Attachment

Implementation Guides on Sea Area Monitoring

1. Tasks of sea area monitoring

The distribution of radioactive materials is different among seawater, sediment and marine biota. The Table 1 shows the tasks of sea area monitoring, which are set taking into account the difference.

Table 1: Task of sea area monitoring

Sample	Tasks of sea area monitoring	Aims of Comprehensive Radiation Monitoring Plan
Seawater	To measure concentrations of radioactive materials including Cs-134/137.	(f)
Sediment	To figure out distribution and time-dependent migration of radioactive materials.	(f)
Marine biota	To measure concentrations and figure out their pathways.	(b), (c), (e) and (f)

2. Monitoring organizations

Organizations involved in sea area monitoring are as follows:

- Nuclear Regulation Authority (NRA);
- Fisheries Agency;
- Ministry of Land, Infrastructure, Transport and Tourism (MLIT);
- Japan Coast Guard;
- Ministry of the Environment (MOE);
- Fukushima Prefectural Government;
- Tokyo Electric Power Co., Inc. (TEPCO);
- Local governments;
- Local fishery unions; and
- Research institutes (as necessary).

The NRA plays a role as headquarters of monitoring organizations.

3. Sea areas to be monitored

The sea area around Fukushima Daiichi NPS is divided into the following four areas in terms of their distance from the NPS:

(a) Sea area close to Fukushima Daiichi NPS;
(b) Coastal area: The area within approximately 30km from the coastline (including river outlets) of Aomori (a part of Aomori), Iwate, Miyagi, Fukushima and Ibaraki Prefectures;
(c) Off-shore area: The area between approximately 30km and 90km from the coastline;
(d) Outer sea area: The area approximately 90km and more far from the coastline.

In addition to the above-described sea areas, Tokyo Bay is the concerned area to be monitored.

(e) Tokyo Bay: The area where radioactive materials are highly likely to flow in via rivers and be deposited.

4. Monitoring materials and methods

Radionuclides that must be measured are Cs-134 and Cs-137. Other radionuclides are to be analyzed as necessary.

Seawater

When a leakage of contaminated water is doubted or found, TEPCO and the central governmental organizations work together to obtain more seawater samplings as necessary in a prompt way.

(a) Sea area close to Fukushima Daiichi NPS

Monitoring is conducted as shown in the Table 2. Monitoring materials and methods are revised, when TEPCO installs underwater in–situ measurement detectors.

Table 2: Sea water monitoring close to Fukushima Daiichi NPS

Sampling points	Radionuclide	Detection limit (Bq/L)	Monitoring frequency	Sampling Depth	Monitoring organization
T-1, T-2-1 (Fig.4)	Cs-134 Cs-137	1	Once/day	Surface (*1)	TEPCO
		$1x10^{-3}$	Once/week		
	I-131	1	Once/week		
	H-3	3	Once/week		
	Sr-90	$1x10^{-2}$	Once/month		
	Pu-238(*2) Pu-239+Pu-240	$1x10^{-5}$	Once/6 months		
T-0-1,T-0-2 T-0-3, T-0-1A, T-0-3A (Fig.4)	Cs-134 Cs-137	1	Once/week	Surface	TEPCO
	H-3	3	Once/week	Surface	
M-101, M-102, M-103, M-104 (Fig.4)	Cs-134 Cs-137	$1x10^{-3}$	Once/month	Surface	NRA
	H-3	$4x10^{-1}$	Once/month	Surface	
	Sr-90	$1x10^{-2}$			
F-P01, F-P02, F-P03, F-P04 (Fig.4)	Cs-134 Cs-137	$1x10^{-1}$	Once/month	Surface	Fukushima Prefectural Government
	H-3	1			
	Sr-90	$1x10^{-3}$			
	Pu-238 Pu-239+Pu-240	$1x10^{-5}$			

*1: “Surface” is defined as 2m below sea level.
*2: U-234, U-235, U-238, Am-241, Cm-242 and Cm243+Cm244 should be measured when Pu-238 is detected.
* Total Beta is to be analyzed as necessary to screen radioactivity in sea water.

(b) Coastal area

Monitoring is conducted as shown in the Table 3.

Table 3: Sea water monitoring in coastal area

Prefecture	Sampling points	Radionuclide	Detection limit (Bq/L)	Monitoring frequency	Sampling Depth (*1)	Monitoring organization
Aomori	E-21, E-22, E-23 (Fig.2)	Cs-134 Cs-137	$1x10^{-3}$	Twice/year	Surface and bottom layers	MOE
Iwate	E-31, E-32 (Fig.2)	Cs-134 Cs-137	1	Once/6 months	Surface and bottom layers	MOE
	E-34, E-35, E-36 (Fig.1)	Cs-134 Cs-137	$1x10^{-3}$	Twice/year	Surface and bottom layers	MOE
Miyagi	T-MG0,T-MG1, T-MG2, T-MG3, T-MG4, T-MG5, T-MG6 (Fig.2)	Cs-134 Cs-137	$1x10^{-3}$	Twice/month	Surface and middle and bottom layers	TEPCO
		Sr-90	$1x10^{-2}$	Once/2 months (*2)	Surface	TEPCO
	E-41, E-42, E-43, E-44, E-45, E-46, E-47, E-48, E-49, E-4A, E-4B, E-4C (Fig.2)	Cs-134 Cs-137	1	Once/1-6 months	Surface and bottom layers	MOE
	E-4F, E-4G, E-4H (Fig.2)	Cs-134 Cs-137	$1x10^{-3}$	Twice/year	Surface and bottom layers	MOE
Fukushima	T-3, T-6 (Fig.5)	Cs-134 Cs-137	$1x10^{-3}$	Once/week	Surface	TEPCO
		H-3	$4x10^{-1}$	Twice/month	Surface	
	T-5, T-D1, T-D5, T-D9 (Fig.5)	Cs-134 Cs-137	$1x10^{-3}$	Once/week	Surface and bottom layers	TEPCO
		H-3	$4x10^{-1}$	Twice/month	Surface	
		Sr-90	$1x10^{-2}$	Once/month		
		Pu-238	$1x10^{-5}$	Once/6 months		
		Pu-239+Pu-240				
	T-4, T-11, T-14 (Fig.5)	Cs-134 Cs-137	$1x10^{-3}$	Once/week	Surface and bottom layers	TEPCO
	T-S1, T-S2, T-S3, T-S4, T-S5, T-S7, T-S8, T-B1, T-B2, T-B3, T-B4, T-13-1, T-7, T-18, T-12,	Cs-134 Cs-137	$1x10^{-3}$	Once/month	Surface and bottom layers	TEPCO

	T-17-1, T-20, T-22, T-MA, T-M10 (Fig.3, Fig.5)					
	E-71, E-72, E-73, E-74, E-75, E-76, E-77, E-78, E-79, E-7A, E-7B, E-7F E-7G, E-7H, E-7I (Fig.3, Fig.5)	Cs-134 Cs-137	1	Once/1-2 months	Surface and bottom layers	MOE
	E-7C, E-7D, E-7E (Fig.3)	Cs-134 Cs-137	$1x10^{-3}$	Twice/year	Surface and bottom layers	MOE
	F-P05, F-P06 (Fig.5)	Cs-134 Cs-137	$1x10^{-1}$	Once/month	Surface	Fukushima Prefectural Government
		H-3	1			
		Sr-90	$1x10^{-3}$			
		Pu-238 Pu-239+Pu-240	$1x10^{-5}$			
	31 points off the coast of Fukushima Prefecture (fishing ports, shoreline and shallow water fishing fields) (Fig.3)	Cs-134 Cs-137 (*3)	1	Once/month	2-7m above sea level	
Ibaraki	T-A, T-B, T-C, T-D, T-E, T-Z (Fig.6, Fig7)	Cs-134 Cs-137	1 (*4)	Once/month	Surface and bottom layers	TEPCO
		Sr-90	$1x10^{-2}$	Once/2 months (*5)	Surface	
	E-81, E-82, E-83, E-84, E-85 (Fig.6, Fig7)	Cs-134 Cs-137	1	Once/3-4 months	Surface and bottom layers	MOE

*1: “Surface and bottom layers” are defined as 3m below sea level and 5m above the sea bottom respectively. “Middle layer” is defined as the layer between the sea surface and the bottom of sea.
*2: Only at the sampling point T-MG5
*3: H-3 is additionally measured at the some sampling points.
*4: Detection limit will be changed to $1x10^{-3}$Bq/L.
*5: Only at the sampling point T-C
* Total Beta is to be analyzed as necessary to screen radioactivity in sea water.

