The Bivalve Fauna of Onagawa Bay, Northeastern Japan

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Summary

Bivalve species from Onagawa Bay were listed in order to obtain an overview of the bay fauna. Bivalves examined in the present study were collected mainly in the years from 1990 to 1995. The bivalves were classified into 103 species of 80 genera and 38 families. The mussel, *Mytilus edulis*, and the oyster, *Crassostrea gigas*, dominated in the intertidal zones of rocky shores. Most of the burrowing species occurred in muddy sand and sandy bottoms, whereas only a few species inhabited muddy bottoms. Among the bivalve fauna, species found widely along the Japan coast accounted for 56.3% of the total number of species, and the proportions of southern and northern species were approximately equal, showing a transitional composition of species.

Onagawa Bay is located in the southernmost area of the Sanriku ria coast. The Oyashio intrusion meets the northern branch of the Kuroshio current near the area, and thus, both cold and warm currents affect the sea conditions of the bay. Furthermore, the complex coastline features peculiar to ria coasts provide various types of habitat for marine organisms. These oceanographical and topographical conditions produce a diversity of flora and fauna in the bay. Although the species composition in the bay has been investigated for various taxa of marine organisms,[1-15] the bivalve fauna of the bay has not yet been reported.

The present paper lists bivalve species from Onagawa Bay and its adjacent waters to attain an overview of the bivalve fauna of the bay, and discusses the characteristics of the fauna. The list consists mainly of species which were collected and recorded in the recent 5 years, including species which had been recorded before the present study.

Materials and Methods

The materials examined in the study were collected between May 1990 and

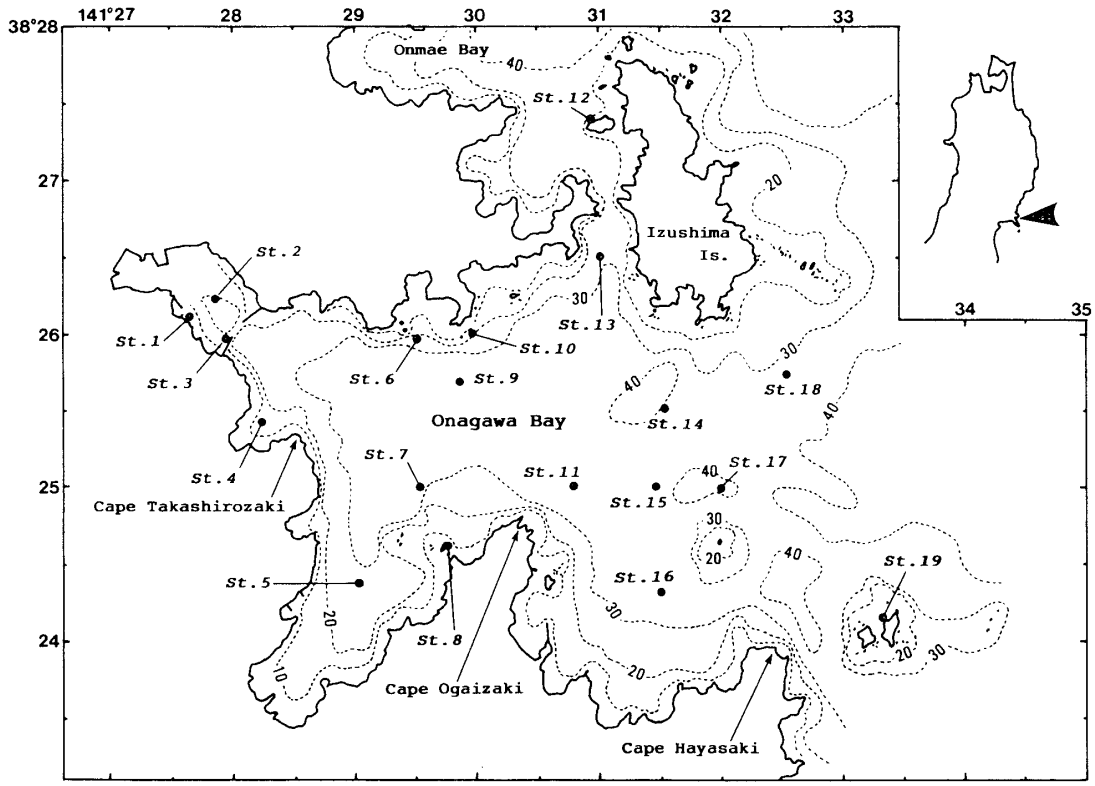

FIG. 1. Map of Onagawa Bay with bottom topography. Solid circles with numerals denote sampling stations.

