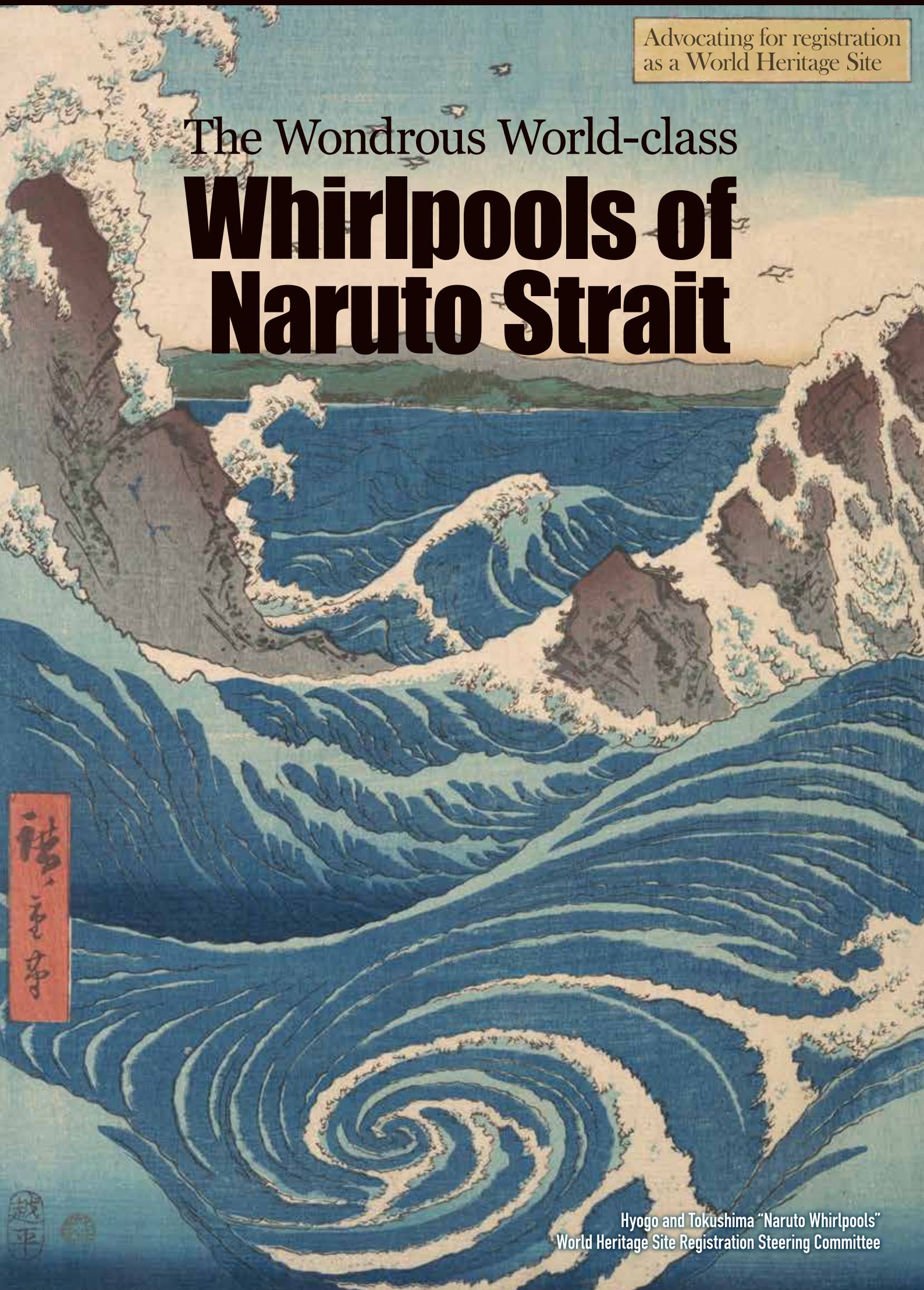
Advocating for registration as a World Heritage Site

The Wondrous World-class Whirlpools of Naruto Strait



Hyogo and Tokushima "Naruto Whirlpools"
World Heritage Site Registration Steering Committee