(c) Off-shore area

Monitoring is conduct as shown in the Table 4.

Table 4: Sea water monitoring in off-shore area

Sampling points	Radionuclide	Detection limit (Bq/L)	Frequency	Sampling depth	Monitoring organization
M-A1, M-A3, M-MI4, M-B1, M-B3, M-B5, M-C1, M-C3, M-D1, M-D3, M-E1, M-E3, M-E5, M-F1, M-F3, M-G0, M-G1, M-G3, M-G4, M-H1, M-H3, M-I0, M-I1, M-I3, M-J1, M-IB2, M-J3, M-K1, M-IB4, M-L1, M-L3, M-M1 (Fig.2, Fig.3, Fig6, Fig7)	Cs-134 Cs-137 (*1)	$1x10^{-3}$	Once/3 months	Surface, middle (*2) and bottom layers	NRA

*1: Sr-90 and H-3 are additionally measured at some sampling points considering the consistency of the past monitoring results.

*2: "Surface and bottom layers" are defined as 2m below the sea level and 40m above the bottom of sea respectively. "Middle layer" is defined as the layer between the sea level and the bottom of sea. Some monitoring activities are conducted at 50m or 100m below the sea level.

* Total Beta is to be analyzed as necessary to screen radioactivity in sea water.

(d) Outer sea area

Monitoring is conducted as shown in the Table 5.

Table 5: Sea water monitoring outer sea area

Sampling points	Radionuclide	Detection limit (Bq/L)	Frequency	Sampling depth	Monitoring organization
M-10, M-11, M-14, M-15, M-19, M-20, M-21, M-25, M-26, M-27 (Fig.8)	Cs-134 Cs-137	$1x10^{-3}$	Once/6 months	Surface (2m), 100m, 200m, 300m and 500m below sea level	NRA
K-1, K-2, K-3, K-4 (Fig.9)	Cs-134 Cs-137 Sr-90	$1x10^{-3}$	Once/year	Surface (2m), 800m below sea level	Japan Coast Guard

(e) Tokyo Bay

Monitoring is conducted as shown in the Table 6.

Table 6: Sea water monitoring in the Tokyo Bay

Sampling points		Radionuclide	Detection limit (Bq/L)	Frequency	Sampling depth (*)	Monitoring organization
River outlet	E-T1, E-T2, E-T3, E-T4, E-T5, E-T6, E-T7, E-T8 (Fig.10)	Cs-134 Cs-137	1	4-7 times/year	Surface and bottom layers	MOE
	E-T1, E-T2, E-T3, E-T4 (Fig.10)	Cs-134 Cs-137	$1x10^{-3}$	Once/year	Surface	NRA
Center of the bay	K-T1, K-T2 (Fig.10)	Cs-134 Cs-137	$1x10^{-3}$	6 times/year	Surface	NRA
	M-C6, M-C9 (Fig.10)	Cs-134 Cs-137	$1x10^{-3}$	Once/year	Surface	NRA
Around the center of bay-mouth	KK-U1 (Fig.10)	Cs-134 Cs-137	5	Once/2 weeks	Surface	MLIT
		Cs-134 Cs-137	$1x10^{-3}$	Once/year	Surface	NRA

* “Surface and bottom layers” are defined as 2m below the sea level and 2m above the bottom of sea respectively.

Sediment

(a) Sea area close to Fukushima Daiichi NPS

Monitoring is conducted for sediment close to Fukushima Daiichi NPS as shown in the Table 7.

Table 7: Sediment monitoring close to Fukushima Daiichi NPS

Sampling points	Radionuclide	Detection limit (Bq/kg dry)	Frequency	Monitoring organization
T-1, T-2-1 (Fig.4)	Cs-134	1	Once/month	TEPCO
	Cs-137			
	Sr-90	2	Once/2 months	
	Pu-238 (*)	$3x10^{-2}$	Once/6 months	
	Pu-239+Pu-240			
F-P01, F-P02, F-P03, F-P04 (Fig.4)	Cs-134 Cs-137	1	Once/3 months	Fukushima Prefectural Government
	Sr-90	$2x10^{-1}$		
	Pu-238 Pu-239+Pu-240	$2x10^{-2}$		

* U-234, U-235, U-238, Am-241, Cm-242 and Cm243+244 should be measured when Pu-238 is detected.

(b) Coastal area

Monitoring is conducted for sediment in coastal area as shown in the Table.8

Table 8: Sediment monitoring in coastal area

Prefecture	Sampling points	Radionuclide	Detection limit (Bq/kg dry)	Frequency	Monitoring Organization
Aomori	E-21, E-22, E-23 (Fig.1)	Cs-134 Cs-137	1	Twice/year	MOE
		Sr-90	$2x10^{-1}$		
Iwate	E-34, E-35, E-36 (Fig.2)	Cs-134 Cs-137	1	Twice/year	MOE
		Sr-90	$2x10^{-1}$		
	E-31, E-32 (Fig.2)	Cs-134 Cs-137	$1x10^{1}$	Once/6 months	MOE
Miyagi	E-4F, E-4G, E-4H (Fig.2)	Cs-134 Cs-137	1	Twice/year	MOE
		Sr-90	$2x10^{-1}$		
	E-41, E-42, E-43, E-44, E-45, E-46, E-47, E-48, E-49, E-4A, E-4B, E-4C (Fig.2)	Cs-134 Cs-137	$1x10^{1}$	Once/1-6 months	MOE
Fukushima	T-3, T-4, T-5, T-11, T-14, T-B1, T-B2, T-B3, T-B4, T-D1, T-D5, T-D9, T-S1, T-S2, T-S3, T-S4, T-S5, T-S7, T-S8, T-①, T-②, T-③, T-④, T-⑤, T-⑥, T-⑦, T-⑧, T-⑨, T-⑩, T-⑪, T-⑫, T-⑬ (Fig.3, Fig5)	Cs-134 Cs-137	1	Once/month	TEPCO
	T-7, T-12, T-13-1, T-17-1, T-18, T-20, T-22, T-M10, T-MA, T-S7 (Fig.3, Fig5)	Cs-134 Cs-137	1	Once/2 months	TEPCO
	E-7C, E-7D, E-7E (Fig.3)	Cs-134 Cs-137	1	Twice/year	MOE
		Sr-90	$2x10^{-1}$		

	E-71, E-72, E-73, E-74, E-75, E-76, E-77, E-78, E-79, E-7A, E-7B, E-7F, E-7G, E-7H, E-7I (Fig.3, Fig5)	Cs-134 Cs-137	$1x10^{1}$	Once/1-2 months	MOE
		Sr-90	1	Twice/year	
	F-P05, F-P06 (Fig.5)	Cs-134 Cs-137	1	Once/3 months	Fukushima Prefectural Government
		Sr-90	$2x10^{-1}$		
		Pu-238 Pu-239+Pu-240	$2x10^{-2}$		
	42 points off the coast of Fukushima (sea bottom) (Fig.5)	Cs-134 Cs-137	$1x10^{1}$	Once/month to twice/year	
Ibaraki	E-81, E-82, E-83, E-84, E-85 (Fig.6, Fig7)	Cs-134 Cs-137	$1x10^{1}$	Once/3-4 months	MOE

(c) Off-shore area

Monitoring is conducted for sediment in off-shore areas as shown in the Table.9

Table 9: Sediment monitoring in off-shore area

Sampling points	Radionuclide	Detection limit (Bq/kg dry)	Monitoring frequency	Monitoring organization
M-A1, M-A3, M-MI4, M-B1, M-B3, M-B5, M-C1, M-C3, M-D1, M-D3, M-E1, M-E3, M-E5, M-F1, M-F3, M-G0, M-G1, M-G3, M-G4, M-H1, M-H3, M-I0, M-I1, M-I3, M-J1, M-IB2, M-J3, M-K1, M-IB4, M-L1, M-L3, M-M1 (Fig.2, Fig.3, Fig.6, Fig.7)	Cs-134 Cs-137 (*)	1	Once/3 months	NRA

* Sr-90, Pu-238, Pu-238+240, Am-241, Cm-242 and Cm-243+244 are measured in some sampling points (e.g., sampling points where high Cs-134 and Cs-137 levels were found) with the detection limits as follows;

- Sr-90: $1x10^{-1}$Bq/kg of dry sediment
- Pu-238 and Pu-239+Pu-240: $1x10^{-2}$BqBq/kg of dry sediment
- Am-241: $2x10^{-2}$Bq/kg of dry sediment
- Cm242 and Cm-243+244: $1x10^{-2}$Bq/kg of dry sediment

(d) Outer sea area

Monitoring is not conducted for sediment in outer sea area.