March 1995. Fig. 1 shows a map of Onagawa Bay with the bottom topography and sampling sites. Bivalves were collected by hand at Sts. 1, 3, 8 and 10 in the intertidal zones of rocky shores. Small dredges and a Smith-McIntyre grab sampler were used for collection at the other sites. These investigations were done using the laboratory research vessel "Suiko" (14.9 tons).

The study also examined specimens deposited in the faunal collection of the Marine Fisheries Laboratory, Faculty of Agriculture, Tohoku University, at Onagawa, Miyagi.

Results and Discussion

Table 1 is a list of the bivalve fauna of Onagawa Bay and its adjacent waters, following the taxonomic nomenclature of Habe.[16] Each species is accompanied by a set of information consisting of the Japanese name, distributional pattern, relative abundance in the bay, and sampling sites at which the specimens were collected. The distributional pattern of species is classified into three types based on their ranges recorded by Habe,[16,17] Okada,[18] Okutani,[19] and Habe and Kosuge[20]: [N] northern species which are chiefly distributed north of the Boso Peninsula, [S] southern species distributed mainly south of the peninsula, [T]

TABLE 1. *Bivalves collected in Onagawa Bay and its adjacent waters*

Subclass CRYPTODONTA
Order Solemyoida
Family Solemyidae
Petrasma pusilla (Gould, 1861)
: kinutaregai, [T], common, Sts. 11, 15
Acharax japonicus (Dunker, 1882)
: asahikinutaregai, [T], common, St. 15
Subclass PALAEOTAXODONTA
Order Nuculoida
Family Nuculidae
Acila (Acila) divaricata (Hindas, 1843)
: ôkiraragai, [T], recorded previously, not detailed
Acila (Truncacila) insignis (Gould, 1861)
: kiraragai, [N], very common, Sts. 7, 11, 15, 17
Acila (Truncacila) minutoides Kuroda & Habe, 1958
: tsubomikiraragai, [S], rare, St. 17
Ennucula tenuis (Montagu, 1808)
: kogurumigai, [N], common, Sts. 11, 15
Family Nuculanidae
Nuculana (Thestyleda) yokoyamai (Kuroda, 1834)
: araborirôbaigai, [T], very common, Sts. 14, 15, 17
Saccella (Saccella) confusa (Hanley, 1860)
: genrokusodegai, [S], rare, Sts. 12, 17
Saccella (Saccella) sematensis (Suzuki & Isizuka, 1943)
: arasujisodegai, [S], common, St. 16
Yoldia (Cnesterium) notabilis Yokoyama, 1922
: furisodegai, [N], very rare, St. 17
Yoldia (Cnesterium) johanni Dall, 1925
: ezosodegai, [N], common, Sts. 11, 12
Subclass PTERIMORPHIA
Order Arcoida
Family Arcidae
Arca avellana Lamarck, 1819
: funegai, [S], rare, St. 13
Arca boucardi Jousseaume, 1894
: koberutofunegai, [T], common, Sts. 3, 10
Scapharca broughtonii (Schrenck, 1867)
: akagai, [T], recorded previously, St. 12
Family Parallelodontidae
Porterius dalli (Smith, 1885)
: shikoroegai, [T], common, Sts. 7, 15
Family Glycymerididae
Glycymeris (Glycymeris) vestita (Dunker, 1877)
: tamakigai, [T], common, St. 14
Glycymeris (Glycymeris) imperialis Kuroda, 1934