1

An Extraordinary Natural Wonder: The Whirlpools of Naruto Strait

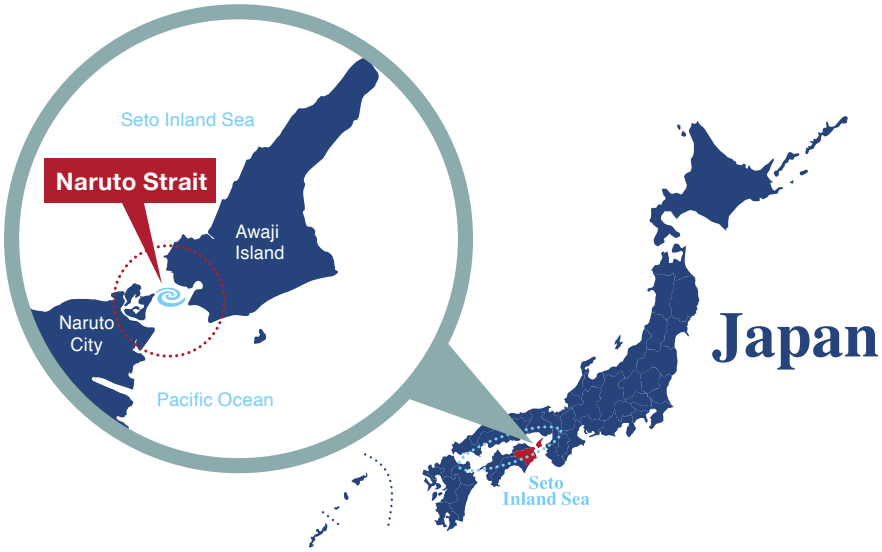
The Seto Inland Sea in western Japan, at times likened to the Aegean Sea, is one of the world's major archipelagos and is surrounded by the Honshu, Shikoku, and Kyushu islands. Baron Ferdinand Freiherr von Richthofen, a prominent German geographer noted for defining the term "Silk Road," visited this region in 1860 and praised its breathtaking scenery as follows: "Such elegant natural beauty over a vast area—no place in the world could be more beautiful than this. (...) This place has been conserved over long periods of time, and I pray that it will remain protected from here on out."

An extraordinary natural beauty, the "Whirlpools of Naruto Strait" may be observed in this Seto Inland Sea, specifically at Naruto Strait which lies between Awaji Island, the largest island of this sea, and Shikoku. Rapid currents that are generated due to tidal level differences on two sides of this strait—the Seto Inland Sea and the Pacific Ocean—create some of the largest whirlpools in the world.

The Whirlpools of Naruto Strait are also known for their diversity, such as "*uzuren* (repetitive whirlpools)," of which as many as 7 swirls may be seen at once, and "*uzutsui*," or a pair of whirlpools rotating in opposite directions that drift together.

Since the 18th century, its beauty has been depicted by famous *ukiyo-e* painters including Utagawa Hiroshige and Katsushika Hokusai, and attracting many visitors.

Today, a project is under way to advocate that the whirlpools of Naruto Strait be registered and conserved as a World Heritage site, with the cooperation of local residents and local governments. As Baron von Richthofen had hoped, we, as residents of this region, must protect this exceptional natural beauty blessed to us from this earth and pass it down to future generations.

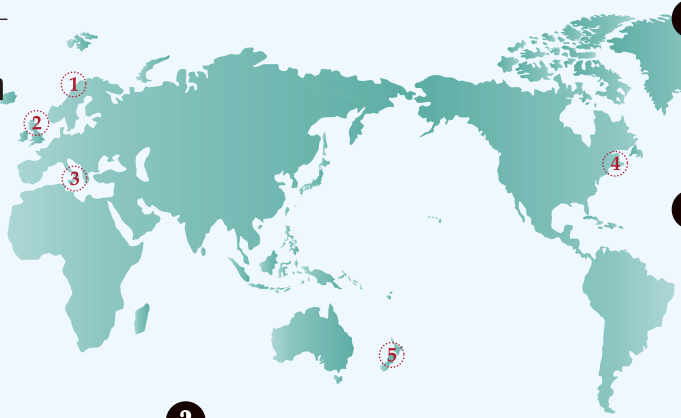






Whirlpools in the world

Whirlpools are found around the world. We will continue our research on their sizes and generation mechanisms and seek to collaborate with international institutions specializing in whirlpools.



