A Research Design to Estimate the Contribution of *Spartina densiflora* to the Net Primary Productivity of Humboldt Bay’s Salt Marshes

Luc Lagarde USFWS, HSU
Photosynthesis
Carbon Dioxide & Water & Light Energy → Sugar & Oxygen
\[(\text{CO}_2 + \ldots \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \ldots)\]

Cellular Respiration
Sugar & Oxygen → Carbon Dioxide & Water & Energy
\[(\text{C}_6\text{H}_{12}\text{O}_6 + \ldots \rightarrow \text{CO}_2 + \ldots)\]
What is Net Primary Productivity?

- The rate of carbon “in” minus the rate of carbon “out”
- Essentially the rate of growth
- NPP is usually measured in units of grams of carbon per square meter per year (g C/m²/yr)
The Flow of Carbon in Wetlands

**Figure 7.3**

Schematic showing how animal secondary production in wetlands is based trophically on carbon from living macrophytes, detritus, and algae, with the link with algae being particularly strong.
Example of a Wetland Food Web

![Image of wetland food web diagram]

Figure 10.8
How is Net Primary Productivity Measured?

- **Early Marine NPP:**
  - Light and Dark Bottle Method
    - Gaarder and Gran (1927)

- **Early Terrestrial NPP:**
  - Maximum Minus Minimum Live Biomass
  - Smalley’s (1959) Method
    - Both live and dead biomass are sampled
    - Production = $\Delta$ live biomass + $\Delta$ dead biomass
    - Negative values = 0
  - Wiegert and Evans’ (1964) Method
    - Estimates rate of decomposition
John D. Rogers HSU Master’s Degree Study
Site A
Eureka Slough
Site B
Jacoby Creek
Spartina densiflora Net Primary Productivity (Rogers 1981)
Sarcocornia Pacifica Net Primary Productivity (Rogers 1981)
Distichlis Spicata Net Primary Productivity (Rogers 1981)
Some Problems With Early Methods Used to Measure NPP

- Belowground production
- Herbivory
- Litterfall
- Volatile organic compounds
- Root exudates
- Symbionts
Modern Methods Used to Measure NPP

- Gas Flux
- Isotopes
- Chlorophyll
- Fluorescence Kinetics
- Satellite Imagery
Measuring Salt Marsh NPP

- Terrestrial and Marine
- Annual and Perennial Plants
- Elevation
- Tides
- Parasitic Plants
Fig. 4. Estimated daily GPP of the four algal mat sampling stations. Algal mats are named by their over-story dominants.
Fig. 2. Ability of the method to detect a relationship between CO$_2$ flux and dry biomass for *Sporobolus virginicus* was assessed. A strong relationship exists between CO$_2$ flux measurements and aboveground plant biomass under light (top) and dark (bottom) conditions. Dashed lines show the 95% confidence band for slope of the regression lines. CO$_2$ flux measurements are expressed in terms of $\mu$g C m$^{-2}$ plant cover s$^{-1}$.
Initial Methods for the Measurement of the Contribution of *Spartina densiflora* to the NPP of Humboldt Bay’s Salt Marshes

- Monthly cover monitoring, density monitoring, plant dimension measurements, and biomass sampling
- Monthly *in-situ* closed chamber CO$_2$ flux / relative humidity / temperature / photosynthetically active radiation measurements
- Monthly *in-situ* sealed bottle dissolved oxygen / temperature / photosynthetically active radiation measurements