NORTH PACIFIC MARINE SCIENCE ORGANIZATION (PICES) PROJECT ON "EFFECTS OF MARINE DEBRIS CAUSED BY THE GREAT TSUNAMI OF 2011"

Year 2 Final Report

1. PROJECT INFORMATION

Title:	PICES Tohoku coast field survey (fouling plate) – supplemental study for U.S. tsunami debris spp. list	
Award period	riod July 15, 2015 – March 31, 2016	
Amount of funding	\$ 68,965 CAD	
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2. EXECUTIVE SUMMARY

Introduction

During the Great East Japan Earthquake and tsunami in 2011, vast amount of debris got washed out from land and some became Japanese Tsunami Marine Debris (JTMD) and reached Hawaii and west coast of the U.S. and Canada with many coastal fouling organisms attached. It is uncertain amount and species of fouling organisms which were transferred from Japan to the U.S. and Canada. This research is the survey which is aimed to obtain a thorough collection of fouling organisms to morphologically and genetically complement the existing collection of JTMD species in Japan.

Materials and method

The survey was conducted at several locations in the Tohoku coast. Fouling plates of 14 cm square were placed in 3 different locations; Miyako (Iwate prefecture), Kesennuma and Matsushima (Miyagi prefecture) in July or August, 2015 (Figure 1).

Tohoku coast is a ria coast and each survey site is in the inlet. The inlets have the brackish-water inputs which make the areas suitable for coastal fishery and the aquaculture. In the ria coasts, shallow and narrow inlets trapped and focused incoming tsunami waves and created destructive swells and currents that pushed large volumes of water far inland. All survey sites suffered serious damage by the tsunami after the Great East Japan Earthquake.

The fouling plates were retrieved after about 1 month (the first survey) and 3 months (the second survey) at each site (Table 1).

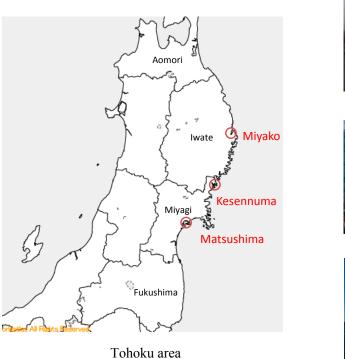


Fig. 1 Fouling plate deployment sites.



Miyako



Kesennuma



Matsushima

Table 1 *Schedule of the field survey.*

	Placement (# of plates)	1 month (# plates)	3 month (# plates)
		First survey	Second survey
Miyako	Aug. 12 th (30)	Sep. 8 th (15)	Nov. 10 th (15)
Kesennuma	Aug. 4 th (10*)	Sep. 8 th (5)	Nov. 11 th (5)
Matsushima	Jul. 24 th (30)	Sep. 10 th (15)	Nov. 12 th (15)

^{*}In Kesennuma, due to limited availability of space, minimum # of plates were deployed.

The species of fouling organisms on the fouling plates were identified, and morphological specimens and samples for DNA analysis were prepared. The morphological specimens were stored in 70% ethanol, and the samples for DNA analysis were stored in pure ethanol (99.5%). In case where only small number of samples was available, preparation of samples for DNA analysis was prioritized to preserving for morphological analysis. The DNA samples are to be sequenced by Dr. Jonathan Geller at Moss Landing Marine Laboratories.

Results

The appearance of fouling plates in each location is illustrated in Table 2. The numbers of morphological specimen and samples for DNA analysis are shown in Table 3. The number of the samples for DNA analysis means the number of identified species. The state of the fouling species varies depending on the location. The number of species found was the highest in Matsushima, and the fewest in Miyako. More species were detected in the second survey than the first survey in all sites. Phylum Arthropoda (especially Class Malacostraca) dominated at all sites (Table 4).

 Table 2
 Retrieved fouling plates.

	First survey	Second survey
Miyako		2015 11 10
Kesennuma	015 09 09	2015 11 11
Matsushima	210 6 10	2015 11 12

 Table 3
 Number of the prepared specimens.

	First s	survey	Second survey	
	Samples for DNA analysis	Morphological specimens	Samples for DNA analysis	Morphological specimens
Miyako	31	15	51	16
Kesennuma	35	9	65	14
Matsushima	63	22	79	26

 Table 4
 Number of the appearance species.

