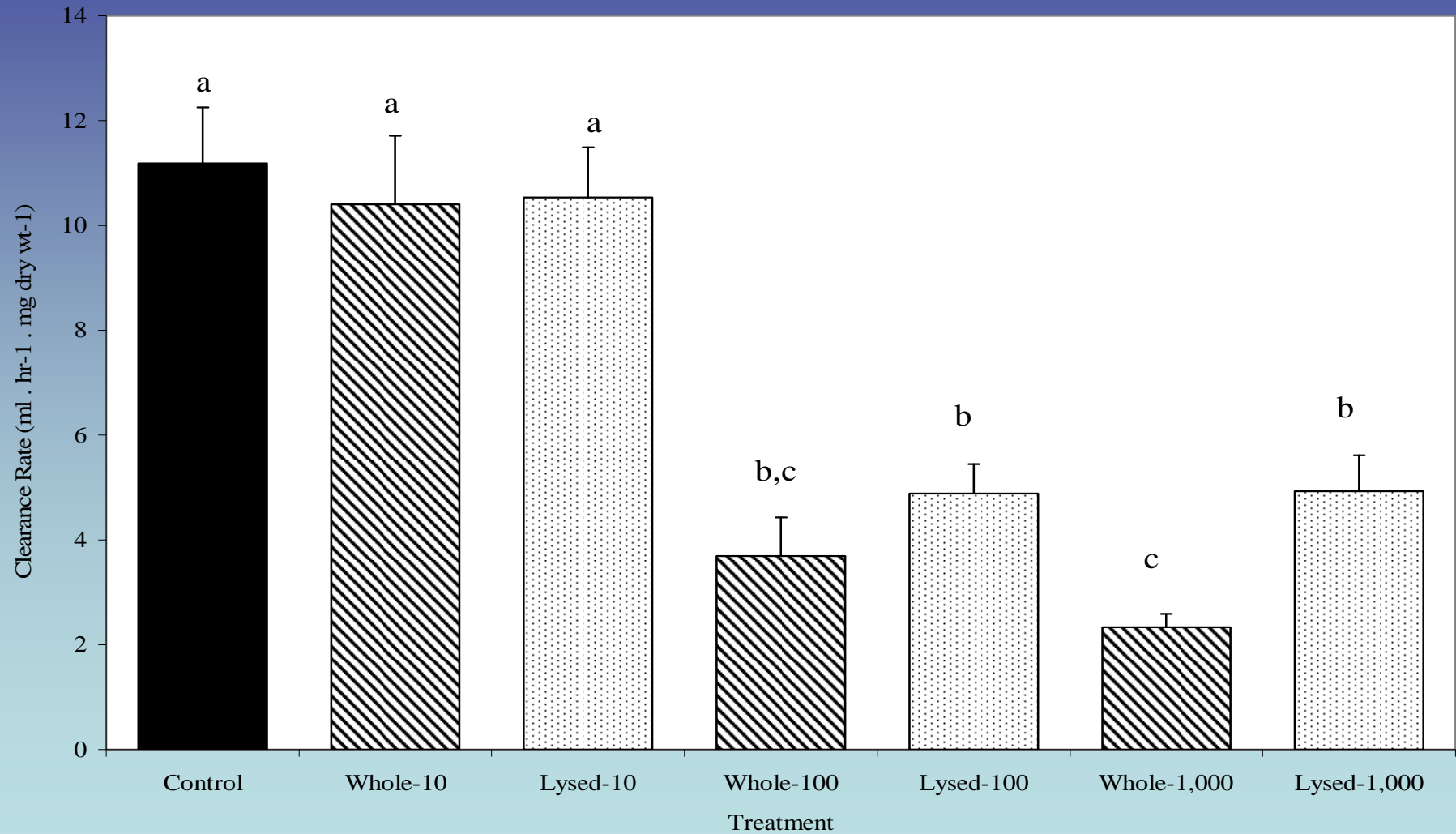


Conclusion from larval paper:

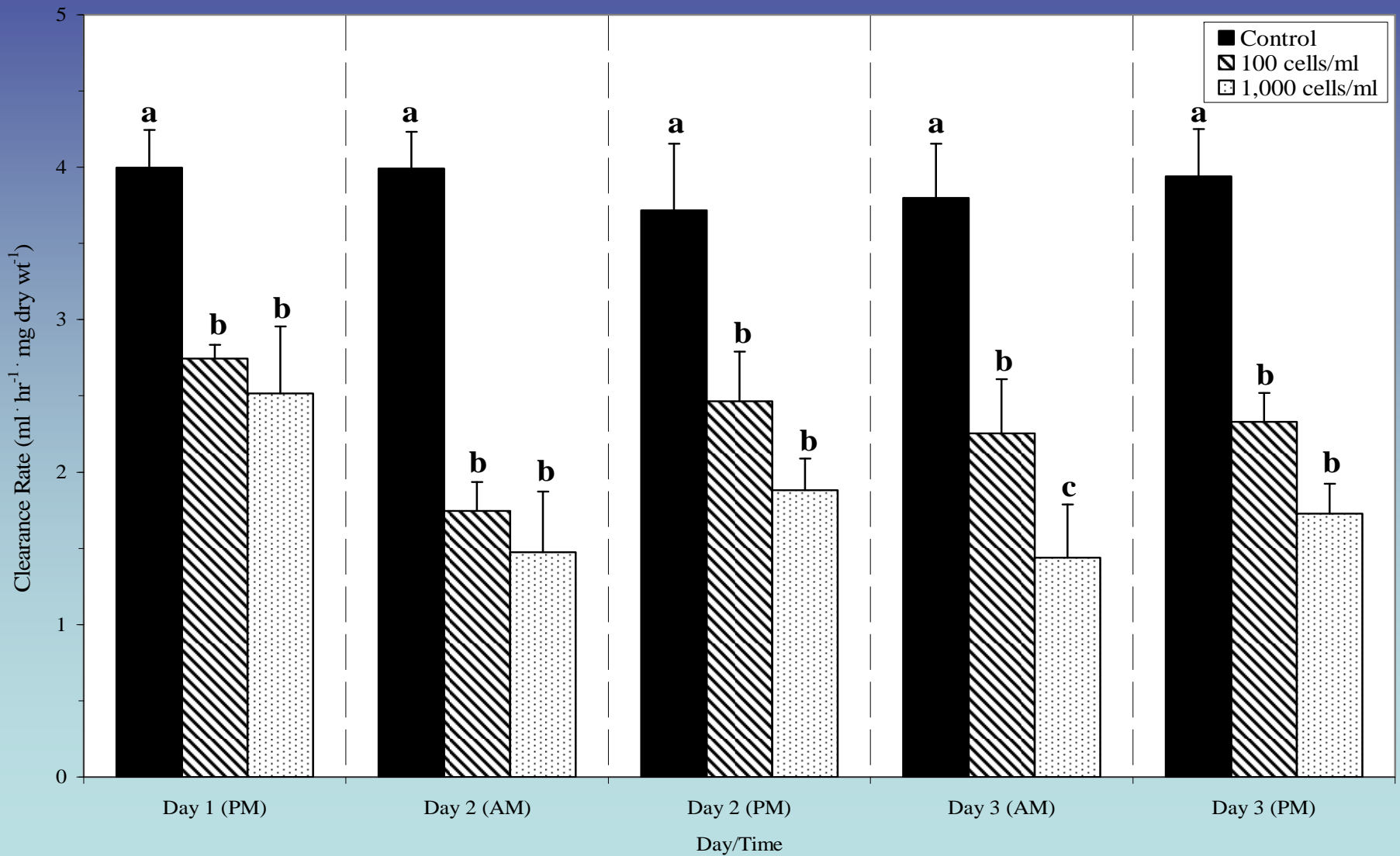
“Special attention should be paid to blooms of *K. brevis* where these shellfish occur naturally or where aquaculture and restoration activities are either ongoing or planned.”

