

## 山口県響灘における小型底びき網の漁獲物

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### Aquatic animals caught by a small beam trawl net from Hibiki-nada Sea off Yamaguchi Prefecture, Japan

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**Abstract:** Aquatic animals fished by 37 operations of a small beam trawl net at the Hibiki-nada Sea off Yamaguchi Prefecture, Japan, were surveyed in all seasons from 2002 through 2009. A total of 317 species including 1 chordate, 204 fishes(FS) and 112 invertebrates(IV) were caught. Among them, 126 FS and 75 IV were judged as rare(caught in less than 8 operations), 36 FS and 28 IV as occasional(8 to 14 operations), 21 FS and 8 IV as often(15 to 22 operations), 16 FS and 1 IV as frequent(23 to 29 operations), and 5 FS and 0 IV as general(more than 29 operations). Sixty-eight FS and 28 IV were caught in all seasons, 107 FS and 71 IV were in spring, 139 FS and 79 IV were in summer, 148 FS and 81 IV were in autumn, and 125 FS and 43 IV were in winter. From distributional point of view, 70 FS and 42 IV were subtropical species, 91 FS and 62 IV were temperate region species, and 43 FS and 7 IV were large areal species.

**Key words:** trawl fishery, fish, invertebrate, rare species, by-catch, biodiversity

### 緒言

響灘は、山口県西部から福岡県北部に至る水深 80m 以下の日本海南西部の海域で、沖合を対馬暖流が北東流する。海域の島礁周辺では好漁場が発達して沿岸漁業が盛んに営まれており<sup>1)</sup>、小型底びき網漁業はこの海域を代表する漁業の一つである。この漁法は魚介類選択性の低い漁業であり、その漁獲物は海域の生物相をよく代表していると考えられている<sup>2)</sup>。本海域を含む山口県日本海域に出現した魚類は 39 目 197 科 870 種<sup>3)</sup>、稀に出現する特記的生物は無脊椎動物 140 種、脊索動物 4 種、魚類 245 種、爬虫類 4 種におよぶことが報告されているが<sup>4,5)</sup>、実際に漁獲される魚介類の季節的変動や多寡については必ずしも明らかではなく、さらに無脊椎動物については特記種以外の十分な調査がなされているとは言い難い。本調査研究は、7年

間にわたって小型底びき網漁船に同乗し、漁獲される魚介類の周年変動等に関する基礎資料を得ることを目的とした。

### 材料及び方法

本調査で乗船した漁船は、下関市吉見沖から吉母沖の響灘において水深 28m から 35m の海域 (Fig. 1) で操業する「エビ漕ぎ網」と称される小型底びき網漁船一隻 (総トン数 2.9 トン) である。調査に用いた漁具は 1 条びき 1 網で、曳網長は 200m、ビーム長 13m、網全長 22m、コッドエンドの目合 24 本 9 節であった。曳網速度は 1.4 から 1.7 ノットで、曳網時間は 2 時間から 2 時間 30 分であった。1 操業での曳網回数は 3 回から 5 回で、日没前の 1 回目の網上げ以降は夜間操業であった。調査は 2002 年 9 月

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から 2009 年 10 月の間の周年にわたり, 春期 6 回, 夏期 11 回, 秋期 12 回, 冬期 8 回の合計 37 回実施した (Table 1)。

漁獲物は可能な限り船上で同定しおよその漁獲量を記録したが, 同定困難な種は持ち帰り, 分類群ごとの専門書<sup>6-15)</sup>に基づいて種の査定を行った。メバル属 *Sebastes* についてはアカメバル *S. inermis* Cuvier, クロメバル *S. ventricosus* Temminck and Schlegel, シロメバル *S. cheni* Barsukov に区別されているが<sup>6)</sup>, 船上での同定が困難であるものの重要な食用魚で持ち帰ることができなかったため, 本研究では *Sebastes* spp. と一括して扱うこととした。アカエビ属 *Metapenaeopsis* においても, アカエビ *M. barbata* (De Haan), トラエビ *M. acclivis* (Rathbun), ツノソリアカエビ *M. dura* Kubo, モギエビ *M. mogiensis* (Rathbun), およびキシエビ *M. dalei* (Rathbun) が混在すると考えられたが, 同様に持ち帰ることができなかったため本研究では *Metapenaeopsis* spp. と一括して扱うこととした。

出現したそれぞれの種について, 鈴木・宇野による研究<sup>16)</sup>を参考に漁獲時期を春期 (3-5 月), 夏期 (6-8 月), 秋期 (9-11 月), 冬期 (12-2 月) に区分し, 1 操業時の漁獲数を 1 個体 (1), 2-19 個体 (+), 20-99 個体 (++) , 100 個体以上 (+++) に分けて整理した。

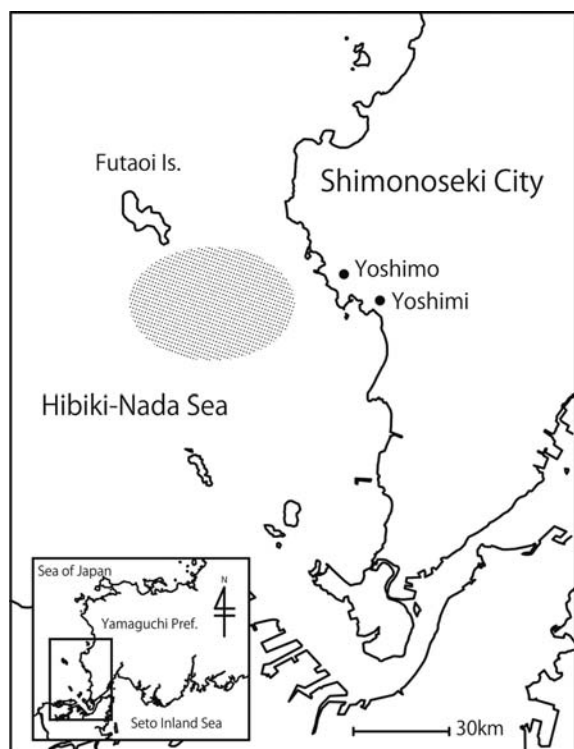


Fig. 1. Map showing the Hibiki-nada Sea area where beam trawl fishing was operated.