1

Norway
Strait of Saltstraumen



2

United Kingdom (Scotland)
Gulf of Corryvreckan

3

Itary
Strait of Messina

4

Canada
Old Sow

5

New Zealand
Te Aumiti / French Pass

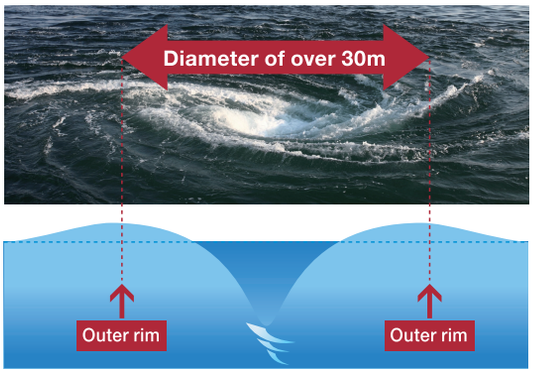


2

How the World's Largest Whirlpools are Generated

World-class Whirlpools

Naruto's whirlpools are caused by a combination of complex factors, such as rapid currents and the geographical features of the seafloor. The rapid currents are triggered due to the rise and fall of the tides, which occurs in approximately 6-hour intervals. Although the whirlpools are formed throughout the year, some of the greatest in size are formed during spring and autumn, when world-class whirlpools of over 30 meters in diameter are occasionally observed.



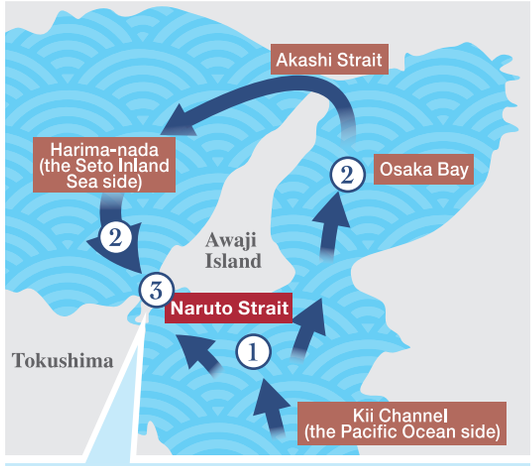
The whirlpools of Naruto Strait flow in downward spirals. Their size is defined by the distance between two points on the outer rim, the highest above the ocean's surface.

The Generation Mechanism of the Whirlpools

1. Tidal influences

Tidal currents from the Pacific Ocean are split into two at the Kii Channel, one of which flows to the south side of Naruto Strait and causes a high tide (①). The other flows through Osaka Bay and Akashi Strait, reaching the north side of Naruto Strait after approximately 6 hours and thus raising the tidal level here as well (②).

However, at the time the north side of Naruto Strait reaches high tide, the south side is at low tide. This results in a significant difference in the water level between the Kii channel (the Pacific Ocean side) and Harima-nada (the Seto Inland Sea side) of the strait (③). This water level difference (approx. 1.5m) is what triggers the rapid currents of up to 11 knots (approx. 20km/h). This generation mechanism cannot be seen in any other strait in Japan.

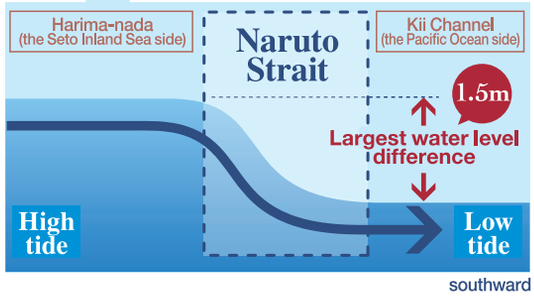


2. Geomorphologic factors

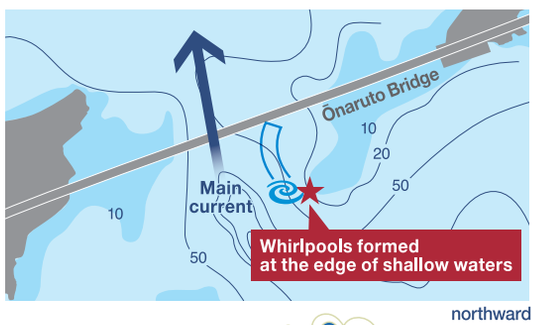
The Naruto Strait lies between the Kii Channel (the Pacific Ocean side) and Harima-nada (the Seto Inland Sea side), and is about 1.3 kilometers wide at its narrowest, the area between the protruding capes of Awaji Island and Naruto City. The seafloor at the point where the two capes are closest (the narrowest point) is V-shaped and is approximately 80 meters deep.

Tidal currents caused by a difference in water level of up to 1.5 meters between the two sides of Naruto Strait—the Pacific Ocean side and the Seto Inland Sea side—concentrate into the narrowest point between the two capes, therefore creating a strong current.

