

Fate of recently fixed nitrogen in the eastern Gulf of Mexico: Does the regeneration of nitrogen fixed by *Trichodesmium* support the growth development of *G. breve* blooms?

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Abstract

Blooms of the toxic red tide dinoflagellate, *Gymnodinium breve* Davis, are an important feature of the Florida Shelf ecosystem. It has been hypothesized that blooms initiate and develop in an oligotrophic, mid-shelf region 18-75 km offshore of west Florida. However, these waters are characterized by low concentrations of both dissolved inorganic and organic nitrogen (DIN and DON), it is unclear how *G. breve* blooms meet their N demand for growth. Ambient N concentrations, model predictions, and stoichiometric calculations of nutrient requirements for growth based on observed biomass suggest that N inputs from riverine, upwelling and in situ N regeneration are insufficient to support the observed *G. breve* blooms in this region. Furthermore, unpublished research, anecdotal information and historical red tide monitoring data suggest a correlation between the timing and magnitude of *G. breve* blooms and the occurrence of the filamentous, N₂ fixing cyanobacteria, *Trichodesmium spp.* in both the Gulf of Mexico and Atlantic coastal waters (Walsh and Steidinger, accepted). Little is known about the fate and significance of new N inputs derived from recently fixed N₂ or of the pathways of trophic transfer whereby this new N is assimilated into oligotrophic marine ecosystems. It is critical that we determine the fate of new N in oligotrophic systems and the effects of N inputs from N₂ fixation on the community structure and function so that we can accurately assess the impact of new N on regenerated and export production. We propose that the oligotrophic west Florida Shelf ecosystem, which is characterized by large blooms of these species, is an ideal model system in which to examine the fate of new N inputs from N₂ fixation by *Trichodesmium spp.* and the pathways facilitating the trophic transfer of this N. We hypothesize that that blooms of *G. breve* in west Florida shelf waters are supported by the release and regeneration of DIN and DON from N₂ recently fixed by co-occurring or preceding blooms of *Trichodesmium spp.* We propose to address this hypothesis with a three-year program consisting of:

- Laboratory and field studies to determine the capacity for and kinetics of N uptake and regeneration by *G. breve*. We will examine the uptake and release of both inorganic N (¹⁵NO₃⁻ and ¹⁵NH₄⁺) and organic N (¹⁵N-labeled amino acids, urea and *in situ* produced DON).
- Laboratory and field studies to determine whether direct or indirect regeneration of NH₄⁺ and DON from recently fixed N₂ by *Trichodesmium* provides sufficient N substrates to support the observed growth of *G. breve*. We will determine whether there is a direct link between these two species using a combination of ¹⁵N tracer and natural abundance techniques.
- Laboratory and field studies using ¹⁵N tracer and microscopic techniques to identify associated communities and examine trophic pathways whereby newly fixed N₂ derived from *Trichodesmium spp.* stimulates production in otherwise oligotrophic waters.
- Active collaboration with currently funded projects which 1) model the development of *Trichodesmium* blooms on the west Florida shelf and their response to Fe and P fertilization using *in situ* and satellite data, and 2) model the development of *G. breve* blooms using physical, chemical and biological data from monthly cruises within an array of 15 ADCP buoys (ECOHAB: Florida).