Blue Papers
2022 (Vol. 1 No. 1), 88-97
10.58981/bluepapers.2022.1.09

On the Frontline of Climate Change: The Underwater Cultural Heritage of Stone Tidal Weirs

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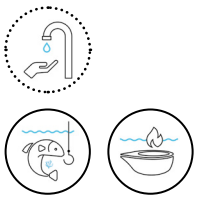
Stone tidal weirs are not just relics of the past; they also serve as a guide to future sustainable marine ecological conservation. They symbolize the ability of humans to adapt, use, and live in balance and harmony with the ocean environment. Situated along intertidal or coastal zones, these stone tidal weirs are on the frontline of climate impact and are often abandoned as the local community cannot afford the costs of repair. This has led to loss of this valuable traditional resource management system that contributes to tangible and intangible heritage of coastal communities, as well as to culture and biodiversity.

KEY THEMES



< *Fig.1 Stone tidal weirs in Japan (Source: Akifumi Iwabuchi).*

^ *Fig. 2 Stone tidal weirs in Timor-Leste (Source: Akifumi Iwabuchi).*

Introduction

Stone tidal weirs, a form of underwater cultural heritage, are a type of fish trap or barrier, operated only by tidal amplitude. These structures are made of large rocks or coral limestone, extending along the shoreline on a colossal scale in a semicircular, circular, arrow-like, or almost linear shape (fig.1). Stone tidal weirs are completely submerged during high tide, but emerge into full view at low tide, allowing people to collect fish, which cannot escape their stone walls (Iwabuchi 2014). Many examples still exist and provide a tangible link to a sustainable or eco-friendly fishing practice that has incorporated traditional ecological knowledge and is connected to the spirit world, providing balance and harmony for indigenous people for thousands of years. In other words, this tangible heritage also has intangible or living heritage features, and combining the two it forms a local traditional resource management system. In many local coastal communities, almost all the weirs are still used for fishing. They are located within seascapes created and maintained by harmonious interactions between humans and marine ecosystems (Montgomery et al. 2015). For instance, the indigenous ecological knowledge tells local people that the quantity and quality of fish has been improved after they build stone tidal weirs along the coastal zones. However, this traditional knowledge is usually shared only among local networks and not at the national level.

Current Approaches to Preserving and Managing Water Heritage

Today these weirs are not just relics of the past, but they also serve as a guide to future sustainable marine ecological conservation. Stone tidal weirs symbolize the ability of humans to adapt, use and live in balance and harmony with the ocean environment. Stone tidal weirs contribute to marine biodiversity. Compared to intertidal zones without stone tidal weirs, those with stone tidal weirs host a greater diversity of marine species (Pattrick et al. 2022; Zayas 2019).

The stone tidal weirs also contribute to rich intangible heritage values that often inspire creativity and continuity of traditional knowledge for local communities (Jeffrey 2013). For example, in Hainan Island, China, the traditional ecological knowledge of local songs and other oral traditions, which mention the lunar calendar and days and times of the flood and neap tides. Local fishermen have passed down songs from generation to generation as a reminder of the fishing season at stone tidal weirs. In commemoration of a good haul at a stone tidal weir, the Mullet Memorial Service Pagoda was built in western Japan by its owner. Mullet, and fish in general, are anthropomorphic beings with spirits, which are respected profoundly by local people in Japan. In celebration of large catches with stone tidal weirs, therefore, the local community conducts ceremonial rituals and erects religious memorial service pagodas, which are actuated by the community spirit of local coastal communities. The rich local traditional ecological knowledge around stone tidal weirs is maintained by members of local coastal communities, which perform fishery-related ritual activities such as beach-opening ceremonies and frequent community-led repair work. On the island of Hawai'i, some stone tidal weirs have been diverted into fishponds to be used by locals to produce fry (young fish). Traditionally, local communities use stone tidal weirs twice a month during the spring tide; a custom that has been preventing overfishing. In Timor-Leste, only fish spears are allowed to be used inside stone tidal weirs, because the stone tidal weirs

^ *Fig. 3 Stone tidal weirs in the People's Republic of China (Source: Akifumi Iwabuchi).*

function not only as fishing gears but also as fish spawning grounds. Local fishermen only manage to catch large fish with the spears, while small fish continue to grow (fig. 2). As a communal activity, Timorese throw raw chicken meat into stone tidal weirs at the beginning of the fishing season, praying for good fishing, and then they all undress together to repair stone tidal weirs.

Current and Future Challenges to this System

The stone tidal weirs are extremely vulnerable to global climate change, specifically to the ocean climate crisis. Recent field surveys and participant observation reveals that many stone tidal weirs have been abandoned or simply not repaired, largely because of ocean environmental change. If sea levels rise more than a meter, stone tidal weirs no longer function as fishing gear. These days, many fishermen in coastal communities agree that the tide is not ebbing as much as previously. Climate change is fueling destructive storms and high waves, and then subsequently, coastal erosion; after stone tidal weirs have been destroyed, many coastal communities cannot afford to repair them and leave them abandoned. Once stone tidal weirs are abandoned, fewer fish are caught. As the attention of local people shifts to destructive modern fishery, all aspects connected to cultural diversity have also disappeared. In order to maintain sustainable coastal communities, biocultural diversity must be retained; stone tidal weirs can serve as a symbol of such diversity.

All over the world, indeed, the underwater cultural heritage of stone tidal weirs is in danger of being lost, as cultural heritage and as traditional fishing gear. Especially in East Asia, typhoons are the greatest threat to stone tidal weirs. As a result, it is now difficult to carry out community activities and take care of spirits properly. In Southeast Asia, stone tidal weirs near larger towns have been catching not fish, but only ocean plastic debris. Just outside them, modern fishery fleets and fishing nets are catching almost all the available young fish, which could manage to escape the stone walls of stone tidal weirs as well as from fishermen's spears. In addition, ocean acidification is depriving stone tidal weirs of their important function as an artificial womb for marine species.

Conclusion and Future Approaches

Stone tidal weirs have improved community health, since higher-nutrient fish contributes to people's well-being, and is associated with lower child mortality, improved cognitive performance, and strengthened immune function. Heritage items situated along the intertidal or coastal zones, including the underwater cultural heritage of stone tidal weirs, would be the first cultural property to disappear as a result of climate change. On the other hand, some coastal communities have started to use the stone tidal weirs as a tourist attraction and the site of environmental education for younger generations (Zayas 2019). According to the UNESCO 2001 Convention on the Protection of the Underwater Cultural Heritage, the stone tidal weir is one of the most typical underwater cultural heritage items to be safeguarded, but its future is uncertain. A few countries, such as the Federated States of Micronesia or Taiwan, have already started to safeguard the underwater cultural heritage of stone tidal weirs, within the framework of national governmental cultural policy. However, many countries, such as China (fig. 3), Japan, or Timor-Leste, do almost nothing to safeguard them, mainly because stone tidal

weirs are not the underwater cultural heritage of shipwrecks.

Acknowledgment

This contribution was peer-reviewed. It was edited by members of the editorial team of the UNESCO Chair Water, Ports and Historic Cities: Carola Hein and Queenie Lin.

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