

Spatial and temporal variability in autotrophic production and heterotrophic carbon utilization in Mobile Bay

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General Project Hypothesis

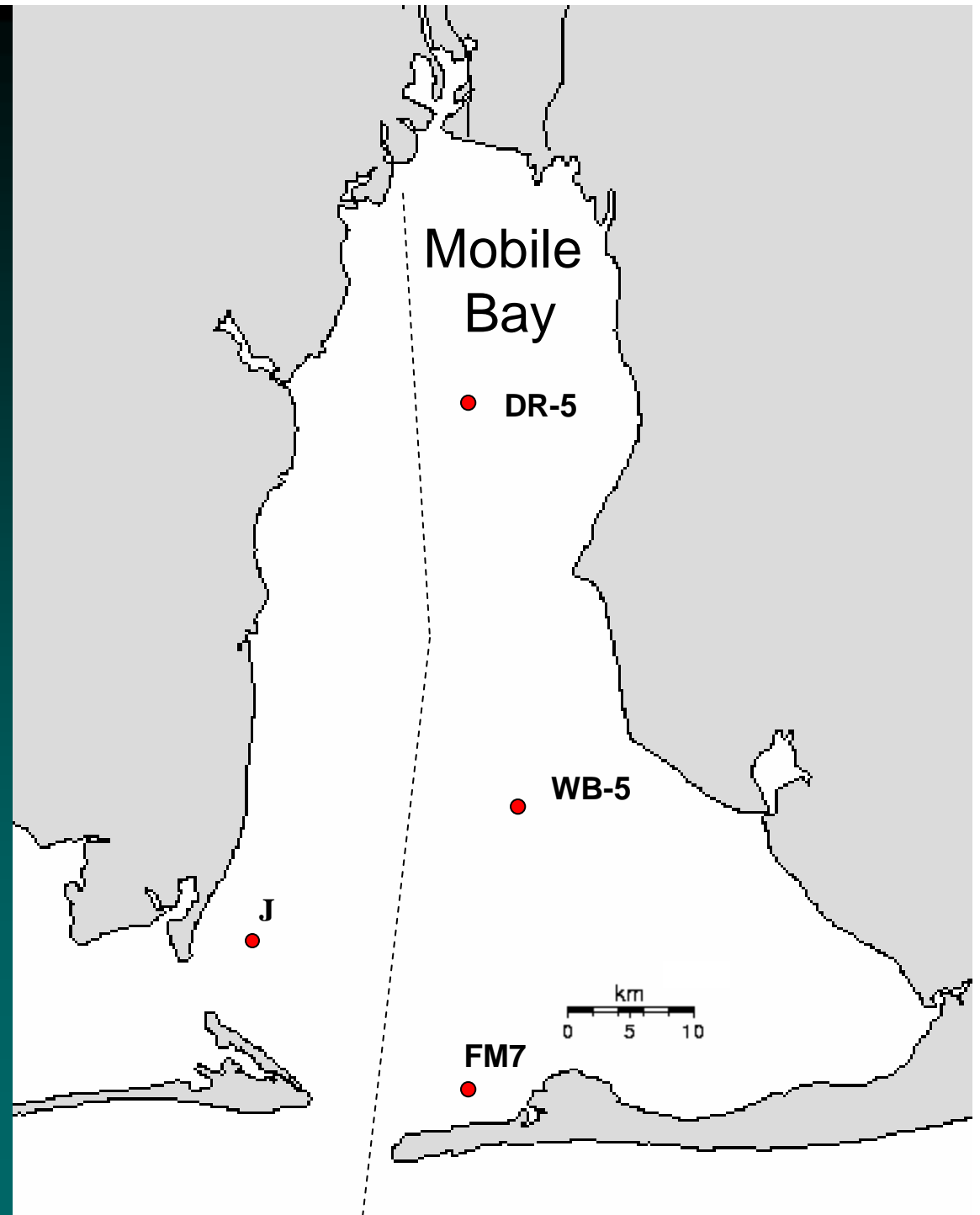
- *Variations in river discharge and wind-driven resuspension in Mobile Bay have dramatic effects not only on the biological community and trophic structure, but also on the way in which anthropogenic nutrients are processed by the estuarine ecosystem*

Project Objectives:

- 1) Determine spatial and temporal variation in net carbon production in the Mobile Bay system
- 2) Determine how variations in freshwater delivery and sediment resuspension affect trophic efficiency in the phytoplankton and bacterioplankton communities