また, 調査回数 37 回に対する出現頻度は, 稀 (rare, 7 回以下), やや稀 (occasional, 8-14 回), 普通 (often, 15-22 回), やや頻繁 (frequent, 23-29 回), 頻繁 (general, 30 回以上) の 5 段階に区分した。さらに, 分類群ごとの専門書<sup>6-15)</sup>による情報を基に, 海洋生物気候帯区分に基づく生物地理区に従って<sup>7,17)</sup>, 南方系種 (subtropical species), 温帯性種 (temperate region species) および広域分布種 (large areal species) の 3 群に分布特性を大別した。

## 結果及び考察

出現した漁獲生物は魚類 204 種 (複合種 1 を含む), 無脊椎動物 112 種 (複合種 1 を含む), 及び脊索動物ホヤ綱 1 種の合計 317 種であった (Appendix 1)。魚類の内訳はヌタウナギ綱 1 種, 軟骨魚綱 11 種, 硬骨魚綱 192 種, 無脊椎動物の内訳は刺胞動物 12 種, 有櫛動物 2 種, 軟体動物 32 種, 環形動物 1 種, 節足動物 50 種, 棘皮動物 15 種であった。

稀種は魚類 126 種, 無脊椎動物 75 種, やや稀種は魚類 36 種, 無脊椎動物 28 種, 普通種は魚類 21 種, 無脊椎動物 8 種, やや頻繁種は魚類 16 種, 無脊椎動物 1 種, 頻繁種は魚類 5 種, 無脊椎動物 0 種であった。

多くの種が稀にしか漁獲されず, 逆に頻繁種はマダイ *Pagrus major*, シログチ *Pennahia argentata*, タマガンゾウピラメ *Pseudorhombus pentophthalmus*, メイタガレイ *Pleuronichthys cornutus*, カワハギ *Stephanolepis cirrhifer* の 5 種で, タマガンゾウピラメ以外はいずれも重要な漁獲対象魚類であった。

魚類 17 種, 無脊椎動物 10 種については調査期間を通じて 1 個体しか漁獲されなかった。魚類ではシャチブリ *Ateleopus japonicus*, イタチウオ *Brotula multibarbata*, ヨロイイタチウオ *Hoplobrotula armata*, サギフエ

Table 1. Sampling numbers at beam trawl operations in Hibiki-nada Sea, Yamaguchi Prefecture, from 2002 through 2009

Year	Spring	Summer	Autumn	Winter	Total
2002	0	0	3	0	3
2003	3	3	2	3	11
2005	0	1	2	1	4
2006	1	1	1	1	4
2008	0	4	2	2	8
2009	2	2	2	1	7
Total	6	11	12	8	37

*Macroramphosus sagifue*, タツノオトシゴ  
*Hippocampus coronatus*, キツネメバル  
*Sebastes vulpes*, シマヒメヤマノカミ  
*Dendrochirus brachypterus*, アブオコゼ  
*Erisiphex pottii*, ヒレナガカナガシラ  
*Lepidotrigla kanagashira*, ハタタテダイ  
*Heniochus acuminatus*, カゴカキダイ  
*Microcanthus strigatus*, マサバ *Scomber japonicus*, サワラ *Scomberomorus niphonius*, アラムガレイ *Tarphops oligolepis*, ベニカワムキ *Triacanthodes anomalus*, サラサハギ *Thamnaconus hypargyreus*, ハコフグ

*Ostracion immaculatum*であった。そのうち、マサバ、サワラ、ハコフグのように本海域に多く生息していると推測されるものの底びき網の漁獲特性から入網しにくかった種以外は、実際に本海域では稀な魚類がほとんどであると考えられる。一方、無脊椎動物はスナインソギンチャク *Dofleinia armata*, ウミカラマツ *Antipathes japonica*, ウズラミヤシロガイ *Tonna sukosa*, ホソハスエラウミウシ *Armina semperi*, オオカイカムリ *Dromidiopsis dormia*, サメハダヘイケガニ *Paradorippe granulata*, アカホシコブシ *Urnalana haematostica*, シワガザミ *Liocarcinus corrugatus*, シマイシガニ *Charybdis (Charybdis) feriata*, アカウニ *Pseudocentrotus depressus*で、定置網や潜水などのほかの漁法でも漁獲されるシワガザミ、アカウニ以外はこの海域では珍しい種であると考えられる。

季節を通じて周年出現した魚類は68種、無脊椎動物は28種におよんだ。春期に出現した魚類は107種、無脊椎動物71種、夏期に出現した魚類は139種、無脊椎動物79種、秋期に出現した魚類は148種、無脊椎動物81種、冬期に出現した魚類は125種、無脊椎動物43種で、魚類、無脊椎動物共に秋期が最も出現種数が多く、逆に出現種数が少なかったのは魚類では春期、無脊椎動物では冬期という結果であった。

