Approaches to reduce the negative influence of Aquafarming on the biodiversity and water quality of costal ecosystems

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It is now very apparent that climate change significantly affects most ecosystems, resulting in potentially dramatic changes of food webs. Our focus is to effectively use aquaculture and at the same time protect natural resources. This might be realised by complex aquatic circulation systems, which can be stabilised under different environmental conditions. The goal is, to run these systems with minimum input of natural resources and avoidance of waste products, which are having toxic effects on the environment. Due to the interactions of several species in one system, common monoculture systems with high risk of biological collapse can be avoided.

In such multi-complex systems, resources can be shared between different species and wastewater can be strongly reduced. We are currently working on this resource protection technology, where we bring our knowledge in aquatic, marine, and ecotoxicological science together. This knowledge is useful for assessing potential risks in aquaculture and simulating effects under laboratory conditions.
We are presenting circulation systems, combining algae, water plants, invertebrates, and fish species from salt and freshwater ecosystems.

Multifunctional Circulating Aquaculturing Systems

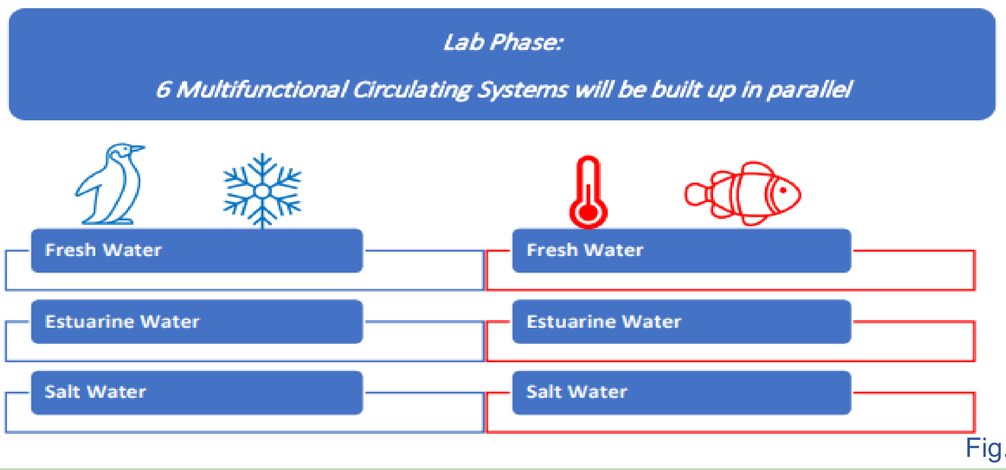

Fig. 1

Systems with cold water species as well as systems with warm water species, belonging to freshwater, estuarine or saltwater ecosystems will be first developed and established in the laboratory (Fig. 1). The systems will contain several species of different trophic levels (Fig 2). Cultures of several aquatic organisms (algae, macroalgae, macrophytes, zooplankton, shrimps, crabs, insects, snails, mussels) will be used for the fish production. Where feasible, laboratory cultures will be set up based on OECD guidelines, which are well-proven for several aquatic species. For fish, potential species will be screened beforehand on their useability and cultivability for aquaculture purposes. With this approach fish may be used for both, farming and restocking.
To protect natural resources, it is important for us to create new fish feed, generated from our own resources, instead of using fish meal and fish oil, which still is mainly derived from wild fisheries. Especially, by using algae, water plants, zooplankton and insects, natural resources can be preserved. Therefore, these organisms will be preferred sources for the cultured fish diets. Where necessary, products of small fish species, shrimps and mussels will be used as feed for omnivore or carnivore fish species. These species will also be cultured in the circulation system and can be feed with lower trophic level species like algae, water plants, zooplankton, and insects.
Furthermore, micro- and macroalgae and water plants have an important role for the stability of ecosystems. Due to their water cleaning capacity and their importance as protein source, they will play a key role for sustainable, aquaculture systems.

