Indicator: Seaweed

Question

How has the amount of seaweed in the Great Bay Estuary changed over time?

Short Answer

At intertidal sampling sites, green and red seaweeds (combined) increased from approximately 8% mean percent cover in 1980 to 19% cover in 2016. At these same sites, invasive species now dominate the red seaweed category, which comprised approximately 15% of all seaweeds in 2016.

PREP Goal
No increasing trends for seaweeds.

Why This Matters

Seaweeds are an important and critical group of estuarine primary producers, but many of the factors affecting estuaries globally (e.g., climate change, sedimentation, nutrient pollution) also accelerate the growth of some seaweeds (Thomsen et al. 2012; Mathieson and Dawes 2017). In these situations, seaweeds can grow so abundant that they shade eelgrass. Since they can "bloom"—that is, grow and die very quickly—they can also negatively impact sediment conditions by decomposing on the estuary floor (Hauxwell et al. 2001). This can negatively impact shellfish and benthic invertebrates as well as eelgrass.

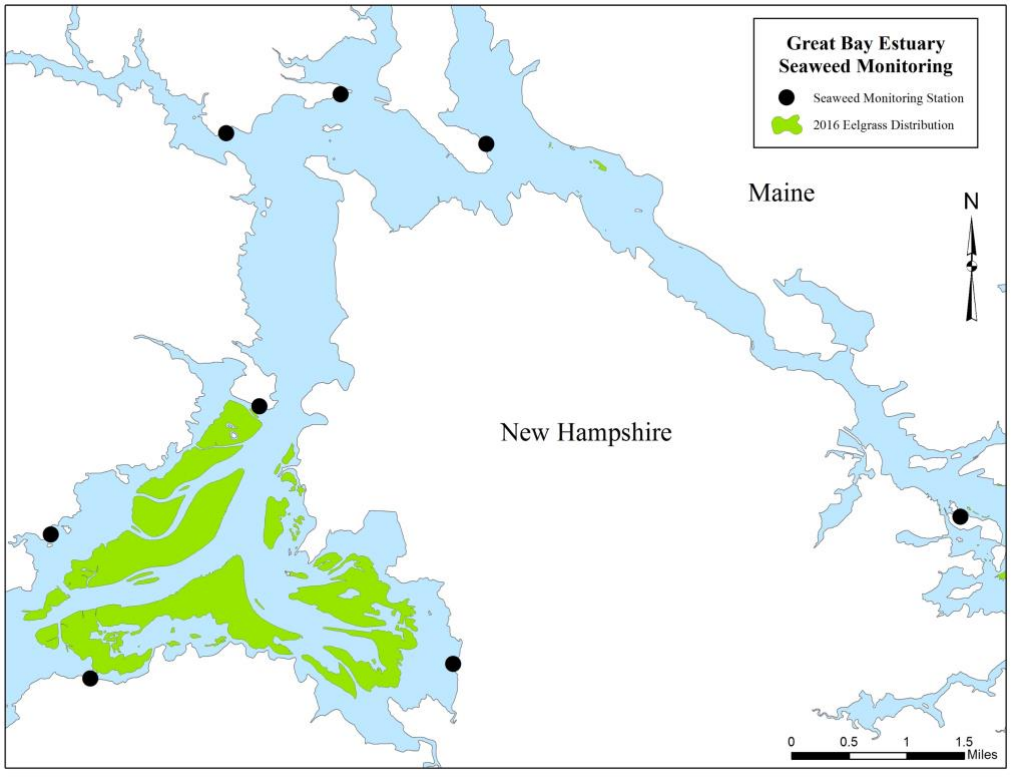

Figure S-1. Locations of the eight intertidal seaweed monitoring sites are designated by the black circles. Green areas indicate mapped eelgrass habitat from 2016.

Explanation (from 2018 State of Our Estuaries Report)

Great Bay Estuary seaweeds can be categorized as brown, green and red. This indicator (intertidal seaweeds) focuses on changes in the red and green seaweeds, which are much more abundant in the subtidal areas (those areas always covered by water) and are more likely to compete with eelgrass. However, there are only a few data points in the Great Bay Estuary that allow for assessment of changes in the abundance of these seaweeds where impacts on eelgrass could also be assessed (Figure S-1).