(e) Tokyo Bay

Monitoring is conducted for sediment in Tokyo Bay as shown in the Table 10.

Table 10: Sediment monitoring in Tokyo Bay

Sampling points		Radionuclide	Detection limit (Bq/kg dry)	Monitoring frequency	Monitoring organization
River outlets	E-T1, E-T2, E-T3, E-T4, E-T5, E-T6, E-T7, E-T8 (Fig.10)	Cs-134 Cs-137	$1x10^{1}$	4-7 times/year	MOE
	M-C1, M-C3, M-C4, M-C7, M-C8, M-C10, C-P1, C-P2, C-P3, C-P4, C-P5, C-P8 (Fig.10)	Cs-134 Cs-137	1	Once/3 months	NRA
Center of the bay	K-T1, K-T2 (Fig.10)	Cs-134 Cs-137	1	Once/2 months	NRA
	M-C2, M-C5, M-C6, M-C9 (Fig.10)	Cs-134 Cs-137	1	Once/3 months	NRA

Marine biota

Monitoring is conducted for marine biota in the sea areas mainly facing to Fukushima Prefecture with reference of the previous monitoring results, as shown in the Table 11.

Table 11: Marine biota monitoring

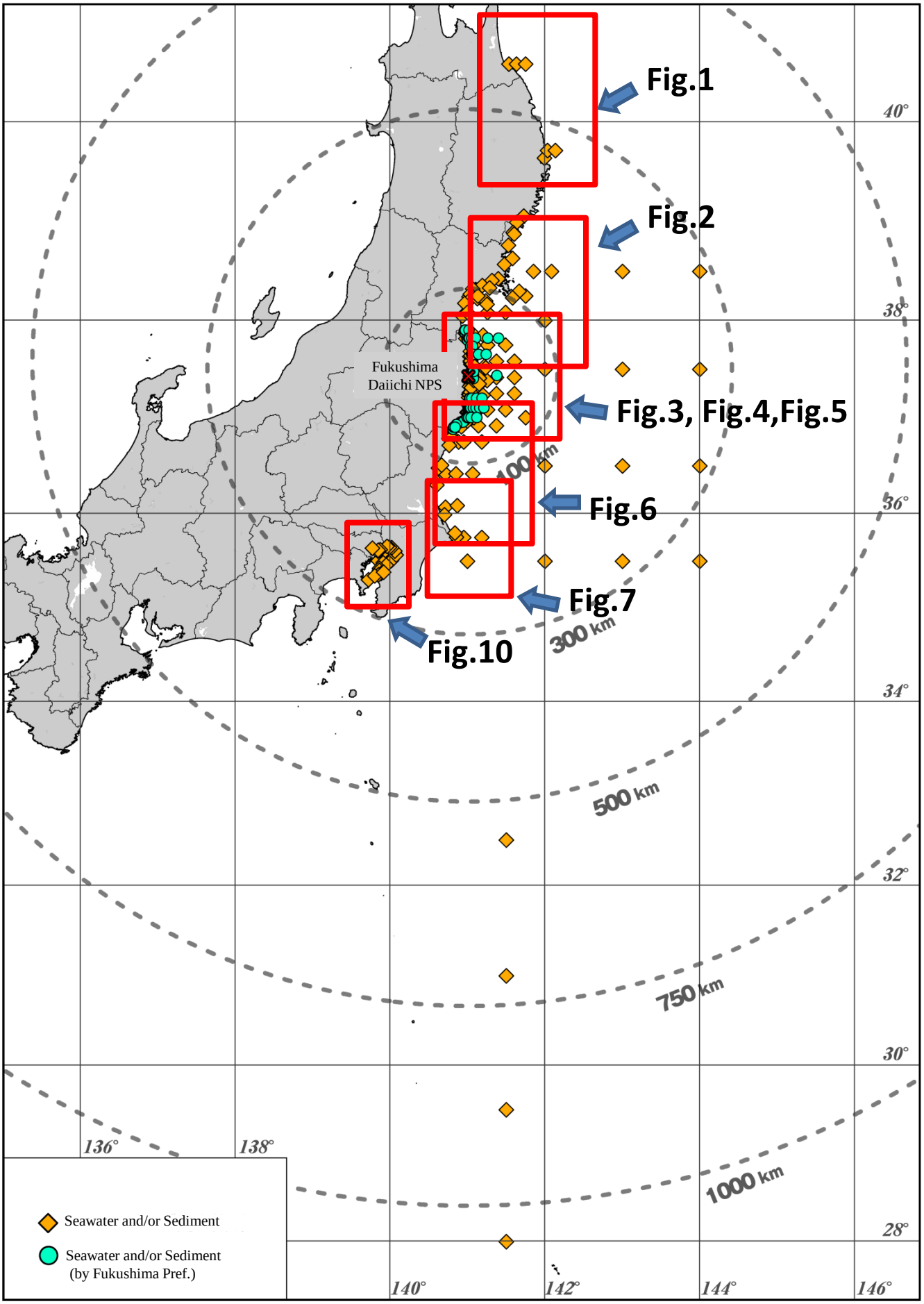
Sea area to be monitored (See the above-described paragraph 3)	Monitoring subject	Radionuclide	Detection limit (Bq/kg wet)	Monitoring frequency	Monitoring organization
(b)	Fish and shellfish	Cs-134 Cs-137 (*1)	$1x10^{1}$	once/month	TEPCO
(b), (c), (d) and (e)	Marine products	Cs-134 Cs-137	$1x10^{1}$	once/week (*2)	Fisheries Agency
(b)	Marine biota including fish, shellfish and prey organisms (*3)	Cs-134 Cs-137 (*1)	$1x10^{-3}$ to $1x10^{-2}$	once/3-4 months	MOE