	Miyako		Kesennuma		Matsushima	
PHYLUM	1st survey	2nd survey	1st survey	2nd survey	1st survey	2nd survey
PORIFERA	0	1	0	2	1	3
CNIDARIA	1	1	1	1	3	2
NEMERTINEA	0	1	0	1	0	1
KAMPTOZOA	0	0	0	0	0	1
TENTACULATA	1	5	3	5	3	7
MOLLUSCA	0	3	3	4	6	9
ANNELIDA	2	9	3	15	15	10
ARTHROPODA	21	22	21	30	27	35
CHORDATA	6	9	4	7	8	11
Total	31	51	35	65	63	79

The complete lists of species found in each survey are shown in section 3(c). Most of fouling organisms identified in this survey are native to Japanese coasts. Several non-native species were found such as *Amphibalanus eburneus* and *Amphibalanus amphitrite*. According to the result of this survey, *Crassostrea gigas* was not detected in Miyako. On the other hand, *Caprella mutica*, which is northern species, was detected only in Miyako. Although *Nemertellina yamaokai* was detected only in Hokkaido in the past surveys, it was found in Miyako and Kisennuma in this survey.

3. PROGRESS SUMMARY

The proposed research is the survey which is aimed to obtain a thorough collection of fouling organisms to morphologically and genetically complement the existing collection of JTMD species, as well as to identify additional/new genetic strains that may have invasion potential. The survey was to be conducted at several locations in the Tohoku area. The survey design was planned and organized by mainly U.S. scientists and coorganized by Dr. Takami, Dr. Otani and personnel from JANUS.

The survey was to be conducted as follows:

- Deploy fouling plates of 14 cm square in 3 different locations; Miyako (Iwate prefecture), Kesennuma and Matsushima (Miyagi prefecture) (Figure 1). Plates were provided by the U.S. scientists (supports are given by Dr. Greg Ruiz, Dr. James Carlton and Dr. Jonathan Geller).
- Retrieve the fouling plates after 1 month and 3 months of their placement.
- Analyze the retrieved fouling plates and identify spp. on the plates (basic protocol shown by the U.S. scientists).
- Detail identification in laboratory and extract samples for DNA analysis shipment to the U.S.
- Shipment of oysters and mussels for analysis on parasites (if possible).

The planned deliverables are:

- Progress report by the Contractor as soon as the surveys is completed (Already submitted);
- Supplemental information upon request for the final scientific reports prepared by Principle Investigators of related individual projects;
- Financial report and official financial statement (report of expenditures) by JANUS by April 30, 2016.

a. Describe progress

All the planned activities have been successfully completed. The deployment and retrieval of fouling plates, the morphological identification, and sample extraction for DNA analysis have been conducted as mentioned above. Shipment of oysters and mussels could not have been completed due to financial constraints and non-emergency. These samples are kept frozen and are planned to be shipped with the samples collected during the coming spring surveys.

b. Describe results

The appearance of fouling plates after retrieval and the number of specimen prepared are shown above (Tables 2-3). The results of morphological identification in each location are listed in the tables below (Tables 5-7).

 Table 5
 Identified species in Miyako.

The first survey			
	PHYLUM	CLASS	Species
1	CNIDARIA	HYDROZOA	Halecium pusillum
2	TENTACULATA	BRYOZOA	Celleporina sp.
3	ANNELIDA	POLYCHAETA	Hydroides ezoensis
4			Neodexiospira alveolata
5	ARTHROPODA	MAXILLOPODA	Amphibalanus improvisus
6			Perforatus perforatus
7		MALACOSTRACA	Ampithoe sp. 1
8			Aoroides sp.
9			Monocorophium achersicum
10			Ericthonius convexus
11			Jassa slatteryi
12			Paradexamine sp.
13			Polycheria sp.
14			Melita sp.
15			Leucothoe nagatai
16			Stenothoe sp. 2
17			Stenothoe sp. 1
18			Caprella equilibra
19			Caprella mutica
20			Caprella scaura
21			Paranthura japonica
22			Ianiropsis serricaudi
23			Synidotea hikigawaensis
24			Cymodoce japonica
25			Zeuxo sp. (aff. Z. coralensis)
	CHORDATA	ASCIDIACEA	Diplosoma listerarium
27			Distaplia dubia
28			Botryllidae gen. sp. 1
29			Botryllidae gen. sp. 2
30			Botryllidae gen sp. 3
31			Botryllidae gen sp. 4

