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To whom it may concern

Invasion Myths

Fact is that shipping continues since centuries and that ballast water is in use for more than 125 years. Some thoughts, formerly entitled "Invasions Myths" (Carlton pers. comm.), arise:

"**Every species what could have been introduced is here by now!"**
This is simply not the case. The "window of introduction" theory explains that all factors need to be favourable to enable a successful species introduction. These factors include e.g. temperature, salinity, food availability, lack of predators and the number of specimens for a founder population. It is believed that a successful invasion is only enabled when all these factors involved form the right environment for the new invader. However, the factors listed are highly flexible and one can easily think of thousands of theoretical combinations. It is unlikely that all optimum conditions enabling an invasion occurred already in combination with the release of a sufficient number of individuals to form a self-sustaining population. Further, improvements in shipping result in more frequent ship arrivals and shorter voyage durations increasing the survival rate of species in transit. One example is the introduction of the zebra mussel in the North American Great Lakes in the 1980s. Shipping from source regions of the species occurred for many decades before the species was introduced.

"**Why do we need to go active right now?"**
The number of invaders was increasing towards the end of the last century. Several investigations have shown that since 1950s the number of new records of invaders have clearly increased. Further new free trade agreements and ship improvements (larger and faster ships result in more frequent ship arrivals) may possibly increase the invasion rate even further. The increasing invasion rate indicates the need for immediate action.

"Invasions are part of nature and would happen anyway. The only thing shipping does is to speed up the process."
This is simply not true as there is no natural means to transport an aquatic species from e.g. USA to Australia. Biogeographical textbooks describe the Pacific Ocean as a migration barrier as the duration of the larval phase of zooplankton organisms is too short to enable a distribution across the Pacific with natural means. Human mediated vectors are essential here. Further, ballast water transports when using fresh water may result in the movement of fresh water organisms across the oceans. These organisms would not be able to migrate through higher saline water by natural means, i.e. an introduction without ballast water movements is unlikely.

“Humans should not interfere with species distributions as this is a natural phenomenon.”
As most scientists, invasion biologists know that biological components and their interaction in an environment are not a stable process. It was agreed that initiatives should not be undertaken to hinder natural migration activities of species. However, human mediated introductions should be kept to a minimum as matter of a precautionary approach. Case histories have shown severe, unwanted impacts of invaders being introduced unintentionally with e.g. ballast water. Natural migrations and human mediated introductions should clearly be treated separately.

“**Only 10% of the invasions have a significant impact.”**
A statement what refers to the "10´s"-rule. The rule was originally postulated based on invasion histories in terrestrial habitats. The figure was revised frequently. No matter how detailed these revisions were it has to be noted that each invasion has its impact on the receiving habitat. In some cases the impact is quite clear, in other instances the impact is not as obvious. Further, in many cases an impact is noted when the invader forms a mass development what may occur long time after the initial introduction.

“**Phytoplankton species are not matter of discussion as these species are distributed world-wide anyway.”**
It was documented that the number of phytoplankton blooms was increasing during the last two decades world-wide. It was suggested that this is supported by biological invasions. The recent first record of the potentially toxin producing phytoplankton algae in the North Sea is a good indication that we should be prepared for additional invaders of this kind.

“**Keep the ballast water onboard as long as possible as the species will die over time.”**
Although many species die during the first days in ballast tanks, scientific studies have shown that even after 116 days living zooplankton can be found in ballast tanks. Further, under certain circumstances some zooplankton species even reproduce in ballast tanks. In addition, some plankton species are enabled to form resting stages that survive unfavourable conditions for years. Therefore, keeping ballast water onboard for longer periods of time is not a measure to significantly reduce the risk of species invasions.

“The exchange of ballast water in high seas is a an appropriate means to reduce the number of invaders.”
The exchange of ballast water in mid-ocean can reduce the abundance and diversity of taxa in ballast water. It is unlikely that coastal organisms taken up in ports will survive open ocean conditions when ballast water is exchanged – and plankton from high seas is unlikely to survive in coastal areas.
In contrast scientists showed that the exchange of ballast water can increase the species diversity in ballast tanks, especially in many domestic shipping routes, where no deep water exchange zones occur. Even when exchanging the ballast water in mid-ocean the number of individuals in ballast tanks may increase when ballast water exchange is undertaken in zones with phytoplankton blooms.
Ballast water exchange is recommended as a very first measure to reduce the organism load in ballast water. It is well known that this is not very effective and may further pose a safety risk to shipping. Effective treatment measures are urgently needed to avoid ship-mediated species invasions in the future.

Further questions? Please do not hesitate to contact us at sgollasch@aol.com