Post Dredging Response in Benthic Communities: Implications for Restoration Goals

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Benthic Communities Are……

- Directly exposed to sediment based contamination
- Largest pool of SQCs/SQGs
- Directly affected by sediment removal or capping
- Easily sampled
- Some species recreational/commercially important

Objectives for the Presentation

- Present the trends in recovery of the benthic communities between large areas and isolated, satellite remediation areas
- Present community level trends by remedial alternative
- Assess if there are implications for post remedial recovery monitoring duration between the main and satellite areas

Benthic Community Case Study: Tabbs Creek, Norfolk, VA

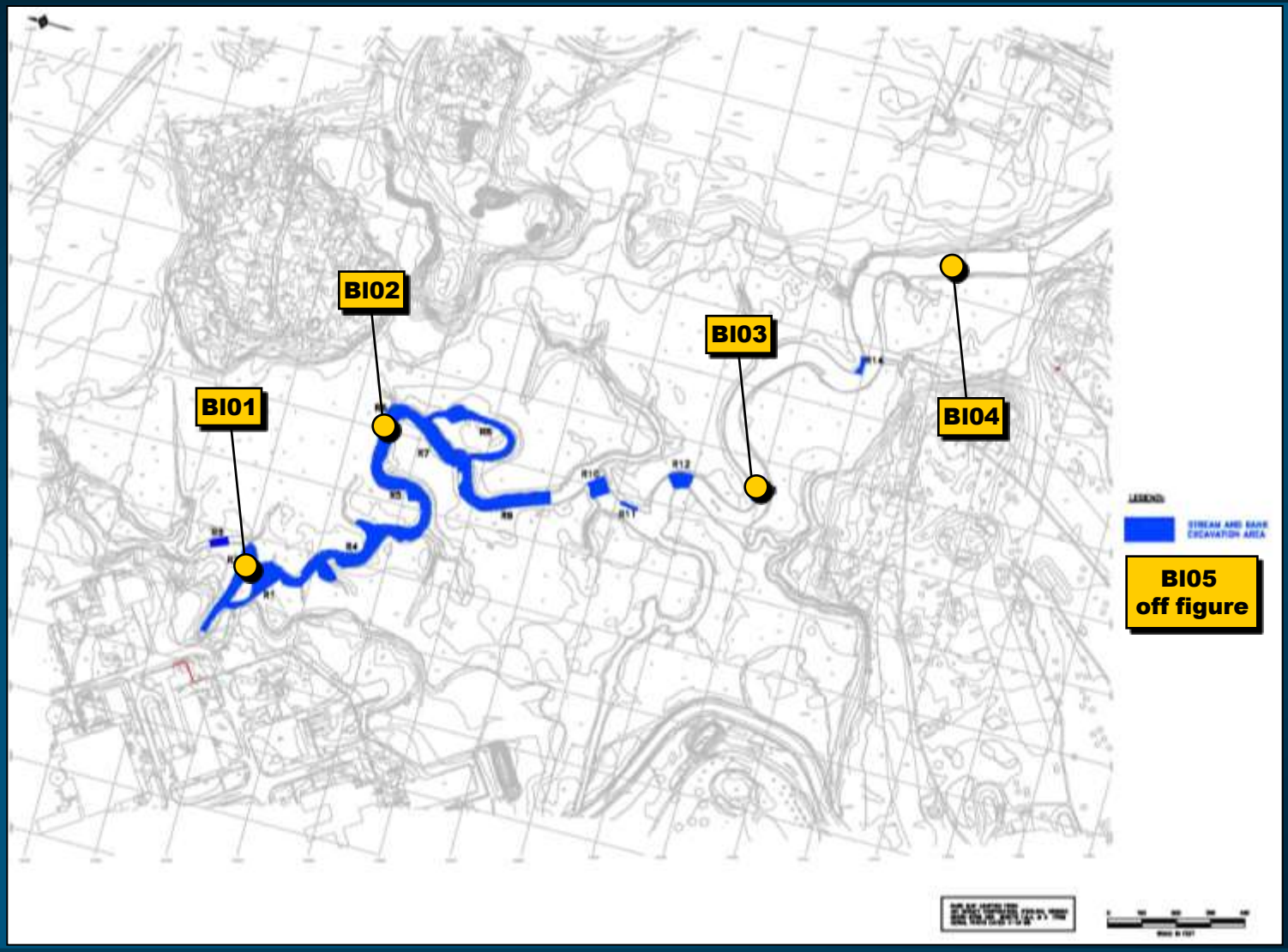
Environmental Setting

- Tidal tributary of Back River, James River Basin
- 2.0 miles in length
- High and low marsh edges
- Mesohaline to meso-polyhaline gradient
- Phragmites dominates upper marsh area

