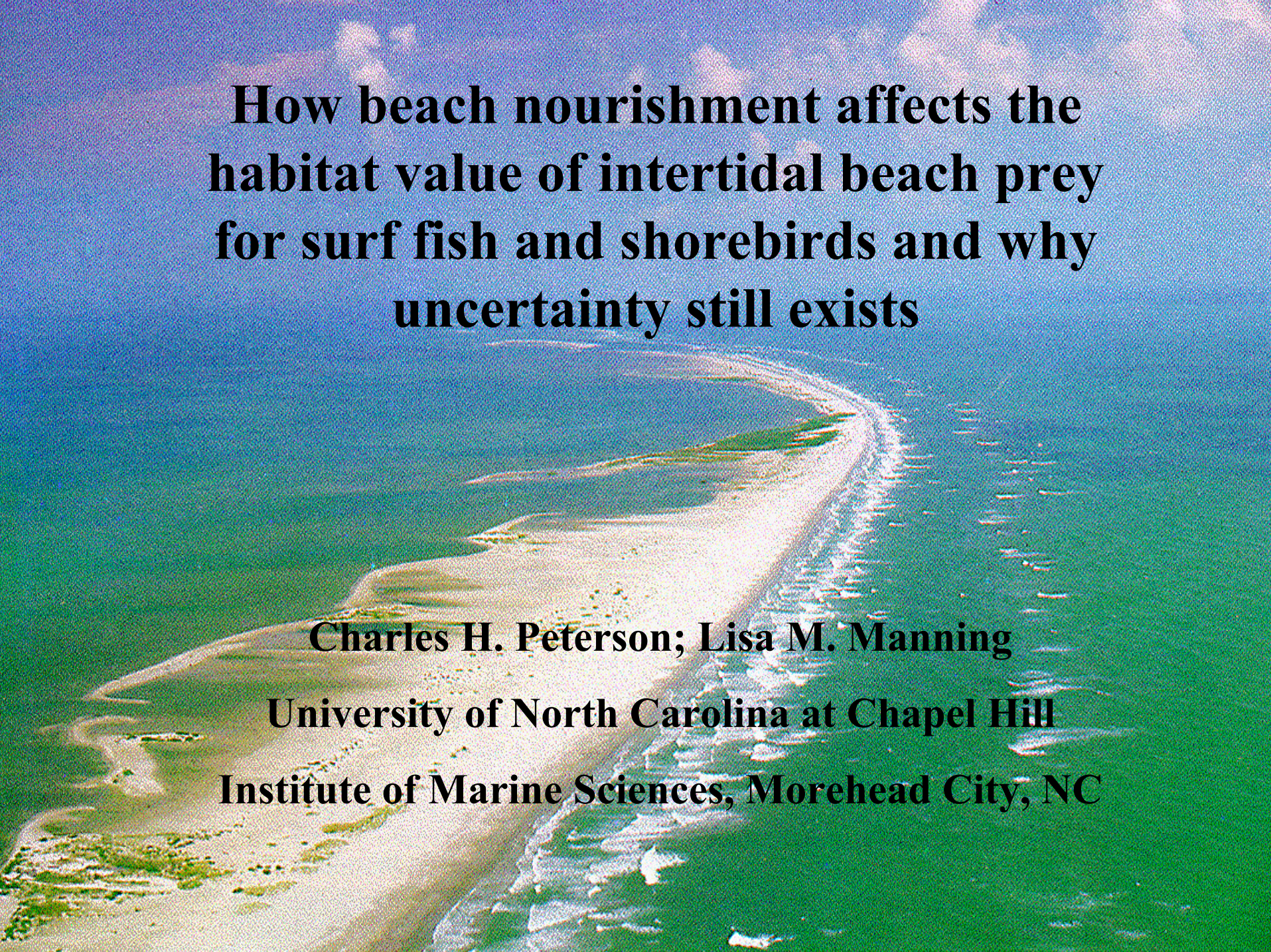

How beach nourishment affects the habitat value of intertidal beach prey for surf fish and shorebirds and why uncertainty still exists

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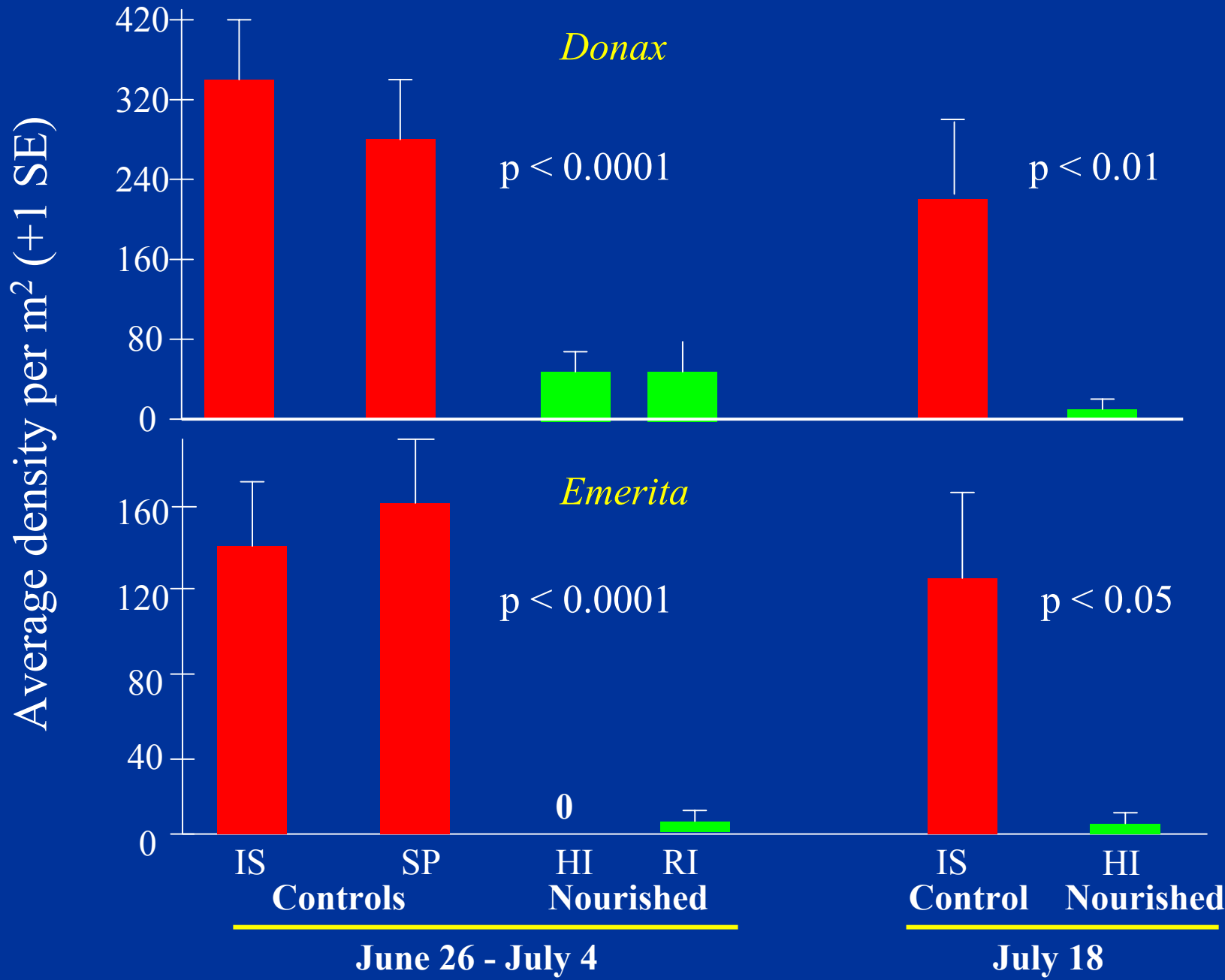
Components of the presentation