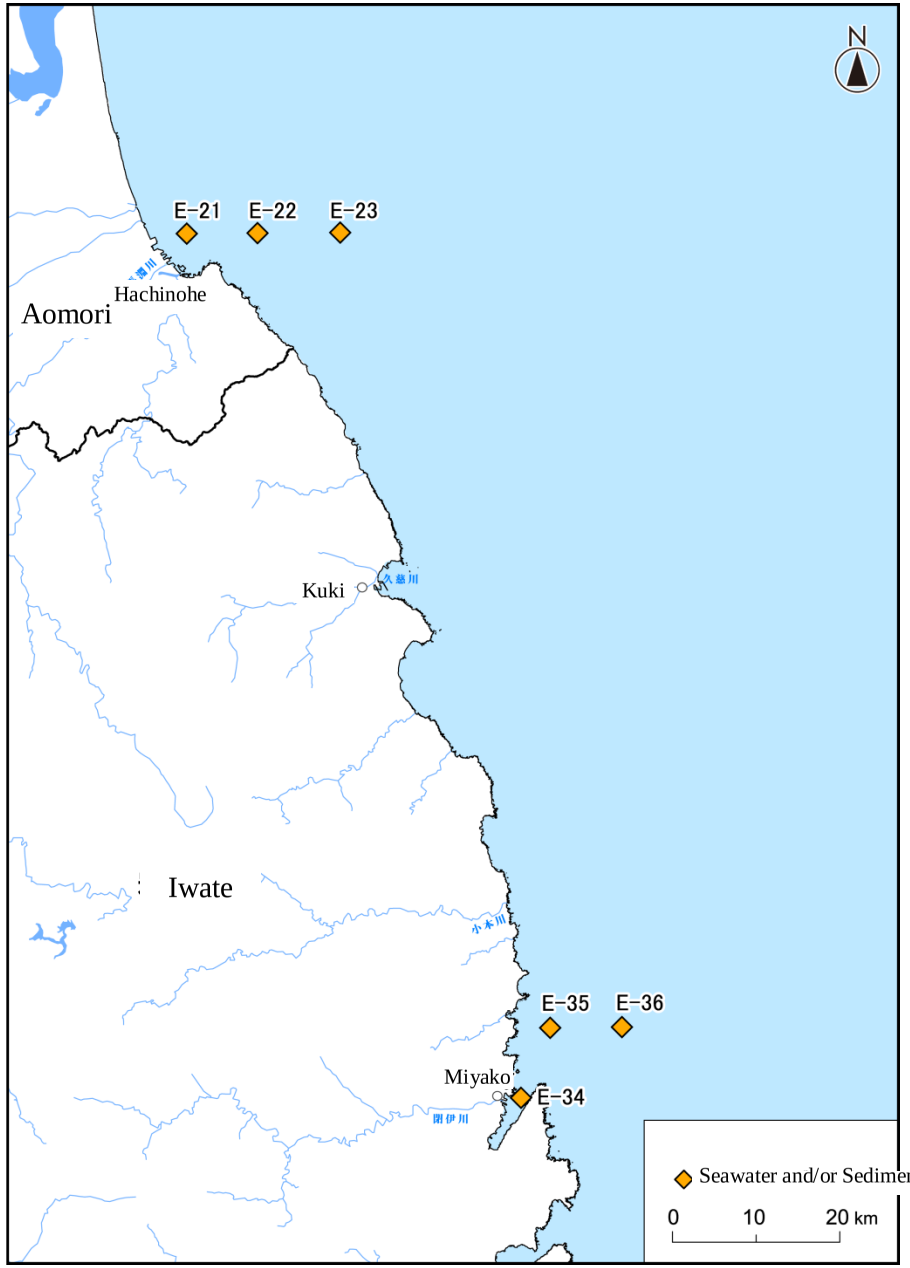
*1: The concentration of Sr-90 is measured as necessary with the detection limit of $2x10^{-2}$ Bq/kg of wet weight.

*2: Monitoring frequency can be changed according to the past results.

*3: Prey organisms are subject to monitoring so that the monitoring results can be used to figure out dynamics of radioactive materials in the marine.

Sampling Points for Sea area Monitoring

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E-22
E-23
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Miyako
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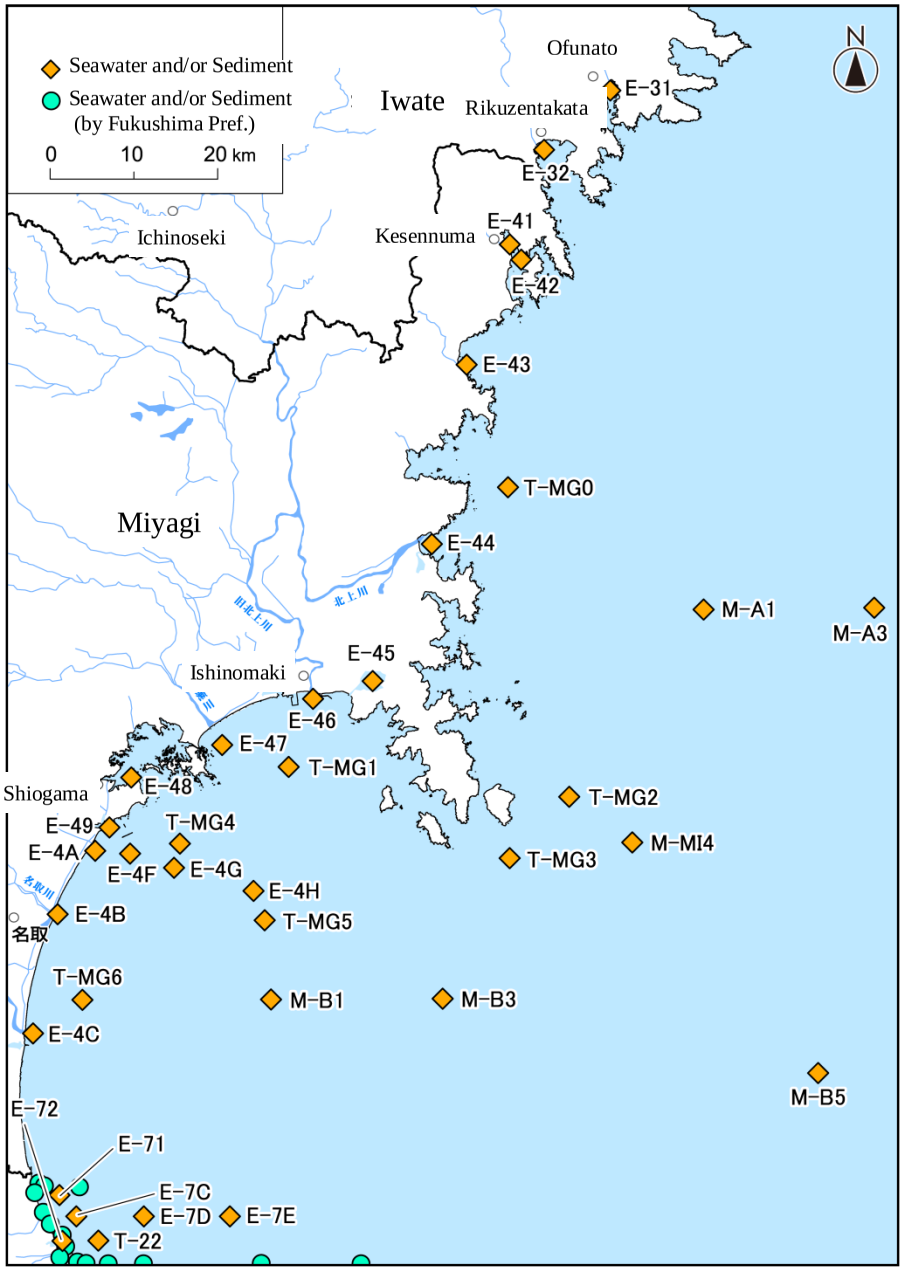
10
20 km

