Pressure-response relationships of sponges to dredge pressures – a laboratory approach

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Dredging activity poses an environmental risk to filter feeders as sediments may smother the animal surface, clog the aquiferous system or reduce light penetration required for photosynthesizing symbionts. Despite the abundance and ecological importance of sponges, our understanding of how they respond to dredging pressures is limited. To address this knowledge gap, we undertook experimental research in the National Sea Simulator at the Australian Institute of Marine Science to test pressure: response relationships and determine thresholds for sponges and their microbial symbionts. Experiments incorporated a selection of representative sponge species, comprising different morphologies and nutritional strategies (phototrophs vs. heterotrophs). A suite of response variables were assessed, with a particular focus on sponge health (i.e. growth, bleaching, mortality), feeding strategies (i.e. respiration, energetic reserves) and changes in microbial symbiosis (i.e. maximum quantum yields, chlorophyll concentrations, composition of the microbial community). Independent cause/effect experiments teased apart the effects of light reduction, elevated suspended sediments and sedimentation associated with dredging activity, and a final experiment assessed the effect of combined stressors using simulated dredging scenarios. Results revealed that i) light attenuation can adversely impact phototrophic species, with low light levels (<0.8 mol photons m^{-2} d^{-1} for >7 d) causing irreversible damage to *Carteriospongia foliascens,* ii) high suspended sediment concentrations (SSCs) can adversely impact the filter-feeding mode of nutrition, compromising energy stores in the long term, although SSCs of <10 mg L^{-1} could be easily tolerated by most species, and iii) sediment smothering for up to 30 d does not affect adult sponge holobionts as most species possess active and/or passive self-cleaning strategies that enable them to continue feeding. However, the response of some species to the combined effects of all three dredging-related pressures was more immediate and severe than when stressors were applied in isolation. Our results indicate that, although sponges have mechanisms or adaptations to cope with dredging-related pressures in the short term, sponge health can be negatively affected by realistic moderate to high turbidity scenarios (≥10 mg L^{-1}, ≤0.8 mol photons m^{-2} d^{-1}). The sub-lethal stress and mortality thresholds derived from this research will assist regulators and environmental managers in reducing risks from dredging development for this ecologically important group of filter-feeders.