- Monitoring nourishment projects in NC
  - 1990 beach fill on Bogue Banks from ICW
  - 1999 and 2000 beach fills on Topsail Island
- Experimental tests of sediment grade and turbidity
  - on *Donax* growth and burrowing rate
  - on pompano feeding rate
- Review of design problems of past studies

Peterson et al. (2000) JCR paper

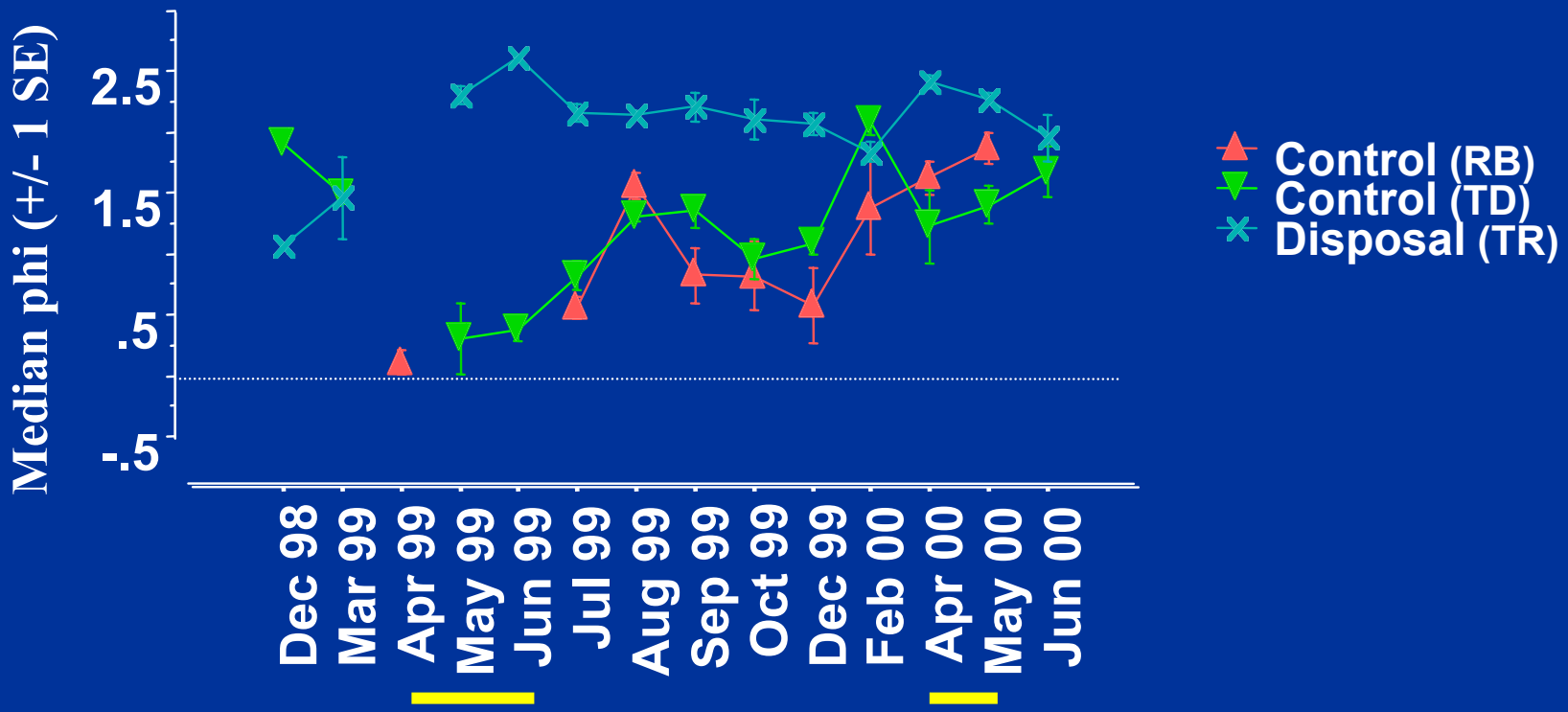
- Beach fill of 2 sites on Bogue Banks(NC) from maintenance dredging of ICW
- Filling from early March-mid April and mid-April-24 May 1990
- Fining of sediments resulted as median phi changed from 2.3 to 3.7
- Increase in shell debris


Average density per m2 (+1 SE)
420
320
240
160
80
0
Donax
p < 0.0001
p < 0.01
160
120
80
40
0
Emerita
p < 0.0001
p < 0.05
0
IS
SP
HI
RI
IS
HI
Controls
Nourished
Control
Nourished
June 26 - July 4
July 18