春期だけの出現は魚類10種と無脊椎動物8種、夏期だけの出現は魚類20種と無脊椎動物10種、秋期だけの出現は魚類20種と無脊椎動物14種、冬期だけの出現は魚類10種と無脊椎動物1種であった。一季節しか出現しないが大量に出現する種としては、春期のカナダ *Lepidotrigla guentheri*, 秋期のキダイ *Dentex hypselosomus*, 秋期のイトフエフキ *Lethrinus genivittatus*, 夏期のアンドンクラゲ *Carybdea brevipedalia*, 春期のスルメイカ *Todarodes pacificus*が挙げられ、それらは定期的な回遊種でキダイや

**Table 2.** Numbers of species collected by the beam trawl fishing in Hibiki-nada Sea from 2002 through 2009, shown by the occurrence frequency from rare to general and by the distribution area from subtropical to large areal species

Distribution area	Occurrence frequency					Total
	Rare	Occasional	Often	Frequent	General	
<b>FISH</b>						
Subtropical sp.	43(34.1%)	15	8	4	0	70(34.3%)
Temperate sp.	50(39.7%)	17	9	10	5	91(44.6%)
Large areal sp.	33(26.2%)	5	4	1	0	43(21.1%)
<b>INVERTEBRATE</b>						
Subtropical sp.	29(39.2%)	10	2	1	0	42(37.8%)
Temperate sp.	42(56.8%)	14	6	0	0	62(55.9%)
Large areal sp.	3(4.0%)	4	0	0	0	7(6.3%)

スルメイカは重要な水産資源となっている。これら5種以外は季節的に来遊する稀な種であると考えられる。

山口県日本海域に出現が確認されている魚類870種<sup>3)</sup>のうち、約23%に相当する種が本調査で確認された。山口県での特記的な(稀な)魚類245種<sup>4,5)</sup>のうちの32種(13%)が、無脊椎動物140種<sup>4,5)</sup>のうち15種(11%)が本調査で確認されたが、それ以外の種はこの海域で通常に分布する種と考えられる。

分布特性においては、魚類では南方系種70種(34.3%)、温帯性種91種(44.6%)、広域分布種43種(21.1%)、無脊椎動物では南方系種42種(37.8%)、温帯性種62種(55.9%)、広域分布種7種(6.3%)であった。出現頻度と分布特性の関係をTable 2に示した。南方系の種がより稀に出現する、またはその逆などの傾向は特に認められなかった。

本研究での出現魚類の分布特性を、鳥取県浦富<sup>17)</sup>、福岡県津屋崎<sup>18)</sup>、及び長崎県野母崎<sup>19)</sup>の沿岸魚類相と比較すると(Table 3)、南方系魚類は北に行くに従って減少し、逆に温帯性魚類は増加する傾向にあったが、南方系魚類は鳥取県浦富より若干少ない割合であった。また、本調査における山口県の結果では広域分布種が約20%と他地域よ

**Table 3.** Coastal fish species composition in % as shown by the distribution area from subtropical, temperate, and large areal species, from Nagasaki (Nomozaki<sup>19)</sup>), Fukuoka (Tsuyazaki<sup>18)</sup>), Yamaguchi (Hibiki-nada), and Tottori (Tottori<sup>17)</sup>) Prefectures

	Nomozaki <sup>19)</sup>	Tsuyazaki <sup>18)</sup>	Hibiki-nada	Tottori <sup>17)</sup>
Subtropical sp.	63.0	49.8	34.3	37.9
Temperate sp.	28.7	42.2	44.6	53.1
Large areal sp.	8.3	8.0	21.1	9.0

17)Wada et al.(2014); 18)Nishida(2008); 19)Tawa and Takegaki(2009).

り高い傾向が認められた。これは、今回が底びき網の漁獲物調査であることに對し、他地域では沿岸の潜水調査に基づいたものであることによるものと考えられる。

今後、定置網のような他の漁法についても同様の調査を行うことにより、この海域での水産資源生物の出現状況がさらに明らかになってくるものと考えられる。また本調査で、漁獲生物の多くが稀にしか出現しないものであることが明らかとなった。しかもそれらの多くは有用種の混獲として取扱われることが多いであろう。それら低利用資源の有効利用を図ること、およびできるだけそのような混獲を避ける漁法を工夫することは、資源を無駄にしないためにもますます重要になってくるであろう。

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Appendix 1. List of animals caught by the beam trawl fishing in Hibiki-nada Sea, Yamaguchi Prefecture, from 2002 through 2009