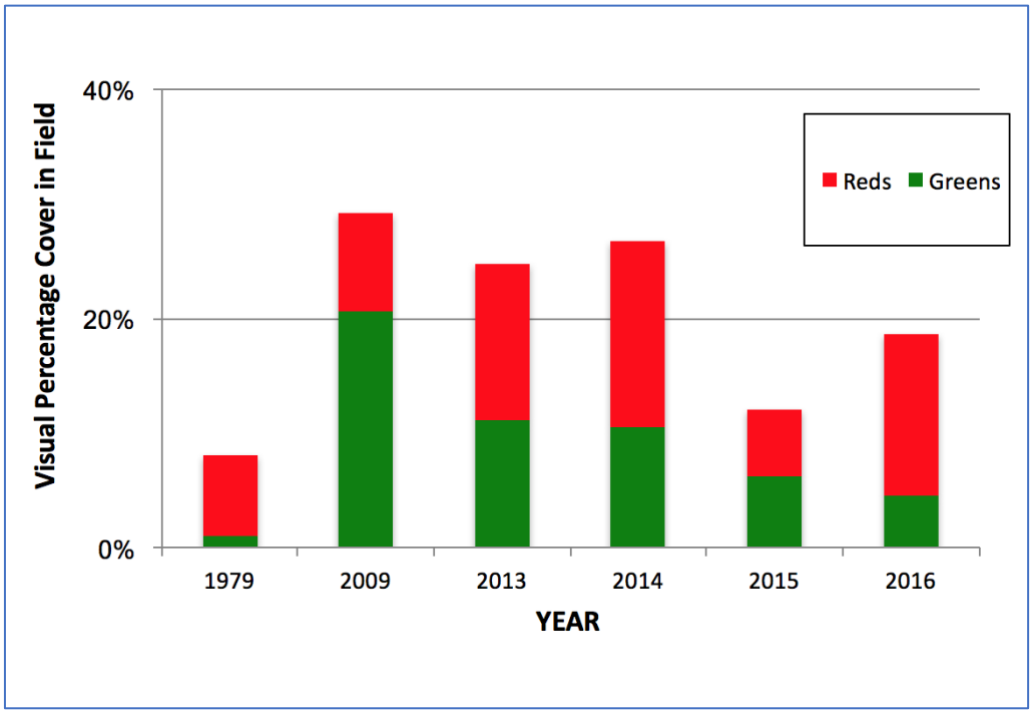

Figure S-2. Percent cover of red and green seaweed at selected intertidal sites in the Great Bay Estuary. Data Source: UNH Jackson Estuarine Laboratory.

The mean percent cover of green and red seaweeds (combined) at a limited number of sampling sites in the Great Bay Estuary was 8% in 1980 but increased to 19% by 2016 (Figure S-2). For green seaweeds, this increase includes the presence of both native and invasive species of *Ulva*. It is notable that no invasive species of *Gracilaria* (a red seaweed) were seen in 1980, but now two major invasive Asiatic red seaweeds (*Gracilaria vermiculophylla* and *Dasysiphonia japonica*) along with a native species (*Gracilaria tikvahiae*) dominate the red seaweeds (Burdick et al. 2017).

While the seaweed data are cause for concern, it is important to note that this dataset is not comprehensive in time and space; more research is required to verify these trends. In addition, these data are restricted to intertidal areas. While important steps to establish a baseline in the subtidal area have occurred, this work needs to be followed up by additional monitoring to better assess trends.

Methods and Data Sources

Seaweed populations have been researched extensively in the Great Bay Estuary and surrounding areas (e.g., Mathieson 1975; Short 1992; Jones 2000; Pe'eri et al. 2008). However, seaweed percent cover has not been monitored in a consistent fashion until recently (Cianciola and Burdick 2014), with the most recent report issued in 2017 (Burdick et al. 2017); this most recent report describes methods in detail and summarizes trends since 2013.

Figure S-2 also incorporates data collected from two earlier studies: the first occurred 1979-1980 (Hardwick-Witman and Mathieson 1983) and the second occurred 2008-2010 (Nettleton et al. 2011).

Seaweed trends were also discussed at two separate PREP Technical Advisory Committee meetings in 2016 and 2017 (PREP 2016; PREP 2017). At the 2017 meeting, data from a recent SeagrassNet report (Short 2017) noted an increase (since 2007) in subtidal seaweed within 12 replicate quadrats sampled along three permanent transects in Great Bay.