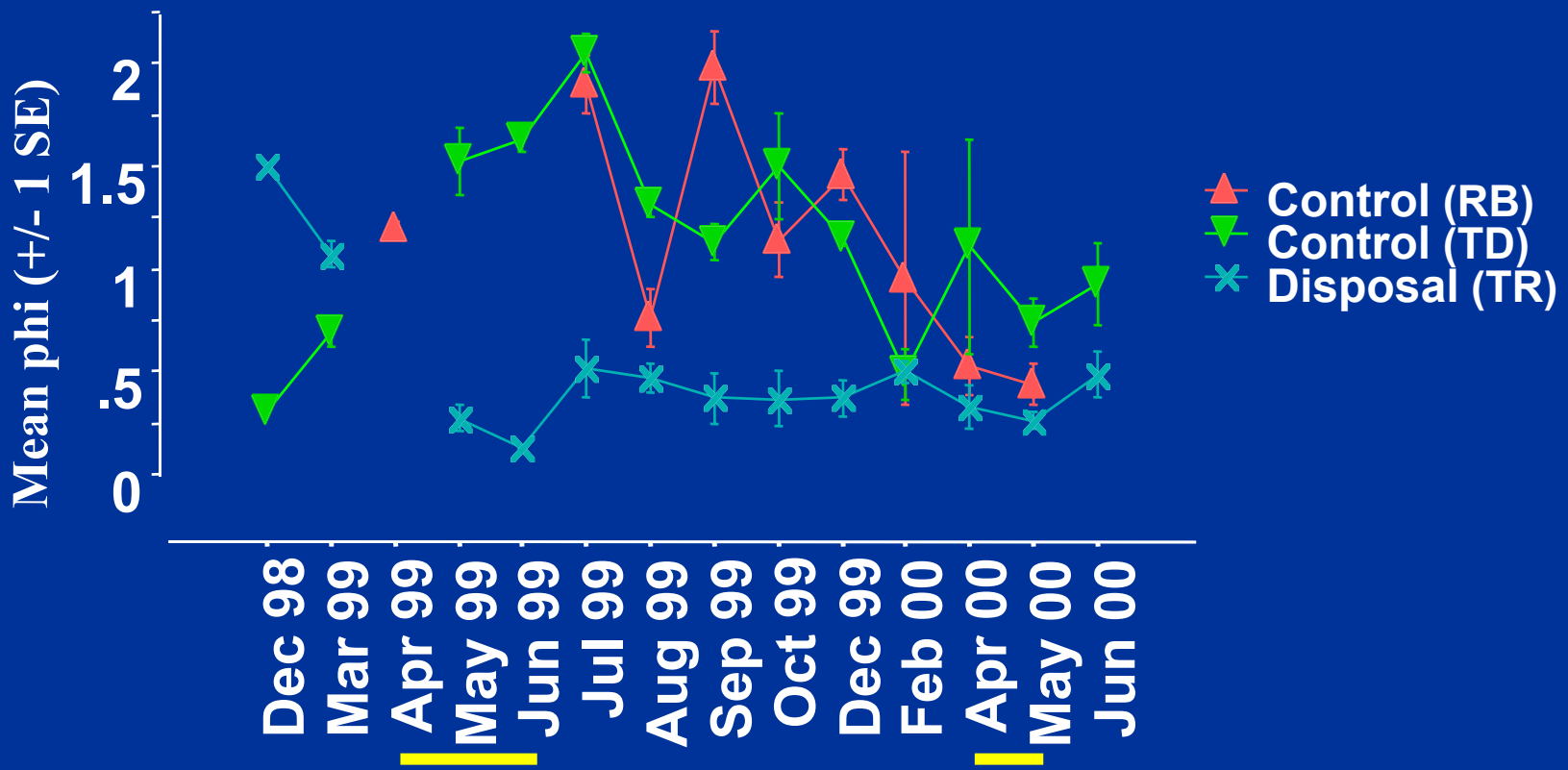
Topsail Island (NC) beach fill from inlet dredging (Manning 2002)

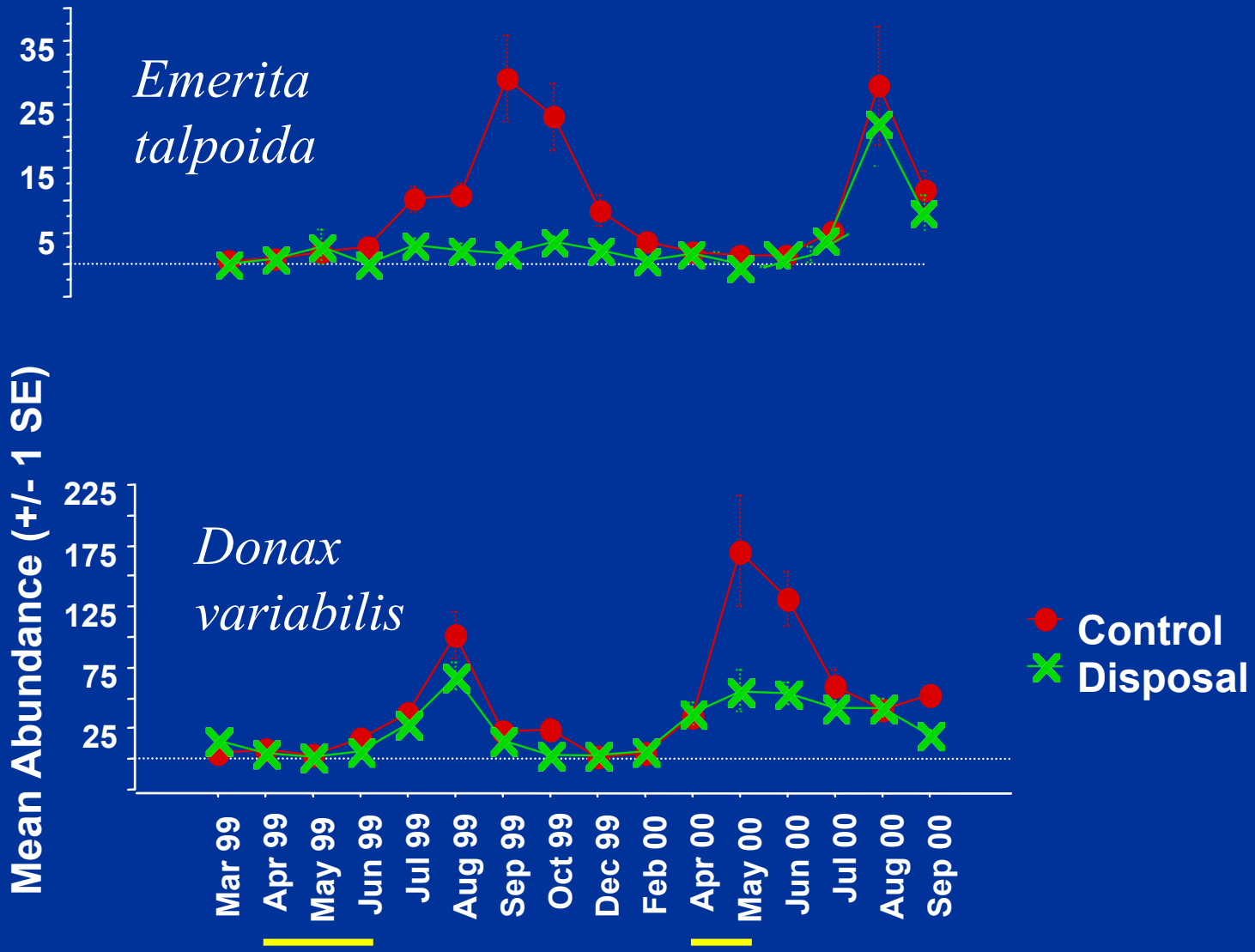
- 1999 - April-June 8 - 139,000 cu yds
- 2000 - April-early May - 40,000 cu yds
- Fining of sediments (1.25 vs 2.25 phi)
- Increase in sorting (0.9 vs 0.4 phi)
- Elevated turbidity in surf zone during active pumping