	The second survey			
	PHYLUM	CLASS	Species	
1	PORIFERA	DEMOSPONGIAE	Halichondria sp.	
2	CNIDARIA	HYDROZOA	Halecium pusillum	
3	NEMERTINEA	ENOPLA	Nemertellina yamaokai	
4	TENTACULATA	BRYOZOA	Membranipora sp.	
5			Tricellaria inopinata	
6			Celleporaria sp.	
7			Celleporina porosissima	
8			Escharella takatukii	
9	MOLLUSCA	GASTROPODA	Sakuraeolis sp.	
10		BIVALVIA	Mytilus galloprovincialis	
11			Musculista senhousia	
12	ANNELIDA	POLYCHAETA	Hemilepidonotus helotypus	
13			Anaitides sp.	
14			Eularia viridis japanensis	
15			Syllis sp.	
16			Nereis pelagica	
17			Platynereis bicanaliculata	
18			Arabella sp.	
19			Nicolea sp.	
20			Hydroides ezoensis	
21	ARTHROPODA	PYCNOGONIDEA	Anoplodactylus crassus	
22		MAXILLOPODA	Balanus trigonus	
23			Amphibalanus amphitrite	
24			Amphibalanus improvisus	
25			Fistulobalanus albicostatus	
26			Perforatus perforatus	
27		MALACOSTRACA	Ampithoe sp. 1	
28			Aoroides sp.	
29			Monocorophium achersicum	
30			Gammaropsis japonica	
31			Ericthonius convexus	
32			Jassa slatteryi	
33			Polycheria sp.	
34			Stenothoe sp. 2	
35			Caprella equilibra	
36			Caprella mutica	
37			Caprella scaura	
38			Paranthura japonica	
39			Ianiropsis serricaudis	
40			Synidotea hikigawaensis	
41			Cymodoce japonica	
42			Zeuxo sp. (aff. Z. maledivensis)	
	CHORDATA	ASCIDIACEA	Distaplia dubia	
44	. ,		Ciona savignyi	
45			Perophora japonica	
46			Ascicia sp.	
47			Botryllus schlosseri	
48			Botryllidae gen. sp. 1	
49			Botryllidae gen. sp. 2	
50			Botryllidae gen. sp. 3	
51			Styela sp.	
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 Table 6
 Identified species in Kesennnuma.

The first survey			
PHYLUM	CLASS	Species	
1 CNIDARIA	ANTHOZOA	Diadumene lineata	
2 TENTACULATA	BRYOZOA	Tricellaria inopinata	
3		Celleporina sp.	
4		Watersipora cucullata	
5 MOLLUSCA	BIVALVIA	Anomia chinensis	
6		Crassostrea gigas	
7		Protothaca jedoensis	
8 ANNELIDA	POLYCHAETA	Syllis sp.	
9		Hydroides ezoensis	
10		Neodexiospira alveolata	
11 ARTHROPODA	MAXILLOPODA	Chthamalus challengeri	
12		Balanus trigonus	
13		Amphibalanus improvisus	
14		Perforatus perforatus	
15		Megabalanus rosa	
16	MALACOSTRACA	Ampithoe sp. 2	
17		Gammaropsis japonica	
18		Ericthonius convexus	
19		Jassa slatteryi	
20		Polycheria sp.	
21		Pontogeneia sp.	
22		Maera pacifica	
23		Melita sp.	
24		Gitanopsis sp.	
25		Anamixis sp.	
26		Parapleustes sp.	
27		Stenothoe sp. 2	
28		Caprella equilibra	
29		Paranthura japonica	
30		Ianiropsis serricaudi	
31		Cirolana harfordi japonica	
32 CHORDATA	ASCIDIACEA	Diplosoma listerianum	
33		Botryllidae gen sp. 1	
34		Botryllidae gen sp. 2	
35		Symplegma reptans	