Species		Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Japanese name							
<b>FISH</b>							
MYXINI							
Myxiniformes							
Myxiniidae	<i>Eptatretus burgeri</i> (Girard)	+	+	+	+	rare (7)	temperate
<b>CHONDRICHTHYES</b>							
Carchariniformes							
Triakididae	<i>Mustelus manazo</i> Bleeker	+	+	1~+	1~++	often (20)	temperate
	<i>Mustelus griseus</i> Pietschmann	1~+	+	1~+	+	often (16)	temperate
Rhinobatiformes							
Rhinobatidae	<i>Rhinobatos hymnephthalmus</i> Richardson	+	1~+	+	+	fequent (29)	temperate
Platyrimidae	<i>Platyrrhina tangi</i> Iwatsuki, Zhang and Nakaya		1	+	1~+	occasional (9)	temperate
Torpediniformes							
Torpedinidae	<i>Narke japonica</i> (Temminck and Schlegel)	+	+	1~+	+~++	occasional (11)	temperate
Rajiformes							
Rajidae	<i>Dipturus kwangtungensis</i> (Chu)		1	+	+	rare (6)	temperate
	<i>Okameji kanojei</i> (Müller and Henle)	1~+	+	+	1~++	often (16)	temperate
Myliobatiformes							
Dasyatidae	<i>Dasyatis akajei</i> (Müller and Henle)	+	+	1~+	++	fequent (25)	subtropical
Gymnuridae	<i>Gymnura japonica</i> (Temminck and Schlegel)	1~+	+	1~+	+	occasional (11)	subtropical
Myliobatidae	<i>Myliobatis tobijei</i> Bleeker	1~+	1~+	1~+	+	often (17)	subtropical
	<i>Aetobatus narutobiei</i> White, Furumitsu and Yamaguchi		1	+		rare (3)	subtropical
<b>OSTEICHTHYES</b>							
Anguilliformes							
Muraenidae	<i>Gymnothorax minor</i> (Temminck and Schlegel)		1~+			rare (2)	subtropical
Ophichthidae	<i>Ophisurus macrohynchus</i> Bleeker	1		+		rare (2)	subtropical
	<i>Ophichthus altipennis</i> (Kaup)		1~+	+		rare (4)	temperate
Congridae	<i>Ariosoma meeki</i> (Jordan and Snyder)	+		1~+	+	occasional (9)	large area
	<i>Ariosoma majus</i> (Asano)			1	+	rare (4)	subtropical
	<i>Conger myriaster</i> (Brevoort)	1~+	1~+	1~+	1~+	often (20)	large area
	<i>Conger cinereus</i> Rüppell		+			rare (1)	subtropical
	<i>Conger japonicus</i> Bleeker		1			rare (2)	large area
Muraenesocidae	<i>Muraenesox cinereus</i> (Forssakái)	1~+	+	1~+	+~++	often (21)	large area
Clupeiformes							
Clupeidae	<i>Konosirus punctatus</i> (Temminck and Schlegel)	+			1	rare (3)	large area
Engraulidae	<i>Engraulis japonica</i> Temminck and Schlegel	+	+		+	rare (5)	large area
Siluriformes							
Plotosidae	<i>Plotosus japonicus</i> Yoshino and Kishimoto	+~++	+	+~+++	+~+++	often (21)	subtropical

+, 2-19 individuals: ++, 20-99; +++, 100 or more.

Rare, less than 8 times: occasional, 8-14; often, 15-22; frequent, 23-29; general, 30 or more.



Appendix 1. Continued		Species							Distribution area	
	Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)				
Ateleopodiformes										
Ateleopodidae	<i>Ateleopus japonicus</i> Bleeker		1				rare (1)		large area	
Aulopiformes										
Synodontidae	<i>Saurida elongata</i> (Temminck and Schlegel)	++~++++	++~++++	+~++++	+~+++		frequent (27)		temperate	
	<i>Saurida macrolepis</i> Tanaka	+	++	++	+		occasional (10)		subtropical	
	<i>Wanieso wanieso</i> Shindo and Yamada	++	++	++~++++	+~++		often (15)		subtropical	
	<i>Trachinocephalus myops</i> (Forster)		+	1~++	1		occasional (8)		subtropical	
	<i>Hime japonica</i> (Gunther)		1				rare (1)		large area	
Aulopidae										
Gadiformes										
Macrouridae	<i>Coelorrhinus multispinulosus</i> Katayama				+		rare (1)		large area	
Ophidiiformes										
Ophidiidae	<i>Brotula multibarbata</i> Temminck and Schlegel			1			rare (1)		subtropical	
	<i>Sirembo imberbis</i> (Temminck and Schlegel)	+	+~++	1~+	+~++		often (19)		subtropical	
	<i>Hoplobrotula armata</i> (Temminck and Schlegel)		1				rare (1)		large area	
Lophiiformes										
Lophiidae	<i>Lophiomus setigerus</i> (Vahl)	1	+		1		rare (6)		large area	
	<i>Lophius litulon</i> (Jordan)	+	1~+	1	1~++		occasional (12)		large area	
Antennariidae	<i>Antennarius striatus</i> (Shaw)		+		1		rare (2)		large area	
Ogcocephalidae	<i>Malthopsis annulifera</i> Tanaka		1	1			rare (2)		subtropical	
Beryciformes										
Monocentridae	<i>Monocentris japonica</i> (Houttuyn)	+	1~+	1~+			rare (6)		large area	
Zeiformes										
Zeidae	<i>Zenopsis nebulosa</i> (Temminck and Schlegel)		+				rare (4)		large area	
	<i>Zeus faber</i> Linnaeus	1~+	1~+		+		occasional (14)		subtropical	
Gasterosteiformes										
Fistulariidae	<i>Fistularia petimba</i> Lacepède		+	+			rare (3)		large area	
	<i>Fistularia commersonii</i> Rüppell		+		+		rare (4)		subtropical	
Macroramphosidae	<i>Macroramphosus sagifae</i> Jordan and Starks	1					rare (1)		large area	
Syngnathidae	<i>Hippocampus trimaculatus</i> Leach		1				rare (2)		large area	
	<i>Hippocampus kelloggi</i> Jordan and Snyder			1	+		rare (2)		large area	
	<i>Hippocampus coronatus</i> Temminck and Schlegel	1					rare (1)		temperate	
Perciformes										
Sebastidae	<i>Sebastes marmoratus</i> (Cuvier)	+	+	+	+~++		often (19)		temperate	
	<i>Sebastes tertius</i> Barsukov and Chen		+				rare (1)		large area	
	<i>Sebastes schlegelii</i> Hilgendorf				+		rare (1)		temperate	
	<i>Sebastes</i> spp.	+	+	+			rare (7)		temperate	
	<i>Sebastes vulpes</i> Döderlein				1		rare (1)		temperate	

+, 2–19 individuals: ++, 20–99; +++, 100 or more.