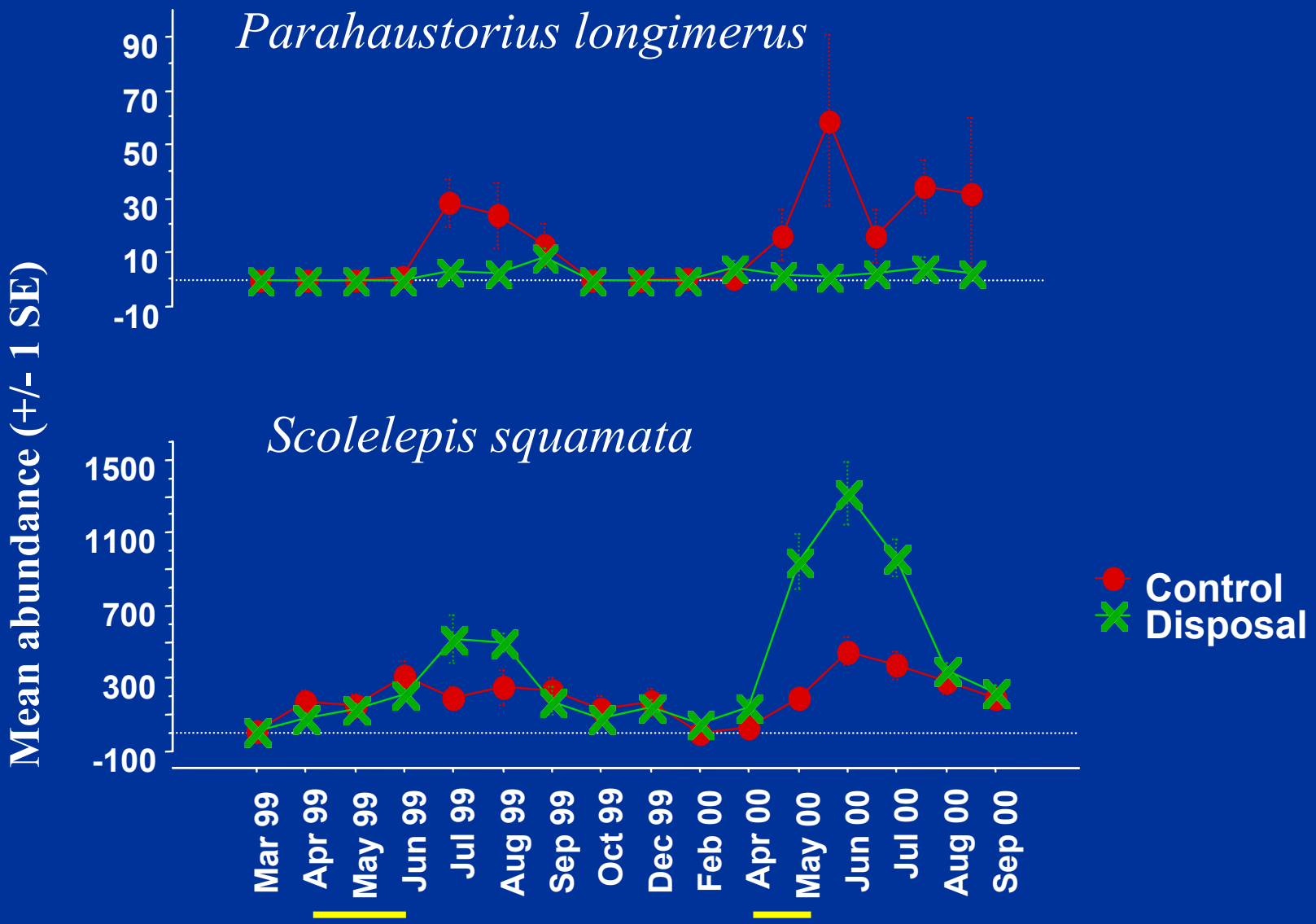
North Topsail: Sediment grain size, low-intertidal zone



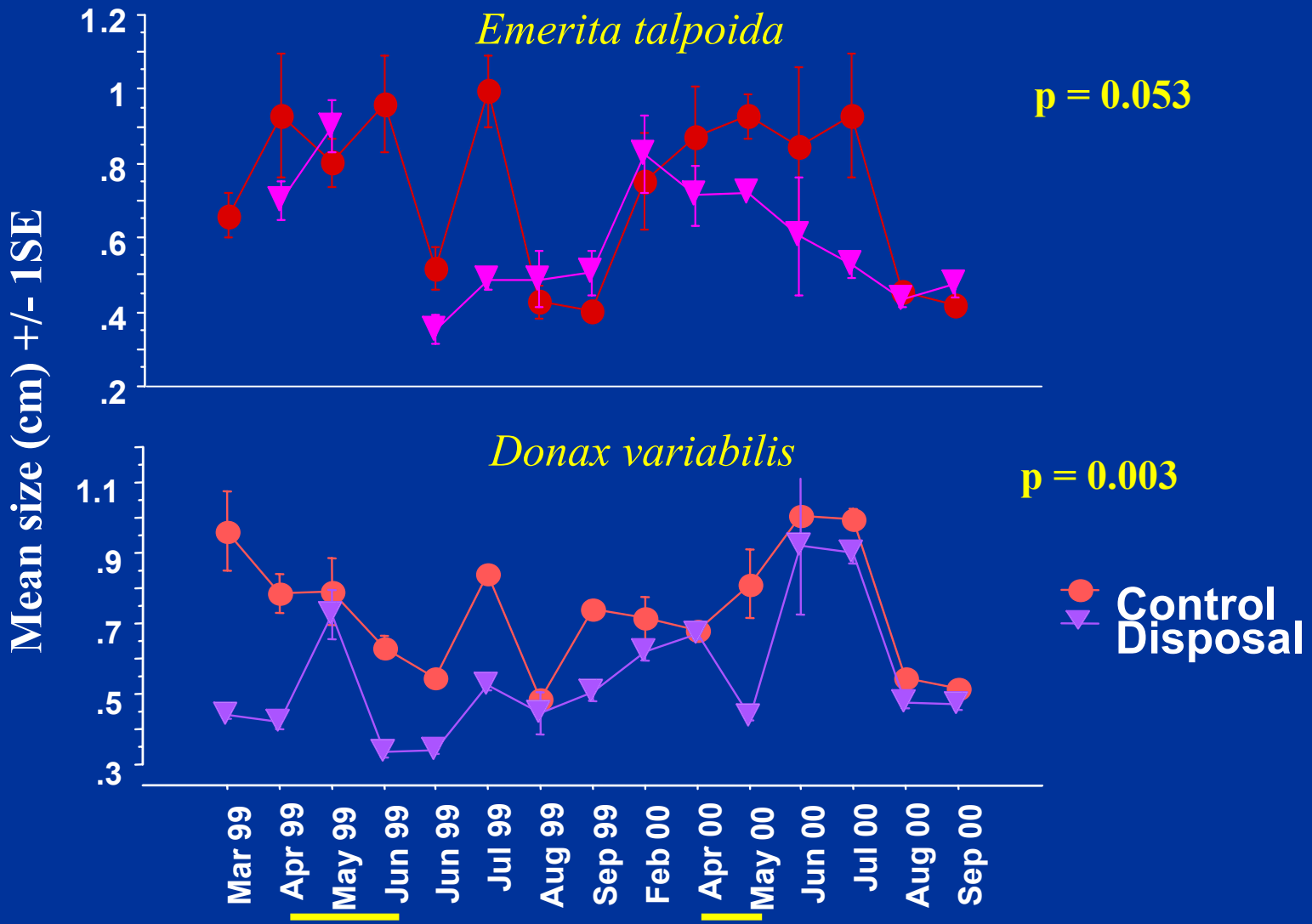
North Topsail: Sediment sorting values, low-intertidal zone