Fig.1


Seawater and/or Sediment
Seawater and/or Sediment
(by Fukushima Pref.)
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10
20 km
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Ofunato
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Iwate
Rikuzentakata
E-32
Ichinoseki
Kesennuma
E-41
E-42
E-43
T-MG0
Miyagi
E-44
M-A1
M-A3
Ishinomaki
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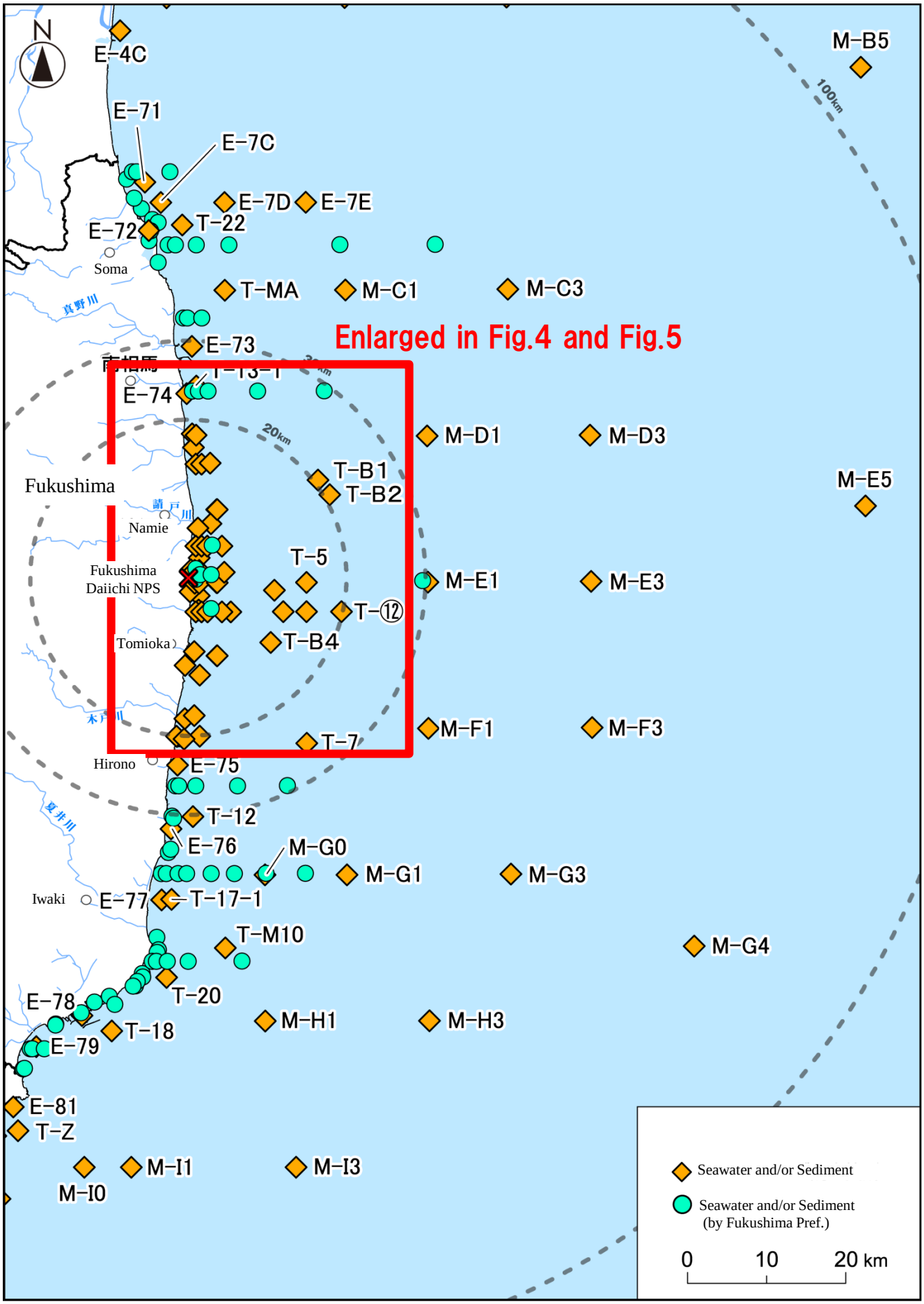
Fig.2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Soma
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M-B5
100km
真野川
Enlarged in Fig.4 and Fig.5
E-73
T-13-1
E-74
20km
M-D1
M-D3
T-B1
T-B2
Fukushima
M-E5
請戸川
Namie
T-5
Fukushima
Daiichi NPS
M-E1
M-E3
T-⑫
Tomioka
T-B4
木戸川
M-F1
M-F3
T-7
Hirono
E-75
T-12
夏井川
E-76
M-G0
M-G1
M-G3
Iwaki
E-77
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M-G4
E-78
T-20
M-H1
M-H3
T-18
E-79
E-81
T-Z
M-I1
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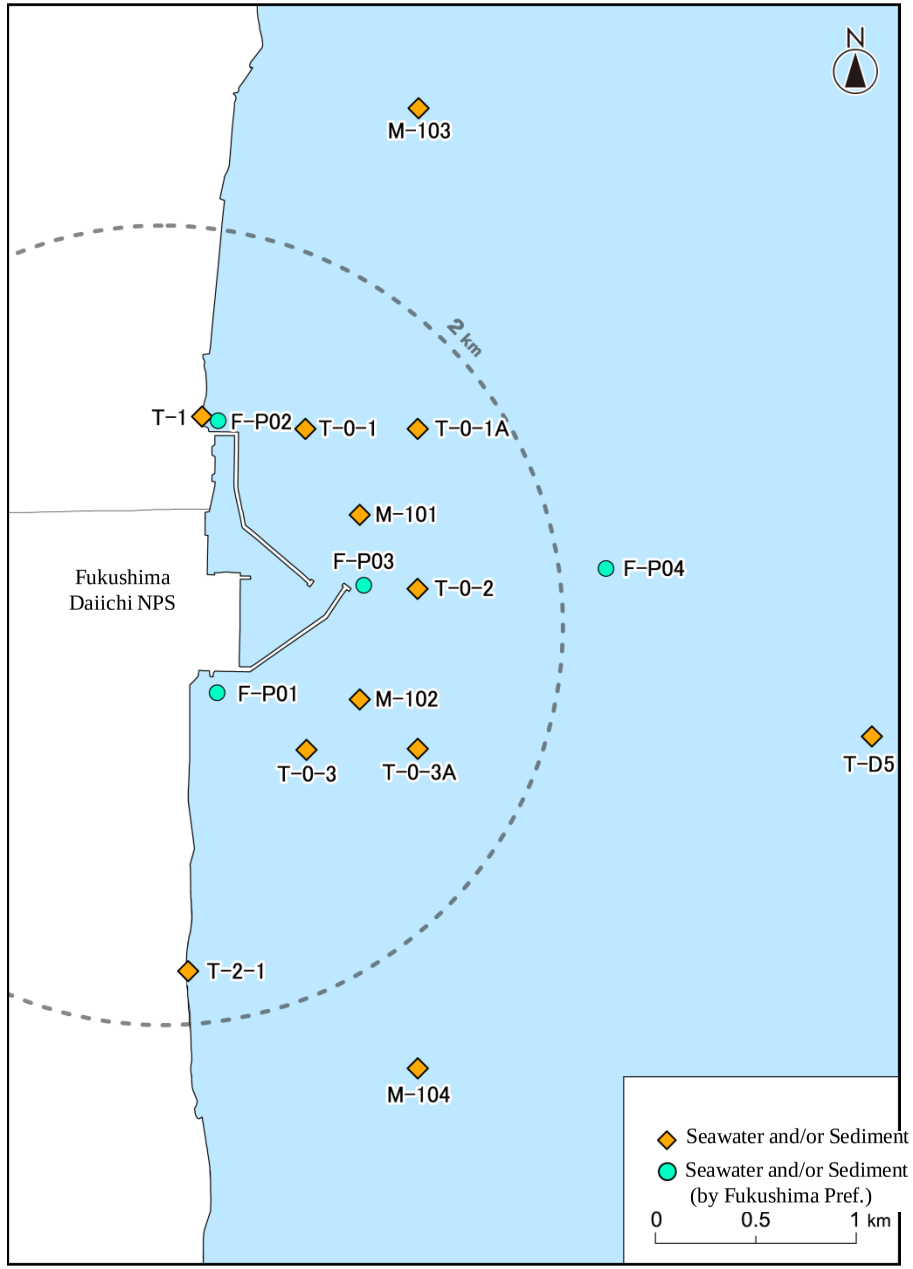
(by Fukushima Pref.)
0
10
20 km