Rare, less than 8 times: occasional, 8–14; often, 15–22; frequent, 23–29; general, 30 or more.

Appendix 1. Continued

	Species	Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Scorpaenidae	<i>Pterois limulata</i> Temminck and Schlegel	Minokasago	1~+	1~+	+~++	+	frequent (23)	subtropical
	<i>Dendrochirus brachypterus</i> (Cuvier)	Shimahimeyamanokam	1				rare (1)	subtropical
	<i>Scorpaenopsis cirrosa</i> (Thunberg)	Onikasago		+	+		rare (3)	subtropical
	<i>Scorpaena miosoma</i> Günther	Kokuchifusakasago	+~++	+	+~++	+~+++	frequent (26)	temperate
	<i>Scorpaena onaria</i> Jordan and Snyder	Fusakasago		+	1~+	+	rare (2)	large area
	<i>Apistus carinatus</i> (Bloch and Schneider)	Hachi	1~+				occasional (8)	subtropical
	<i>Hypodytes rubripinnis</i> (Temminck and Schlegel)	Haokoze	1		+	+	rare (6)	subtropical
	<i>Inimicus didactylus</i> (Pallas)	Himeoniokoze	1		+	+	rare (3)	subtropical
	<i>Inimicus japonicus</i> (Cuvier)	Oniokoze	+~++	1~+	1~++	+~+++	frequent (28)	subtropical
	<i>Minous monodactylus</i> (Bloch and Schneider)	Himeokoze	+	1~+	+	1~++	occasional (10)	subtropical
Aplouactinidae	<i>Minous pusillus</i> Temminck and Schlegel	Yaseokoze		+			rare (1)	subtropical
	<i>Erosa erosa</i> (Cuvier)	Darumaokoze	1~+		1~+	1~+	often (17)	subtropical
	<i>Kanektonia florida</i> Tanaka	Hanachigookoze		+			rare (1)	temperate
	<i>Erisphex pottii</i> (Steindachner)	Abuokoze	1				rare (1)	large area
	<i>Chelidonichthys spinosus</i> (McClelland)	Houbou	+	+	+	1~++	occasional (25)	large area
	<i>Lepidotrigla japonica</i> (Bleeker)	Tokekanagashira		+	+~+++	+~+++	rare (7)	subtropical
	<i>Lepidotrigla guentheri</i> Hilgendorf	kanado	+++				rare (1)	subtropical
	<i>Lepidotrigla kanagashira</i> Kamohara	Hirenaganagashira				1	rare (1)	subtropical
	<i>Lepidotrigla kishinouyei</i> Snyder	Onikanagashira				+	rare (1)	subtropical
	<i>Lepidotrigla microptera</i> Gunther	Kanagashira		+			rare (2)	large area
Platycephalidae	<i>Platycephalus</i> sp.2	Magochi	1~+	+	1~+	+	occasional (10)	temperate
	<i>Cociella crocodila</i> (Cuvier)	Inegochi	+	+~++	+	+	rare (6)	temperate
	<i>Inegocia japonica</i> (Cuvier)	Tokagegochi	+~++	+	+~++	+~+++	frequent (29)	subtropical
	<i>Inegocia ochitai</i> Imahara	Wanigochi			+	+	rare (2)	subtropical
	<i>Sugggrundus meerdervoortii</i> (Bleeker)	Megochi	1		+	1	rare (4)	temperate
	<i>Onigocia spinosa</i> (Temminck and Schlegel)	Onigochi		+	+	+	rare (7)	subtropical
	<i>Thysanophrys celebica</i> (Bleeker)	Serebesugochi	+~++	+	+	+	occasional (10)	subtropical
	<i>Lateolabrax japonicus</i> (Cuvier)	Suzuki	+	+		+	rare (7)	temperate
	<i>Triso dermatopterus</i> (Temminck and Schlegel)	Tobihata			+		rare (1)	subtropical
	<i>Aryperodon leucogrammicus</i> (Valenciennes)	Azukahata	1				rare (2)	subtropical
Opistognathidae	<i>Epinephelus septemfasciatus</i> (Thunberg)	Mahata	+	1~+	1~++	+	occasional (14)	subtropical
	<i>Epinephelus areolatus</i> (Forsskal)	Oomohata				+	rare (1)	subtropical
	<i>Epinephelus awoara</i> (Temminck and Schlegel)	Aohata	+	+	1~++	1~+	often (19)	subtropical
	<i>Opistognathus evermanni</i> (Jordan and Snyder)	Nijiamadai		1	1	1	rare (3)	temperate
	<i>Priacanthus macracanthus</i> Cuvier	Kintokidai		+~++	+	+	rare (6)	subtropical

+ , 2-19 individuals: ++, 20-99: +++, 100 or more.

Rare, less than 8 times: occasional, 8-14: often, 15-22: frequent, 23-29: general, 30 or more.