ACES Lower Trophic Study Sampling Locations in Mobile Bay

- Monthly sampling in 2000-2001 for physical, chemical and biological parameters at 3 stations covering three distinct hydrographic regimes
- “Event” scale sampling every 3 to 4 days during March 2002 to capture both resuspension events and quiescent periods



Routine Data Collection – ACES Lower Trophic Study

Primary production

- Phytoplankton production (^{14}C)
- Chl *a* (water and sediment)
- Nutrient conc. (NO_3^- , NH_4^+ , PO_4^{3-} , Si, Urea, DOC, DIC, DIN)

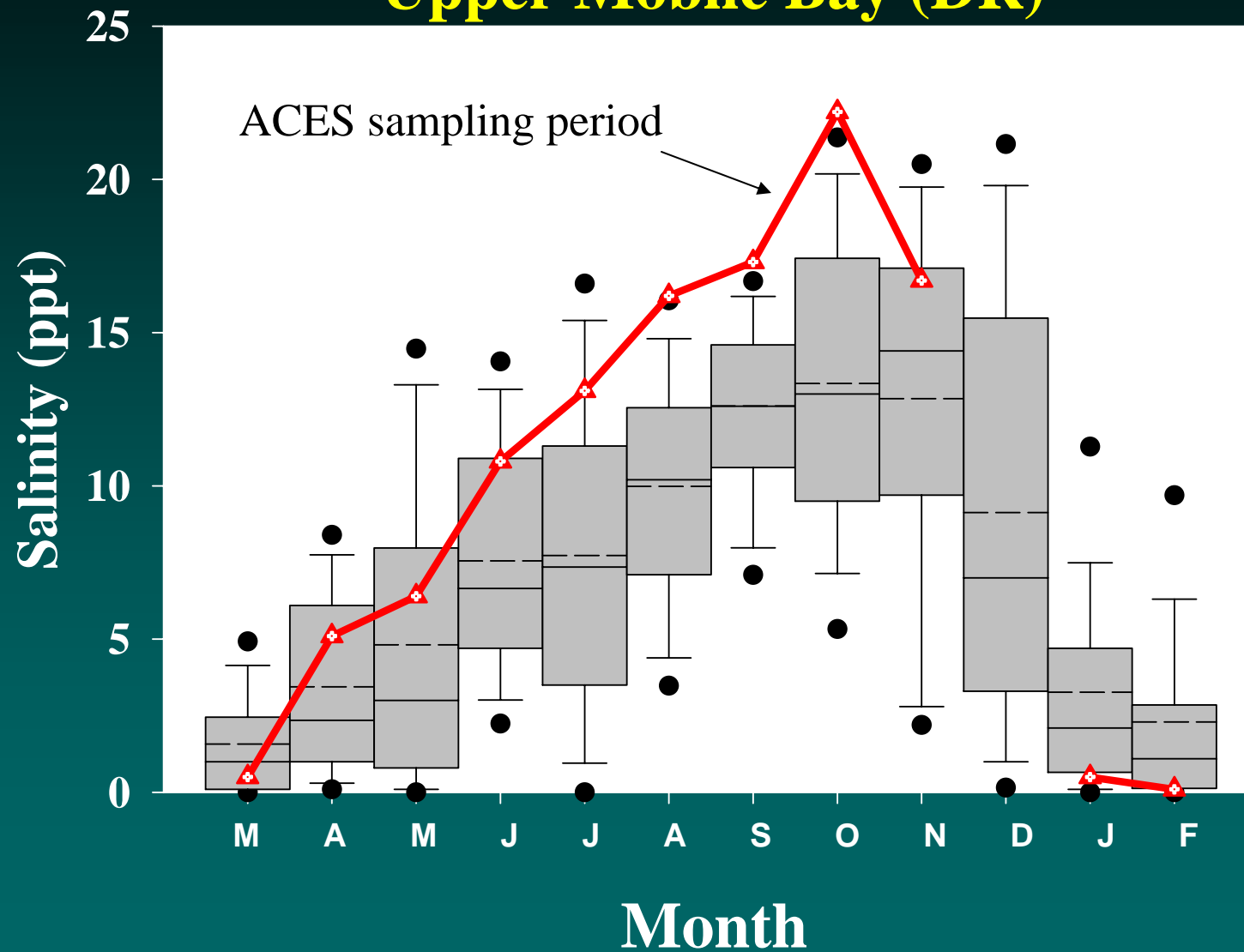
Respiration

- Water column community O_2 respiration (precision Winkler)
- Sediment O_2 consumption for integrated respiration (whole core incubations)