Emerita talpoida
35
25
15
5
Donax variabilis
225
175
125
75
25
Mean Abundance (+/- 1 SE)
Mar 99
Apr 99
May 99
Jun 99
Jul 99
Aug 99
Sep 99
Oct 99
Dec 99
Feb 00
Apr 00
May 00
Jun 00
Jul 00
Aug 00
Sep 00
Control
Disposal


Parahaustorius longimerus
90
70
50
30
10
-10
Scolelepis squamata
1500
1100
700
300
-100
Mean abundance (+/- 1 SE)
Mar 99
Apr 99
May 99
Jun 99
Jul 99
Aug 99
Sep 99
Oct 99
Dec 99
Feb 00
Apr 00
May 00
Jun 00
Jul 00
Aug 00
Sep 00
Control
Disposal

North Topsail: *Donax* & *Emerita* sizes



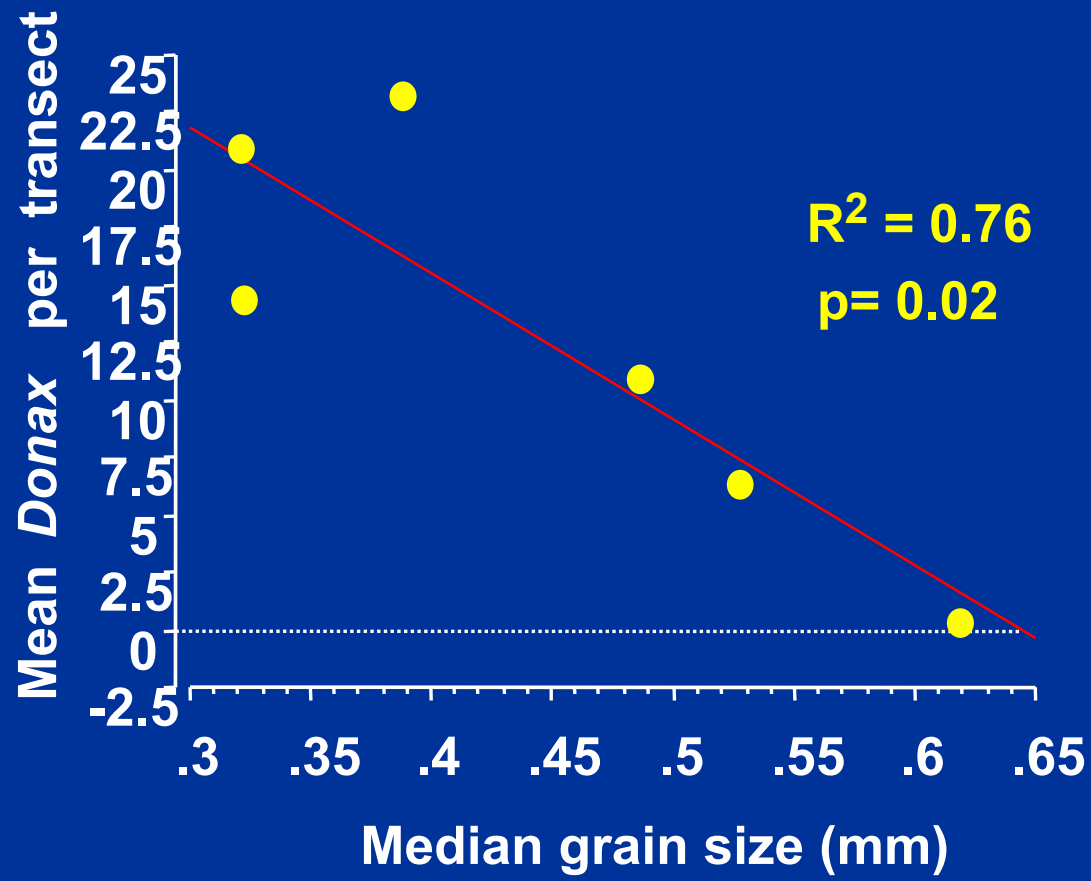
Habitat implications of NC projects

- Loss of foraging opportunity by spring migrant shorebirds
- Loss of foraging opportunity by summer surf fishes and summer resident shorebirds
- Loss of foraging opportunity by fall migrant shorebirds and surf fishes

Factors likely to affect impacts

- Sedimentology - fines, shell or gravel, sorting in fill materials
- Seasonal timing of project
- Spatial scale of project
- Location of dump site - intertidal beach vs. outer sand bar
- Importance of beach invertebrates to surf fishes and shorebirds