Remediation

- Excavation preferred approach based upon environmental constraints
- 10,000 cubic yards of sediment removed from main and satellite areas
- Back fill with clay/silt/fine sand and OC enriched, manufactured sediment
- Restore open water habitats

Remediation Footprint



Restored Creek Channel/Marsh

Remedial Action Considerations

- Monitoring program DQOs
  - Establishment of stable benthic communities of taxa reflecting the environmental characteristics of the restored areas
    - Main Area
    - Satellite Areas
    - MNR Areas
    - Duration – Five years

Post Remedial Benthic Program

Benthic Community Monitoring

- Began six months after completion of remediation
- Main Foot Print
  - Station Bl01 Upper channel area main footprint
  - Station Bl02 Lower channel area main footprint
- Satellite Area – Station Bl03
- Satellite/Recovery Area – Station Bl04
- Recovery Area – Station Bl05

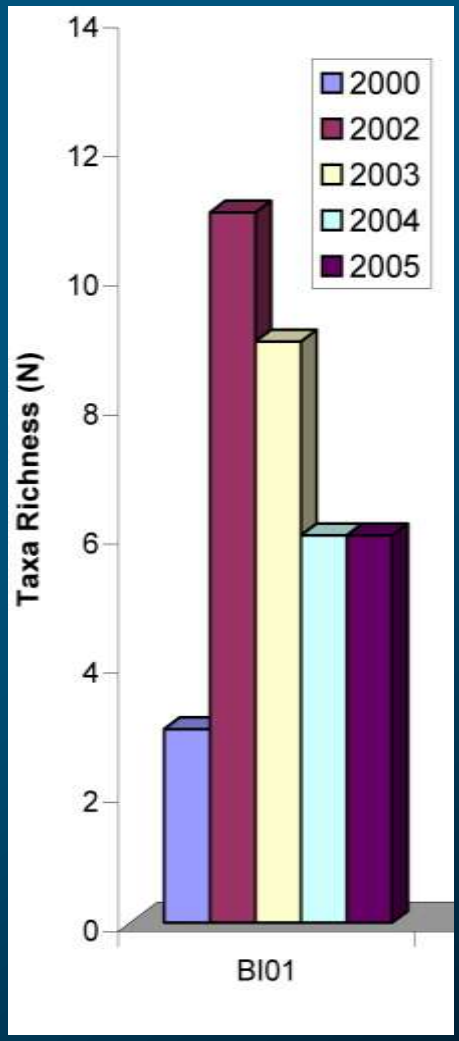
Benthic Community Field Collections

- Annual sampling for 5 yrs.
- Three replicate grabs per station
- Consistent grab volume required for each replicate
- Taxonomic laboratory for all identification
- 100% post sort review
- 10% sort recount and 10% sample re-quantification of taxa count and identification

Benthic Community Metrics
Observed Trends Taxa Richness – Main Footprint

Station Bl01

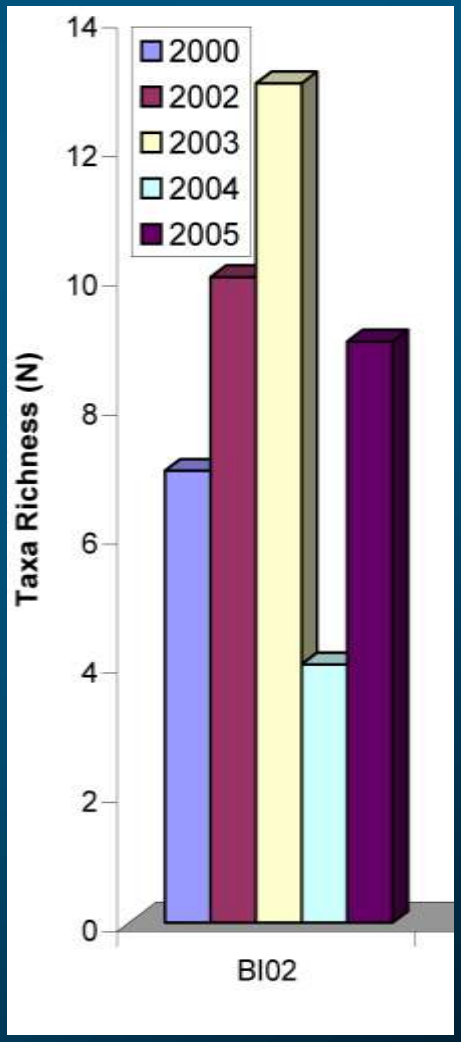
- Farthest inland station
- Three taxa present within 6 months post remediation
- Taxa richness for Yrs 1-5 ranged 3-11 taxa
- Yr 1 lowest taxa richness of monitored stations
- Taxa dominated by clam worms in Yr 1
- Yrs 2-5 dominated by clam and paddle worm taxa