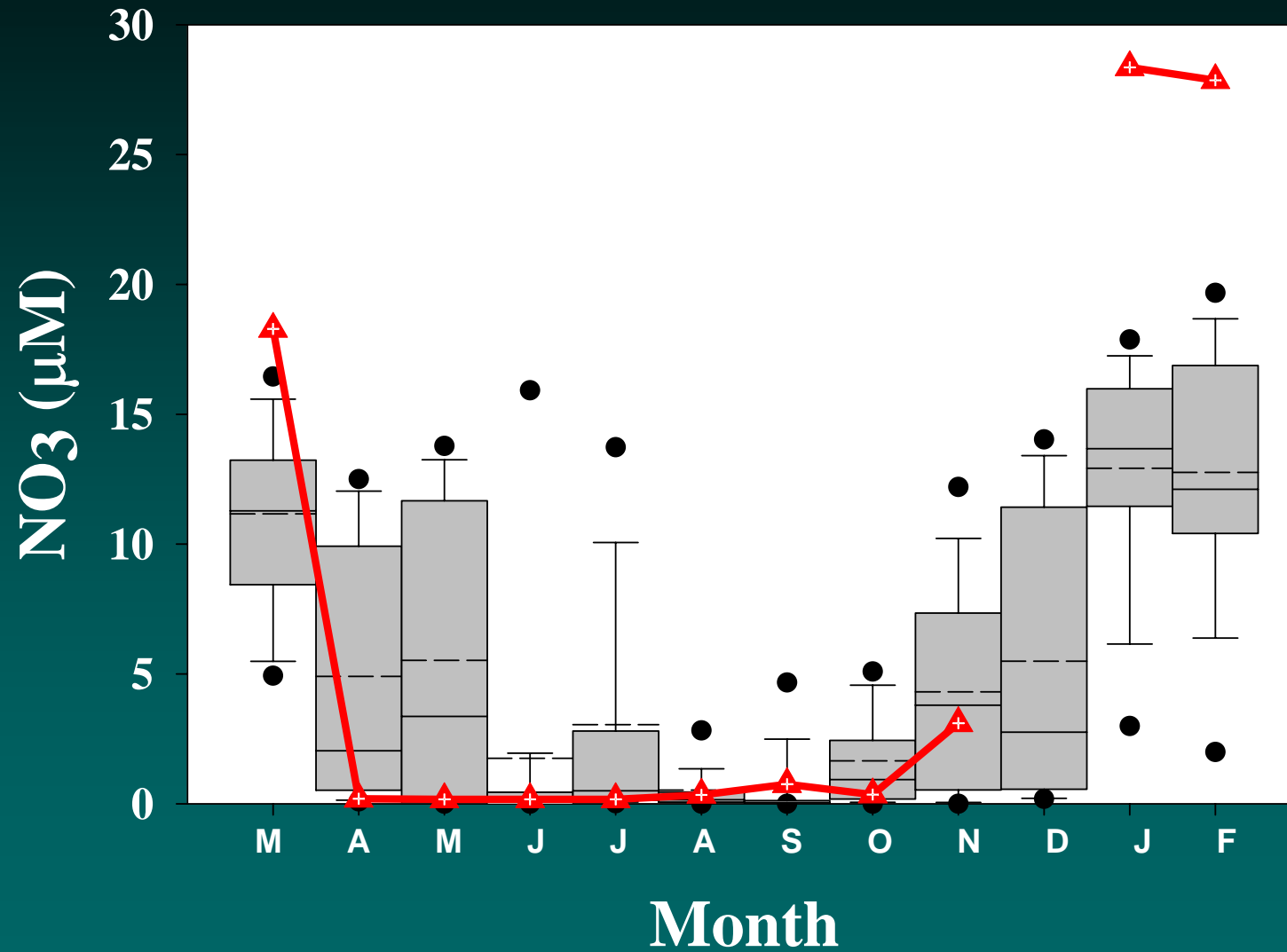
Secondary production & fluxes

- Bacterial production (^3H -Leucine) and abundance (DAPI counts)
- Bacterial growth efficiency (BGE)
- Sediment nutrient exchanges (NO_3^- , NH_4^+ , PO_4^{3-}) and % organic C