Shackleford Banks, NC



Donax burrowing rate as a function of sediment grade

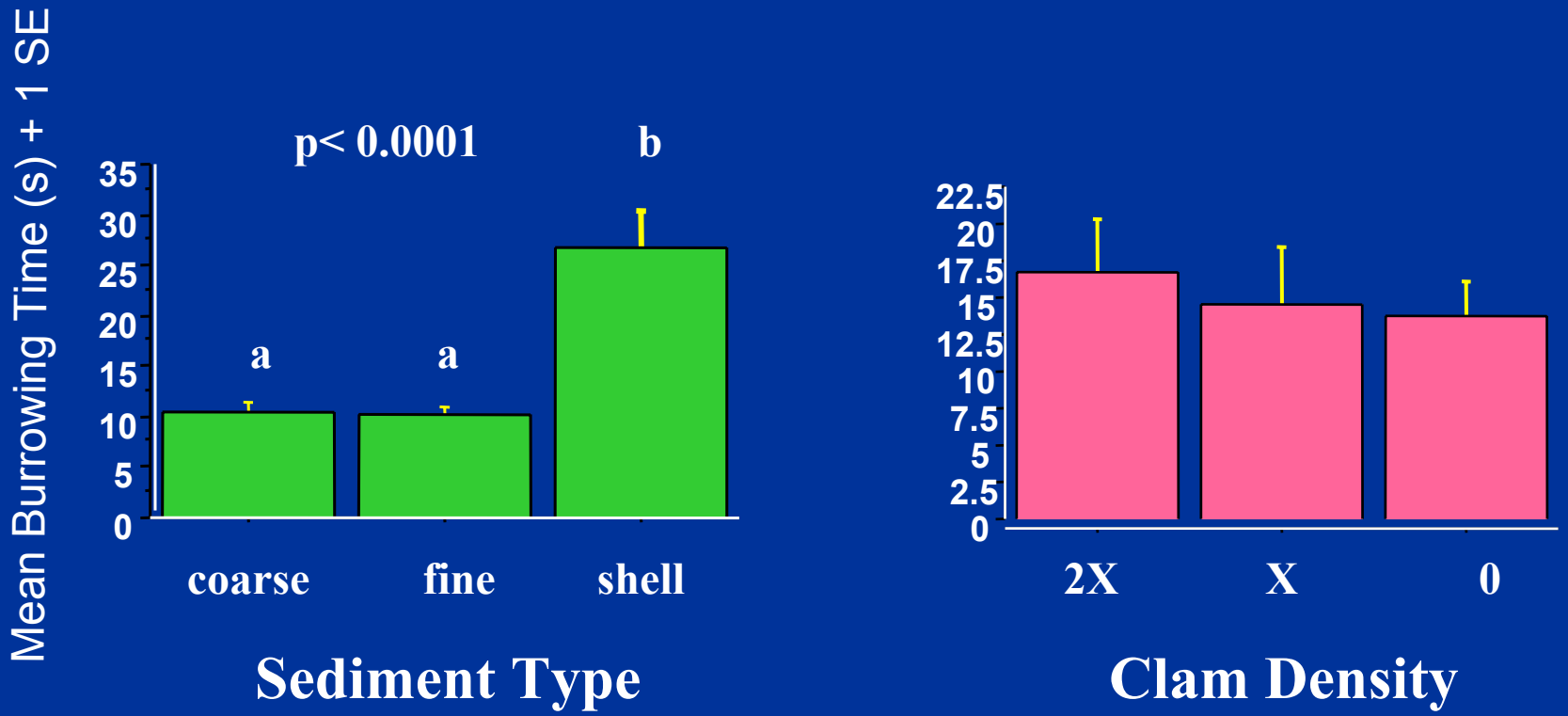
- Done in the beach swash inside arenas
- Timing started with initiation of digging
- Three sediments taken from different locations on the beach
  - fine - 180 um median size
  - coarse - 500 um median size
  - shell - 1 mm median size

Experimental design: *Donax* burrowing

		zero	X (123 clams)	2X (246 clams)
fine 180 µm, mod. well sorted	(n = 3)	20	20	20
medium 500 µm, mod. sorted	(n = 3)	20	20	20
shelly 1 mm, poorly sorted	(n = 3)	20	20	20

= 180 clams total

Effect of sediment and clam density on burrowing speed

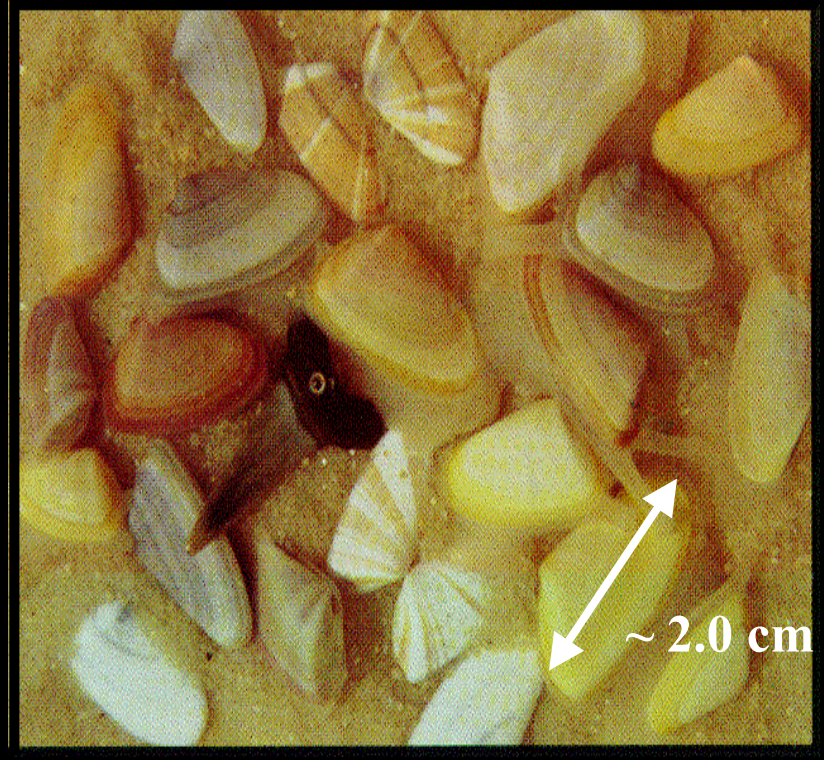


Pompano feeding rate as a function of shell content

- In wave tank mesocosms (15 replicates)
- Five min trial with 10 *Donax variabilis* and 3 pompano (10.5-15 cm long)
- Two sediment types
  - medium sand with 12.5% shell by wt
  - fine sand with 1.7% shell by wt

