SPECIAL FEATURE

Data rescue—collection of precious and laborious in situ observed data

Traits database of tidal flat macrobenthos along the Northwest Pacific coast of Japan

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Abstract
We collected information on the functional traits of the macrobenthos that inhabit mainly tidal flats along the Northwest Pacific coast of Tohoku, Japan, based on the species that were present during a survey after the Great East Japan Earthquake of 2011. The dataset contains information on 33 traits of 246 species and includes their taxonomic position, distribution, body length, habitat, reproduction type, and other characteristics such as diet type, migratory type, and invasiveness. Information about most basic traits such as body length, distribution, and habitat characteristics is complete, and more than 50% of trait information is complete for over 100 species, but information about reproduction is relatively limited. Although we did not limit our study to specific taxa and even included vegetation in the database, the majority of the taxa are Arthropoda, Mollusca, and Annelida. This file also has a table that compares the traits data to the existing traits database BIOTIC (Biological Traits Information Catalogue) to facilitate transformation and reuse of the data. Because the area of this survey was very adversely impacted by the Great East Japan Earthquake and Tsunami of March 11, 2011 and by post-disaster anthropogenic activities, this database will be relevant to assessments of post-disaster changes of the benthic community due to both the tsunami and human activities. The database is expected to fill the gap between the identification of species and assessments of community composition. The detailed Metadata for this abstract published in the Data Paper section of the journal is available in MetaCat in JaLTER at http://db.cger.nies.go.jp/JaLTER/metacat/metacat/ERDP-2020-23.1/jalter-en.

KEYWORDS
benthic organisms (benthos), biological traits, body size, life history, taxonomy

1 INTRODUCTION

The Great East Japan Earthquake of 2011 caused extensive damage to many coastal ecosystems. Several studies have been conducted of benthic organisms before and after the earthquake and of the process of recovery of the organisms after the earthquake (e.g., Kanaya, Nakamura, Higashi, & Maki, 2013; Kitahashi et al., 2014;...
Yamakita, 2018; Yamakita et al., 2018; Yamakita, Fujiwara, Tsuchida, et al., 2016; Yamakita, Matsuoka, & Iwasaki, 2017). As a result, there is evidence of not only a decrease in the total biomass and numbers of organisms in the coastal area, but also of an increase or decrease in the abundance of particular species, depending on the species and location. Although it is common to evaluate the change of a community after such impacts by comparing species richness and biomass as well as by calculating community similarities, these indices will not directly reflect the identity of the species that respond to such disturbances. A better way to group species is to assign them to guilds or trophic levels in the case of food web research. More general ways of grouping individual species are needed to capture the characteristics and trends of changes in organisms after such disasters.

There have been a number of previous studies of terrestrial plant ecosystems that compared community characteristics using functional groups based on trait databases (Daz, Kattge, Cornelissen, et al., 2016). The larger numbers of higher taxonomic groups among marine versus terrestrial organisms makes it more difficult to obtain standardized data. However, at small spatial scales and for small taxonomic groups, the importance of considering individual functional groups has been pointed out, even for marine organisms (e.g., Yamada, Hori, Tanaka, Hasegawa, & Nakaoka, 2010). It is not unusual to show the importance of functional characteristics qualitatively, even in wide spatial comparisons (Wahl et al., 2011). However, there has been no comprehensive information on the various functions and taxa of benthic organisms that would enable an assessment of the entire community affected by this disaster.

Traits data make it possible to understand changes in communities at a higher level than individual species but in more detail than is likely to be provided by community indices. For example, functional diversity is a better indicator than species diversity for evaluating characteristics of a community that have responded to environmental change (Mouillot, Graham, Villéger, Mason, & Bellwood, 2013). It is also believed that functional redundancy improves the ability of the entire ecosystem to compensate for the loss of individual species. Thus, this dataset can also be used to evaluate the relationship between compensatory effects in the responses of species and communities to environmental changes (Elmqvist, Bengtsson, Angelstam, et al., 2003; Mori, Furukawa, & Sasaki, 2013).