Juvenile bay scallops

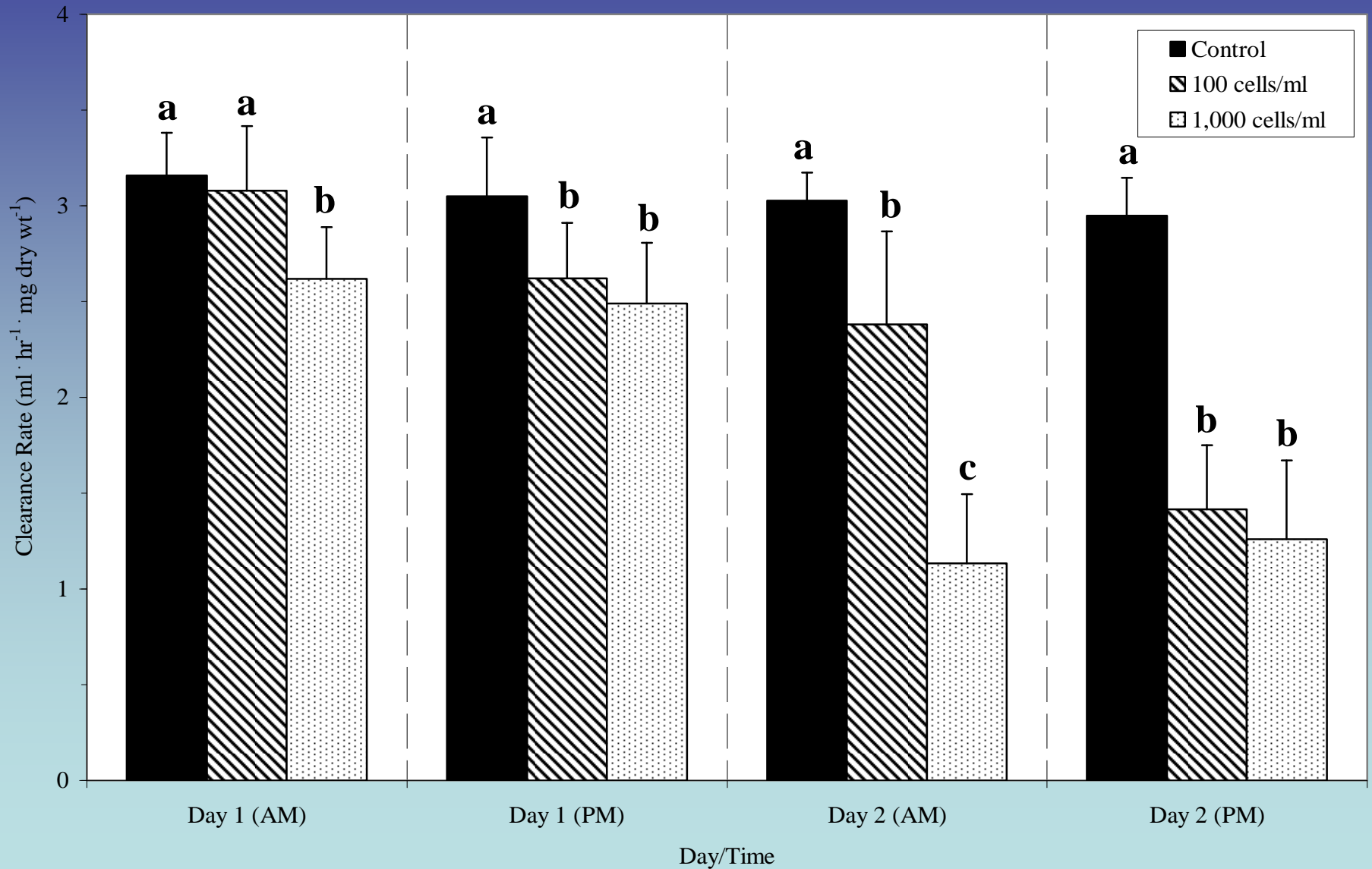
Clearance rate of juvenile bay scallops exposed to *K. brevis*



Clearance rate of juvenile scallops exposed to whole *K.brevis* under flow-through conditions



Clearance rate of juvenile scallops exposed to lysed *K.brevis* under flow-through conditions



Conclusion from juvenile paper:

“The prospect for recovery of bay scallop populations in Florida estuaries where they were once abundant may be hampered by recurring blooms of *K. brevis*.”

Optimal Ranges for Florida Bay Scallops

WATER QUALITY PARAMETER	TARGET
Temperature (Bottom)	25 – 30° ideal; not to exceed 32° for prolonged periods
Salinity (Bottom)	Greater than 20 ppt (24 – 30 optimal)
DO (Bottom)	Not less than 2 mg/L for less than 2 hours
Turbidity	5 – 10 NTUs
Total Suspended Solids	Less than 40 mg/L
TSS/VSS Ratio	Greater than 1.282 (inorganic C % of seston < 78%)
Chlorophyll a	5 – 10 µg/L
Phytoplankton	Density: less than 5 x 10 ⁶ cells/L; Species; blooms harmful; <i>Karenia breve</i> fatal.
Seagrass	<i>Thalassial Syringodium</i> mix ideal. Density: > 75 shoots/m ² ; Continuous seagrass beds preferred.