

# Stone Tidal Weirs, Underwater Cultural Heritage or Not?

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## Abstract

*The stone tidal weir is a kind of fish trap, made of numerous rocks or reef limestones, which extends along the shoreline on a colossal scale in semicircular, half-quadrilateral, or almost linear shape. At the flood tide these weirs are submerged beneath the sea, while they emerge into full view at the ebb. Using with nets or tridents, fishermen, inside the weirs at low tides, catch fish that fails to escape because of the stone walls. They could be observed in the Pacific or the Yap Islands, in the Indian Ocean or the east African coast, and in the Atlantic or Oleron and Ré Islands. The UNESCO's 2001 Convention regards this weir as underwater cultural heritage, because it has been partially or totally under water, periodically or continuously, for at least 100 years; stone tidal weirs have been built in France since the 11th century and a historical record notes that one weir in the Ryukyu Islands was built in the 17th century. In Japan every weir is considered not to be buried cultural property or cultural heritage investigated by archaeologists, but to be folk cultural asset studied by anthropologists, according to its domestic law for the protection of cultural properties. Even now in many countries stone tidal weirs are continuously built or restored by locals. Owing to the contemporary trait, it is not easy to preserve them under the name of underwater cultural heritage. Sometimes their bases were constructed several hundred years ago while their upper parts were repaired very recently.*

**Key words:** stone weir, tide, fish trap, underwater cultural heritage, 2001 Convention

## Introduction

The stone tidal weir is a kind of fish trap, made of numerous rocks, boulders, or reef limestones, which extends along the shoreline on a colossal scale (Fig. 1), in semicircular, circular, half-quadrilateral, horseshoe, keyhole, or almost linear shape. At the flow tide it is completely submerged beneath the sea, while at the ebb, in particular during the spring tide, it gives its entire figure on the tidal zone. Then, fishermen step into such weirs in order to catch fish, which fails to escape from them owing to the stone walls, by hand or with small fishing gears such as hand-nets or tridents (Fig. 2). Occasionally, some opening spaces between stone walls or tunnels under each wall are cut through a weir for the purpose of being drained water easily and being gathered preys; outside such spaces or tunnels, fishing nets, gratings, or basket traps are usually



Fig. 1 Stone Tidal Weir in Japan. (A. Iwabuchi)

set. The passive fishing gear of stone tidal weir, which operates only on the strength of tidal amplitude, is different from the active fishing gear of fish fence or trapped chamber, which guides the fish into the specially arranged ends or labyrinths where they are trapped (Gabriel et al., 2005).

Usually, however, we cannot draw a hard and fast line between those two

kinds of gears. Some stone tidal weirs have pectinate fish fences which project from their walls, and some have labyrinths at their outer tips.

### **A Wide Distribution**

Stone tidal weirs could widely be observed all over the world, viz. in tidal zones of western Japan, southern Korea, Formosa, Southeast Asia, Micronesia, Polynesia, Melanesia, the Indian Ocean, and Europe. In Kyushu Island and its adjacent small islands of western Japan, stone tidal weirs are named *ishihibi* or *sukki*. Around Ariake Bay of Kyushu Island, approximately 200 weirs did exist around 1707, and then until recently no less than 100 stone tidal weirs were still on active service. The most famous one was 'Bora-zukki' or 'Mullet Tidal Weir', which was filled up innumerable mullet in 1881; there is a stone monument in commemoration of this event on the seashore near this stone tidal weir's ruin. In the Ryukyu or Okinawa Islands, they are named *kaki*, which used to number about 100 (Iwabuchi, 2012a). In 1972, there were 27 stone tidal weirs around Kohama Island: 7 were still on active service, 11 were abandoned, and 9 were left only their traces. Other than the last 9 disappeared weirs, however, it is said that many small stone tidal weirs which has already faded completely out from sight seem to have existed before. In this isle of the Ryukyu Islands some stone tidal weirs have semicircular shape and some have linear one. The length of stone walls varies in stone tidal weirs; the longest wall is approximately 800 m, while the shortest one is 200 m (Yano et al., 2002). Generally in Japan, including this isle, stone tidal weirs are owned not by professional fishers but by local peasants.