A trait database for such purposes has already been assembled for the major vascular plants, for which there is much well-organized information about specimens and lineages (Daz et al., 2016). In the case of aquatic species, progress has been made mainly on fish (Albouy et al., 2015; Stuart-Smith et al., 2013). Recently, a database dealing with benthic organisms has been initiated. For example, the BIOTIC database includes data from more than 680 species (Costello et al., 2015). In the case of specific taxa, the Polytraits database has been actively archiving information mainly about nematode and other meiofauna including polychaetes (Faulwetter et al., 2014). In recent years, progress has been made on a database of the functional traits of deep-sea hydrothermal organisms (sFDvent https://peerj.com/preprints/26627/). In this way, the assembling of databases and advancement of understanding of the functions of marine organisms other than fish have begun.

To contribute to the tidal flat survey along the northeastern coast of the Japanese archipelago, which was very adversely impacted by the Great East Japan Earthquake, we collected information on the functional traits of benthic organisms that inhabit mainly tidal flats. Our survey was not limited to specific taxa. As with other benthic databases that have been initiated in recent years (Costello et al., 2015; Daz et al., 2016; Faulwetter et al., 2014), this database is characterized by information on the distribution, body length, life history, and physiological characteristics of organisms across taxa.

2 | DATA DESCRIPTION

2.1 | Identifier

ERDP-2020-23

2.2 | Contributor

2.2.1 | Dataset owner

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2.3 | Projects

2.3.1 | Title

1. Tohoku Ecosystem-Associated Marine Sciences (TEAMS)
2. KAKENHI (17K07580) JSPS
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2.3.2 | Personnel

Projects 1 and 3
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2.3.3 | Funding

A. The Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan
B. KAKENHI (17K07580) JSPS

2.4 | Geographic coverage

2.4.1 | Geographic description

Coastal areas of Iwate and Miyagi prefectures, Japan.

2.4.2 | Geographic position

From 38.42°N, 141.42°E to 37.82°N, 140.98°E (WGS 84).

2.5 | Temporal coverage

Best available data prior to May 1, 2017.

2.6 | Methods

2.6.1 | Study sites

We focused on the major species observed on tidal flats along the Northwestern Pacific coast of Tohoku, Japan, based mainly on the locations sampled as a part of the Survey of the Natural Environment in the Pacific coast of the Tohoku district, part of the “Monitoring 1000” project of the Ministry of the Environment (Biodiversity Center Nature Conservation Bureau, Ministry of the Environment, 2012, 2013). We also made use of several other publications that have described monitoring of ecosystems after the earthquake (Hayasaka, Yamada, & Uchida, 2016; Kanaya, Suzuki, Maki, et al., 2012; Urabe, Suzuki, Nishita, & Makino, 2013). The study included 20 locations from Aomori Prefecture to Chiba Prefecture (Figure 1): Takahoko Numa Lagoon, the Takase River, Osuka Coast, Kuji Coast, Tofugaura Coast, Akedo Coast, the Tsugaruishi River, the Orikasa River, the Unosumai River, the Kitakami River, Nagatsuraura Lagoon, Mangokuura Lagoon, Matsushima Lagoon.
Bay, Gamou Lagoon, Idoura Lagoon, the Hiroura tidal flat, Torinoumi Lagoon, Matsukawaura Lagoon, the Ichinomiya River, and the Isumi River. These study sites can be characterized as western Pacific temperate ecosystems. The study sites are mainly lagoons and river-mouth tidal flats.

### 2.6.2 List of the species

The species in the database are summarized in Figure 2. The data are based mainly on research conducted in 2011 and 2012 during the year after the earthquake (Biodiversity Center Nature Conservation Bureau, Ministry of the Environment, 2012, 2013; Hayasaka et al., 2016; Kanaya et al., 2012; Urabe et al., 2013). We selected 246 species that we deemed appropriate for evaluating macrobenthos communities in the region focused mainly around Sendai Bay. For this selection, we considered the number of occurrences in the data and generality of the distribution in our study region based on expert opinion. After the selection, the availability of trait information reduced the number of species. Figure 2 shows the taxonomic distribution of the dataset. The majority of the phyla were Arthropoda, Mollusca, and Annelida;

![Figure 2: Taxonomic distribution in this dataset. (a) Phylum level, (b) class level](wileyonlinelibrary.com)
each of those phyla accounted for more than 10% of the species. The remaining species, which accounted for <15% of the total species, came from a variety of taxa. The majority of the species belonged to the classes Malacostraca, Polychaeta, Gastropoda, and Bivalvia. Although the original list of species contained several species that could not be identified, those specimens were eliminated because of the limitations of the traits data.