TABLE 1. *Continued*

: mitamakigai, [T], common, Sts. 14, 15, 17
Glycymeris (Glycymeris) yessoensis (Sowerby, 1886)
: ezotamakigai, [N], common, Sts. 14, 17
Family Limopsidae
Crenulilimopsis oblonga (A. Adams, 1860)
: namijiwashirasunagai, [T], common, St. 11
Order Mytiloida
Family Mytilidae
Mytilus edulis Linnaeus, 1758
: murasakiigai, [T], very common, Sts. 1, 3, 8
Mytilus coruscus Gould, 1861
: igai, [T], common, St. 6
Septifer (Mytilisepta) virgatus (Wiegmann, 1837)
: murasakiinkogai, [T], common, Sts. 8, 10
Septifer (Mytilisepta) keenae Nomura, 1936
: himeigai, [T], rare, St. 8
Modiolus (Modiolus) modiolus difficilis Kuroda & Habe, 1950
: ezohibarigai, [N], rare, St. 15
Modiolus (Modiolus) auriculatus (Krauss, 1848)
: hibarigai, [T], recorded previously, St. 12
Modiolus (Modiolus) margaritaceus (Nomura & Hatai, 1940)
: mamehibarigai, [T], rare, St. 8
Solamen spectabilis (A. Adams, 1862)
: kisagaimodoki, [T], common, Sts. 11, 17
Musculus (Modiolarca) cupreus (Gould, 1861)
: tamaegai, [T], rare, St. 15
Musculista senhousia (Benson, 1842)
: hototogisugai, [T], common, Sts. 1, 3, 8
Order Pterioida
Suborder Pteriina
Family Pectinidae
Chlamys (Swiftopecten) swiftii (Bernardi, 1858)
: ezokinchakugai, [N], common, St. 11
Chlamys (Azumapecten) farreri nipponensis Kuroda, 1932
: akazaragai, [N], very common, St. 5
Pecten (Oppenheimopecten) sinensis puncticulatus Dunker, 1877
: hanaitayagai, [S], rare, St. 7
Pecten (Notovola) albicans (Schroter, 1802)
: itayagai, [T], common, Sts. 7, 16
Patinopecten (Mizuhopecten) yessoensis (Jay, 1857)
: hotategai, [N], common, Sts. 1, 9
Family Anomiidae
Anomia chinensis Philippi, 1849
: namimagashiwagai, [T], recorded previously, St. 12
Family Limidae

TABLE 1. *Continued*

Limaria (Limaria) basilanica (A. Adams & Reeve, 1850)
: yukiminogai, [S], common, Sts. 7, 11, 17
Limatula (Limatula) kurodai Oyama, 1943
: kurodayukibanegai, [S], rare, St. 18

Suborder Ostreina
Family Ostreidae
Crassostrea gigas (Thunberg, 1793)
: magaki, [T], very common, Sts. 1, 3, 8, 10
Crassostrea nipponica (Seki, 1934)
: iwagaki, [T], common, St. 6
Saccostrea echinata (Quoy & Gaimard, 1836)
: kegaki, [T], very rare, St. 6

Subclass HETERODONTA
Order Veneroida
Family Lucinidae
Pillucina (Sydlorina) yamakawai (Yokoyama, 1920)
: araumenohanagai, [S], very rare, St. 17
Wallucina lamyi (Chavan, 1938)
: chijimiumenohanagai, [S], very rare, St. 15
Lucinoma annulata (Reeve, 1850)
: tsukigaimodoki, [T], common, Sts. 15, 17
Lucinoma yoshidai Habe, 1958
: yoshidatsukigaimodoki, [N], very rare, St. 11
Family Thyasiridae
Thyasira (Thyasira) tokunagai Kuroda & Habe, 1951
: hanashigai, [T], very common, Sts. 7, 9
Axinopsida subquadrata (A. Adams, 1862)
: yukiyanagigai, [N], common, St. 7
Family Ungulinidae
Cycladicama cumingii (Hanley, 1844)
: shiogamagai, [S], recorded previously, St. 4
Felaniella usta (Gould, 1861)
: usoshijimigai, [N], rare, Sts. 4, 17
Phlyctiderma japonicum (Pilsbry, 1895)
: yaeumenohanagai, [T], recorded previously, not detailed
Family Chamidae
Chama dunkeri Lischke, 1870
: keitôgai, [S], very rare, St. 18
Family Lasaeidae
Lasaea undulata (Gould, 1861)
: chirihagigai, [T], common, Sts. 8, 14
Kellia porculus Pilsbry, 1904
: kohakunotsuyugai, [T], very rare, St. 15
Family Carditidae
Cardita nodulosa Lamarck, 1819