Fig.3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T-0-1A
M-101
Fukushima
Daiichi NPS
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T-0-2
F-P01
M-102
T-0-3
T-0-3A
T-D5
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Seawater and/or Sediment
Seawater and/or Sediment
(by Fukushima Pref.)
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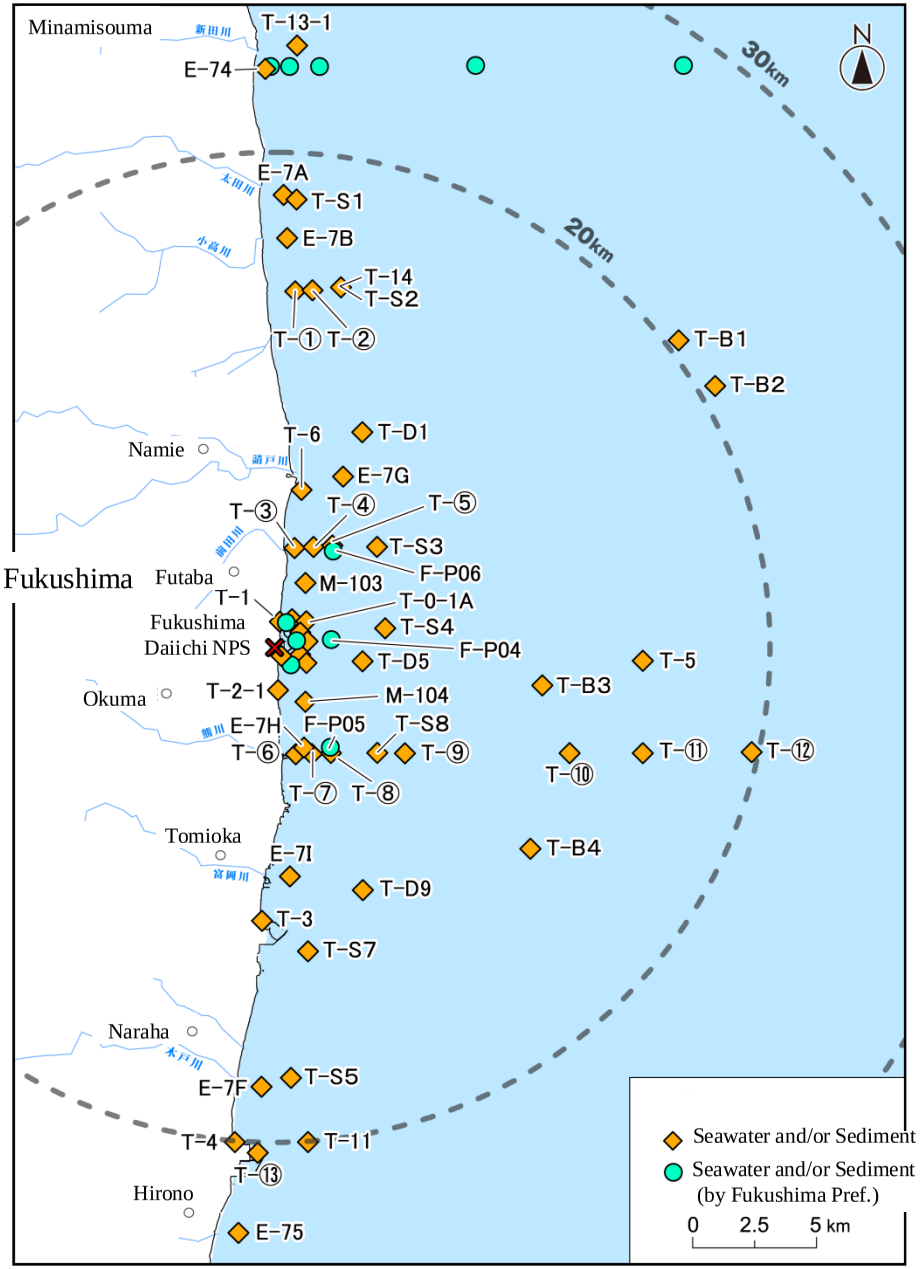
0.5
1 km

Fig.4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20km
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T-14
T-S2
T-① T-②
T-B1
T-B2
T-6
T-D1
Namie
請戸川
E-7G
T-③
T-④
T-⑤
新田川
T-S3
F-P06
Fukushima
Futaba
M-103
T-1
T-0-1A
Fukushima
Daiichi NPS
T-S4
F-P04
T-D5
T-5
T-2-1
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Okuma
E-7H
熊川
F-P05
T-S8
T-⑥
T-⑨
T-⑪
T-⑫
T-⑩
T-⑦
T-⑧
Tomioka
E-7I
T-B4
富岡川
T-D9
T-3
T-S7
Naraha
木戸川
E-7F
T-S5
T-4
T-11
T-⑬
Hirono
E-75
Seawater and/or Sediment
Seawater and/or Sediment
(by Fukushima Pref.)
0
2.5
5 km

Fig.5

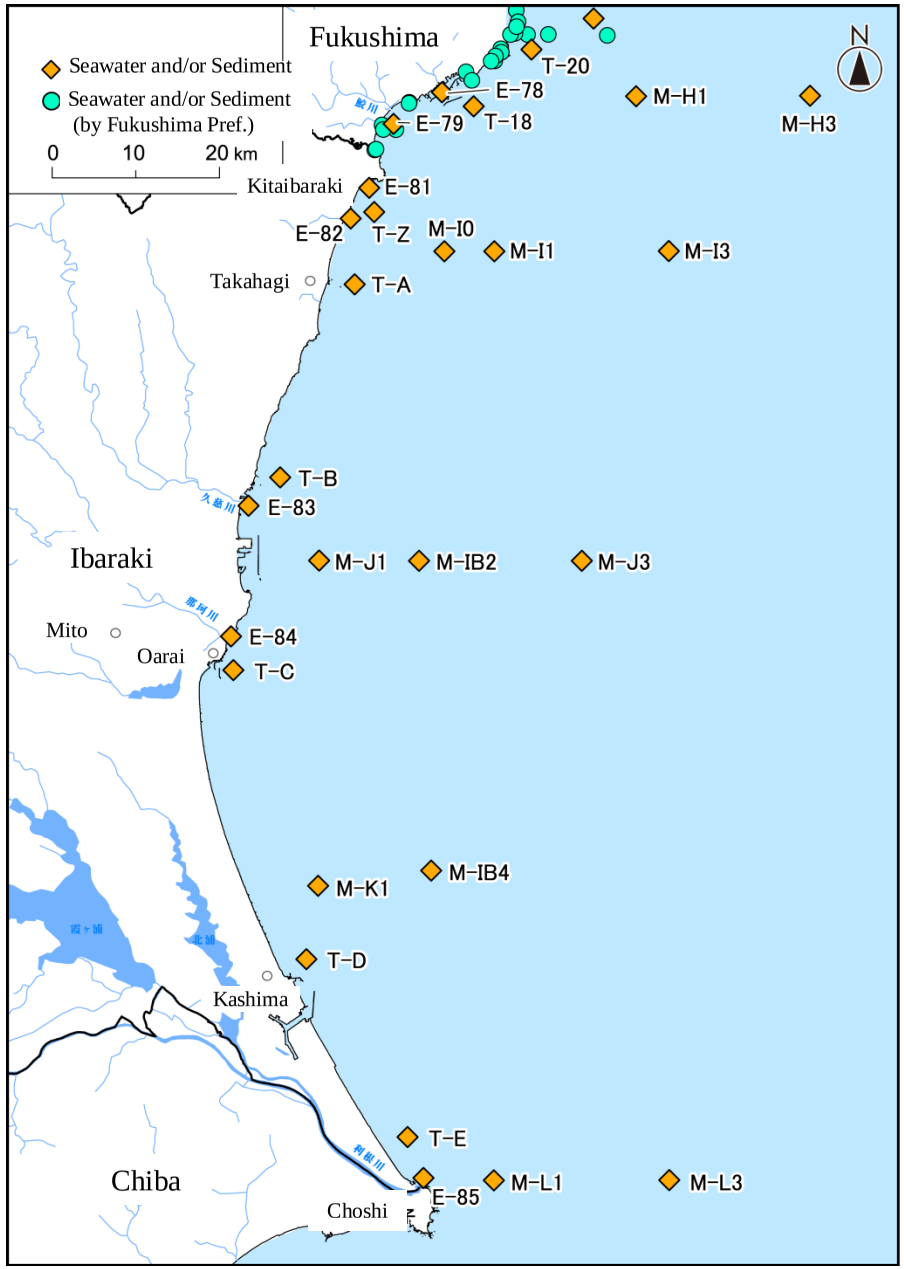
Seawater and/or Sediment
Seawater and/or Sediment
(by Fukushima Pref.)
0 10 20 km
N
Fukushima
T-20
E-78
E-79
T-18
M-H1
M-H3
Kitaibaraki
E-81
E-82
T-Z
M-I0
M-I1
M-I3
Takahagi
T-A
T-B
E-83
Ibaraki
M-J1
M-IB2
M-J3
Mito
Oarai
E-84
T-C
M-K1
M-IB4
T-D
Kashima
T-E
Chiba
E-85
M-L1
M-L3
Choshi