## Appendix 1. Continued

Species		Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area	
Apogonidae	<i>Apogon kiensis</i> Jordan and Snyder	Teppouishimochi	++	+++	+++		rare (7)	subtropical	
	<i>Apogon semilineatus</i> Temminck and Schlegel	Nenbutudai	++	++	+++	++	often (17)	temperate	
	<i>Apogon endekataenia</i> Bleeker	Kosujishimochi		+	++		rare (4)	subtropical	
	<i>Apogon niger</i> Döderlein	Kuroishimochi	++	+++	++	+	occasional (8)	subtropical	
	<i>Apogon carinatus</i> Cuvier	Matoishimochi	++	+++	++	+	occasional (8)	subtropical	
	<i>Apogon lineatus</i> Temminck and Schlegel	Tenjikudai	+++	+++	+++	+++	frequent (24)	large area	
	<i>Scombrops boops</i> (Houttuyn)	Mutsu			+		rare (1)	large area	
	<i>Rachycentron canadum</i> (Linnaeus)	Sugi			+		rare (3)	large area	
	Family Carangidae	<i>Seriolina nigrofasciata</i> (Rüppell)	Aiburi			++		rare (2)	subtropical
		<i>Trachurus japonicus</i> (Temminck and Schlegel)	Maaji	+	++	+++	++	frequent (23)	temperate
Leiognathidae	<i>Decapterus maruadsi</i> (Temminck and Schlegel)	Maruaji		+++	+++	++	occasional (11)	subtropical	
	<i>Alectis ciliaris</i> (Bloch)	Itohikiaji		+	+		rare (2)	large area	
	<i>Kaivarinus equula</i> (Temminck and Schlegel)	Kaiwari	+	+++	+++	++	often (21)	large area	
	<i>Nucleoquula nuchalis</i> (Temminck and Schlegel)	Hiragi	+	++	++	+	rare (7)	temperate	
	<i>Equulites rivulatus</i> (Temminck and Schlegel)	Okhiragi	+	+++	+++		often (15)	temperate	
	<i>Lufjanus ophuyssenii</i> (Bleeker)	Yokosujifuedai			1		rare (1)	subtropical	
	<i>Parapristipoma trilineatum</i> (Thunberg)	Isaki		+	+++		rare (5)	temperate	
	<i>Diagramma picta</i> (Thunberg)	Korodai			+++	1	occasional (9)	subtropical	
	<i>Plectrohinchus cinctus</i> (Temminck and Schlegel)	Kosyoudai	1		++	1	rare (5)	subtropical	
	<i>Nemipterus virgatus</i> (Houttuyn)	Itoyridai	++	+++	+++	+++	often (17)	subtropical	
Sparidae	<i>Acanthopagrus schlegelii</i> (Bleeker)	Kurudai	+	1	++	+	rare (5)	large area	
	<i>Pagrus major</i> (Temminck and Schlegel)	Madai	+++	+++	+++	+++	general (34)	temperate	
	<i>Eynnys tumifrons</i> (Temminck and Schlegel)	Chidai			++	+	rare (1)	large area	
	<i>Dentex hypselosomus</i> Bleeker	Kidai			+++		rare (1)	subtropical	
	<i>Lethrinus genivittatus</i> Valenciennes	Itofuefuki			+++		rare (3)	subtropical	
	<i>Pennahia argentata</i> (Houttuyn)	Shiroguchi	+	++	++	+++	general (30)	temperate	
	<i>Sillago japonica</i> Temminck and Schlegel	Shirogisu	++	++	++	+++	frequent (24)	temperate	
	<i>Upeneus japonicus</i> (Houttuyn)	Himeji	+++	+++	+++	+++	frequent (27)	temperate	
	<i>Heniochus acuminatus</i> (Linnaeus)	Hataitedai			1		rare (1)	subtropical	
	<i>Heniochus diphreutes</i> Jordan	Murehataitedai			+		rare (1)	subtropical	
Pomacanthidae	<i>Roa modesta</i> (Temminck and Schlegel)	Genrokudai	+	+	++	+	occasional (9)	subtropical	
	<i>Chaetodontoplus septentrionalis</i> (Temminck and Schlegel)	Kinchakudai		+	+	+	rare (6)	temperate	
	<i>Goniistius zonatus</i> (Cuvier)	Takanohadai		+			rare (2)	temperate	
	<i>Goniistius quadricornis</i> (Günther)	Yudachitakanoha		++	1		rare (2)	temperate	
	<i>Goniistius zebra</i> (Döderlein)	Migimaki		+			rare (1)	temperate	
	<i>Capola schlegelii</i> Bleeker	Sumitsukiakatachi		+		1	rare (2)	temperate	
	<i>Acanthocephala limbata</i> (Valenciennes)	Ittenakatachi	+	+	++	+	occasional (8)	temperate	
	<i>Acanthocephala krusensternii</i> (Temminck and Schlegel)	Akatachi	++	++	++	1	often (20)	temperate	

+, 2–19 individuals; ++, 20–99; +++, 100 or more.

Rare, less than 8 times; occasional, 8–14; often, 15–22; frequent, 23–29; general, 30 or more.