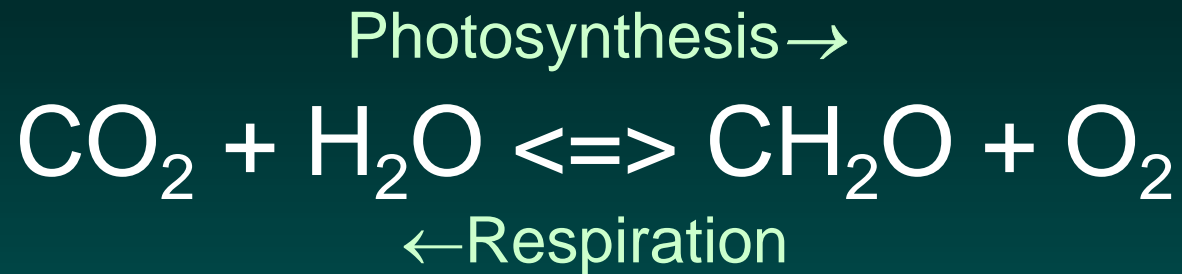
ACES 2000-2001 Salinity and 10 year Averages Upper Mobile Bay (DR)



ACES 2000-2001 Nitrate and 10 year Averages Upper Bay (DR)



Photosynthesis and Respiration Balance

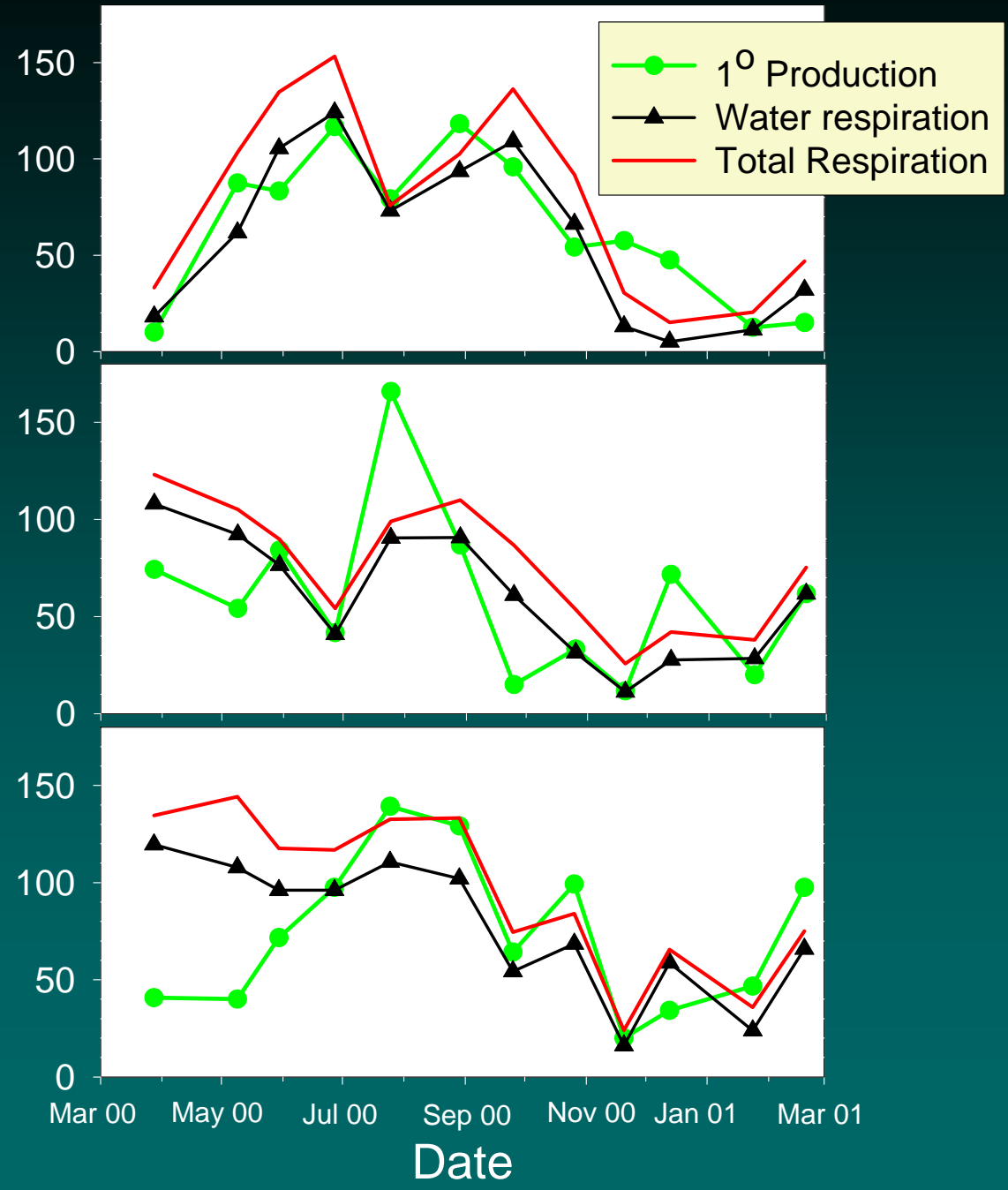


Net photosynthesis – system is autotrophic

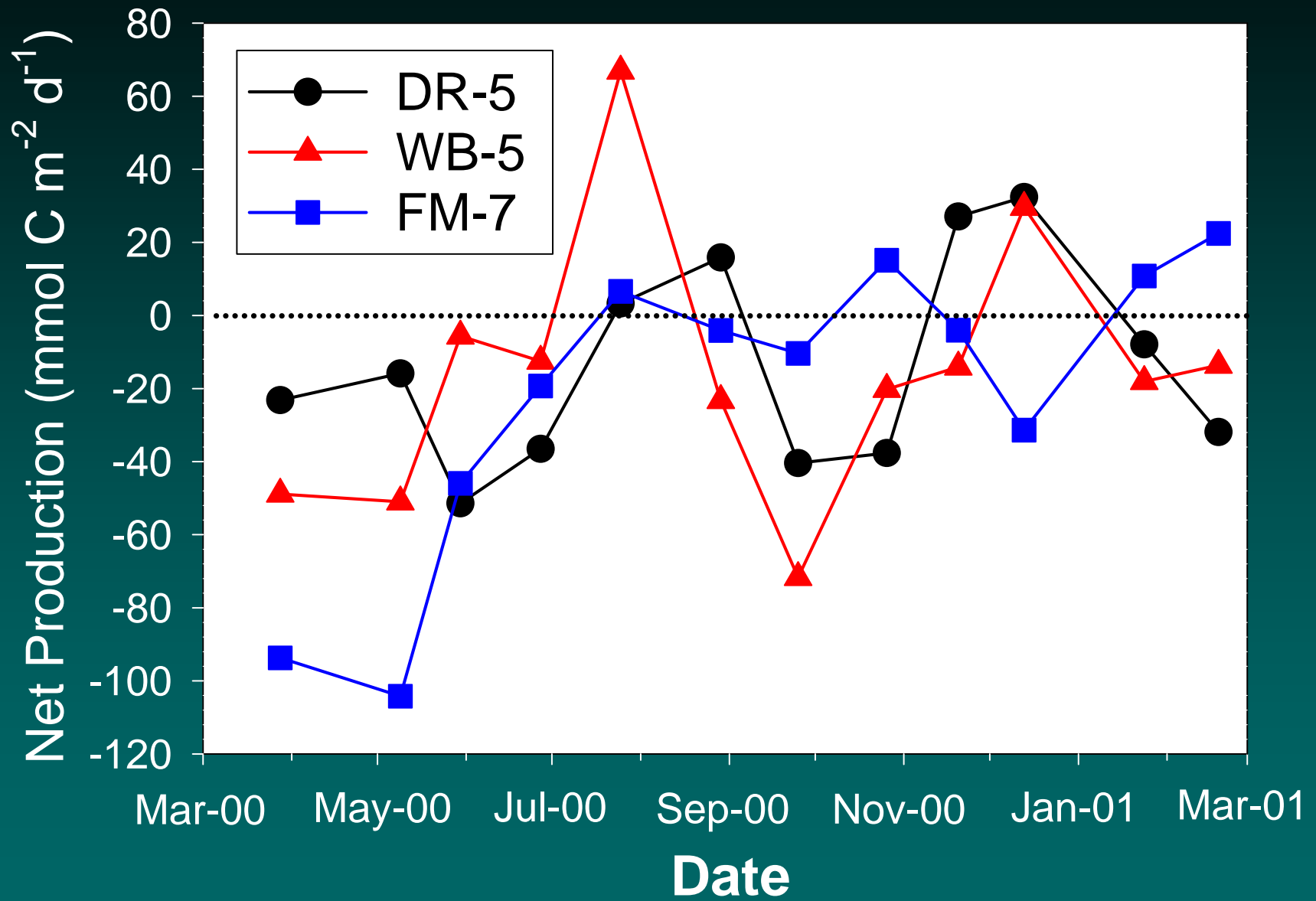
Net respiration – system is heterotrophic

