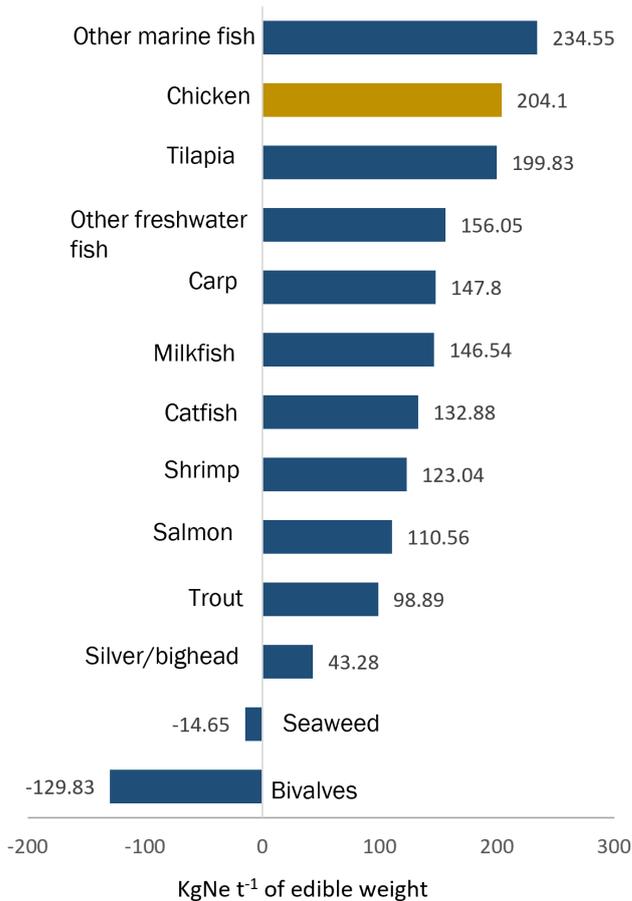


# Ecosystem Services and Environmental Condition Accounting for Oyster Farmers

Moreton Bay Rock Oyster Farm

Oyster aquaculture is well-known to provide a suite of ecosystem services and benefits, including the provision of aquatic habitat and nitrogen removal. In recognition of these benefits, FRDC and Oysters Australia commissioned NineSquared to identify opportunities for the oyster industry in the emerging field of ecosystem service and environmental condition accounting. This is a synopsis of a wider study.



Aquaculture nitrogen emissions showing bivalves as one of two farmed seafoods which remove, rather than produce nitrogen. Chicken is included for comparison as the "lowest-carbon" land-based meat.

## Summary

- 1 The oyster industry outperforms many other sources of land-based protein when viewed from an environmental stress perspective. This can enhance the potential opportunities and role that the oyster industry could play within sustainable diets and shifting demand from relatively high to low stressor foods. Valuing ecosystem services and tracking environmental condition over time allow for these benefits to be measured and communicated.
- 2 Ecosystem services accounting provides a finance-based platform for quantifying natural goods and services to demonstrate the economic benefits of biodiversity and the significance of its loss.
- 3 Environmental condition accounting can help to show the positive/negative effects of oyster aquaculture on ecosystem assets and services over time.
- 4 Recent studies indicate that bivalve aquaculture is associated with higher abundance and species richness of wild macro-fauna when compared to both seaweed farms and reference sites highlighting the role that oyster farms can play as a habitat supporting service.

## Ecosystem Services (ES)

The commercial cultivation of oysters can deliver valuable ecosystem goods and services beyond generating a food product for human consumption.

Types of services are shown in the figure below and range from habitat supporting services to regulating water quality through nitrogen removal, provision of employment and cultural identity.

### Payment for ecosystem services

Payment for Ecosystem Services (PES) translate these positive attributes into monetary terms, rewarding ecosystem service providers for their conservation efforts using positive and conditional economic incentives.