Appendix 1. Continued

Species	Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Pomacentridae	<i>Chromis fumeus</i> (Tanaka)		+	+	++	rare (5)	subtropical
Teraponidae	<i>Terapon theraps</i> Cuvier		+	+	+	rare (3)	temperate
	<i>Rylichopelates oxyrhynchus</i> (Temminck and Schlegel)				+	rare (1)	temperate
Microcanthidae	<i>Microcanthus strigatus</i> (Cuvier)		1			rare (1)	subtropical
Centrolophidae	<i>Psenopsis anomala</i> (Temminck and Schlegel)		+	1~+	+	occasional (11)	large area
Stromateidae	<i>Pampus punctatissimus</i> (Temminck and Schlegel)		+	1~+	1~+	rare (7)	temperate
Labridae	<i>Choerodon azurite</i> (Jordan and Snyder)		1~+	1~+	1~+	occasional (12)	subtropical
	<i>Pseudolabrus sieboldi</i> Mabuchi and Nakabo	+	+	1~+	+	occasional (11)	temperate
	<i>Parajulis poecileptera</i> (Temminck and Schlegel)	+	+	1		rare (2)	temperate
	<i>Halichoeres tenuispinis</i> (Günther)		+			rare (3)	temperate
Liparidae	<i>Liparis tanakae</i> (Gilbert and Burke)	+	+	+	+	rare (5)	large area
Pholidae	<i>Pholis nebulosa</i> (Temminck and Schlegel)	1~+	1~+	+	++	occasional (10)	temperate
Pinguipedidae	<i>Paraperis pulchella</i> (Temminck and Schlegel)	1~+	++	+	++	occasional (10)	temperate
	<i>Paraperis sexfasciata</i> (Temminck and Schlegel)	+	+	++	+++	frequent (29)	temperate
	<i>Paraperis multifasciata</i> Döderlein		+	++	+	rare (1)	temperate
Champsodontidae	<i>Champsodon snyderi</i> Franz		+			rare (1)	temperate
Uranoscopidae	<i>Uranoscopus japonicus</i> Houttuyn		1~+	++		rare (4)	temperate
	<i>Uranoscopus chinensis</i> Guichenot	+	1~+	+	1~+	occasional (13)	temperate
	<i>Uranoscopus bicinctus</i> Temminck and Schlegel	+	1~+	+	+	rare (5)	subtropical
Callionymidae	<i>Calliurichthys japonicus</i> (Houttuyn)	+	++	+	+	occasional (11)	temperate
	<i>Repomucenus luguenini</i> (Bleeker)	+	++	+		rare (7)	temperate
	<i>Repomucenus valenciennesi</i> (Temminck and Schlegel)	+	++	+	+	rare (3)	temperate
	<i>Repomucenus curvicornis</i> (Valenciennes)	+	++	++	1~+	occasional (14)	temperate
	<i>Repomucenus beniteguri</i> (Jordan and Snyder)	+	++			rare (5)	temperate
Gobiidae	<i>Amblychaeturichthys sciotisus</i> (Jordan and Snyder)	+	++			rare (1)	temperate
	<i>Amblychaeturichthys hexanema</i> (Bleeker)	+	++			occasional (12)	temperate
	<i>Pterogobius virgo</i> (Temminck and Schlegel)	++	+	1~+	1~+	rare (3)	temperate
	<i>Acanthogobius flavimanus</i> (Temminck and Schlegel)		+	1		rare (1)	temperate
	<i>Lubricogobius olivaceus</i> (Temminck and Schlegel)		+	+	+	rare (1)	subtropical
	<i>Glossogobius olivaceus</i> (Temminck and Schlegel)		+	+	+	occasional (9)	temperate
	<i>Cryptocentrus filifer</i> (Valenciennes)	1~+	1~+	1~+	+	rare (1)	temperate
Siganidae	<i>Siganus fuscescens</i> (Houttuyn)		+	+	+	occasional (10)	temperate
Sphyraenidae	<i>Sphyraena forsteri</i> Cuvier		+	++	+	rare (1)	large area
	<i>Sphyraena pinguis</i> Günther		+	++	+	rare (3)	large area
	<i>Sphyraena japonica</i> Bloch and Schneider	+	+	++	++	occasional (13)	temperate
Trichiuridae	<i>Trichiurus japonicus</i> Temminck and Schlegel	+	+	++	++	rare (6)	subtropical
Scombridae	<i>Scomber japonicus</i> Houttuyn		+	++	+	often (18)	large area
	<i>Scomberomorus nipponius</i> (Cuvier)		1	1		rare (1)	large area
	<i>Scomberomorus niphonius</i> (Cuvier)		1			rare (1)	large area

+, 2-19 individuals: ++, 20-99; +++, 100 or more.

Rare, less than 8 times; occasional, 8-14; often, 15-22; frequent, 23-29; general, 30 or more.