Respiration generally followed primary production

Primary production, water-column and total respiration (mmol C m⁻² d⁻¹)



Net production (P-R) for 3 stations in Mobile Bay



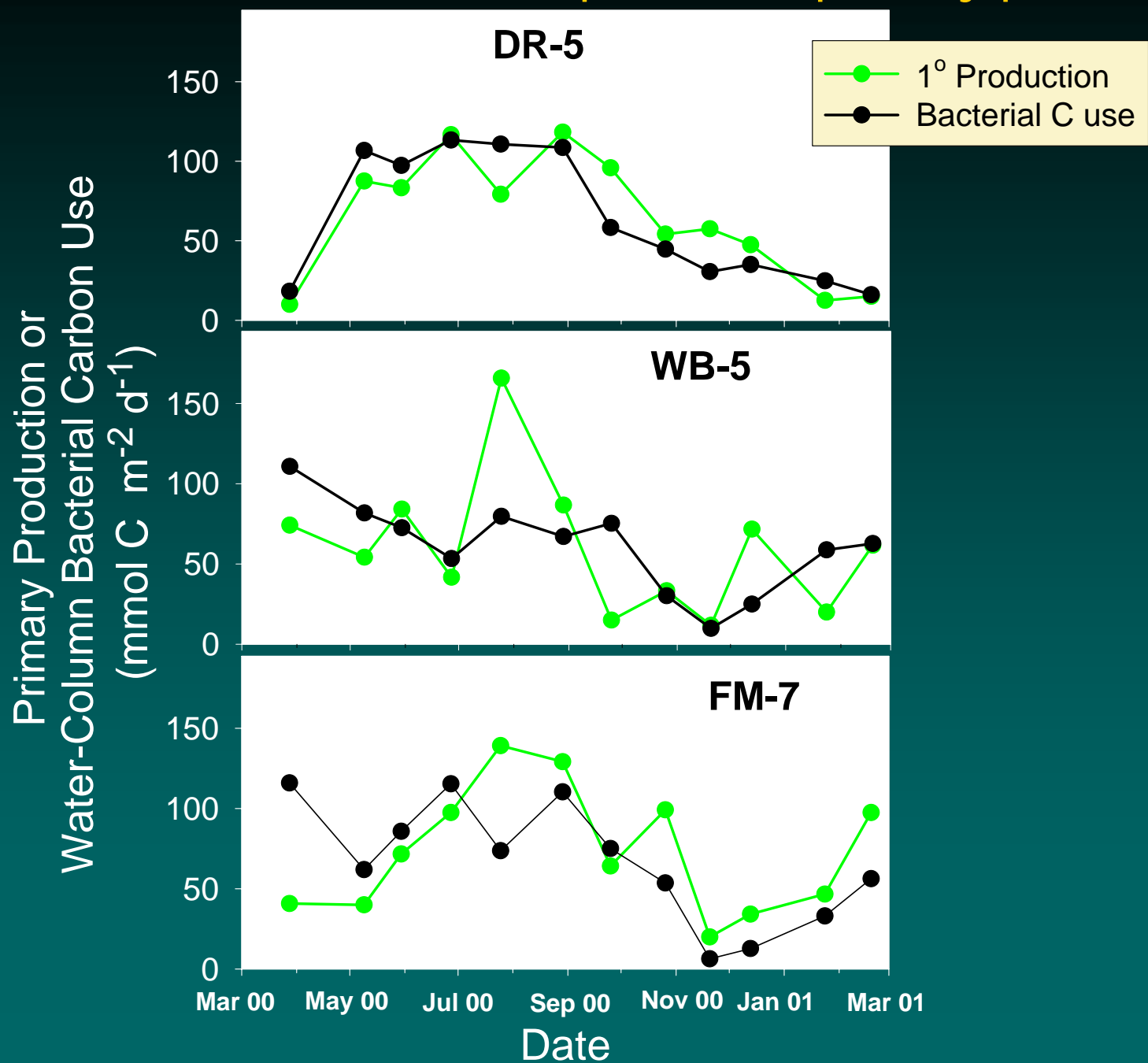
Production-Respiration balance for Mobile Bay

Annual integrated primary production or respiration at three stations in Mobile Bay, Alabama. Values are in $\text{mol C m}^{-2} \text{y}^{-1}$.