In southern Korea, the stone tidal weirs are called *döksal*, *sŏkpangryŏm*, *sŏkchŏn*, or *wŏn*. Although they used to be important at Korean traditional fishery, their number has already decreased to an extreme. Around Jeju Island in the Korea Strait, 4 stone tidal weirs are still being used, in particular, for the sake of catching anchovies. In Formosa around the Penghu Islands, there are still approximately 500 stone tidal weirs named *chioh-ho*. In terms of their types, they could be divided into three. The first consists of traditional semicircular or horseshoe-shaped stone tidal weirs. The second is composed of stone tidal weirs,



Fig. 2 Japanese Fisher. (A. Iwabuchi)

each of which has several pectinate short stone walls extended inward from an original stone wall; these short walls serve for driving fish as well as for dividing a stone tidal weir into several parts with each family's fishing right. The last type is stone tidal weirs, each of which has at its tip a labyrinth as fish trap. In the Penghu Islands, the golden age of stone tidal weirs, which used to be one of the most important fishing methods at coastal villages there, was 100 years ago, but their economic or social value has already been diminished mainly because of modern onshore fishery. Nowadays their touristic and educational purposes are more stressed (Tawa, 2007). In Southeast Asia, stone tidal weirs are reported to be in the Philippines, Thailand, and Indonesia. In the Philippines, the stone tidal weirs named *atob* around the Visaya Islands already existed at the beginning of the 20th century, and then still in the 1970's new weirs kept being built or old weirs kept being restored (Tawa, 2007). Eastern Indonesia seems perhaps to be the world-centre of stone tidal weirs:

*Stone walls in tidal areas can be used in a similar manner, as is done in Indonesia (western Flores). There, a wall is built in the shallow water parallel to the sea shore. As in some of the Japanese stone walls, there are passages through which the fish can enter with the flood, but they are prevented from escaping on the ebb tide. The outlets are closed and the fish remain in the water-filled channel behind the walls until they are collected (Gabriel et al., 2005).*

In Indonesia, fish fences set in the form of labyrinths, made of brushwood, are ubiquitous on tidal zones, and stone tidal weirs as primordial type of such fish fences are still widely used; new ones are also continuously built by locals, in particular, when famine strikes maritime settlements. Almost all islands of Micronesia, including the Caroline, Palau, or Gilbert Islands, used to have millions of stone tidal weirs around them. In the Chuuk Islands the stone tidal weirs are named *maai* and in the Yap Islands *aech*. In the former, there are three types, i.e. conventional semicircular type, tennis racket-shaped one, and inverted keyhole-shaped one. In the last type, the seaward open side of each weir seems to be closed by fishing nets or trap baskets when the tide is on the ebb. In the Yap Islands, the stone circle of the Chuuk's second type is transformed into the boomerang-shaped or arrow-shaped stone circle, inside which people catch fish at the ebb. There, however, some do not have 'racket' shafts lying perpendicular to the shoreline. In olden times, moreover, there inverted triangular stone weirs seem to have existed; as the outward bottom of each triangle did not possess any stone walls, locals set nets or trap baskets when the tide was outgoing (Tawa, 2007). They say that possibly more than a thousand years or more ago these weirs were built, and from 700 to 800 stone tidal weirs have been documented (Guérin et al., 2010), but with reducing island population after Europeans arrived those stone tidal weirs began falling away into disuse. At the end of the last century, many seemed to have been abandoned and never been repaired again.