TABLE 1. *Continued*

: momoirotomayagai, [T], very rare, St. 18
Cyclocardia ferruginea (Clessin, 1888)
: kuromarufumigai, [T], common, Sts. 11, 15
Carditellopsis toneana (Yokoyama, 1922)
: keshifumigai, [S], rare, St. 17
Family Cardiidae
Laevicardium undatopictum (Pilsbry, 1904)
: madarachigotorigai, [S], common, St. 9
Clinocardium (Keenocardium) californiense (Deshayes, 1839)
: ezoishikagegai, [N], very common, Sts. 9, 15, 17
Clinocardium (Keenocardium) buellowi (Rolle, 1896)
: ishikagegai, [T], common, St. 15
Fulvia mutica (Reeve, 1844)
: torigai, [T], rare, St. 2
Fulvia bullata (Linnaeus, 1758)
: emaibotangai, [S], rare, St. 15
Family Mactridae
Spisula (Mactromeris) polynympha Stimpson, 1860
: nagaubagai, [N], common, Sts. 14, 17
Tresus keenae (Kuroda & Habe, 1952)
: mirukuigai, [T], recorded previously, St. 12
Raetellops pulchella (Adams & Reeve, 1850)
: chiyonohanagai, [T], very common, Sts. 9, 11, 15
Family Tellinidae
Angulus vestalioides (Yokoyama, 1920)
: kumorizakuragai, [S], common, St. 17
Peronidia venulosa (Schrenck, 1861)
: saragai, [N], rare, St. 17
Cadella lubrica (Gould, 1861)
: tobazakuragai, [N], very common, Sts. 14, 15
Nitidotellina nitidula (Dunker, 1860)
: sakuragai, [T], common, St. 14
Nitidotellina mimuta (Lischke, 1872)
: uzuzakuragai, [T], very common, St. 9
Macoma (Macoma) tokyoensis Makiyama, 1927
: goisagigai, [T], very rare, St. 16
Macoma (Macoma) incongrua (Martens, 1865)
: himeshiratorigai, [T], rare, St. 15
Macoma (Macoma) contabulata (Deshayes, 1854)
: sabishiratorigai, [T], rare, Sts. 15, 16
Macoma (Macoma) nipponica (Tokunaga, 1906)
: nihonshiratorigai, [T], very common, Sts. 14, 17
Family Semelidae
Theora fragilis A. Adams, 1855
: shizukugai, [T], common, St. 14

TABLE 1. *Continued*

Family Psammobiidae
Gari maculosa (Lamarck, 1818),
: ashigai, [S], recorded previously, St. 12
Gobraeus kazusensis (Yokoyama, 1922)
: ezomasuogai, [N], common, St. 30
Psammotaea virescens (Deshayes, 1855)
: ochibagai, [T], recorded previously, not detailed
Nuttallia ezonis Kuroda & Habe, 1955
: ezoisoshijimi, [N], recorded previously, not detailed
Family Solecurtidae
Azorinus abbreviatus (Gould, 1861)
: zunguriagemakigai, [S], recorded previously, not detailed
Family Solenidae
Solen (Ensisolen) krusensterni Schrenck, 1867
: ezomategai, [T], common, St. 17
Family Cultellidae
Siliqua pulchella (Dunker, 1852)
: mizogai, [S], rare, St. 14
Family Kelliellidae
Alvenius ojianus (Yokoyama, 1927)
: keshitorigai, [S], common, Sts. 9, 15
Family Veneridae
Mercenaria stimpsoni (Gould, 1861)
: binosugai, [N], rare, St. 15
Callithaca adamsi (Reeve, 1863)
: ezo-nunomeasari, [N], common, Sts. 7, 15
Protothaca (Notochione) jedoensis (Lischke, 1874)
: oniasari, [T], recorded previously, St. 12
Phacosoma japonicum (Reeve, 1850)
: kagamigai, [T], common, Sts. 14, 15
Ruditapes philippinarum (Adams & Reeve, 1850)
: asari, [T], rare, Sts. 5, 16
Irus (Irus) mitis (Deshayes, 1854)
: matsukazegai, [T], recorded previously, St. 1
Callista (Callista) shinensis (Holten, 1803)
: matsuyamawasuregai, [S], rare, Sts. 15, 17
Callista (Ezocallista) brevisiphonata Carpenter, 1865
: ezowasuregai, [N], rare, St. 17
Saxidomus purpuratus (Sowerby, 1852)
: uchimurasakigai, [T], rare, St. 11
Family Petricolidae
Pseudoirus mirabilis (Deshayes, 1853)
: chijimiiwahorigai, [T], recorded previously, St. 19
Order Myoida
Suborder Myoida