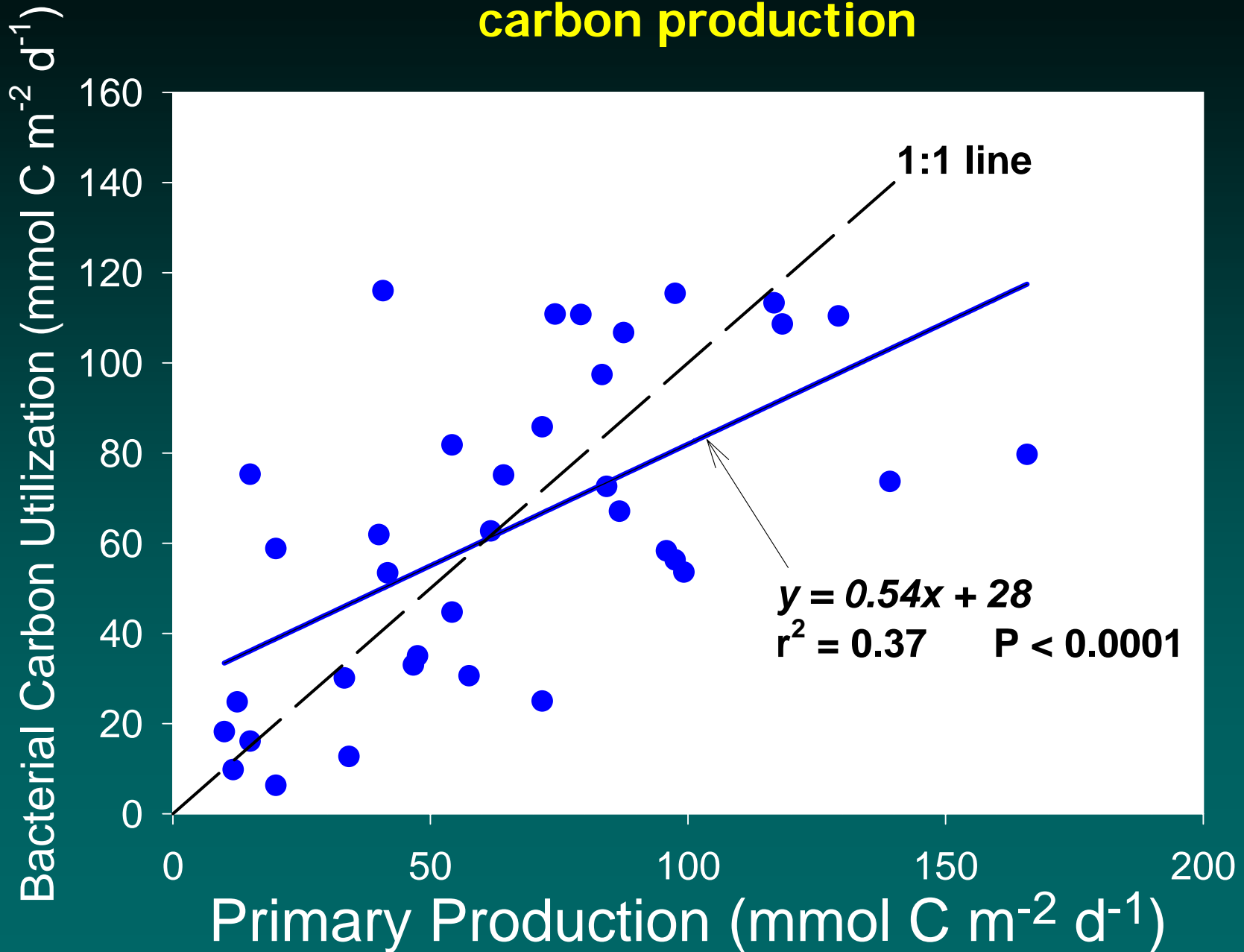
Station	1° Prod	Water Column Respiration	Sediment Respiration	Net Prod. (P-R)	Net as % of 1° Prod
DR-5	22.7	20.7	6.8	-4.9	-21%
WB-5	22.3	22.4	5.5	-5.5	-25%
FM-7	26.8	28.2	6.6	-8.0	-30%

Mobile Bay consumes more carbon than it produces!