In the Hawaii Islands, the stone tidal weirs are called *loko 'umeiki*. There, there are also many fishponds named *lokokuapa*, of which shapes are entirely similar to conventional stone tidal weirs. Some fishponds are built across the mouth of a small bay or between two points of land, and some semicircular-shaped ones are built independently on seashores in order to be raised fish such as mullet or milkfish. Contrariwise, each stone tidal weir is surrounded by a low wall that is submerged at the high tide and has opening,

walled on each side like lanes, leading in or out of the weir (Nishimura, 1981). In Rarotonga Island of the Cook Islands every tidal weir is also used as fish trap into which fish is driven toward nets between boulders by locals, although its detail is not clear. There it is named *pā* (Takeda, 1993), which originally means an eel weir in the Maori language. The Maori of New Zealand uses even today stone walls for their eel fishery; these are not artificial, but built by nature by the strong wave of the sea (Gabriel et al., 2005). Around many islands in Torres Strait as well as around Cape York at Melanesia, numerous stone tidal weirs could be observed, and they represent the most obvious fishing technique utilized in this area.

*On the eastern aspect of the large fringing reefs of a few of the western islands, but notably in the eastern islands, long low walls of unworked boulders of stone were built, or rather piled up, to a height of three or four feet. These walls enclosed large irregular areas of the reef, graz(W.), sai (E.). During the north-west monsoon, when the sea is calm on the lee-side of the island, large numbers of fish swim over the walls at high tide, they are prevented by the low night tide from escaping and so fall an easy prey (Haddon, 1912).*

Of the Eastern Islands around Darnley Island there are 34 stone tidal weirs, and in Stephens Island there are 23. Some have at their tips protruding navels without labyrinth where a lot of fish gather at the ebb (Barham, 2000). Similar navels are reported from stone tidal weirs of the Ryukyu Islands or of southern Korea. Around the Indian Ocean, much information upon stone tidal weirs is not available. It is said that the Mascarene Islands (Yabuuchi, 1978) and the Lakshadweep Islands have stone tidal weirs. In the latter, the stone tidal weirs are called *padhi*; as their open ends face the lagoon while the seaward ends are usually closed, fish that tries to leave the lagoon during receding tide enters and remains in the enclosure. They are family owned properties which are acquired by inheritance (Anand, 1996). Along the East African coast, there seem to be stone tidal weirs. Coast Bushmen and pastoral Hottentots are reported to have constructed and used stone tidal weirs (Nishimura, 1981). Near the towns of Stilbaai and Arniston in South Africa there are stone tidal weirs (Parthesius, 2011), but the relation between these weirs and ones by Bushman and Hottentots is obscure. Along the western coast of Africa, stone tidal weirs are constructed by natives, such as Guineans (Gabriel et al., 2005), but we do not really know much about them.





Fig. 3 'Mouffet' in Ré Island. (A. Iwabuchi)

There are many stone tidal weirs in Scotland (Bowens, 2009) or in western France. Ré, Aix, and Oleron Islands off the western coast of mainland France would be the European centre of stone tidal weirs. In Oleron Island there were about 40 stone tidal weirs at the end of the 19th century (Bithoneau et al., 1993), while in Ré Island there were something over 30 weirs at the beginning of the 15th century, approximately 140 in the latter part of the 19th century, and only 14 at the end of the 20th century. A French stone tidal weir is named *l'écluse à poissons* and weirs are *les écluses à poissons*, but all tidal weirs have their own proper names. The largest stone tidal weir at Ré Island, whose length is about 1000

m, is named 'Mouffet' or 'Skunk' (Fig. 3), and the smallest one, whose length is about 300 m only, is 'Le Petit-Port' or 'Small Port'. Every weir is collectively owned by local peasants who catch fish at time assigned as separately with a hand-net or a trident inside his weir sometimes in the daytime and sometimes at night. One stone tidal weirs named 'La Belle-Pointe' is equipped a metal basket trap, as replica of an old wooden basket, on the outer side of a drain gap between the stone walls (Fig. 4). Fish caught is only for domestic consumption; it is never on the distribution channel to commercial fish markets (Iwabuchi, 2002).

