OXYGEN DYNAMICS OF SEA STAR WASTING SYNDROME IN THE SOUTHERN OCEAN

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Introduction

Sea star wasting syndrome (SSWS) has decimated starfish populations along many of the world's coastlines, leading to major changes in community dynamics. While the etiology of SSWS is not well understood, a leading hypothesis is that hypoxia at the starfish dermis - water interface is an important driver. As part of an investigation into the first-known outbreaks of SSWS in the high Antarctic, in 2023 we travelled to McMurdo Station to measure oxygen dynamics on the benthos and on the surfaces of starfish at two sites where we documented outbreaks of SSWS in 2019 and 2022.

Method

We used a diver-deployed AquaPHox system at two sites close to McMurdo Station to assess whether oxygen levels on the benthos at "starfish height" were lower inside areas of known SSWS outbreaks than in areas where stars were unaffected. We also measured and compared oxygen levels on the surface of diseased and healthy starfish to see whether SSWS was associated with surface hypoxia of individual animals. One large outbreak of SSWS was co-located with a methane seep with large associated mats of the sulfur-oxidizing *Beggiatoa*. Along with measuring O_2 on the benthos, we also measured O_2 in and around *Beggiatoa* mats to see whether they caused localized drawdown of oxygen.

FIG. 1. Diver using AquaPHox-LX system with robust oxygen to measure oxygen at the surface of a healthy individual of the Antarctic starfish *Odontaster validus*. Photo by R. Robbins.