Benthic Community Metrics
Observed Trends Taxa Richness – Main Footprint

Station BI02

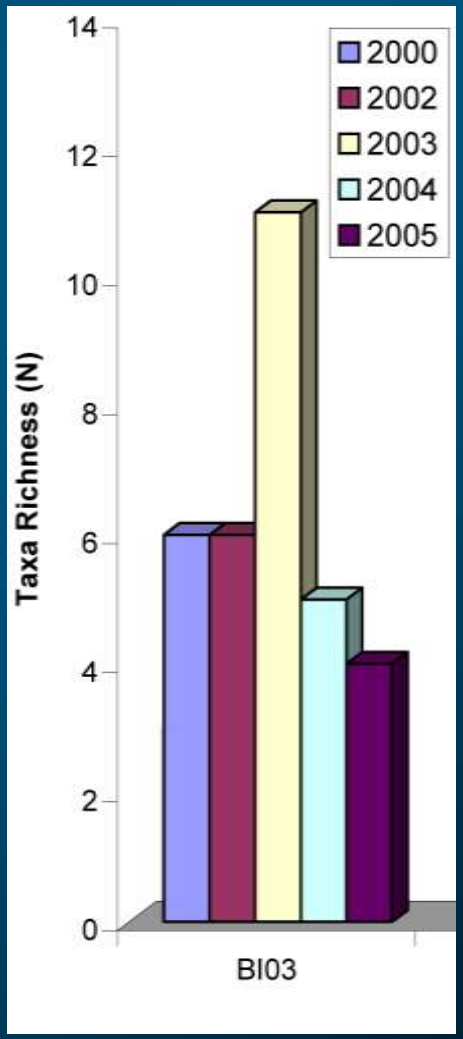
- 7 taxa w/in 6 months
- 6 of 7 taxa are worm species and one bivalve species first year
- 13 taxa in Yr. 3
- Bivalves were non-persistent after Yr. 1
- Clam worms dominant community



Benthic Community Metrics
Observed Trends Taxa Richness – Satellite Footprint

Station BI03

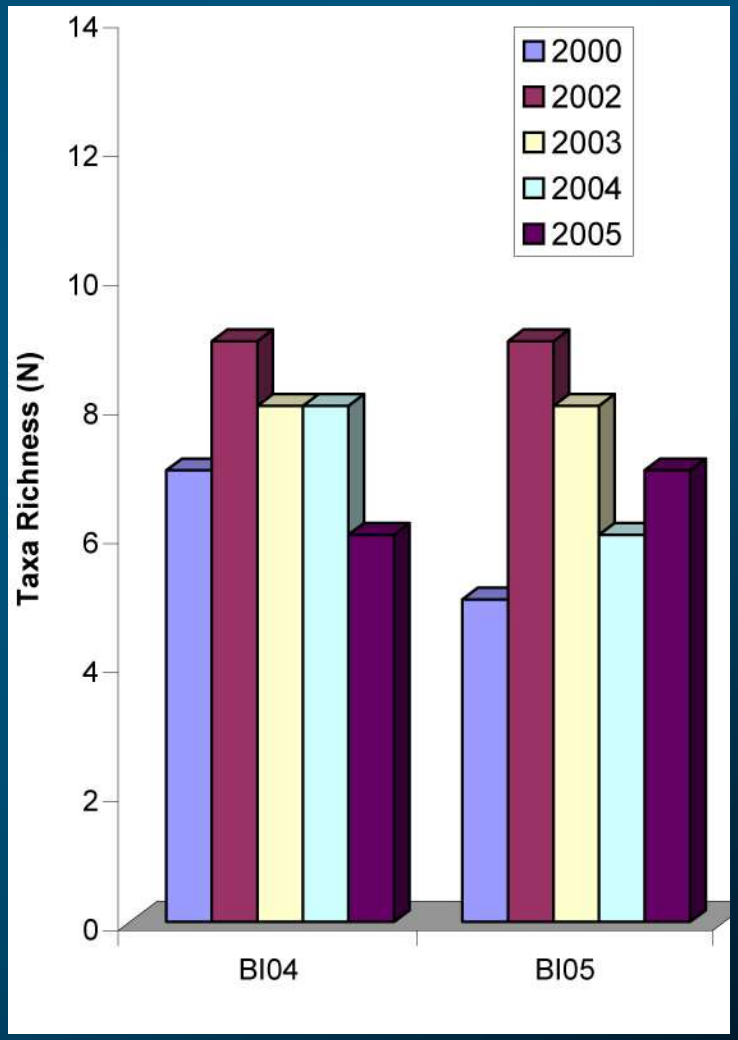
- 6 taxa by first event -Five worm and one amphipod species
- Taxa richness for Yrs 1-5 ranged 4 to 11 taxa
- Bivalves appear in Yr 2 and persist thereafter to Yr 5
- Community composed of amphipods, thread worms and clam worms