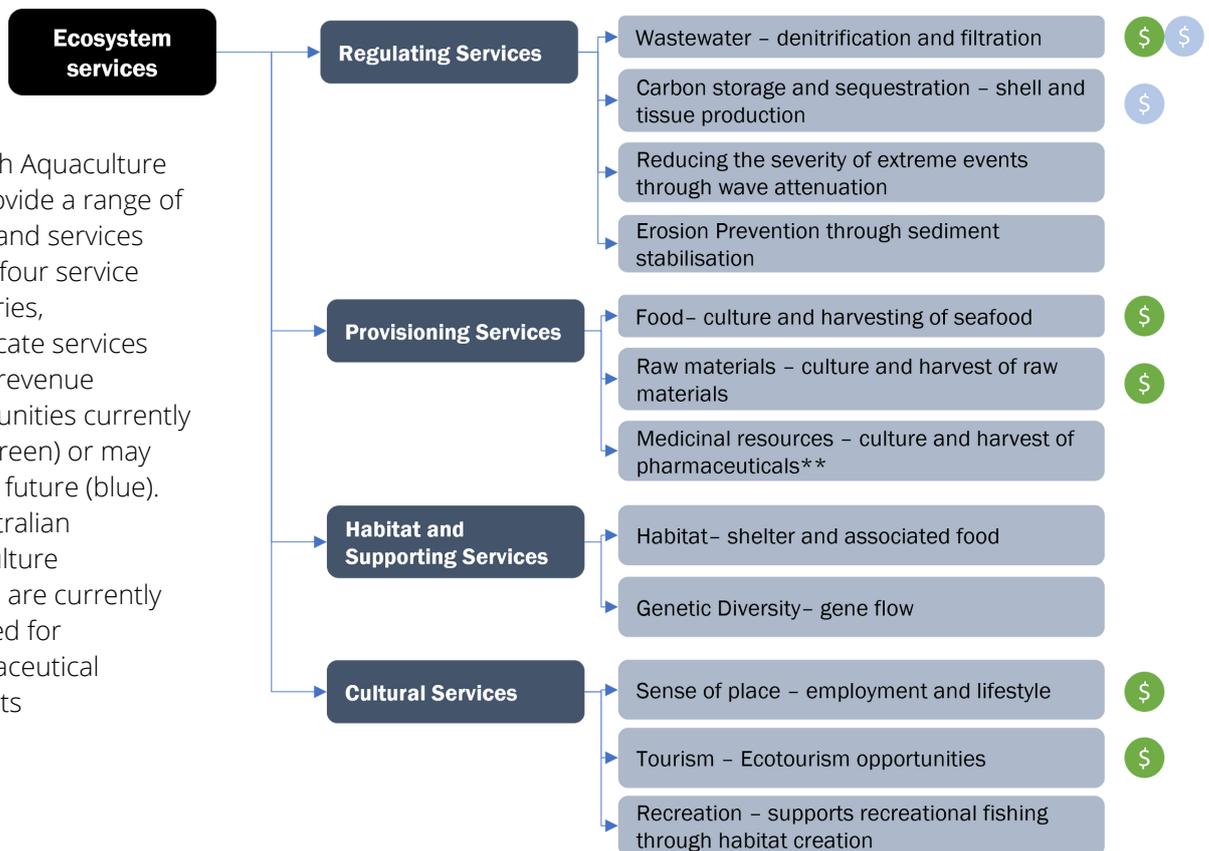
Examples include:

- Food tourism
- Nitrogen removal
- Oyster reef restoration
- Carbon storage



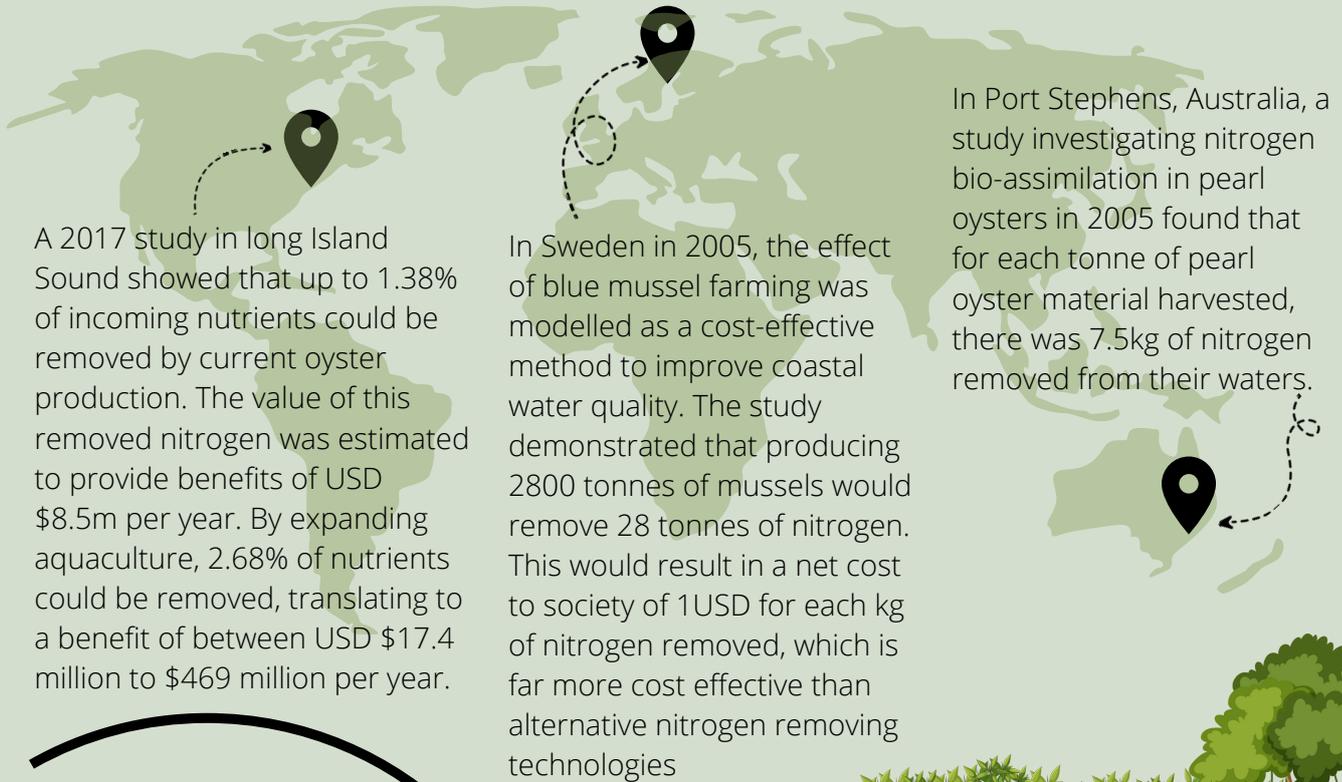
**“** Whilst oysters themselves are small in size, they are one of the most sustainable no feed, no-waste aquaculture operations on the planet. Oysters also provide additional environmental benefits through the filtration of nutrients whilst providing economic and social benefit to the regions in which they occur **”**

Shellfish Aquaculture can provide a range of goods and services across four service categories, (\$) indicate services where revenue opportunities currently exist (green) or may exist in future (blue). \*\* Australian aquaculture oysters are currently not used for pharmaceutical products



# Nitrogen Removal

There are many examples where the removal of anthropogenic nutrients from water through the aquaculture of shellfish has been proposed, modelled, or piloted across the world:

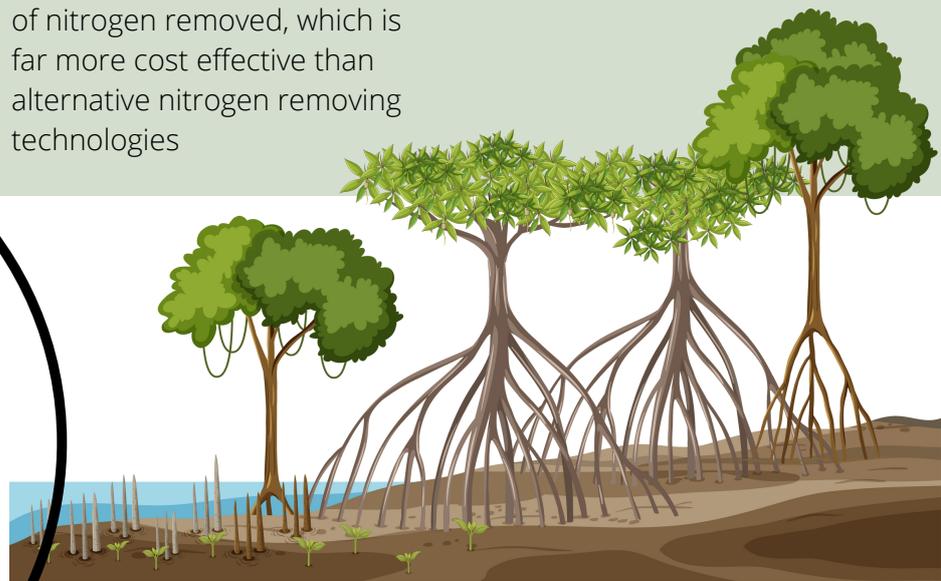


A 2017 study in Long Island Sound showed that up to 1.38% of incoming nutrients could be removed by current oyster production. The value of this removed nitrogen was estimated to provide benefits of USD \$8.5m per year. By expanding aquaculture, 2.68% of nutrients could be removed, translating to a benefit of between USD \$17.4 million to \$469 million per year.