### Stone Tidal Weirs and the UNESCO's 2001 Convention

Article 1-1 of the UNESCO's 2001 Convention on the Protection of the Underwater Cultural Heritage provides that 'underwater cultural heritage' means all traces of human existence having a cultural, historical or archaeological character which have been

partially or totally under water, periodically or continuously, for at least 100 years. First of all, all stone tidal weirs are partially or totally under water periodically, and so they do correspond to the first half of the above definition. However, not all stone tidal weirs are more than 100 years old. Indigenous people in Southeast Asia or in the Pacific are still constructing new weirs every day. Owing to ecological conditions, nonetheless, they seem not to build stone tidal weirs on completely virgin tidal zones. They always build them exactly on traces for old weirs or, at least, on tidal zones which used to have millions of old stone tidal weirs. These days, in other words, most locals are, not constructing, but repairing old weirs every day. According to A. C. Haddon, no native within the memory of man ever made a stone tidal weir around Torres strait, and all they can do now is to repair them (Haddon, 1912).



*Fig. 4 'Le Petit-Port' in Ré Island. (A. Iwabuchi)*

It is within the bounds of possibility that only the lower parts or stones of a new tidal weir or its basement are more than 100 years old. However, it is extremely difficult to guess

how old even its base is, mainly because no written historical material is recorded for almost all stone tidal weirs. Some anthropologists insist that the stone tidal weir itself is considered a very old fishing method, and some existing today date back to early Neolithic times, and even to the pre-Sapiens phase of human evolution (Nishimura, 1968). It is true that contemporary foragers are also using a kind of stone tidal weir. Canadian Eskimo, for example, uses not only fish traps but also stone tidal weirs named *haput'*. This horseshoe-shaped weir is built at a river mouth. Its stone wall seems to be extremely low, in comparison with Taiwanese or French walls, but it is completely submerged at the high tide and then at the ebb foragers go into the weir, which has depth 60 cm only, to catch charr. Similarly, northwest coast Indians used to build stone tidal weirs, in particular, at river mouths (Stewart, 1993). It is said that Australian aborigines also use stone tidal weirs. Impounding shallow enclosure of boulder fences were formerly in use among them, although Hornell classifies this technology as fish trap, not as stone tidal weir (Hornell, 1950).

Nevertheless, stone tidal weirs among primitive foragers are rather smaller-scaled than modern tidal weirs observed in Japan, Formosa, or France. Very few written records say that the large-scaled stone tidal weirs were all constructed during the feudal age. In Ré Island, stone tidal weirs were started to be constructed at the 11th century or at the Middle Age (Boucard, 1984). In Kyushu Island of western Japan their golden age was around 1707; the local feudal lord imposed corvée to the peasants to construct or restore large-scaled stone tidal weirs. In the Ryukyu Islands, there is one historical document written in 1824 telling us that a female priest who was granted an official court rank by the lord of Ryukyu kingdom mobilized commoners by royal decree to build a stone tidal weir whose length was about 1200 m around the 17th century (Nishimura, 1975; 1981). In Korea and Formosa, there is no evidence that the class of rulers played a large role in constructing stone tidal weirs, but usually all the villagers seem to have turned out in full force for restoring or building them. Without substantial labour power, it would not have succeeded in constructing large-scaled stone weirs. In the Hawaii islands as well, the remarkably well-preserved chain of offshore fishponds is a leftover of local chiefs, and the ponds are raised fish to feed the ruling class (Nishimura, 1981). Indeed, for example, the Torres Strait Islands do not have any feudal systems, but at



least the society is not a band-based foraging one but a horticultural chiefdom. At those coastal hamlets there seem to have been powerful builders or chiefs who had mobilized villagers in order to construct or repair stone tidal weirs (Haddon, 1912). Building stone tidal weirs might have something to do with the population growth as well as with the pressure on food production, with which people in power had normally to cope. In the Yap Islands, the peak of stone tidal weirs seems to have been at the beginning of the 19th century, when they had the largest population. These stone tidal weirs at the chiefdom level would not look directly to link up with ones at the band level, although their method and concept could 'take place sometimes in antiquity' (Barham, 2000). Judging from instances from the Far East and the South Pacific, it is morally certain that almost all stone tidal weirs, or at least their bases, all over the world at present might have been constructed more than 100 years ago. Perhaps, however, weirs which we could see these days could date back only to not more than several hundred years ago, not to more than 100 thousand years. In short, most stone tidal weirs may not be objects of prehistoric character, but important human sites, structures, buildings, or artifacts together with their archaeological and natural context.