Technical Advisory Committee (TAC) Discussion Highlights

Seaweeds as Stressors on Eelgrass

The topic of eelgrass stressors was the focus of two consecutive TAC meetings on May 9-10, 2017; notes and presentations are available (PREP 2017). In the TAC discussions, there was agreement that, in general, seaweed blooms can degrade ecosystems and impact eelgrass as well as shellfish and other benthic invertebrates. The mechanisms by which seaweeds exert a negative influence are fairly well understood; seaweeds can shade eelgrass, rip eelgrass out of the sediment by getting tangled in the plants when the current is running high, and seaweeds can degrade water and sediment quality when they die and decay. One of the external advisors, Chris Gobler, summarized very recent research indicating that seaweeds also exhibit allelopathy. That is, they secrete chemicals that weaken competing plants, such as eelgrass (PREP 2017).

After two days of discussion, TAC participants were asked to fill out a "matrix," which rated the probability of different stressors exerting negative pressure on eelgrass health. Figure S-3 indicates that, of the 26 participants, 18 participants felt that the evidence supports the assertion that seaweeds are currently exerting a negative influence on eelgrass habitat in the Great Bay Estuary. To read the rationale behind the ratings for some of the participants—not everyone offered their opinions verbally—see PREP (2017).

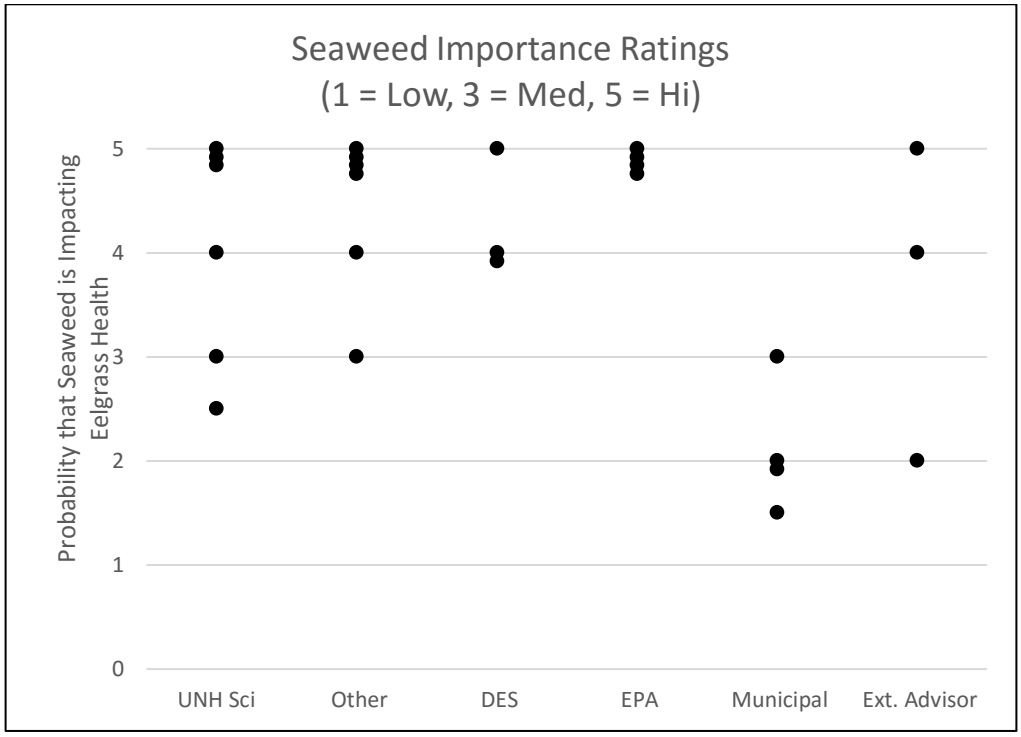

Figure S-3. Results of "matrix" activity asking participants to rate the importance of seaweeds as a stressor on eelgrass. Results are categorized by segments of the community, from left to right: UNH Scientists, Other (e.g., non-profit organizations), NH DES, US EPA, Municipal Representatives, and External Advisors. Dots that are touching represent the same numeric rating, but are separated for visual clarity.

At the May 2017 TAC meeting, the three external advisors advocated that all light-attenuating components (e.g., seaweeds, TSS, colored dissolved organic matter (CDOM) and phytoplankton) be considered together, not separately, because these components act in an additive fashion. This approach to considering light attenuating substances is articulated more fully in the "Stress and Resilience" section of the 2018 State of Our Estuaries Report (PREP 2017b) as well as the "Statement Regarding Eelgrass Stressors" (Kenworthy et al. 2017).

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