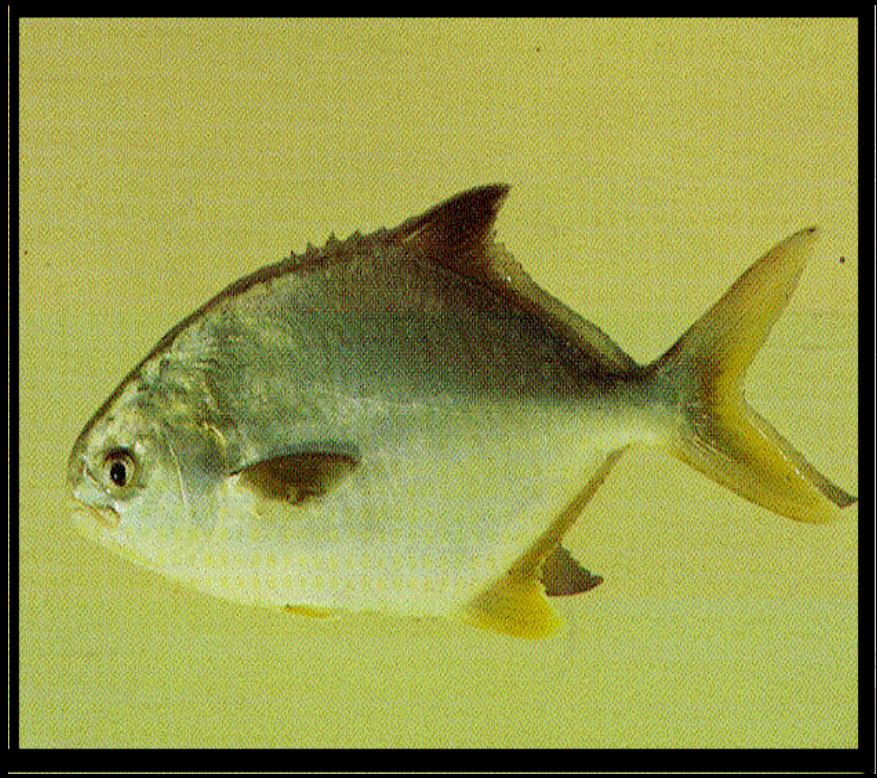
Donax variabilis Say

coquina clam

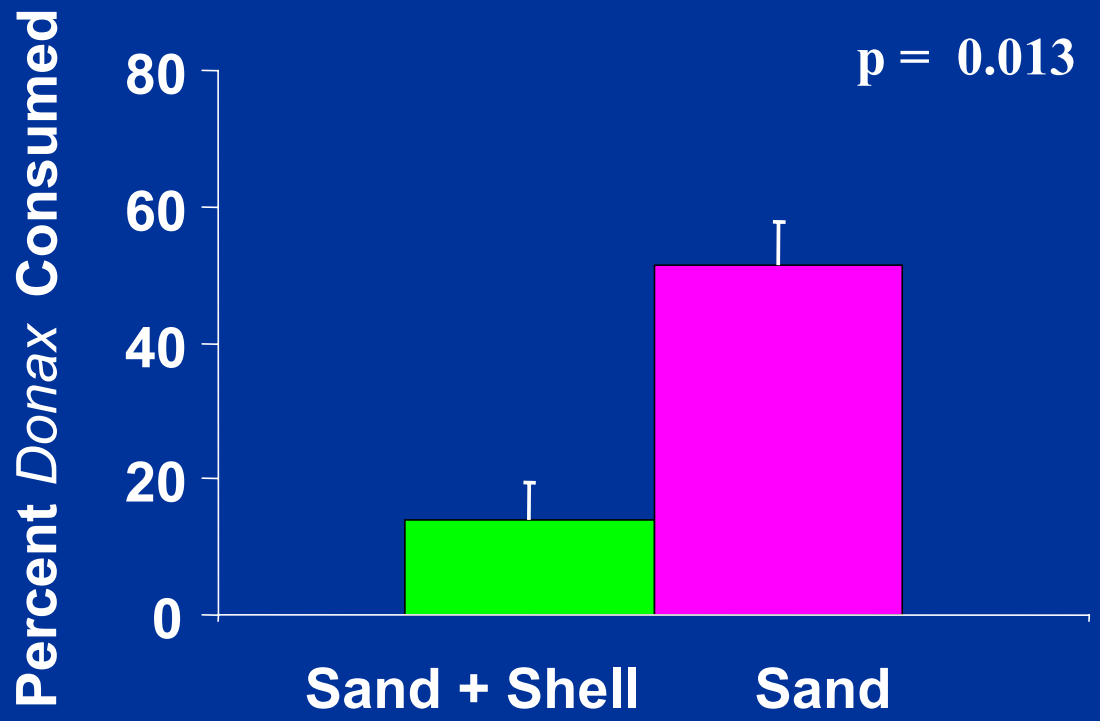


Trachinotus carolinus

Florida pompano



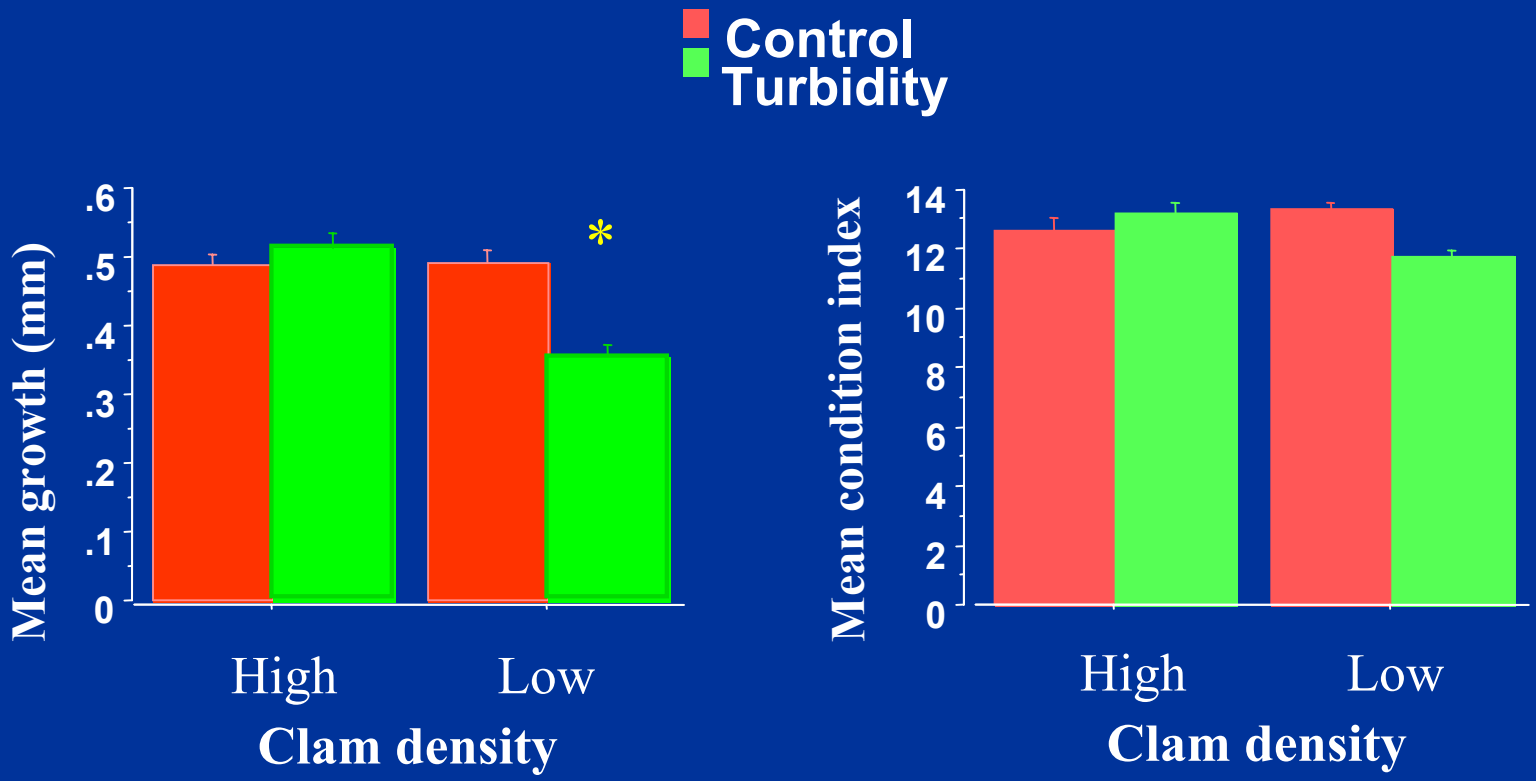
Predation experiment with pompano and *Donax variabilis*



