



Do deposit feeders reduce organic loads from floating aquaculture?

Integrated Multi Trophic Aquaculture (IMTA) is the process of growing trophically compatible species in close proximity. In IMTA, lower trophic species feed on excess food and excreted waste (particulate matter and inorganic nutrients) generated from the aquaculture of higher trophic species.

Sea cucumbers have been observed to effectively consume and reduce total organic material (TOM) and total nitrogen (TN) from finfish and shellfish aquaculture in Canada (Palzat et al., 2008; Hannah et. al. 2013). In some aquaculture settings, the high density of species present can increase organic loading from waste, termed bio-deposits. WADNR is interested in whether the native California sea cucumber, *Parastichopus californicus* (*P.c.*), can consume and process this waste from floating aquaculture leases in Puget Sound. The primary goal of this project is to find ways to reduce environmental impacts from some aquaculture. For leaseholders to adopt IMTA, the culture of sea cucumbers must be of relatively low cost and they should grow at a rate to reach marketable size within a reasonable timeframe.

The California sea cucumber is an economically valuable native species that has been overfished in Washington (Carson et. al. 2016). The Washington Department of Fish and Wildlife (WDFW) manages the fishery, however, there is no long-term marking method for sea cucumber. As such, questions concerned with biology such as life span and movement are largely unknown. Concurrently, there has been recent interest in the prospect of restocking local populations through hatchery production.

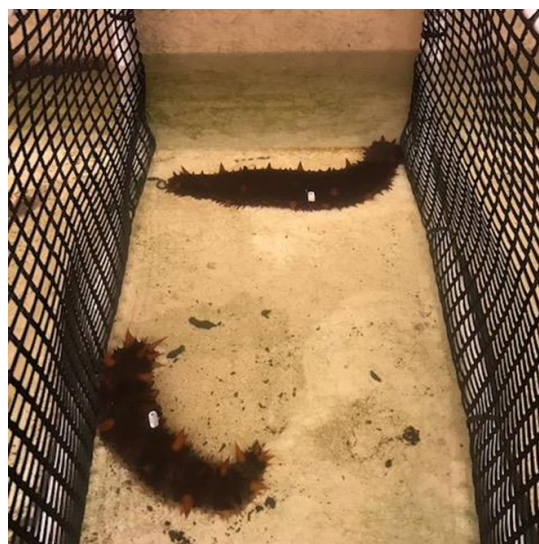
WADNR has designed small and large-scale experiments to investigate: 1. Effective tagging methods, 2. growth rates of *P.c.* at density, and 3. TOM and TN assimilation. We hope to gain enough information to advise whether IMTA can be utilized to clean Puget Sound's waterways.



Juvenile sea cucumber cultured by the Puget Sound Restoration Fund (PSRF) at Manchester/NOAA hatchery.

Why does this matter to DNR?

WADNR aims to the foster water dependent uses while ensuring environmental protection. IMTA could provide benefits to both leaseholders and the environment by economically assimilating organic waste from floating aquaculture.



For more information

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Project Outcomes

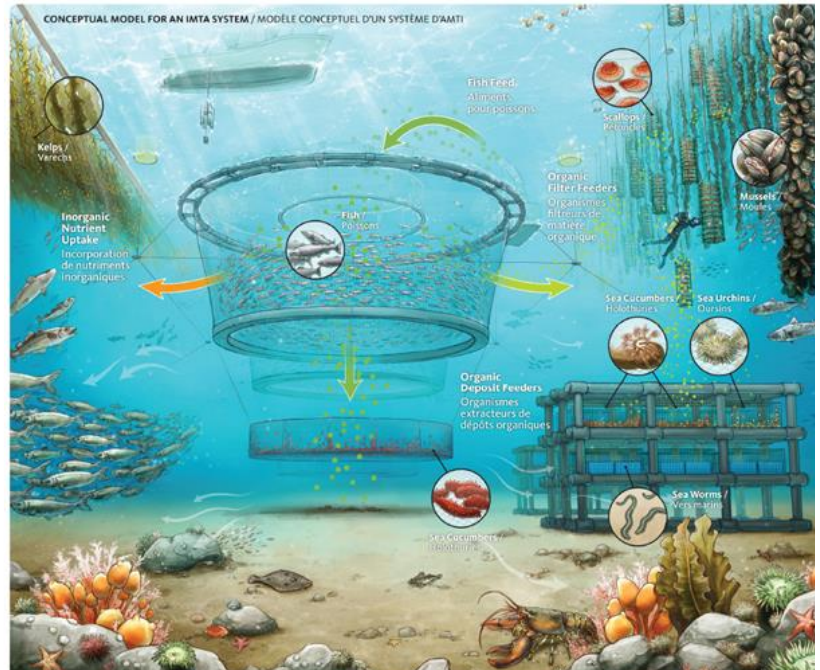
From mesocosm feeding experiments at the Shannon Point Marine Center in Anacortes, WA we have found that *Parastichopus californicus* readily consumes Mediterranean blue mussel (*Mytilus galloprovincialis*) bio-deposits collected from underneath commercial rafts in Totten Inlet WA. We found the total quantity of waste consumed, however, was highest in waste that was lowest in total organic carbon (TOC) and total Nitrogen (TN).

Future Opportunities

The next steps of this study will be to assess the density at which *P.c.* makes a significant impact in consuming the quantity of waste that is produced. To do this, we will place sea cucumbers in cages of different configuration below floating aquaculture. We will assess waste assimilation and animal growth rates as well as TOC and TN conversion. Developing a marking method for *P.c.* is as important for developing IMTA as it is for management and wellbeing of the State fishery. We are currently collaborating in tagging trials with WDFW.



Pilot testing a stainless-loop type tag in the body wall of *Parastichopus californicus*. An effective long-term tag solution will be necessary for both local fisheries and commercial IMTA.



An artistic rendition of a commercial scale IMTA system. Sea cucumbers and other deposit feeders are present below organic fallout from finfish in this system. Photo credit: Fisheries and Oceans Canada, 2019.

Project Outputs

WADNR. 2019. The impact of source of *Mytilus galloprovincialis* bio-deposits on *Parastichopus californicus* consumption, excretion, and composition. Unpublished Report. Interagency Agreement Department of Natural Resources (DNR) NO. 93-096356. Pp. 1-31. Available upon Request.

Project Participants

WDFW is collaborating in tagging effort. WDFW plans to continue involvement in hopes of a large scale mark and recapture effort in Washington State. Research and development projects described above are being developed by graduate students and faculty at Shannon Point Marine Center – in affiliation with Western Washington University.



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