# Chapter 1
# Introduction to Provisioning Services


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**Abstract** Food provisioning is a prominent feature of marine bivalve production, applicable worldwide since ancient times. Easy accessibility of this food source and high nutritional value make bivalves a possible driver in human evolution. In this section bivalve meat production is addressed, as well as other provisioning services including pearls and bio-active compounds. In both bivalve aquaculture and fisheries, harvest and production for meat provisioning must be balanced against carrying capacity and its implications for other services including water quality maintenance and habitat structure. Provisioning of meat through aquaculture can be improved via hatchery and breeding advances, a necessity in the changing ocean climate.

**Keywords** Human health · Evolution · Production

Provisioning of bivalves as food is perhaps the 'original' ecosystem commodity derived from the ocean, going back to the earliest humans. Indeed, the 'Aquatic Ape Hypothesis' links us directly with an ocean origin and dependence on bivalves (Morgan 1982). The specific consequences of fatty acid intake through bivalve consumption are thought to be critical in the evolution of the human brain (Crawford 2002). Bivalves remain tremendously popular as seafood, procured by hand in shallow water and cooked with the simplest of methods. Their position low in the food chain with no addition of feed and medicine makes bivalve aquaculture eminently future-proof. Interestingly, there is a caste system among bivalves, with oysters perceived as having more cachet than lowly mussels. The concept of white tablecloth dining goes hand in hand with oysters on the menu in France, although perhaps the southern US tradition of an oyster with hot sauce between crackers provides an alternative model. Regardless, bivalves are one of the few seafoods that are

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purchased and sometimes eaten live, and thus embody fresh seafood. Their legendary reputation, particularly of oysters, is further enhanced with promises of aphrodisiac properties.

Bivalve fisheries have a similar long tradition with the prominence of regions such as the Limfjorden in Denmark, Zeeland Delta in the Netherlands and Chesapeake Bay in the USA, famed for mussels and oysters respectively. Some aspects of the fishery have become controversial due to fishing methods including dredging for scallops and suction dredging for clams. Removal of bivalve populations through fisheries has consequences for the provisioning of protein, but also for the removal of their many other services, a major theme of this book.

As with fisheries, bivalve aquaculture was developed initially for its provisioning potential. However, as detailed in other chapters, cultured bivalves provide a myriad of different services such as mitigation of eutrophication, and there are reasons to grow them besides food. An interesting aspect of suspended bivalve aquaculture is the way that it expands the habitat of the cultured species well beyond its natural benthic occurrence. A variety of production models have been developed at farm scale and beyond to predict biomass outcomes of farming. They have subsequently been extended to economic returns on farm yields. The deployment of these models, verified through individual growth rates and production statistics, has contributed to the success of bivalve culture worldwide. Moreover, integration of carrying capacity into these models is a means of forecasting maximum production before growth becomes self-limiting through food depletion.

An important caveat to bivalve production is the health benefit of low fat, high protein meat, rich in marine lipids and minerals. Bivalves do not receive the same attention as finfish regarding health consciousness in the media, but bivalve tissue is well known for its food value.

Like other marine products, bivalves provide a wide array of natural products based on both meat and shell. Joining the host of other marine organisms yielding potential therapeutants, bivalves contain both anti-microbial and anti-cancer candidates among other compounds. Beyond the value of soft tissue, in the tropical oyster *Pinctada maxima* pearl culture is far more valuable than oyster meat. Other uses for shell range from paving material to mother of pearl for inlays in furniture and musical instruments.

Although juveniles for many species of cultured bivalves are obtained from wild spat, the potential for improvements in growth rate and disease resistance via selective breeding are well known. Systemic bivalve diseases, perhaps best known in the Eastern oyster *Crassostrea virginica*, have decimated wild populations, and resistant stocks are an important tool in recovery. Triploidy is an important approach to introductions of alternative species. In cold waters, growth rates of cultured animals are slow to the detriment of profitability, and hatchery production is being established even for species with abundant spatfall. The necessity of breeding for potential climate resistance has become urgent with the impact of ocean acidification on early life history stages.

In this section, authors take a diverse view of these topics, and provide an account of the state of the art in the many direct beneficial uses of the Bivalvia.

## References

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