The Great East Japan Earthquake struck off Japan’s Tōhoku coast on March 11, 2011 and triggered a massive tsunami wave that surged inland across kilometres of shoreline. A magnitude of 9.1, this was the most powerful earthquake to hit Japan. More than 15,000 people tragically lost their lives, over 2,500 were reported missing, and more than 6,000 were injured.

Over a million buildings were flattened or damaged, coastal forests were washed away, and almost every item imaginable was swept from coastal cities and villages into the ocean – an estimated 5 million tons of material.

One year later, tsunami debris began arriving on the Pacific coast of North America and later, Hawai‘i. The discoveries astonished researchers: two huge floating docks from Misawa, Japan, landed on Oregon and Washington beaches, and more than 150 small boats washed ashore. They were carrying hundreds of living Japanese plants and animals.

In March 2014, the Japanese Ministry of the Environment generously provided funding to research the impacts of tsunami marine debris on the Pacific coast of North America and the Hawaiian Islands.

The 3-year project, ADRIFT – Assessing the Debris-Related Impact From Tsunami – brought together scientists from Canada, Japan and the United States through the North Pacific Marine Science Organization (PICES).

ADRIFT set out to determine:

- Where would Japanese tsunami marine debris travel in ocean currents?
- Was tsunami debris carrying non-native species from Japan to North America?
- Would these species pose a threat to North American coastal ecosystems and communities?

For more information, visit: www.pices.int

"Tsunami marine debris is a transpacific Noah's ark for Japanese marine life, generated by an unprecedented disaster." Hideaki Maki, PICES Project Co-chair, Japan
Hiroshi Kawai
PICES Marine Ecologist, Japan

"One dock that washed ashore looked like a floating Japanese island. It contained more than 100 Japanese species, including some that can cause big impacts."

"If you had asked me five years ago, if non-native species could survive open ocean crossings of multiple years from Japan to North America, I would have said probably not!"

Jim Carlton
PICES Marine Ecologist, USA

What Types of Marine Debris Landed on Beaches and Shorelines?

The ADRIFT project confirmed that an unprecedented amount of marine debris from the Great Japan Tsunami washed up on North American and Hawaiian coasts. The amount of tsunami marine debris arriving was so significant that it greatly increased the overall amount of debris normally experienced on these coastlines. More is still arriving and may continue to arrive in the years to come. Other ADRIFT Discoveries

- ADRIFT examined 650 pieces of Japanese tsunami debris, including large amounts of plastic and other debris from human activities is making it easier for species to travel and potentially invade and harm native ecosystems. While large amounts of marine debris are afloat at sea, researchers rarely know where the debris is from, when it entered the ocean, or how long it took to arrive at its destination. ADRIFT scientists had the opportunity to study ocean currents in unprecedented conditions. Knowing that tsunami debris had been washed into the waters of Japan's Tohoku coast in March 2011 helped them track where this debris traveled and what it carried.

How Did Marine Debris Move in Ocean Currents?

The ADRIFT team of oceanographers worked with large-scale ocean models to connect the dots and estimate where tsunami debris was carried. For the first time, oceanographers were able to track marine debris over long distances, developing advanced techniques to increase our understanding of where things lost at sea might travel.

Other ADRIFT Discoveries

- Lightweight or floating debris such as polystyrene, a plastic packing material, was found to move rapidly and reliably within a year of the tsunami. Submerged debris, on the other hand, could remain in the ocean for a very long time and become caught up in the vast garbage patch of the North Pacific gyre.
- Debris traveled through the cold waters of the subtropical North Pacific, a fact biologists confirmed by the presence of both warm and cold water species on the debris.

What Types of Species Arrived on Tsunami Debris?

More than 65 taxon from around the world engaged in a massive effort to identify unexpected species. ADRIFT examined 1650 pieces of Japanese tsunami debris. For the first time ever that living species were recorded landing on the shores of North America from Japan carried by marine debris. When the two tsunami debris washed ashore, they were covered with hundreds of Japanese species and thousands of individuals. Scientists were amazed. It was evidence that along with the devastating break-up of land and human structures, marine debris had been a floating canvas and tiny colonizers had thrived and even reproduced at sea as marine debris – some for more than six years. Other ADRIFT Discoveries

- More than 300 species of Japanese plants and animals were discovered on debris, including a seaweed named Ulva lactuca (Laminaria), one of several new species not previously known to science.
- A large number of globally recognized marine invaders arrived – including a horsehair snail, a sea star and bivalve seaweed – but no new invaders of coastal ecosystems on North American or Hawaiian coast have been detected yet. ADRIFT produced a Top 10 Watch List for each region as high-risk species that pose a threat to ecosystems and continued monitoring is advised.
- Despite the large amount of debris generated, ADRIFT found that tsunami debris may present a lower risk for transporting non-native species. Greater threats may come from other forms of transport, such as commercial shipping. ADRIFT Legacy Products

- Marine Collection of Japanese Marine Debris


- The PICES Japanese Tsunami Marine Debris (JTMD) Database Available through the Smithsonian Institution online portal NEMESIS. Provides detailed information for more than 200 marine debris species, contributing to a better understanding of how species move and the traits of successful invaders.

Archival Collection of Aerial Photographs and Data Layers for British Columbia and the Hawaiian Islands.

Available online through the British Columbia Provincial Government and Hawaii’s Department of Land and Natural Resources (see PICES website).