These currents create whirlpools that originate at the edge of the shallow waters of Awaji Island. Furthermore, with the seafloor's contour line as the border, speed differences between the center of the current (main current) and its two sides cause the whirlpools to grow larger as they float along the border.



southward

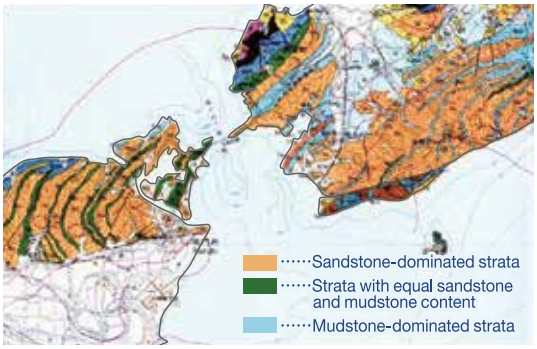


northward

3

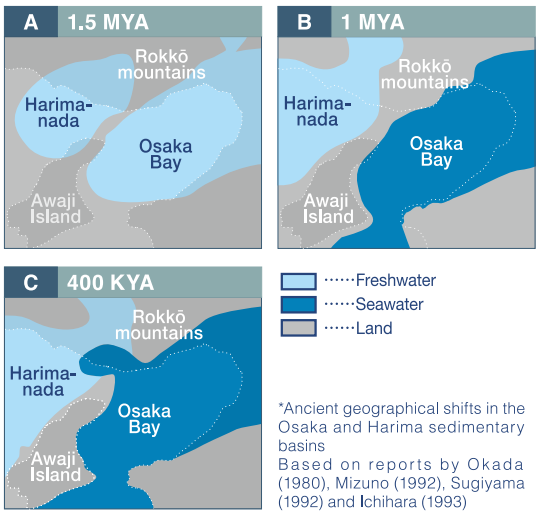
Strata and Geologic Features of Naruto Strait

The narrow terrain of the Naruto Strait is thought to have been formed due to the configuration of the rock strata in the area. The Izumi Group strata on the side of Awaji Island lies just about perpendicular to Naruto Strait, with sandstone-dominated strata (colored in orange) protruding toward the sea, with valleys that were created along the mudstone-dominated strata (colored in blue) due to erosion. On the other hand, the coastline of Naruto City has been comparatively moderately eroded especially along the sandstone-dominated units.



How the Naruto Strait was formed

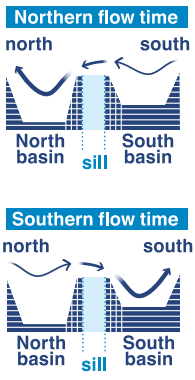
The formation of Naruto Strait is deeply related to the development of "dips," referring to the Osaka Bay and Harima-nada, and "ascents" such as Awaji Island which separates those two waters. The transformation began approximately 1.5 million years ago, with land subsidence (Osaka Bay and Harima-nada) occurring in a north east direction and an uplift of the surfaces (Rokkō mountains and Awaji Island) in between. Sunken areas of Osaka Bay connected with the Kii Channel about 1.2 million years ago, allowing seawater to flow into the bay, while the Harima-nada area was still occupied with lakes and lowlands. Then, about 500,000 to 1 million years ago, active faults underneath Rokkō mountains and Awaji Island shifted horizontally, causing the Akashi Strait to sink, which led seawater to flow into Harima-nada about 400,000 years ago thus creating a bay. Vast coastal terraces along the Harima-nada coast developed about 200,000 years ago, which indicates that most areas of Harima-nada were filled with seawater by that time. On the other hand, a study on the Osaka Group strata surrounding the Akashi Strait points out that the present state of the sea is similar to that of around 120,000 to 130,000 years ago, which means that the Naruto Strait had already been formed by this time.



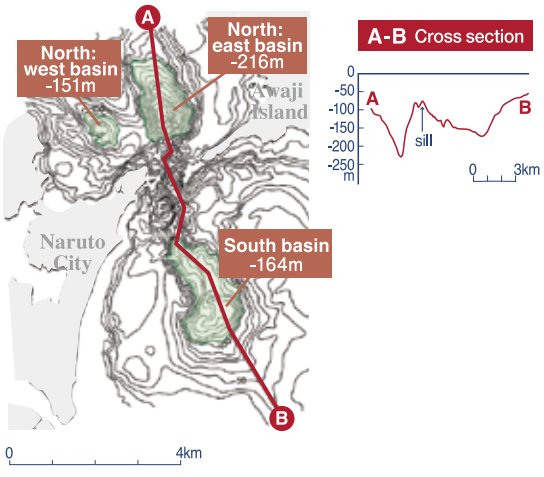
*Ancient geographical shifts in the Osaka and Harima sedimentary basins
Based on reports by Okada (1980), Mizuno (1992), Sugiyama (1992) and Ichihara (1993)

Seabed basins

The seabed terrain of Naruto Strait is unique for having basins on both the north and south sides of its narrowest point (approx. 80m deep), called the twin basins. The north basin is divided into two, of which the east basin is 216 meters deep and the west basin is 151 meters deep, and the south basin is 164 meters deep. A theory suggests that these basins were formed due to rapid down-flowing streams, generated from forcefully converged currents in the Naruto Strait, scraping the ocean floor.



