The Corsica river estuary is a highly degraded tributary of the Chester River in the Chesapeake Bay system. Recent efforts by the state of Maryland have made restoration of the Corsica River an example for future bay-wide restoration. A key to the restoration is identifying what nutrient sources need to be reduced and by how much to improve water quality in the estuary.

**Nutrient Input Management, Benthic Photosynthesis, and Restoration of Shallow Eutrophic Coastal Ecosystems**

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**Nutrient Flows Connect Humans with Corsica Estuary**

- Corsica River watershed is dominated by agricultural land
- Nutrient (Nitrogen & Phosphorus) losses from farm fields is how chl-a concentrations
- The duration of hypoxic events is linked to chl-a concentrations
- Prolonged low oxygen events can cause fish kills in the Corsica and other estuaries

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**Major Nitrogen Sources and Sinks for the Corsica**

- A total nitrogen (TN) budget indicates that N inputs from the watershed are the major source, while N removal via burial & denitrification
- N loads during storm events comprise 25-50% of TN loads during most seasons in the 3 major tributaries of the Corsica

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**In the Corsica River, chl-a peaks occur in the upper estuary (right figure). Summer chl-a is linked to spring-summer nitrogen loading for many shallow Chesapeake Bay estuaries (left figure). The N load-chl-a relationship indicates non-linear dynamics, but more data are needed to characterize TN load effects on chl-a.**

**Elevated chl-a Decreases Water Clarity**

- C1h-a appears to be the primary driver of light attenuation during warm months in the upper and lower estuary
- Thus, it appears that the paradigm of elevated nutrient loading causing increased water column chl-a and reduced water clarity is true for the Corsica River estuary

**Small Increases in Water Clarity Greatly Increase Area of Photic Sediments**

- By reducing chl-a enough to increase Secchi depth by 0.5 m (0.5 to 1 m), ~70% of Corsica sediments could support bottom plants (algae or vascular plants)
- This suggests that small reductions in chl-a may yield large increases in sediment area that could that could support photosynthesis

**Increased Area of Photic Sediments May Trap Nutrients**

- Benthic photosynthesis has been shown to reduce sediment-water nutrient fluxes (e.g., Tyler et al. 2003 L&O V48, Sundback et al. 2004 L&O V49)
- Corsica sediments switched to a net N sink when exposed to light (right figure)
- This indicates the potential for non-linear chl-a declines with TN load reduction via the following sequence (see also left figure):
  1. Initial TN load declines
  2. Reduced chl-a improves water clarity
  3. Improved water clarity allows more light to sediments
  4. Light to sediments
  5. Sediment N retention

**Simple Model of System Responses to Reduced N Loads**

- Reducing TN loads will improve water clarity and restore bottom plants.
- It will also improve oxygen conditions and restore animal habitat.
- A large part (30 - 50%) of TN load is from direct runoff, therefore watershed N management should have immediate effects.
- Because the Corsica is shallow, small improvements in water clarity may allow sediment plant growth to accelerate further restoration.

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