Benthic Community Metrics
Observed Trends Taxa Richness – Natural Recovery Areas

Station Bl04 and BI05

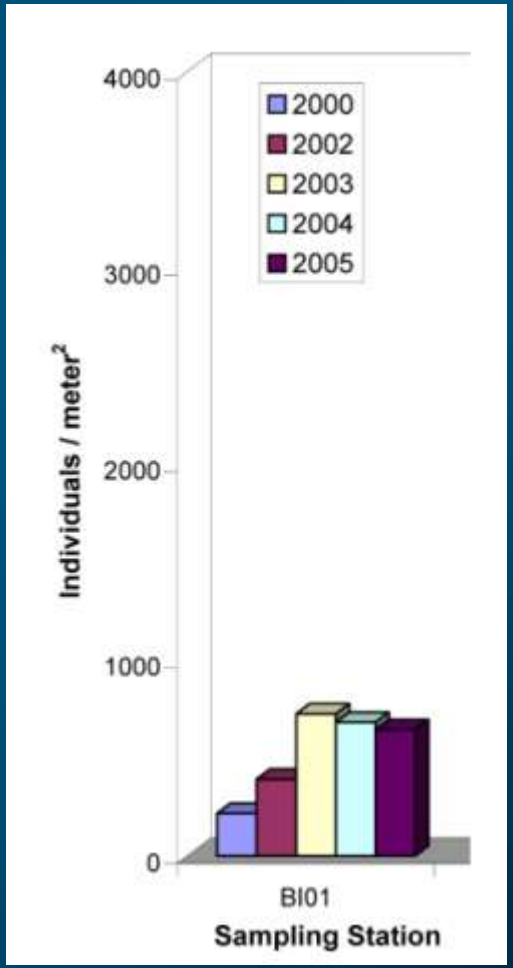
- Yr 1 - 5 (Bl04) and 7 (Bl05) taxa
- Four worm, two amphipod and one isopod species in Yr 1
- Taxa richness for Yrs 1-5 ranged 5 to 9 taxa
- Bivalves present in Yrs 2-5
- Shift in community composition from amphipod-worm community to amphipod, worm and clam community



Benthic Community Metrics
Trends in Community Density – Main Footprint

Station Bl01

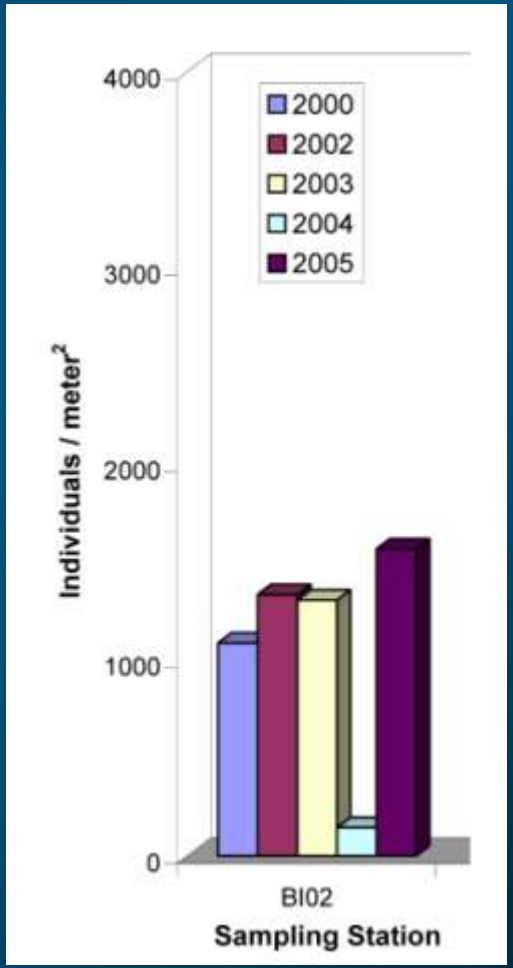
- Yr 1 mean density 217 invertebrates/m^2
- Range 217-724 invertebrates/m^2 for Yrs 1-5
- Maximum density (724 invertebrates/m^2) in Yr 3
- Density remains stable Yrs 3-5