Seabed basins of Naruto Strait and a north-south cross section graphic



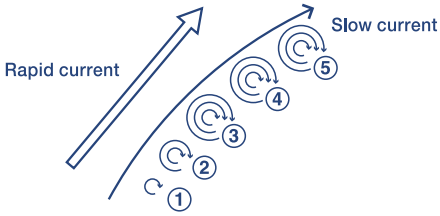
4

The Uniqueness and Diversity of the Whirlpools of Naruto Strait

In 2017, the Hyogo and Tokushima "Naruto Whirlpools" World Heritage Site Registration Steering Committee performed research into Naruto Strait and other marine waters in Japan that have similar geomorphologic features. As a result, various whirlpool configurations and unique features were identified, which could only be observed in the Naruto Strait.

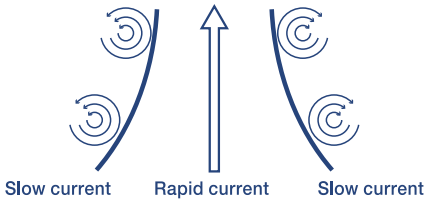
1 Uzuren (Repetitive whirlpools)

Uzuren is a phenomenon that whirlpools occur one after another, with new whirlpools appearing before disappearance of older swirls, which makes them seem aligned. As many as seven whirlpools may be observed at once during peak times.



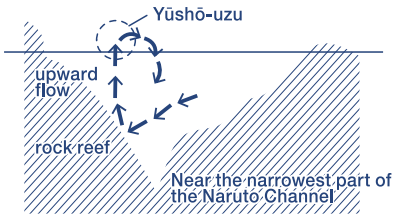
2 Uzutsui (A pair of whirlpools spinning in opposite directions)

A pair of whirlpools spinning in opposite directions, each of which is formed at each side end across the fast stream flowing through the center of the Naruto Strait, is defined as *Uzutsui*.

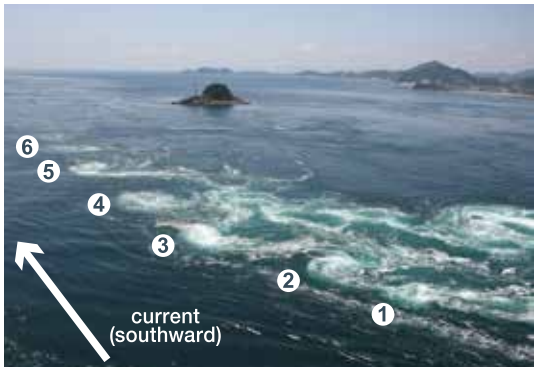


3 Yūshō-uzu (Circular water mass created by upward flow)

Yūshō-uzu is a phenomenon when the ocean's surface rises in a circular form, which is caused by an upward flow due to the ocean floor's geomorphologic features. This variety of whirlpool is also known as a "whirl flower" because of its shape.



1 Uzuren at Naruto Strait



2 Uzutsui at Naruto Strait



3 Yūshō-uzu at Naruto Strait



5

Naruto Whirlpools' Cultural Influences

The *ukiyo-e* of Naruto Strait during Edo period

The Naruto whirlpools have been a popular subject among *ukiyo-e* artists such as Utagawa Hiroshige and Katsushika Hokusai. Although they are mostly depicted as dynamic and energetic, the acclaimed *Awa Naruto no fūkei* by Hiroshige in 1857 likens the whirlpools to delicate flowers.



Utagawa Hiroshige
Awa Naruto no fūkei (View of Naruto strait)
Tokyo National Museum, Tokyo Prefecture

Introduction of the Naruto Strait to European countries

The *NIPPON* series by Philipp Franz Balthasar von Siebold, a German physician who visited Nagasaki in 1823 (late-Edo period), includes a written record and an impressive illustration on the Naruto whirlpools. It is likely that European audiences may have known about the Naruto Strait from early on, through *ukiyo-e* paintings and Siebold's work.