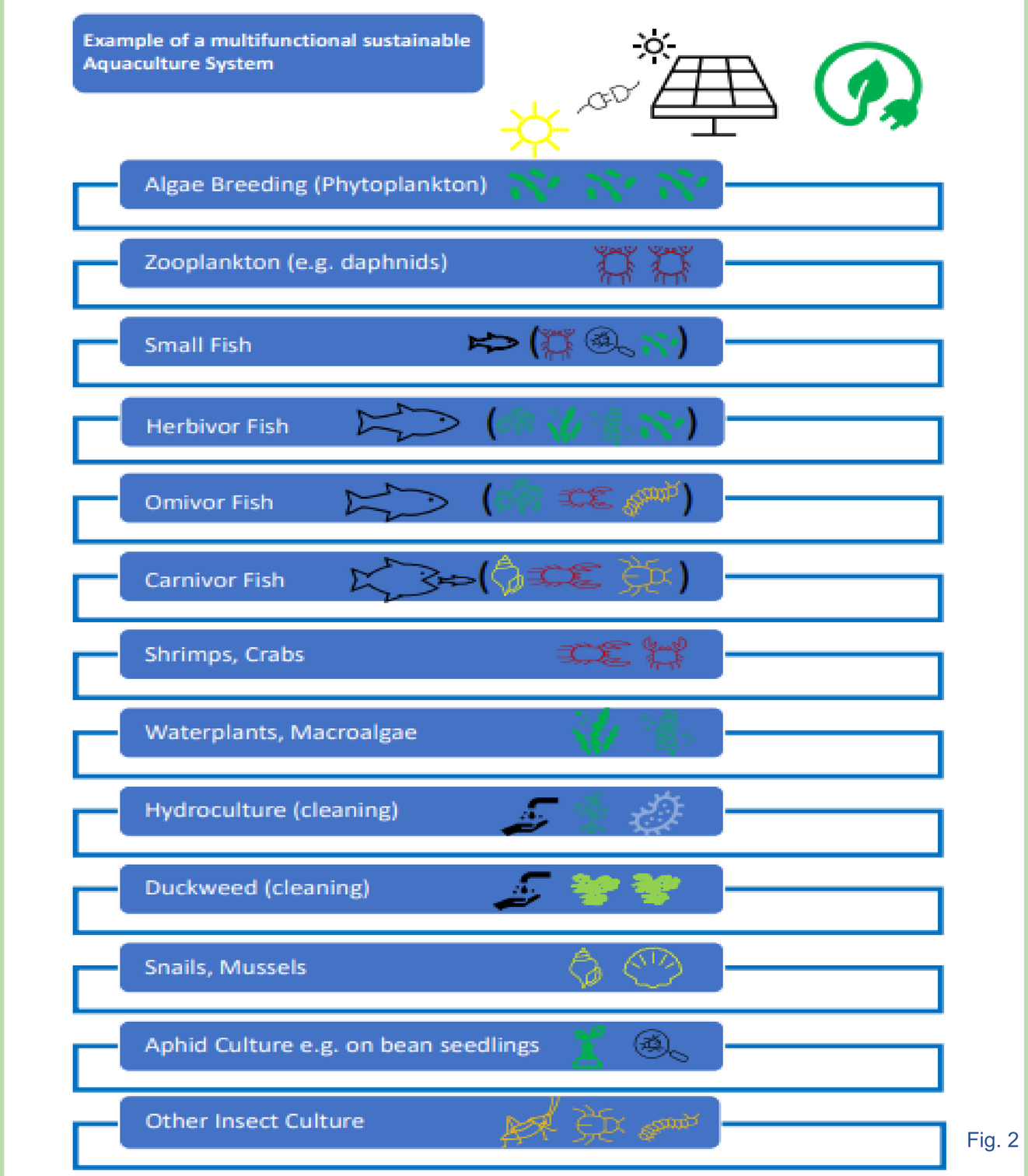

Fig. 2

Multifunctional Circulating Aquaculturing Systems can be used in different climate zones and adapted in different ways. There is the option to run single lines of the multifunctional, sustainable, aquaculture systems (e.g. only cold saltwater species), combining different lines, or running the complete system with all lines. If necessary, different species in the food web can be within a short time replaced with other laboratory cultured species immediately, to ensure good growth of cultured fish. Therefore, this new technology will be more resilient and less vulnerable than currently common aquaculture systems.
In addition, the outcomes cover different kind of positive social impacts. Due to the close monitoring of waste products, the application of ecotoxicological tests and reusing cleaned water, further pollution of marine and freshwater ecosystems will be decreased. Beside this, algae and plant cultures are able to carbonize CO_2. Further, by using green energy (e.g. solar power), CO_2 emissions can be decreased to a minimum.

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