Benthic Community Metrics
Trends in Community Density – Main Footprint

Station BI02

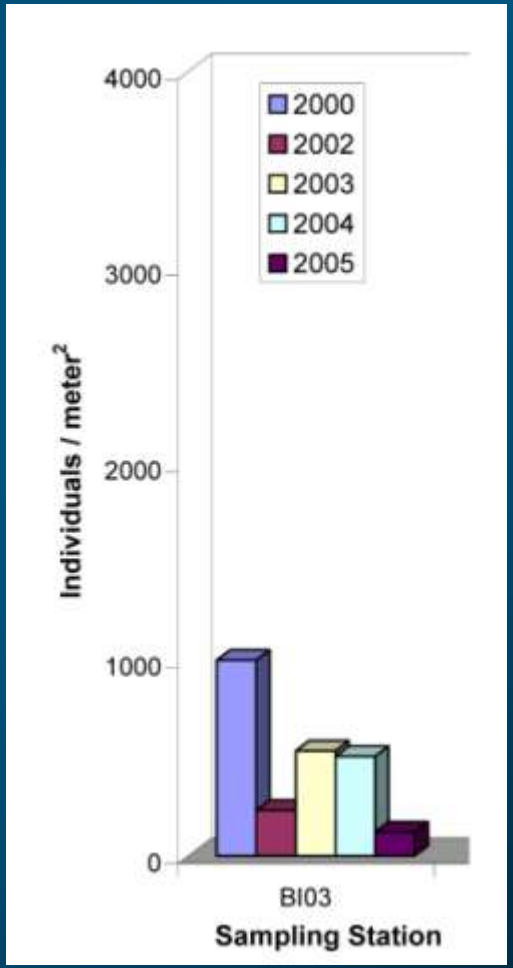
- Yr 1 mean density 1,087 invertebrates/m^2
- Range 145-1,565 invertebrates/m^2
- Density increasing to Yr 3
- Yr 4 statistically significant decrease to 145 invertebrates/m^2
- Yr 5 mean density recovers to 1,565 invertebrates/m^2



Benthic Community Metrics
Trends in Community Density – Satellite Footprint

Station BI03

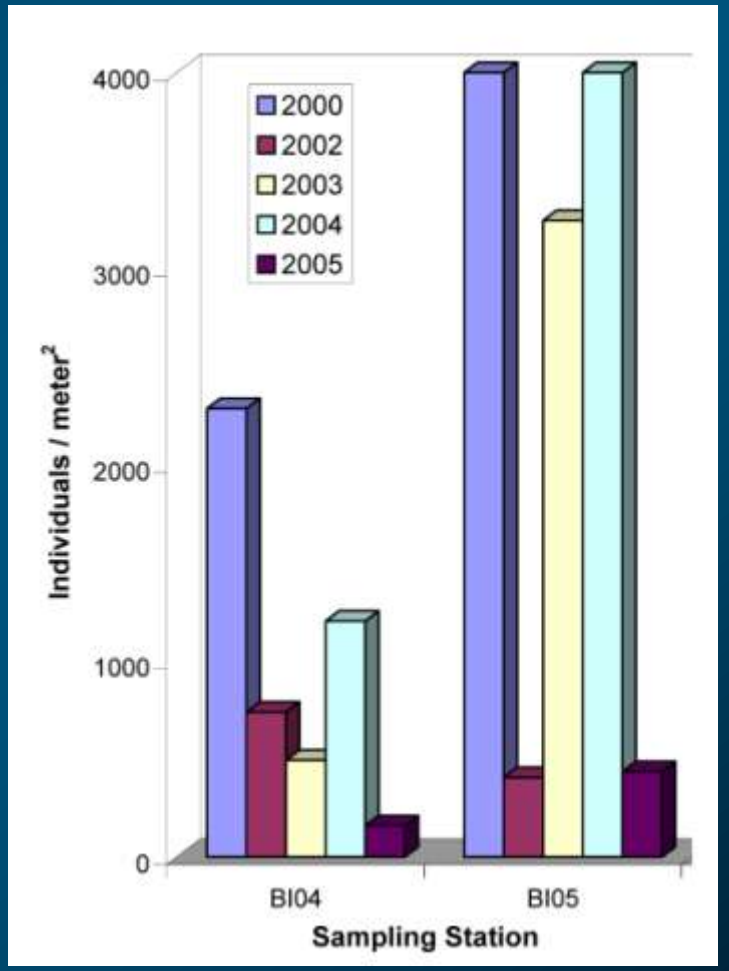
- Range of 101-1,000 invertebrates/m^2
- Yr 1 observed maximum density
- Density decreasing with time to Yr 5 (101 invertebrates/m2)
- Yr 2 (232) and Yr 5 (101) statistically significant decreases