Fig.6

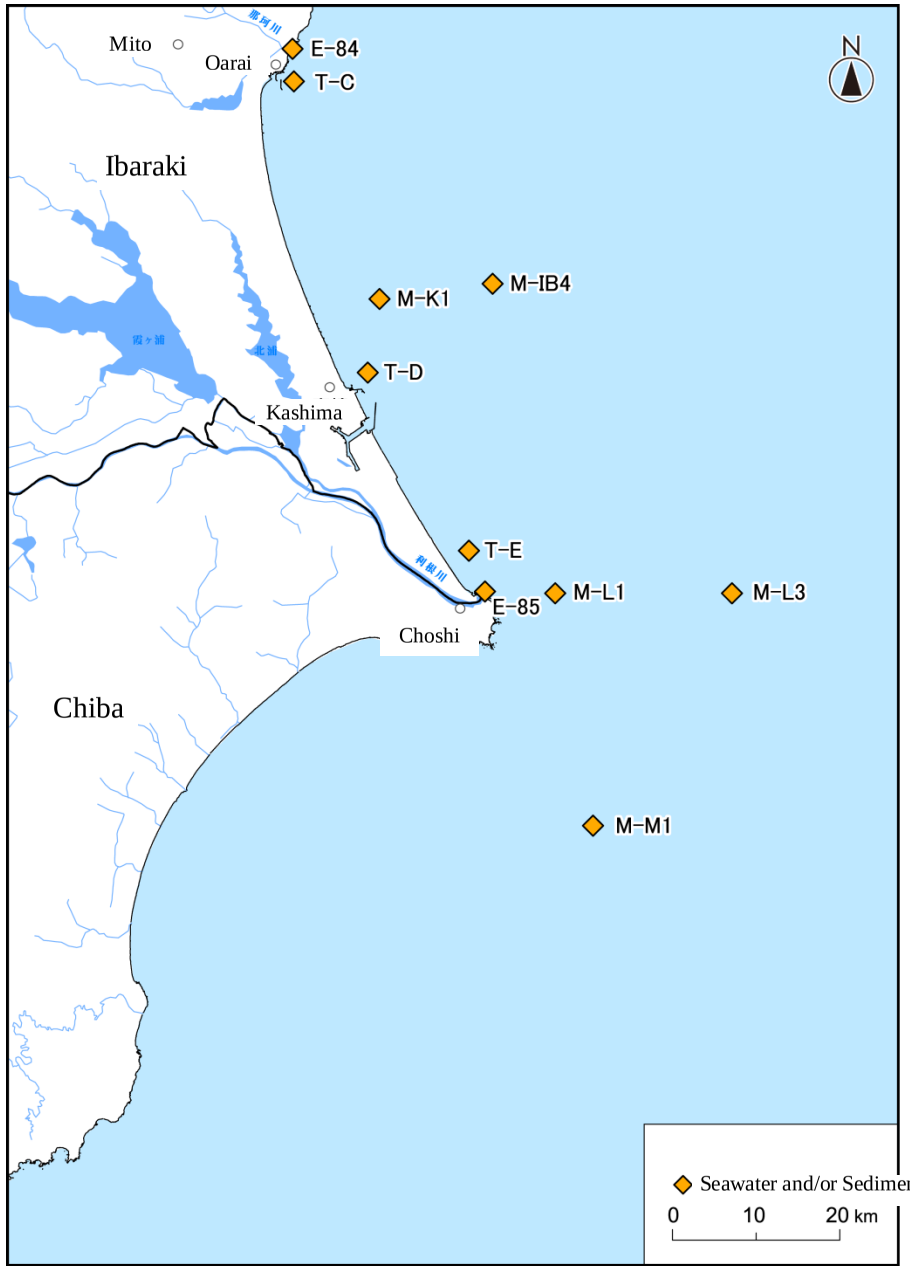
N
Mito
Oarai
E-84
T-C
Ibaraki
M-K1
M-IB4
T-D
Kashima
T-E
E-85
M-L1
M-L3
Choshi
Chiba
M-M1
Seawater and/or Sediment
0 10 20 km