### **How to Protect Stone Tidal Weirs**

Although stone tidal weirs are still being constructed or restored in remote regions on the earth, they are quickly disappearing, being destroyed, or being abandoned, in particular, in civilized countries. Nowadays, first of all, stone tidal weirs cannot catch fish as much as in olden times, because of the intensification of modern fishery on their outsides. Owners of stone tidal weirs are normally local peasants, while onshore fishing are conducted by professional fishers who think weirs as fish stealing traps or as shipping obstacles. Secondly, the modern coastal management for tourism or for industrialization is not always happy with stone tidal weirs which occupy the huge area of tidal zones. For many hotels or fishers stone tidal weirs are only eyesores and real pains in the neck; in actual practice tourists' water motorcycles as well as commercial fishing boats sometimes split on stone tidal weirs. On the contrary, however, the new movements, in which locals make good use of stone tidal weirs for tourism or for activity aimed at enlivening coastal communities, have just begun on grassroots levels, although they are still minor. In France' Association de défense des ecluses à poissons

de l'île de Ré'or in Japan 'Ishihimi Summit' has been organized to plan events, for instance, so tourists could experience fishing inside stone tidal weirs, or to restore old weirs jointly.

On national levels, on the other hand, the conservation activity or management of stone tidal weirs as underwater cultural heritage has not been started yet. Even in France, which has already ratified the UNESCO's 2001 Convention, we have never heard that the Département des recherches archéologiques subaquatiques et sous-marines were doing research upon stone tidal weirs in western France. In Japan, some stone tidal weirs are under the control of the domestic law for the protection of cultural properties, but they are not to be buried cultural property, which is normally studied by archaeologists, but to be folk cultural asset or cultural landscape, which is always studied by anthropologists or by folklorists. Famous Mongolian shipwrecks of northern Kyushu Island are, of course, designated as buried cultural property. In 2006, owing to the bureaucratic sectionalism, not the Agent for Cultural Affairs, but the Fisheries Agency was designated two stone tidal weirs in Japan as selections of 100 historical and cultural heritage sites and heirlooms related to fisheries and fishing villages which we would like to hand down to future generations. However, both central government offices would not plan to excavate either bases of any stone tidal weirs or traces of their old ruins to identify, for instance, when they were built or how large they used to be, because no Japanese civil servant regards them as study object of archaeology, i.e. underwater cultural heritage.

## **Conclusion**

In Japan a research group from Waseda University, Tokyo, which was directed by an anthropologist, started its academic investigation upon stone tidal weirs in 1956, which might be the world-first comprehensive field survey on them. However, no introductory book to underwater archaeology does not mention this important research. On the other hand, all books give the detailed description of the Swedish Vasa project which began in the same year. Even in Japan, no underwater archeological booklet treats this historical research activity, while all do the salvage of the wreck of Kaiyo-maru at northern Japan which began in 1974. Besides as for stone tidal weirs themselves, only two introductory books to underwater archaeology have referred to them unusually: one

is in English (Bowens, 2009), and the other is in Japanese (Iwabuchi, 2012b). Indeed, underwater archeologists have not much been interested in stone tidal weirs, partly because they have been or are concerned about conventional shipwrecks, and partly because stone tidal weirs have mainly been studied, not by archaeologists, but by anthropologists, by folklorists, or by geographers. As mentioned before, nevertheless, the stone tidal weir does be true underwater cultural heritage according to the UNESCO's 2001 Convention. Stone tidal weirs are as important as shipwrecks such as the Uluburun or the Sinan ship.

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