A historical tourist attraction

The scenic views of the Naruto whirlpools and their roaring sounds—Naruto means "roaring gate"—have fascinated people since ancient times. So much so that in the Edo period, the feudal lord of Tokushima set up a temporary castle specifically to admire them. Ancient paintings depicting crowds of people viewing the whirlpools reveal their history as a tourist attraction.

In 1931, Naruto Park and its surroundings were nationally designated as a cultural property and place of scenic beauty. Today, the whirlpools can be viewed from various locations, including sightseeing boats and the Uzonomichi Walkway.



Utagawa Hiroshige
Naruto Whirlpools, Awa Province from the series *Views of Famous Places in the Sixty-Odd Provinces*
The Metropolitan Museum of Art, New York



Katsushika Hokusai
Awa no Naruto from the series *Hokusai Manga, volume 7*
Hagi Uragami Museum, Yamaguchi Prefecture



Siebold, Philipp Franz Balthasar von
The whirlpools of Naruto. NIPPON
Fukuoka Prefectural Library, Fukuoka Prefecture.



Naruto, a place of scenic beauty

6

The Naruto Strait and local life

Fishery

The Naruto Strait has been an abundant source of sea bream and wakame seaweed thanks to the ocean's rapid currents swirling up nutrients from the seabed and enriching the water with plankton. A small strip of wood called *mokkan* on which "wakame" is written, excavated from the ruins of the Heijo Palace from the Nara period, reveals that local seaweed was delivered to the imperial family as a specialty of Naruto. Furthermore, the strait's challenging conditions led the local fishermen to develop fishing methods and equipment that enabled them to counter the currents, including single-hook fishing, tegusu fishing lines (originally silk thread that turned transparent in water), and small kanko boats, all of which were developed in the Edo period.



Naruto sea bream



Wakame harvesting (c. 1964)

Salt production

Salt production in the regions surrounding the Naruto Strait has thrived due to low rainfall and the ocean's high salinity. Early methods of salt production included the use of ocean tides to channel seawater into flat salt pans, which were later modified into gradually sloping fields. Today, salt is manufactured by ion-exchange membrane electrodialysis. The production of pharmaceuticals and chemicals that incorporate bitterns, which are byproducts of salt manufacturing, are also among Naruto's major industries.



Fukunaga Family Residence (Important Cultural Property)

The former residence of a salt producer built in the late Edo period. It is the only historical building in Japan to retain both a salt processing plant and salt fields that channel seawater through ocean tides.

Potentially inspired the *Kuniumi* myth in the *Kojiki*

The first written records in Japan are called the *Kojiki* (Records of Ancient Matters). They open with *Kuniumi*, a story about the creation of the Japanese archipelago by the deities Izanagi and Izanami. The two first created the mythological Onogoro Island, then Awaji Island (the island located to one side of the Naruto Strait), followed by the rest of the archipelago.
The myth surrounding the creation of Onogoro Island contains the phrase "they churned the chaotic mass with a jeweled spear, making sounds as they stirred saltwater," leading to a theory that this ancient legend was inspired by the Naruto whirlpools.



Kobayashi Eitaku
Izanami and Izanagi Creating the Japanese Islands
(Museum of Fine Arts Boston)

7

What are World Heritage Sites?

UNESCO World Heritage Sites must be of Outstanding Universal Value (have exceptional significance for the entire human race) and be recognized by the World Heritage Committee as worthy of conservation. World Heritage Sites are identified as Natural, Cultural, or Mixed (both natural and cultural).

The three conditions to becoming a World Heritage Site

1. Meets at least one of the following selection criteria

i	Creative masterpieces of humankind	Represents a masterpiece of human creative genius E.g., Shrines and Temples of Nikko (Tochigi), Himeji-jo (Hyogo), Itsukushima Shinto Shrine (Hiroshima), etc.
ii	Cultural exchanges	Exhibits an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, townplanning or landscape design E.g., Tomioka Silk Mill and Related Sites (Gunma), Sacred Island of Okinoshima and Associated Sites in the Munakata Region (Fukuoka), etc.
iii	Tradition / civilization	Bears a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared E.g., Mozu-Furuichi Kofun Group: Mounded Tombs of Ancient Japan (Osaka), Hidden Christian Sites in the Nagasaki Region (Nagasaki / Kumamoto), etc.
iv	Sites that represent historic events	An outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates significant stages in human history E.g., Hiraizumi (Iwate), Sites of Japan's Meiji Industrial Revolution (Fukuoka / Yamaguchi), etc.
v	Traditional villages / cultural sceneries	An outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change E.g., Historic Villages of Shirakawa-go and Gokayama (Gifu / Toyama), Iwami Ginzan Silver Mine and its Cultural Landscape (Shimane)
vi	Association with significant works of art	Directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria) E.g., Fujisan (Yamanashi / Shizuoka), Hiroshima Peace Memorial (Hiroshima), etc.
vii	Natural beauty	Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance E.g., Yakushima (Kagoshima)
viii	Geology / Geomorphology	Outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features
ix	Ecosystems	Outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals E.g., Shiretoko (Hokkaido), Shirakami-Sanchi (Aomori / Akita), Ogasawara Islands (Tokyo),Yakushima (Kagoshima)
x	Biodiversity	Contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation E.g., Shiretoko (Hokkaido)