Fig.7

Outer sea area

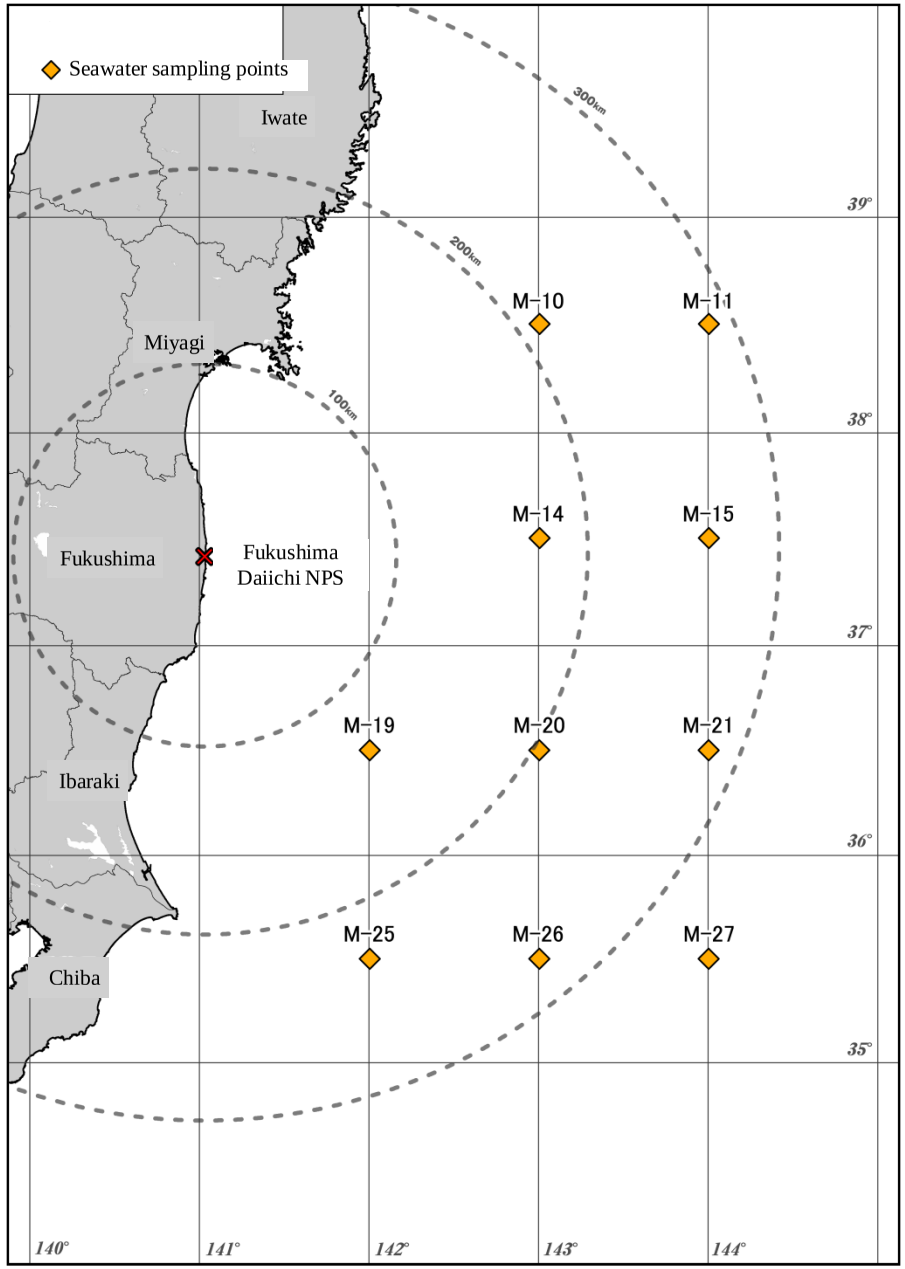

Fig.8

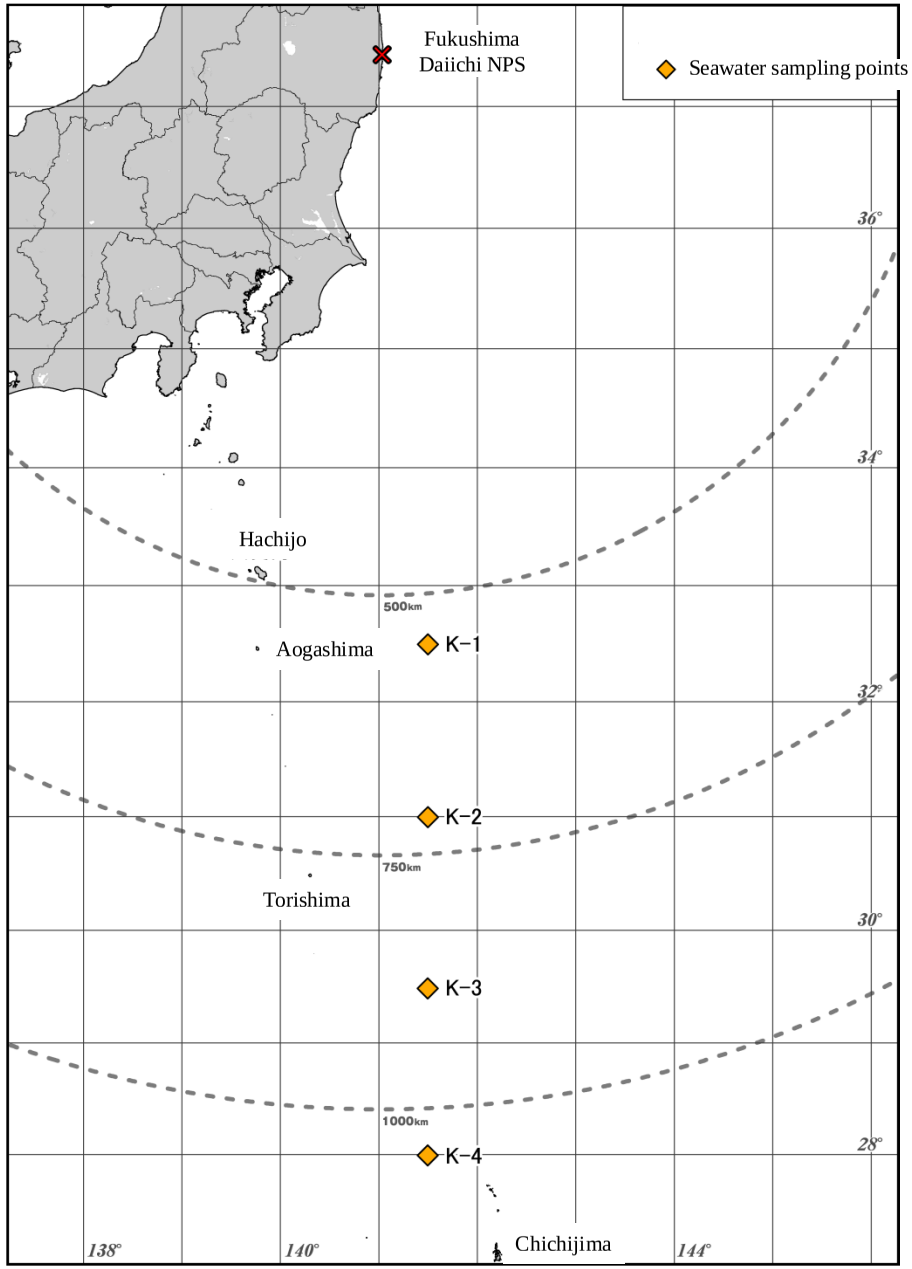

Fig.9

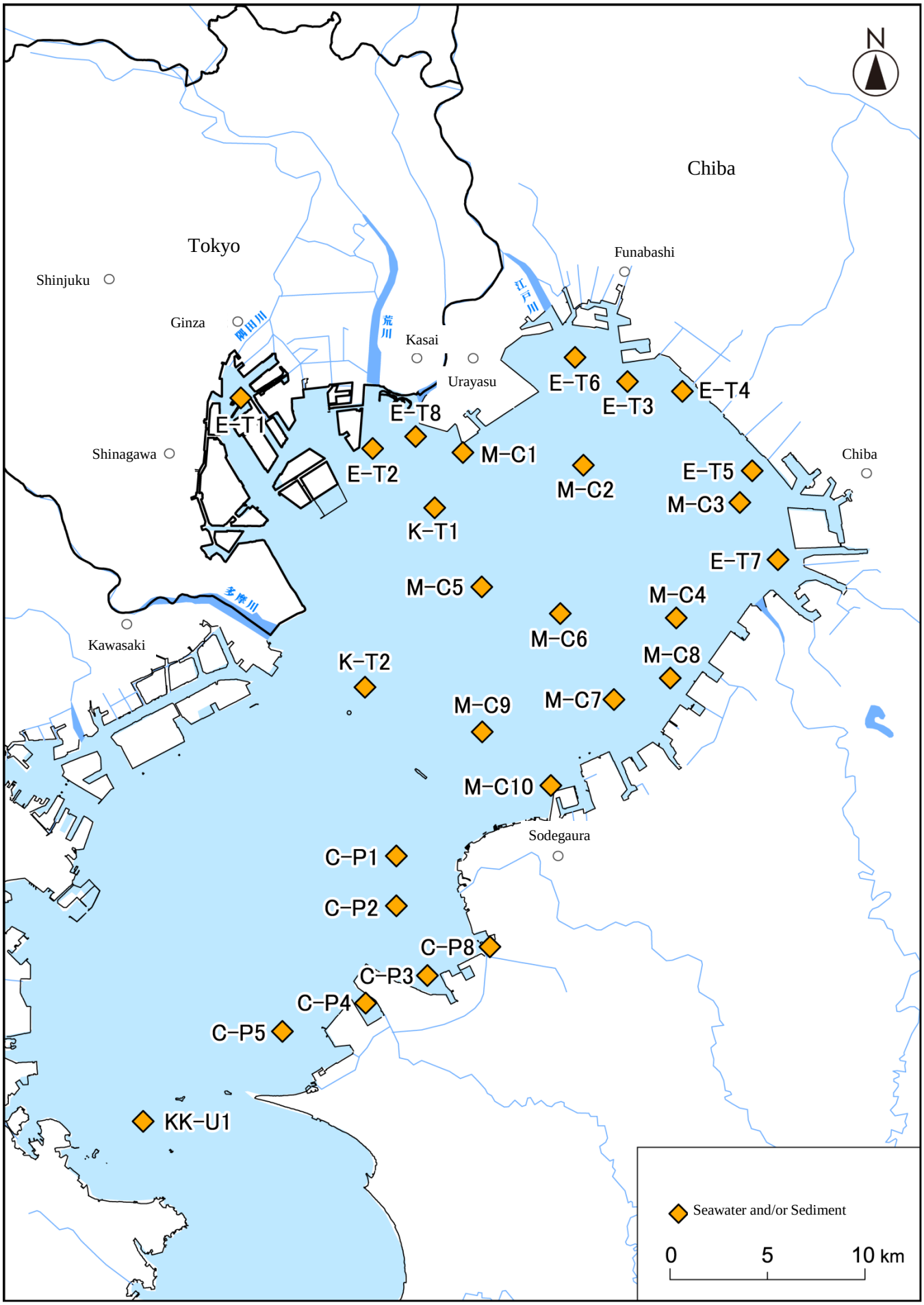
N
Chiba
Tokyo
Shinjuku
Ginza
Shinagawa
Kawasaki
Kasai
Urayasu
Funabashi
Chiba
Sodegaura
隅田川
荒川
江戸川
多摩川
E-T1
E-T2
E-T3
E-T4
E-T5
E-T6
E-T7
E-T8
K-T1
K-T2
M-C1
M-C2
M-C3
M-C4
M-C5
M-C6
M-C7
M-C8
M-C9
M-C10
C-P1
C-P2
C-P3
C-P4
C-P5
C-P8
KK-U1
Seawater and/or Sediment
0
5
10 km

Fig.10