Growth of *Donax variabilis* as a function of turbidity

- Done in wave tank mesocosms
- Two-week experimental duration
- Three replicate tanks of each treatment in a 2x2 factorial design (clam density,turbidity)
  - 222 vs 444 clams per m^2
  - 96 vs 9 NTUs

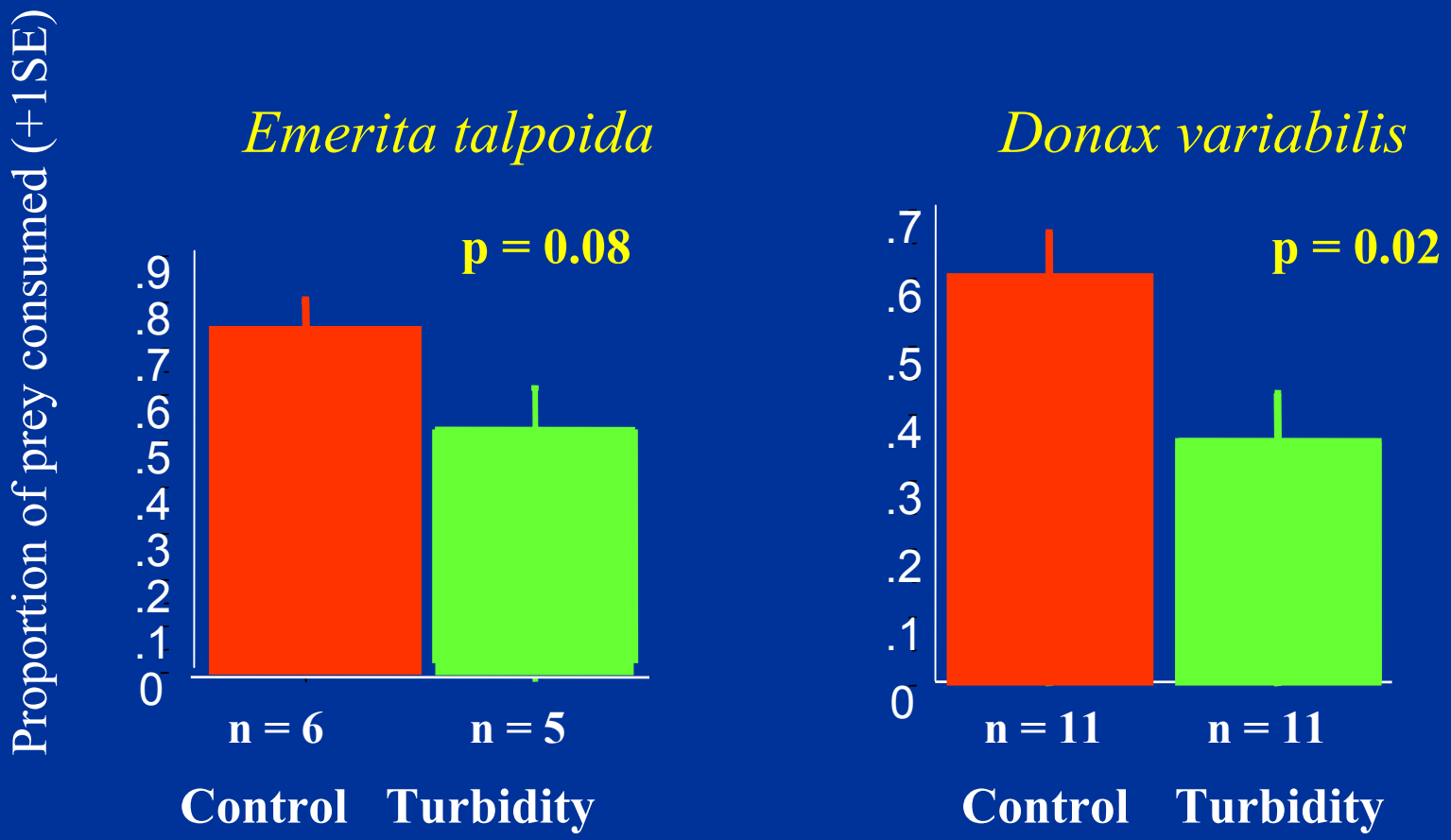
Effect of turbidity on *Donax* growth



Pompano feeding rate as a function of turbidity

- Done in wave tank mesocosms
- Prey buried in active swash zone
- *Emerita* prey ran 4 d with 74 vs. 7 NTUs
- *Donax* prey ran 1 hr with 101 vs. 9 NTUs

Effect of turbidity on predation



Why great biological uncertainty still exists over impacts of beach nourishment

- Experimental research not funded
- Population models not supported
- Monitoring flawed
  - confounding of multiple factors
  - inadequate fed/state review of statistical designs
  - power to detect impacts unmeasured and inadequate - points of failure in sampling

Future needs

- Fund experimental research to develop basic understanding of processes
- Include adequate biostatistical reviews of monitoring projects in permit process
- Require mitigation for losses of ecosystem services like loss of foraging opportunities
- Utilize population models to estimate some impacts impossible to monitor
- Focus on cumulative impacts issues