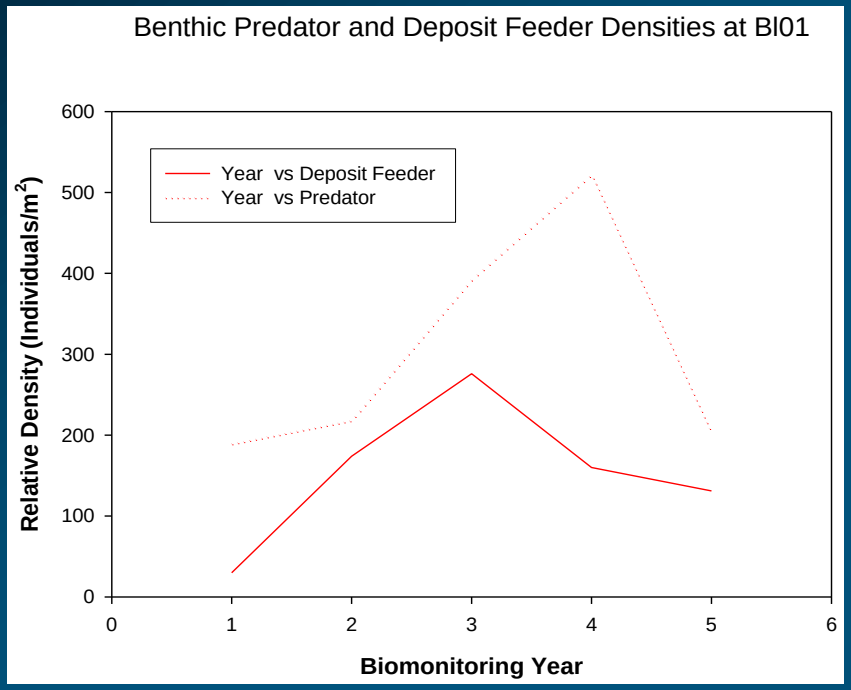
Benthic Community Metrics
Trends in Community Density – Natural Recovery Areas

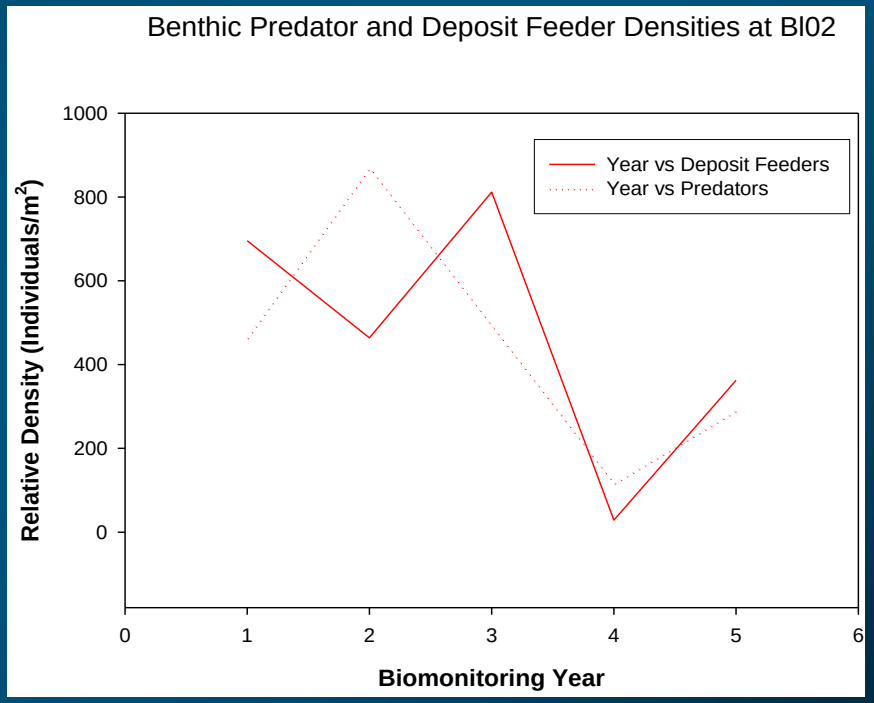
Stations BI04 and BI05

- Max. mean density in Yr 1 2,200 and 7,300 invertebrates/m^2
- 159-7,300 invertebrates/m^2 for Yrs 1-5