2. Possesses integrity and authenticity (applies only to cultural properties)

Integrity: Includes all elements necessary to express its outstanding universal value, is of adequate size to convey the property's significance, and is free from adverse effects of development

Authenticity: Inherits cultural identity or traditional quality, retains its intrinsic value and is free of modifications, excessive restoration or reconstruction by succeeding generations

3. Adequate conservation measures are taken to ensure that its value as a World Heritage Site will be protected in the future

Our Committee is uncovering the Outstanding Universal Values of Naruto's whirlpools from both Natural and Cultural perspectives.

We are advocating to qualify under the following criteria: Natural: vii / viii, Cultural: iii / v / vi

8

Organizational structure and activities

Hyogo and Tokushima "Naruto Whirlpools" World Heritage Site Registration Steering Committee

Local residents and authorities on the two sides of Naruto Strait—Awaji Island, Hyogo Prefecture, and Naruto City, Tokushima Prefecture—have been working together towards a shared goal of having the whirlpools included in the World Heritage List. The "Hyogo and Tokushima' Naruto Whirlpools' World Heritage Site Registration Steering Committee" was established for this purpose in December 2014.

Today, the Hyogo Prefectural Government conducts academic surveys to uncover the whirlpools' intrinsic value from a Natural perspective, while the Tokushima Prefectural Government works from a Cultural perspective. Local communities and academia are also working with administrative bodies to lead various activities, including public relations efforts to build awareness of these incredible whirlpools at home and abroad.

鳴門海峡の渦潮を世界遺産へ

Chairs and Vice-Chairs

Chairs: Governor of Hyogo Prefecture,
Governor of Tokushima Prefecture

Vice-Chairs: Mayor of Minami-Awaji City,
Mayor of Naruto City

Executive Committee

Offices: Exchange Office, Awaji Bureau,
Hyogo Prefecture
Cultural Resources Utilization Division,
Tokushima Prefectural Government

Academic Council

[**Natural Section**]
Office: Hyogo Prefectural Government
Naruto Strait Whirlpools World Heritage Registration
Academic Research Council

[**Cultural Section**]
Office: Tokushima Prefectural Government
"Naruto Whirlpools" World Heritage Registration
Academic Research Committee

History and Establishment

- **1998: The "Initiative to Make Naruto Strait the World's Natural Heritage" was founded among private sectors in Naruto City**
- **October 2012: Establishment of the "Naruto Whirlpools World Natural Heritage Registration Promotion Committee" by 24 public and private organizations in Awaji Island**
- **September 2013: Naruto City and Minami-Awaji City together start the "Naruto Strait Whirlpools World Heritage Promotion Network"**
- **December 2014: Inaugural meeting of the "Hyogo and Tokushima 'Naruto Whirlpools' World Heritage Site Registration Steering Committee" was held**
- **The Committee was formally established by the Governors of both Hyogo and Tokushima Prefectures and Mayors of both Minami-Awaji and Naruto Cities**
- **As of March 2020**



The Committee was inaugurated with the attendance of the Governors of Hyogo and Tokushima prefectures and the Mayors of Minami Awaji and Naruto cities



Academic Research

Fiscal year 2017
- Research on the Naruto whirlpools' scale and generation mechanism
- Comparative research on similar environments in Japan
- Studies on historical and cultural value

Fiscal year 2018
- Literature survey on similar environments around the world
- Geomorphologic and regional survey on the Naruto Strait
- Examination of various scenic views
- Studies on historical and cultural value

Fiscal year 2019
- Fieldwork to study high tides at Saltstraumen, Norway
  1) Observation and video recording from the bridge
  2) Discussion with local researchers for potential joint research
- Literature survey on similar environments around the world
- Studies on historical and cultural value
- Written report that identifies universal values



Examination of the Naruto Strait's scenic views



Meeting with researchers of Nord University

International Symposiums

March 2018 — **Renaissance Naruto Resort, Naruto City**
Keynote Speech "The Requirements to Become a World Heritage"
Hae Un Rii (President, ICOMOS International Scientific Committee)