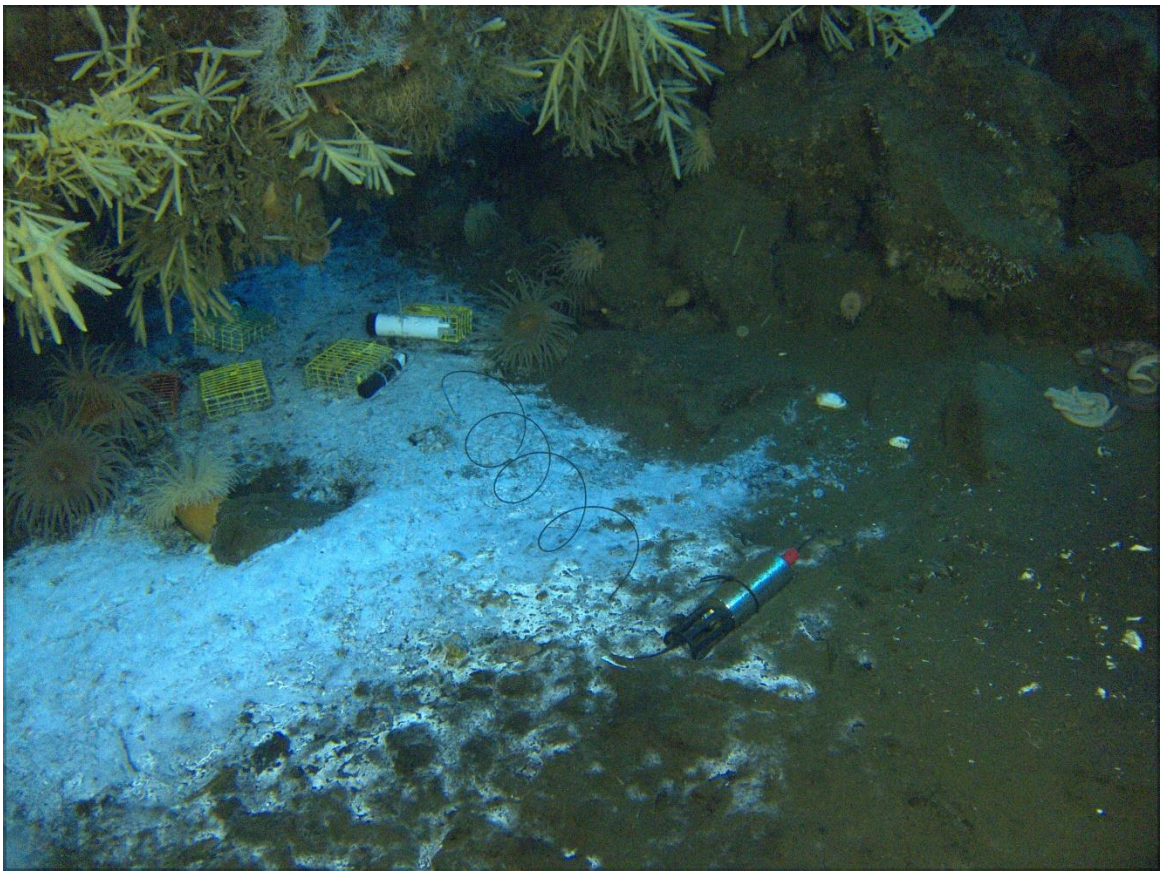

FIG. 2. AquaPHox-LX system with robust oxygen probe deployed at the surface of a microbial mat (Beggiatoa) at 70 ft off the McMurdo Intake Jetty. Photo by R. Robbins.

Preliminary data

Oxygen concentration was low adjacent to *Beggiatoa* mats and the mats themselves were anoxic within 1 mm of the surface. We were not able to detect low O2 at the surfaces of starfish, likely because metabolic oxygen drawdown is so low and neither healthy nor diseased animals had visible bacterial overgrowth.

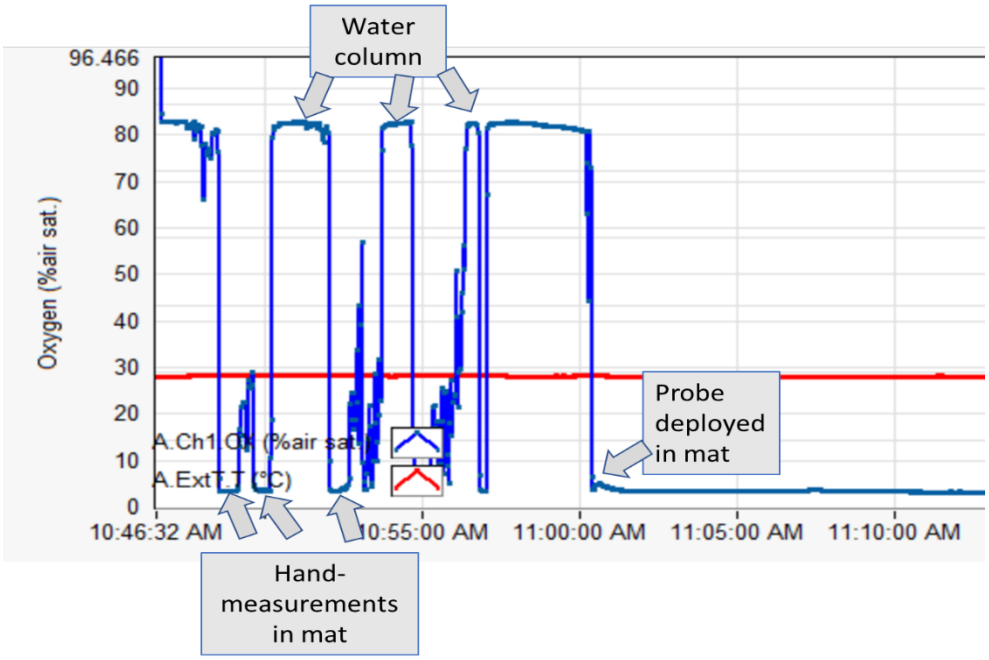

FIG. 3. Oxygen measured in a *Beggiatoa* mat during thedeployment pictured in Fig. 2. The first ~10 minutes of the reading are manual meausurements taken by the diver, who was repeatedly inserting the probe into the top 1 mm of the mat and then removing it. Ambient water column oxygen saturation was ~82%. At ~11:00 the probe was deployed and left with the tip just at the surface of the mat for 30 h.

Conclusion

Our results suggest that organic input (of e.g. methane) drives increased microbial activity on the benthos, and that the increased microbial activity in turn reduces oxygen concentrations at the interface between the benthos and the water column. Hypoxia is a suspected proximal cause of SSWS, so any factors that lead to increased microbial activity on the benthos, such as ocean warming or increasing frequency of methane escape, may lead to more outbreaks of SSWS in the Southern Ocean.