2.6.3 Taxonomy and systematics

The species names were checked by the authors, who are experts of some of these benthic organisms. If we could not obtain sufficient information for species identification from a specimen, we recorded the taxon at a higher taxonomic level (e.g., order or class) that could be specified with certainty. Scientific names followed Okutani (2017), the latest information in Furota and Taru (2016), the WORMS database (http://www.marinespecies.org), and the Catalogue of Life database (http://www.catalogueoflife.org/), in that order of priority. However, we modified Sipuncula and Echiura into Annelida (Sipuncula) and Annelida (Echiura) from the WORMS. Polychaeta was not modified from WORMS because the polyphyletic groups in this class are still not orderd in the WORMS.

2.7 Data structure

2.7.1 Data files

A list of data files is shown in Table 1.

2.7.2 File format

The data files are saved in comma-delimited (csv) text files with UTF-8 encoding.

2.7.3 Definitions and extraction of traits data

The traits are defined in Table 2. The list includes the best available biological and ecological traits from over 40 potential traits identified at the beginning of the study. The traits were ordered as follows: taxonomic position, geographical distribution, body length, habitat, mode of reproduction, and other characteristics such as diet type and migratory type. After an initial draft of this information was produced, the BIOTIC database was published, and we refined our categories to make them consistent in most cases with the BIOTIC database. Some categories that we considered to reflect our thought on traits were retained from the first draft without considering their compatibility with the BIOTIC database (Costello et al., 2015; Nagai, Shibata, Osawa, et al., in press). Those traits included Abundance of the population, Depth of habitat in the substrate, Dispersion type, Egg type, Types of larvae, Feeding devices, Fertilization or pollination methods, Sexual expressions, Fishing pressure, and Alien species. About 20 traits in the BIOTIC database were not adapted because of data limitations and overlap with other categories such as Food type, Flexibility, Habitat, Growth rate, Dispersal potential of adults, Sociability, Regeneration per year, Toxicity, Generation time, Larval settlement period, Fecundity, Egg size, Fertilization type, Larval settling Time, Reproduction Location, Biozone, Growth form, Reproduction type, Water flow, and Wave exposure. These differences are also listed in Table 2.

We input the information about each trait from the literature survey. Base data, in particular, were input based on the references Masuda (1984), Abe (1987), Zukan.com.co.ltd. (2018) mainly for fish, Japan River Front research Center (1996) mainly for vegetation, and Japan Fisheries Resource Conservation Association (1983, 1986, 1992), Miyake (1983) Marine Ecology Research Institute (1991), Nishimura (1992, 1995), Imajima (1996, 2001, 2007), Watanabe (2014), Suzuki, Kimura, Kimura, Mori, & Taru (2014), Furota and Taru (2016), Okutani (2017), Sato (2017) for other benthic organisms. The Japan Fisheries Resource Conservation Association (1992) was especially useful for mapping the feeding method and habits, feeding devices. For the species-specific data, we obtained information from the literature cited in each of the reference columns. Before using online information, we conducted a double check using ourselves as experts.

We also made use of our expert knowledge and estimated the traits of some species for which there were inadequate literature data. Expert knowledge did not

| Table 1 | List of data files |
|---------|-------------------|
| Datafile name | Description |
| Traits_Tidal Flat_Benthos_NW_Pacific_Japan_traitdatabase_v9_clean.csv | List of the values of the trait’s species by species. |
| Traits_DB_Benthos_NW_Pacific_Ja_ref_v5.txt | List of the references that were used to produce the database |
### TABLE 2  Definitions and categorizations of traits (Comparison with the BIOTIC database is also included)