March 2019 — **Hotel New Awaji Plaza Awajishima, Minami-Awaji City**
Keynote Speech "The Latest Trends on the Registration of Natural Heritage Sites"
Kōichirō Matsuura (Former Director-General of UNESCO)



Presentation by a representative from Bodø, Norway

Presentations of International Cases

"Introduction to UNESCO's World Heritage Marine Programme"
Dr. Fanny Douvere (Coordinator, World Heritage Marine Programme, UNESCO)

"The Utilization of the Saltstraumen Whirlpools as a Tourism Resource"
Rolf Kåre Jensen (Deputy Mayor of Bodø, Norway), et al.

Rising community actions

Naruto Strait clean-up mission

For the purpose of protecting the surrounding environments of Naruto Strait, community groups such as "Awaji Island Citizens Group to Make the Whirlpools a World Heritage Site" continually conduct clean-up activities.



"The Whirlpools of Naruto Strait" learning workshop

In order to enhance understanding of the whirlpools among local children and nurture a sense of pride toward their hometown, workshops are provided at elementary schools on Awaji Island.



Via Hyogo Prefecture

By Public Transport

- **Kansai International Airport** — (65 min.) Airport Limousine Bus
- **Kobe Airport** — (20 min.) Port Liner
- **Shin-Kobe Station** — (5 min.) Kobe Municipal Subway

→ **Kobe Sannomiya Bus Terminal** — (90 min.) Express bus → **Fukura Bus Terminal** — (3 min.) Walk → **Whirlpool Sightseeing Boat Dock**

By Car

Via Osaka / Kobe (Hanshin Expressway Route 3) — From Umeda, Osaka (50 min.) / From Sannomiya, Kobe (20 min.) → **Tarumi Interchange (Kobe-Awaji-Naruto Expressway)** — (40 min.) → **Seidan-Mihara Interchange (Exit)** — (15 min.) → **Whirlpool Sightseeing Boat Dock**

Via Tokushima Prefecture

By Public Transport

- **Tokushima Awaodori Airport** — (40 min.) Fixed-route bus
- **JR Tokushima Station** — (60 min.) Fixed-route bus

→ **Naruto Sightseeing Port / Naruto Park**

By Car

Via Tokushima (Kobe-Awaji-Naruto Expressway) → **Naruto-Kita Interchange (Exit)** — (5 min.) → **Naruto Sightseeing Port / Naruto Park**

Sightseeing boats

Boarding from Hyogo

Whirlpool cruises “Kanrinmaru” and “Nipponmaru”
(Fukura Port, Minami-Awaji City)
http://www.uzu-shio.com/

Boarding from Tokushima

Whirlpool sightseeing boats “Wonder Naruto” and “Aqua Eddy”
(Naruto Park Kameura Sightseeing Port, Naruto City)
https://www.uzusio.com/

Uzushio Kisen “Uzushio Line”
(Naruto Park Kameura Sightseeing Port, Naruto City)
https://www.uzushio-kisen.com/



Educational facilities on whirlpools





Uzushio Science Museum inside Uzuno’oka Ōnarutokyō Memorial Hall
(Fukura, Minami-Awaji City)

A large-scale hydraulic model that accurately replicates the Naruto Strait's geography, allowing visitors to observe how whirlpools are generated.
http://kinen.uzunokuni.com/kagakukan.html

Ōnaruto Bridge Crossing Memorial Hall “Eddy”
(Fukura, Minami-Awaji City)

Experience the intensity of the whirlpools through experience-oriented entertainment including a 4K 360-degree theater and LED digital art.
https://www.uzunomichi.jp/usage-guide-eddy/

Uzunomichi Walkway on the Ōnaruto Bridge
(Narutochō, Naruto City)

A 450-meter walkway constructed atop the girders of Onaruto Bridge. A section of the walkway has glass floors, allowing visitors to see the whirlpools directly from above.
https://www.uzunomichi.jp/

Contact us

鳴門海峡の渦潮を世界遺産へ

Hyogo and Tokushima “Naruto Whirlpools” World Heritage Site Registration Steering Committee
http://naruto-uzushio.jp/en/

- **Hyogo Office**
  Exchange Office, Awaji Bureau, Hyogo Prefecture 2-4-5 Shioya, Sumoto-shi, Hyogo
- **Tokushima Office**
  Cultural Resources Utilization Division, Tokushima Prefectural Government 1-1 Bandaicho, Tokushima-shi, Tokushima

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