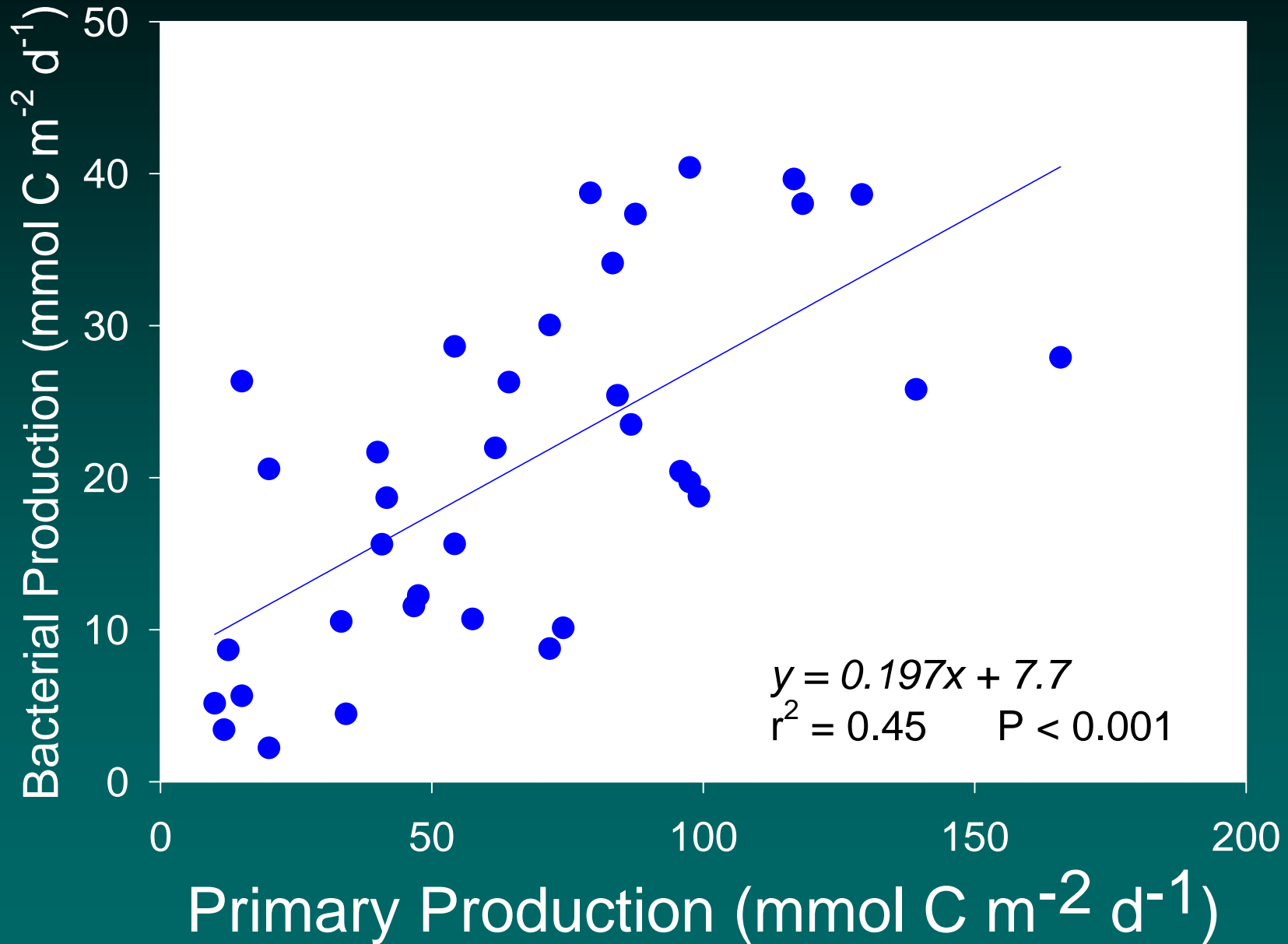
Bacterial carbon use tracked annual pattern of primary production



Bacterioplankton consumed > 50% of autotrophic carbon production



Bacterial secondary production averaged ~20% of primary production



Bacterial production highlights

- Bacterial secondary production averaged ~20% of primary production, with bacteria consuming ~50% PP in terms of carbon
- Bacterial growth efficiency was variable, ranging from 20-60%
- 10-65% of bacterial production was associated with larger particles (detritus, aggregates)
- Bacterial production not strongly related to suspended sediment load (seston)

Conclusions from baseline lower trophic study of Mobile Bay

- Majority of primary production occurs during low flow, low nutrient loading periods (i.e. spring & summer)
- High nutrient inputs during winter are mostly exported from estuary
- Water-column bacterial secondary production and carbon utilization are closely coupled with autotrophic production: bacterioplankton consume a major fraction of primary production
- All three study sites were strongly heterotrophic. Sediments responsible for 19-25% of respiration.
- No clear signal of sediment resuspension events in annual cycle data

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* Thesis related to ACES project