| ID  | Trait name                  | Definition                                                                 | BIOTIC ID | Trait name in BIOTIC database | Summary of definition in BIOTIC database |
|-----|-----------------------------|-----------------------------------------------------------------------------|-----------|-------------------------------|----------------------------------------|
| 1045| SpeciesID                   | Identical number in this data set                                           |           |                               |                                        |
| 1047| WORMS_AphiaID              | Aphia ID used in the WORMS                                                  |           |                               |                                        |
| 1060| Kingdom                     |                                                                              |           |                               |                                        |
| 1070| Phylum                      | Phylum names based in WORMS. Sipuncula was modified to Annelida (Sipuncula)  | 1050      | Phylum                        |                                        |
| 1080| Class                       | Class names based in WORMS. Although Polychaeta contains multiple class the name Polychaeta was used as is | 1060      | Class                         |                                        |
| 1090| Order                       |                                                                              |           |                               |                                        |
| 1100| Family                      |                                                                              |           |                               |                                        |
| 1110| Species name                |                                                                              |           |                               |                                        |
| 1170| Biogeographic distribution (global) | 1. Cosmopolitan, 2. Western Pacific                                    |           |                               |                                        |
| 1171| Geographic distribution N-S | (Edge of approx. S–N)                                                      |           |                               |                                        |
| 1171| Geographic distribution E-W | (Edge of approx. W–E)                                                      |           |                               |                                        |
| 1310| Depth                       | Numerical value of average or range from low to high                       | 1360      | Depth range                   | (expressed as meters below chart datum) |
| 1330| Abundance                   | 1. Frequently dominant; 2. Sometimes dominant; 3. Not dominant, but numerous; 4. Rare; 5. Very rare |           |                               |                                        |
| 1390| Body length                 | Estimated average from any of latter size information 1. <1 cm; 2. 1–2.5 cm; 3. 2.5–5 cm; 4. 5–10 cm; 5. >10 cm; 6. >50 cm | 1120      | Size                          | Six categories from Very small (<1 cm) to Large (>50 cm) |
| 1372| (maximum)                   | 1. <1 cm; 2. 1–2.5 cm; 3. 2.5–5 cm; 4. 5–10 cm; 5. >10 cm; 6. >50 cm       |           |                               |                                        |
| 1374| (minimum adult)             | 1. <1 cm; 2. 1–2.5 cm; 3. 2.5–5 cm; 4. 5–10 cm; 5. >10 cm; 6. >50 cm       |           |                               |                                        |
| 1376| (average)                   | 1. <1 cm; 2. 1–2.5 cm; 3. 2.5–5 cm; 4. 5–10 cm; 5. >10 cm; 6. >50 cm       |           |                               |                                        |
| 1378| Body length [sentence]      | Original data extracted from papers and books                              |           |                               |                                        |
| 1480| Habitat position            | Category (1. Terrestrial; 2. Water surface; 3. Water column; 4. Bottom surface; 5. Shallow substratum; 6. Deep substratum) | 1400      | Envpos                        | Fourteen categories, for example, Epibenthic, Infaunal, Interstitial, Pelagic, Demersal |
| 1520| Depth in habitat substrate  | The depth at the habitat substrate for benthic species (category): 1. 0 cm; 2. 1–10 cm; 3. 10–30 cm; 4. >30 cm |           |                               |                                        |
| 1530| Mobility                    | 1. Permanent attachment/basically attached; 2. Burrower; 3. Drifter; 4. Swimmer; 5. Crawler; 6. Temporary attachment | 1430      | Mobility                      | Swimmer, Crawler, Burrower, Drifter, Attached (permanent, temporary) |