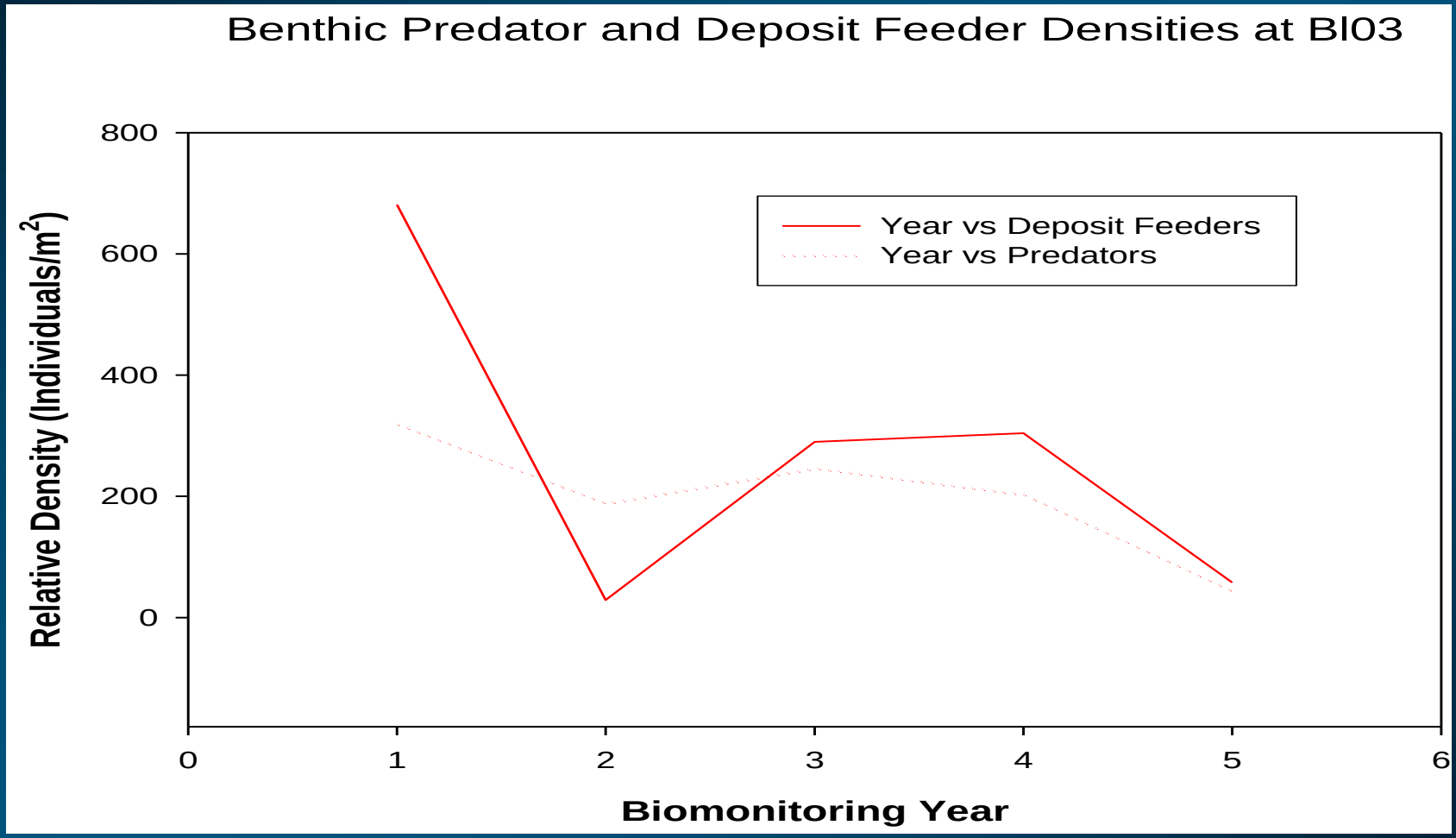
Benthic Community Metrics
Trends in Functional Guilds – Main Footprint Excavation Areas