In Sweden in 2005, the effect of blue mussel farming was modelled as a cost-effective method to improve coastal water quality. The study demonstrated that producing 2800 tonnes of mussels would remove 28 tonnes of nitrogen. This would result in a net cost to society of 1USD for each kg of nitrogen removed, which is far more cost effective than alternative nitrogen removing technologies

In Port Stephens, Australia, a study investigating nitrogen bio-assimilation in pearl oysters in 2005 found that for each tonne of pearl oyster material harvested, there was 7.5kg of nitrogen removed from their waters.

**When compared to other nitrogen removal methods and offsets such as riparian and wetland construction, oyster farming is less intensive and more cost efficient to operate while also achieving sustainable food production and employment benefits**



## Key Challenges

The key challenges of payment for ecosystem services in Australia are:

### Conditionality

Meaning that the payments to ES providers are only made if the provision of the ES can be contractually secured, making it necessary to clearly define the property rights and carefully monitor the ES benefits

### Spatial scales

The role of spatial scales for the environmental and social effectiveness of PES programs has not been sufficiently examined in policy or literature. One critical issue is the distinction between the scale of the ES provision versus the scale of the ES benefits.

### Regional vs national

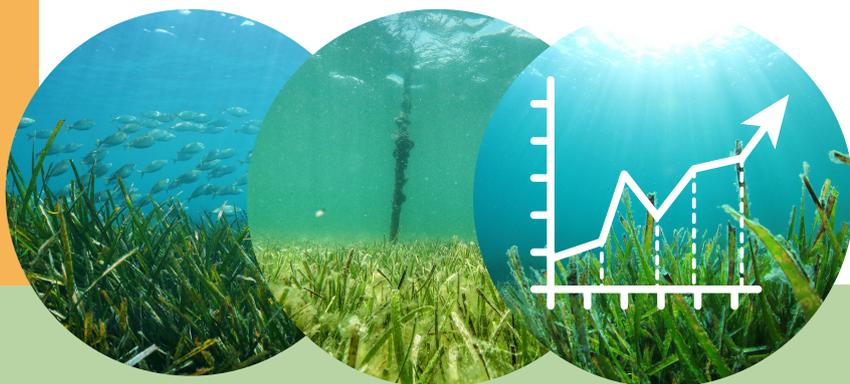
Local and regional schemes provide a range of advantages compared to national or international schemes. There is more indication that local scale PES programs are more effective than other forms, and most PES programs operate at this scale anyway.

## What is it?

- Environmental condition accounting provides standardised, quantifiable assessments of the physical state of “environmental assets” such as agricultural soils, native vegetation and wildlife, rivers and marine ecosystems.
- This enables natural resource managers, policy makers, investors and customers to link the condition of environmental assets with economic decision making.
- Environmental accounting focuses on establishing the condition of environmental assets within a defined area (e.g. farm or protected area) or at a regional (ecosystem) scale.
- Importantly, environmental accounting also seeks to determine the trend in environmental condition - that is, to show whether (or not), and at what rate a resource management activity and underlying investment is making a real and measurable difference on the ground.

The Australian environmental accounting standard is managed by the Accounting for Nature® Framework which is free to be used by any organisation or individual to measure the biophysical condition of their environmental assets over time.

The Accounting for Nature® Framework has been developed so that it complements other standards and certification systems, such as those for developing carbon offset projects, building and assessing impact investment opportunities (e.g. green bond criteria), pursuing corporate sustainability outcomes and achieving global goals such as the Sustainable Development Goals.



## Benefits to an oyster farmer

For oyster farmers who wish to demonstrate the sustainability of their product as well as the low impact nature of their operations on the surrounding environment, the Accounting for Nature Framework provides a certified avenue to support these claims and to also enable a record of management over time.

Examples where this could be beneficial include:

- Creates a long term dataset of how oyster aquaculture and associated operations interacts with the surrounding environment which is becoming increasingly important along with increasing demand for low emissions protein sources from the sea.
- Operating in protected areas where key assets within the lease areas can be monitored and documented over time (i.e seagrass, benthic diversity) to ensure no adverse impact.
- Compliments nitrogen reduction offsets through the monitoring and management of water quality along with other environment assets key to the regional ecosystem.
- Comprehensive data demonstrating sustainable, low impact practices is more likely to assist in future production

# Knowledge Gaps

To more accurately understand and quantify the ecosystem services and benefits that oyster aquaculture operations provide, there are several areas that require further investigation to assist the development of valuation and accounting methodologies and to ensure integrity and transparency of claims. These include:

- Understanding the interacting factors between oyster farms and their surrounding habitats (cause and effect relationships) to better understand how beneficial ecosystem effects can be maximised.
- Understanding the environmental impacts of large-scale expansion, particularly for system specific impacts.