TABLE 1. *Continued*

Family Myidae
Mya (Arenomya) arenaria oonogai Makiyama, 1935
: ônogai, [T], recorded previously, St. 2
Paramya recluzii A. Adams, 1864
: hamakazegai, [S], recorded previously, St. 2
Family Corbulidae
Anisocorbula nipponica Habe, 1961
: inakakuchibenigai, [T], very rare, St. 15
Anisocorbula venusta (Gould, 1861)
: kuchibenidegai, [T], common, Sts. 11, 17
Family Hiatellidae
Hiatella orientalis (Yokoyama, 1920)
: kinumatoigai, [T], common, St. 15
Subclass ANOMALODESMACEA
Order Pholadomyoida
Family Lyonsiidae
Lyonsia ventricosa Gould, 1861
: sazanamigai, [T], common, Sts. 15, 17
Agriodesma naviculum (A. Adams & Reeve, 1850)
: obikuigai, [T], recorded previously, St. 12
Family Pandoridae
Pandorella pseudobilirata (Norura & Hatai, 1940)
: usu-nerigai, [T], common, Sts. 11, 14
Family Myochamidae
Myadora fluctuosa Gould, 1861
: mitsukadokatabiragai, [T], rare, St. 17
Family Thracidae
Trigonothracia pusilla (Gould, 1861)
: nomurasuemonogai, [T], very rare, St. 15
Family Poromyidae
Poromya flexuosa Yokoyama, 1922
: sunamegai, [S], common, Sts. 15, 17
Family Cuspidariidae
Cardiomya (Cardiomya) tosaensis (Kuroda, 1948)
: tosahimeshakushigai, [S], common, Sts. 11, 15

species commonly found throughout the waters adjacent to Japan, from the southern part of Hokkaido to Kyushu. Relative species abundance in the bay is conveniently divided into five categories. Since the study combined data from several surveys that differed in their purpose and method, the definitions of the categories are rather approximate. Very common, abundant and found widely in the bay; Common, always collected in surveys at appropriate sites, but not abundant; Rare, sometimes collected in a restricted area, but small in number; Very rare, collected only once in the study; Recorded previously, species which have been collected previously, and whose specimens are deposited with their collection data, although they were not collected in the study.

Bivalves collected in Onagawa Bay were categorized into 103 species of 80 genera and 38 families. Groups with comparatively large numbers of species included the family Mytilidae with 10 species, Tellinidae with 9 species, Veneridae with 9 species. The mussel, *Mytilus edulis*, of the family Mytilidae and the oyster, *Crassostrea gigas*, of the family Ostridae dominated widely in the intertidal zones of rocky shores, occupying most of the bay coastline. The bay shows a transition of bottom sediments from muddy bottoms in the inner part of the bay to sandy ones in the mouth part.[21] Most of the burrowing species occurred in the muddy sand and sandy bottoms, whereas a few species inhabited muddy bottoms. Species of the families Tellinidae and Veneridae were mainly distributed in muddy sand bottoms, and the nut clam, *Acila insignis*, of the family Nuculidae, one of the most dominant species, was found to inhabit sandy bottoms near the mouth of the bay. The comparatively low occurrence of species in the muddy bottoms may be due to heavy deposition of organic matter, causing oxygen-deficient conditions near the bottom layer in summer (unpublished data).

Table 2 shows the numbers of species for each type of distributional pattern in terms of relative abundance categories. The bay was characterized by a high percentage of the species found widely along the Japan coast, type [T], which

TABLE 2. *Number of species for each distributional pattern in terms of relative abundance categories. Numerals in parenthesis denote percentage relative to the total number of species*

Relative abundance	Southern species [S]	Commonly found [T]	Northern species [N]
very common	0 (0)	7 (6.8)	4 (3.9)
common	7 (6.8)	25 (24.3)	9 (8.7)
rare	9 (8.7)	9 (8.7)	5 (4.9)
very rare	3 (2.9)	5 (4.9)	3 (2.9)
recorded previously	4 (3.9)	12 (11.7)	1 (1.0)
total	23 (22.3)	58 (56.3)	22 (21.4)

accounted for 56.3% of the total number of species, and the proportion of southern species, type [S], to the total was approximately equal to that of northern species, type [N]. Thus, the bay showed a transitional composition of species in which northern and southern species coexisted.

It will be necessary to conduct further investigations of species inhabiting subtidal zones of rocky shores and submarine reefs, which were insufficiently surveyed in the present study.

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