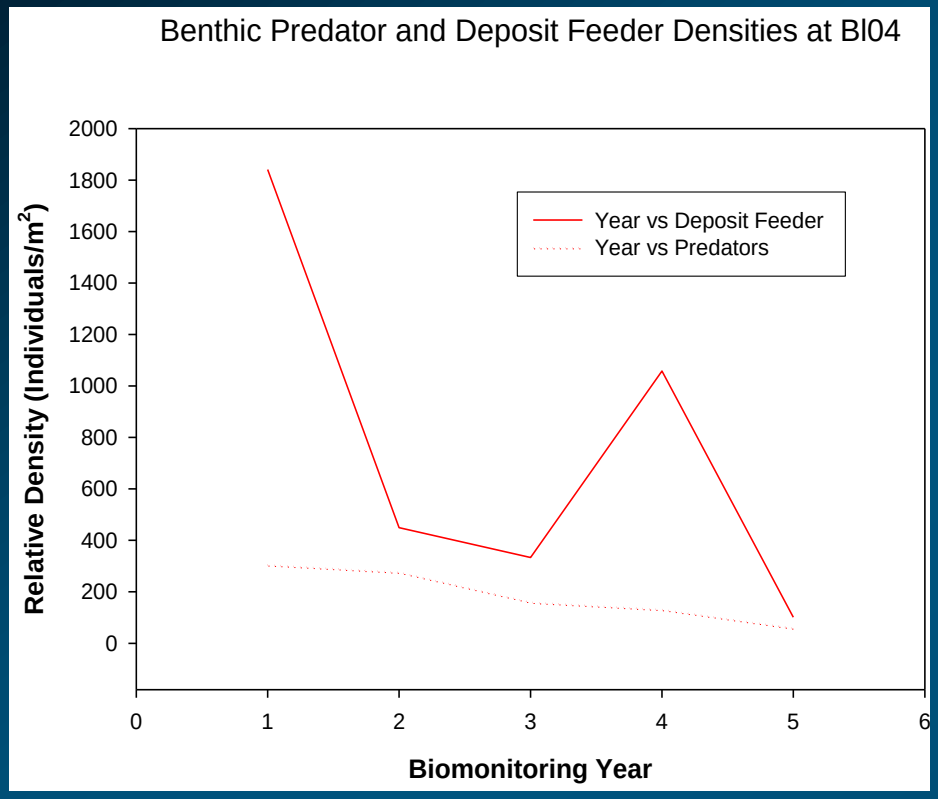


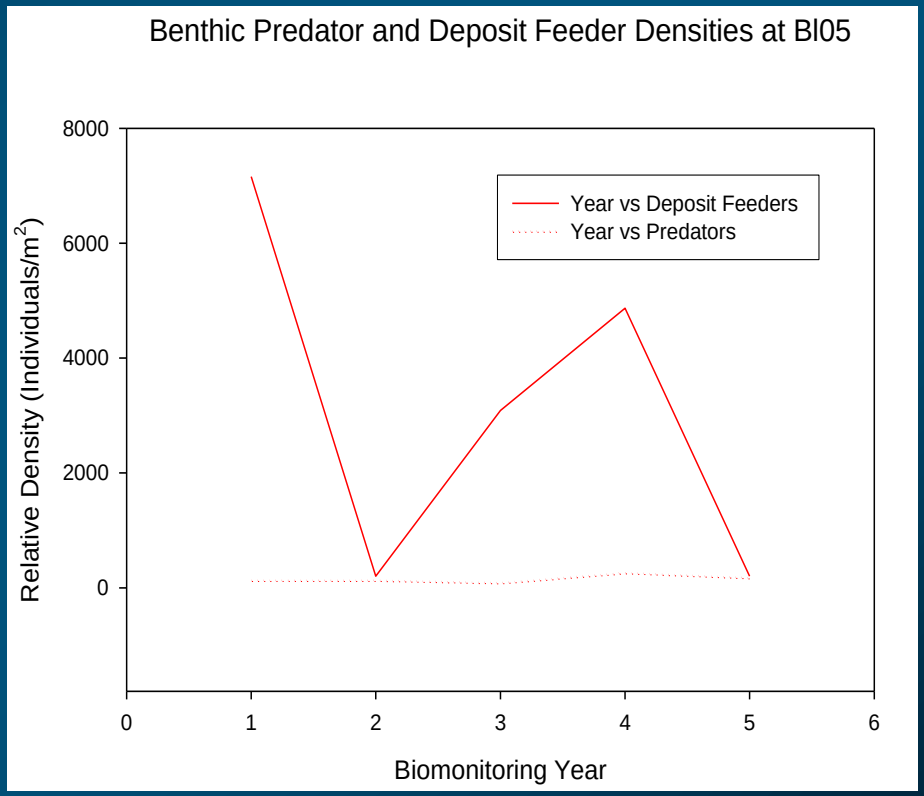
Benthic Community Metrics

Trends in Functional Guilds – Satellite Footprint Excavation Area



Benthic Community Metrics
Trends in Functional Guilds – Natural Recovery Areas





Summary and Conclusions

Excavation Areas in Tidal Creeks

- Early colonization occurs in both main and satellite areas (within 6 months)
- Larger impact areas show greater variation in taxa richness and densities than satellite areas
- Opportunistic, predatory species first to colonize newly restored creek habitats (implications for community richness)
- Isolated footprint and MNR marginal areas increase in taxa richness and density faster than larger action areas
- Longer monitoring period may be required

Summary and Conclusions

Natural Recovery Areas in Tidal Creeks

- Trends in community composition and density more cyclic in nature
- Predator density less variable
- Trend toward lower densities and increased taxa richness
- Deposit feeders outpace predatory species in abundance
- Bivalves become numerically dominant
- Five years appears adequate for recovery demonstration