(Continues)
| ID  | Trait name                     | Definition                                                                 | BIOTIC ID | Trait name in BIOTIC database | Summary of definition in BIOTIC database |
|-----|--------------------------------|---------------------------------------------------------------------------|-----------|-------------------------------|----------------------------------------|
| 1560 | Habitat landscape             | Type of habitat landscape (category): 1. Tidal flats; 2. Rocky reef; 3. Sandy beach; 4. Seagrass or seaweed bed; 5. Subtidal; 6. Estuary; 7. Salt marsh; 8. Swamp; 9. River (freshwater) | 1440      | Physpref                      | Nine categories for example, e.g., Open coast, Strait/sound, Sea loch, Ria/Voe, Estuary |
| 1590 | Substratum types             | Substratum types (category): 1. Rock; 2. Boulders; 3. Gravel; 4. Sand; 5. Sand-mud; 6. silt; 7. Mud; 8. Seagrass; 9. Biogenic reef; 10. Algae; 11. Terrestrial plant; 12. Salt marsh | 1470      | Substratum                    | Thirty-eight categories, for example, b Bedrock, Boulders, Mud, Gravel, Mixed, Other |
| 1640 | Disturbance resistance       | Resistance to disturbances caused by waves and wind. It was assumed by the waves and wind strength the habitat: 1. Highly sensitive; 2. Moderately sensitive; 3. Tolerant | 1140      | Fragility                     | Fragile, intermediary, robust           |
| 1660 | Salinity                     | Suitable salinity (based on Venice System): 1. Mixoeuhaline (30–40); 2. Polyhaline (18–30); 3. Mesohaline (5–18); 4. Oligohaline (0.5–5); 5. Fresh water or terrestrial (0) | 1460      | Salinity                      | Full (30–40), variable (18–40), reduced (18–30), low (<18) |
| 1700 | Reproduction frequency       | Category (1. Opportunistic; 2. Several per year; 3. Annual [once a year] or less) | 1260      | ReprodFreq                    | Seven categories for example, Semelparous, annual episodic, biannual protracted |
| 1720 | Mature years                 | Life of up to breeding: Category (1. >1 year; 2. <1 year)                  | 1240      | Maturity                      | Eight categories from <1 year, to 100+ years |
| 1740 | Lifespan                     | Maximum life span in natural environment: 1. <1 year; 2. 1–5 years; 3. >5 years | 1230      | LifeSpan                      | Eight categories from <1 year, to 100+ years |
| 1760 | Dispersion type              | Type of egg or larvae dispersion: 1. Direct development; 2. Floating occurs (eggs); 3. Floating occurs (larvae); 4. Benthic (eggs, fry); 5. Benthic (larvae); 6. Egg embryonic |           |                               |                                        |
| 1770 | Egg type                     | 1. Separate eggs; 2. Egg sac                                              |           |                               |                                        |
| 1810 | Reproduction season          | 1. Spring; 2. Summer; 3. Autumn; 4. Winter; 5. Not fixed, 1:3. Spring and Autumn (*Spring: March–May; summer: June–August; fall: September–November; winter: December–February) | 1270      | ReprodSeason                  | Seven categories, for example, Semelparous, Annual episodic, Biannual protracted |
| 1790 | Types of larvae              | 1. Veliger; 2. Zoa larvae; 3. Trochophore larvae; 4. Other types of larvae |           |                               |                                        |
| 1930 | Food method and habits       | 1. Primary producer; 2. Predator; 3. Surface deposit feeder (sediments are prey); 4. Deep deposit feeder (lower sediment prey); 5. Grazer; 6. Filtration; 7. Parasitic; 8. Scavenger; 9. Herbivore; 10. Omnivore/generalist | 1410      | feedingmethod                 | Nineteen categories, for example, aAutotroph, Detritivore, Grazer, Predator |
include traits described in quantitative terms, including our unpublished field measurements (labeled as EX: for which we have some reliable information based on personal observations, although values were not formally measured). Unknown values of traits were also assumed based on our expert opinion (AS: predicted value based on our empirical observations). Other values were left blank (NA). To reduce the variance of the data, almost all of the data were categorized, even in the case of data with continuous categories. Table 2 includes a list of the categorization rules.

Table 3 shows the distributions among species of the traits for which we were able to obtain information. Most of basic information about body length, distribution, and habitats was complete, and more than 50% of the traits were complete for >100 species, but information about reproduction was relatively limited. Information about reproductive ecology was relatively limited, especially for the Polychaeta and rare taxa.

2.8  |  Accessibility

2.8.1  |  License

This dataset is provided under a Creative Commons Attribution 4.0 International license (CC-BY-SA 4.0) (https://creativecommons.org/licenses/by/4.0/).
2.8.2  |  Location of storage

The published data were provided by latter web site: http://db.cger.nies.go.jp/JaLTER/metacat/metacat/ERDP-2020-23.1/jalter-en.

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