	The second survey			
	PHYLUM	CLASS	Species	
1	PORIFERA	CALCAREA	Grantessa sp.	
2		DEMOSPONGIAE	Halichondria sp.	
3	CNIDARIA	ANTHOZOA	ACTINIARIA	
4	NEMERTINEA	ENOPLA	Nemertellina yamaokai	
5	TENTACULATA	BRYOZOA	Amathia distans	
6			Tricellaria occidentalis	
7			Celleporina porosissima	
8			Escharella takatukii	
9			Watersipora cucullata	
	MOLLUSCA	GASTROPODA	Mitrella bicincta	
11		BIVALVIA	Mytilus galloprovincialis	
12			Musculus cupreus	
13		DOL VOLLA DEL	Crassostrea gigas	
	ANNELIDA	POLYCHAETA	Halosydna brevisetosa	
15			Lepidonotus elongatus	
16 17			Eulalia viridis japanensis	
18			Eulalia sp. Nereiphylla castanea	
19			Syllis sp.	
20			Neanthes caudata	
21			Nereis multignatha	
22			Nereis neoneanthes	
23			Platynereis bicanaliculata	
24			Armandia sp.	
25			Polyophthalmus pictus	
26			Nicolea sp.	
27			Hydroides ezoensis	
28			Neodexiospira alveolata	
29	ARTHROPODA	MAXILLOPODA	Balanus trigonus	
30		MAXILLOPODA	Amphibalanus improvisus	
31			Perforatus perforatus	
32			Megabalanus rosa	
33		MALACOSTRACA	Ampithoe sp. 1	
34			Aoroides longimerus	
35			Monocorophium sextonae	
36			Monocorophium uenoi	
37			Gammaropsis japonica	
38			Ericthonius convexus	
39			Jassa slatteryi	
40			Podocerus sp.	
41 42			Polycheria sp.	
42			Maera pacifica Maera sp.	
44			Melita rylovae	
45			Gitanopsis sp.	
46			Parapleustes sp.	
47			Stenothoe sp. 2	
48			Orchomene sp.	
49			Cypsiphimedia mala	
50			Caprella equilibra	
51			Caprella polyacantha	
52			Caprella penantis	
53			Caprella scaura	
54			Paranthura japonica	
55			Ianiropsis serricaudis	
56			Cirolana harfordi japonica	
57			Dynoides dentisinus	
58			Eualus leptognathus	
	CHORDATA	ASCIDIACEA	Aplidium sp.	
60			Diplosoma listerianum	
61			Ciona intestinalis type A	
62			Ciona savignyi	
63			Ascidia sydneiensis	
64			Botryllidae gen. sp.2	
65	<u> </u>		Styela canopus	

 Table 7
 Identified species in Matsushima.

	The first survey			
	PHYLUM	CLASS	Species	
	PORIFERA	CALCAREA	Grantessa sp.	
	CNIDARIA	HYDROZOA	Eudendrium sp.	
3		ANTHOZOA	Diadumene lineata	
4			Anthopleura sp.	
	TENTACULATA	BRYOZOA	Amathia distans	
6			Bugula neritina	
7		a. amponon.	Bugula stolonifera	
	MOLLUSCA	GASTROPODA	Dendrodoris fumata	
10		BIVALVIA	Musculista senhousia Chlamys sp.	
11			Anomia chinensis	
12			Crassostrea gigas	
13			Theora fragilis	
	ANNELIDA	POLYCHAETA	Lepidonotus elongatus	
15	AITTELIDA	OETCHAETA	Anaitides sp.	
16			Eulalia viridis	
17			Proceraea sp.	
18			Syllis sp.	
19			Neanthes caudata	
20			Nereis multignatha	
21			Nereis neoneanthes	
22			Platynereis bicanaliculata	
23			Dorvillea sp.	
24			Nicolea sp.	
25			Terebellidae gen. sp.	
26			Pseudopotamilla sp.	
27			Sabella sp.	
28			Hydroides ezoensis	
29	ARTHROPODA	PYCNOGONIDEA	Callipallene sp.	
30			Anoplodactylus crassus	
31		MAXILLOPODA	Amphibalanus improvisus	
32		MALACOSTRACA	Ampithoe sp. 1	
33			Aoroides longimerus	
34			Corophium acherusicum	
35			Jassa slatteryi	
36			Paradexamine sp.	
37			Polycheria sp.	
39			Melita rylovae	
40			Gitanopsis sp. Anamixis sp.	
41			Colomastix sp.	
42			Leucothoe nagatai	
43			Parapleustes sp.	
44			Stenothoe sp. 1	
45			Stenothoe sp. 2	
46			Liljeborgia serrata	
47			Orchomene sp.	
48			Cypsiphimedia mala	
49			Caprella penantis	
50			Caprella scaura	
51			Paranthura japonica	
52			Ianiropsis serricaudi	
53			Cymodoce japonica	
54			Eualus leptognathus	
55			Heptacarpus rectirostris	
	CHORDATA	ASCIDIACEA	Didemnum sp.	
57			Ciona intestinalis type A	
58			Ciona savignyi	
59			Ascidia zara	
60			Ascidia sydneiensis	
61			Botryllidae gen. sp.	
62			Molgula manhattensis	
63			Tridentiger trigonocephalus	

PHYLUM CLASS Species 1 PORIFERA CALCAREA Grantessa Sp. 2 DEMOSPONGIAE Halichondria stitens 3 Halicona Sp. 4 CNIDARIA HYDROZOA Edwardmin Sp. 5 NATHOZOA Diadumene lineata ANTHOZOA Barentsia distoreta 8 IENTACULATA BRYOZOA Amuhia distorats 9 Mehroratipora Sp. 2 10 Bugula nertitina 11 Pricellaria inopinata 12 Celleporinia porastissima 13 Crytostula pallastana 14 GELICONA GASTROPODA Brachystodia munitorium Debendrodoris funata 15 MOLLUSCA GASTROPODA Brachystodia munitorium Debendrodoris funata 16 BUVALVIA Mytilus galloprovincialis 18 WALVIA Mytilus galloprovincialis 18 WALVIA Mytilus galloprovincialis 18 WALVIA Mytilus galloprovincialis 19 WALVIA Mytilus galloprovincialis 19 WALVIA Mytilus galloprovincialis 10 Chilamys Sp. 22 Anoma chinensis 23 ANNELIDA POLYCHAETA Harmothoe Sp. 24 ANNELIDA POLYCHAETA Harmothoe Sp. 25 Lepidonotas elongatus 26 Lepidonotas elongatus 27 Nerephylla castanea 28 Neresh mulignatha 29 Platyneresi bicanaliculata 30 Marphysa Sp. 31 Amphirie Sp. 32 Sabella Sp. 33 ARTHROPODA PYCNOGONIDEA Amphibalanus amphiririe 37 Amphibalanus amphiririe 38 Amphibalanus improvisus 39 MAXILLOPODA Balmans ripoma 39 MAXILLOPODA Balmans ripoma 40 MALACOSTRACA Ampilhoe tarassovi 44 Monocorophium acherusicum 44 Monocorophium acherusicum 45 Monocorophium acherusicum 46 Paradexamine Sp. 46 Melita rylovae 47 Maera Sp. 48 Melita rylovae 49 Gilanopsis Sp. 40 Lepidonotas pp. 50 Anamixis Sp. 51 Colomastix Sp. 52 Leucothoe nagatai 53 Maritius Servicaudis 54 Melita rylovae 55 Leucothoe nagatai 56 Eucoline pagas servicaudis 57 Orrhomen Sp. 58 Cynsphimedia mala 59 Caprella seaura 60 Paramhus sp. 50 Maritius Servicaudis 60 Helpacarpus rectirostris 61 Gel Helpacarpus rectirostris 62 Cynsphimedia mala 62 Cynsphimedia mala 63 Dynoides dentisinus 66 Eucoline pagas servicaudis 66 Eucoline pagas servicaudis 67 Halicarcinus messor 67 Halicarcinus messor 77 Gel Bostylikiae gen. Sp. 77 Clona missignus sp. 77 Clona missignus sp. 77 Clona missignus sp. 78 Bostylikiae gen. Sp. 79 OESTEICHTHYES TOR 71 Gellini missignus sp. 71 Clona missignus		The second survey			
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c. Describe any concerns you may have about your project's progress

The morphological analysis of the samples took more time than according to the original plan, and the shipment of the DNA specimen was delayed. As has been already discussed with the U.S. scientists, the samples from the upcoming survey planned in April 2016 will be shipped as soon as the analysis is completed.

Also, there was a financial constraints regarding shipment of frozen samples of oysters and mussels. These samples were non-urgent items, so they will be re-treated with alcohol once the samples from the spring surveys are collected and will be shipped with the newly collected items once they are ready.

d. Completed and planned publications

None

e. Poster and oral presentations at scientific conferences or seminars

None

f. Education and outreach

Yes, we will provide the detail accordingly by April 30, 2016.

4. PROGRESS STATUS

Overall, the project is on track. The team communicated with the scientists from the U.S. during the PST meeting in Japan in February 2016, and the methodologies and concerns were clarified. The coming survey is to be conducted in April 2016 when it is the most species abundant season. This is expected to flourish the potential species lists.