## Appendix 1. Continued

Species		Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Pleuronectiformes								
Paralichthyidae								
	<i>Paralichthys olivaceus</i> (Temminck and Schlegel)	Hirame	1~+	+	1~+	+~++	frequent (27)	temperate
	<i>Tarphops oligolepis</i> (Bleeker)	Aramegarei	1	++~+++	++~+++	+~++	rare (1)	temperate
	<i>Pseudorhombus pentophthalmus</i> Günther	Tamaganzoubirame	+~++	++~+++	++~+++	+~++	general (33)	temperate
	<i>Pseudorhombus oligodon</i> (Bleeker)	Nanyougarei	1~+	+	+~++	+	rare (6)	temperate
Bothidae								
	<i>Pseudorhombus cinnamomeus</i> (Temminck and Schlegel)	Ganzoubirame	+	+	+~++	+	rare (3)	temperate
	<i>Engypropon grandisquama</i> (Temminck and Schlegel)	Darumagarei	+	+	+~++	+	rare (7)	subtropical
	<i>Engypropon multisquama</i> Amaoka	Chikamedarumagarei	+	+	+	+	rare (5)	temperate
	<i>Arnoglossus tenuis</i> Günther	Nagadarumagarei	+	+	+	+	rare (3)	subtropical
Pleuronectidae								
	<i>Pleuronichthys cornutus</i> (Temminck and Schlegel)	Mettagarei	1~+	++~+++	+	1~++	general (31)	temperate
	<i>Hippoglossoides pinetorum</i> (Jordan and Starks)	Souhachi	+	+	+	1~++	rare (3)	temperate
	<i>Pleuronectes yokohamae</i> Günther	Makogarei	+	+	++~+++	+~++	rare (4)	temperate
Soleidae								
	<i>Heteromycteris japonica</i> (Temminck and Schlegel)	Sasaushinoshita	+	+	++~+++	++	occasional (11)	temperate
	<i>Aseraggodes kobensis</i> (Steindachner)	Tobisasaushinoshita	+	++	+	+~++	occasional (11)	temperate
	<i>Pseudaesopia japonica</i> (Bleeker)	Setoushinoshita	+	1~+	1~+	1~+	often (17)	temperate
	<i>Aesopia cornuta</i> Kaup	Tsunoushinoshita	+	+	+	+	rare (1)	subtropical
	<i>Zebrias zebrius</i> (Temminck and Schlegel)	Shimaushinoshita	1	+	+	++	rare (6)	temperate
Cynoglossidae								
	<i>Paraplagesia japonica</i> (Temminck and Schlegel)	Kuroushinoshita	+	+	+	1	rare (5)	temperate
	<i>Cynoglossus interruptus</i> Günther	Genko	+~+++	+~+++	+~+++	+~+++	often (17)	temperate
	<i>Cynoglossus arei</i> (Bloch and Schneider)	Tenjikuunoshita	+	+	+	+	rare (1)	subtropical
	<i>Cynoglossus robustus</i> Günther	Inuoshita	+	+	+	+	rare (1)	temperate
	<i>Cynoglossus itinus</i> (Snyder)	Minamiakashiabirame	+	+	+	+	rare (1)	temperate
	<i>Cynoglossus abbreviatus</i> (Gray)	Kouraiakashiabirame	+	+	+	+	rare (1)	temperate
	<i>Cynoglossus joyneri</i> Günther	Akashiabirame	+	+	+	+	rare (4)	temperate
	<i>Cynoglossus nigropinnatus</i> Ochiai	Hiregurogenko	+	+	+	+	rare (1)	subtropical
Tetraodontiformes								
Triacanthodidae								
Balistidae								
Monacanthidae								
	<i>Triacanthodes anomalous</i> (Temminck and Schlegel)	Benikawamuki	1	+	+	+	rare (1)	temperate
	<i>Canthidermis maculata</i> (Bloch)	Amimongara	+	+	+	+	rare (1)	large area
	<i>Aluterus monoceros</i> (Linnaeus)	Usubahagi	+	+	+	1	rare (2)	large area
	<i>Rudarius ercodes</i> Jordan and Fowler	Amimehagi	+	+	+	+	rare (2)	temperate
	<i>Thamnoconus modestus</i> (Günther)	Umazurahagi	1~++	+~++	1~++	+~+++	frequent (23)	temperate
	<i>Thamnoconus hypargyreus</i> (Cope)	Sarasahagi	+	1	+	+	rare (1)	subtropical
	<i>Stephanolepis cirrhifer</i> (Temminck and Schlegel)	Kawahagi	+~++	+~++	+~+++	+~++	general (32)	temperate
	<i>Paramonacanthus oblongus</i> (temminck and Schlegel)	Yosogi	+	1~+	+	1~++	often (17)	subtropical
Ostraciidae								
	<i>Ostracion immaculatum</i> Temminck and Schlegel	Hakofugu	+	+	1	+	rare (1)	temperate

+, 2–19 individuals: ++, 20–99: +++, 100 or more.

Rare, less than 8 times: occasional, 8–14: often, 15–22: frequent, 23–29: general, 30 or more.

Appendix 1. Continued

Species		Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Tetraodontidae	<i>Takifugu pardalis</i> (Temminck and Schlegel)	Higanfugu	+		+	1~+	rare (7)	large area
	<i>Takifugu snyderi</i> (Abe)	Syousaifugu	+	+	+	1~++	occasional (12)	temperate
	<i>Takifugu vermicularis</i> (Temminck and Schlegel)	Nashifugu	1	+	1	+	rare (5)	temperate
	<i>Takiugu poecilnotus</i> (Temminck and Schlegel)	Komofugu	+	+	1~+++	+~++	frequent (27)	temperate
	<i>Takiugu niphobles</i> (Jordan and Snyder)	Kusafugu	+	+	+	+~++	rare (1)	large area
	<i>Takifugu rubripes</i> (Temminck and Schlegel)	Torafugu	+	1~+	1~+	1~+	occasional (11)	temperate
	<i>Lagocephalus spadiceus</i> (Richardson)	Shirosabafugu	+	1~++	1~+	1~+	occasional (14)	large area
Diodontidae	<i>Diodon holocanthus</i> Linnaeus	Harisenbon	+		1		rare (2)	subtropical
<b>INVERTEBRATE</b>								
<b>SCYPHOZOA</b>								
Semaostomeae								
Pelagiidae	<i>Chrysaora pacifica</i> (Goette)	Akakurage	+~++	+		1~+++	occasional (8)	temperate
	<i>Pelagia noctiluca</i> (Forsk.)	Okikurage	++	+			rare (2)	subtropical
	<i>Aurelia aurita</i> (Linne)	Mizukurage	+~++	+~+++	+++		occasional (9)	large area
Ulmaridae	<i>Nemipilema nomurai</i> (Kishinouye)	Echizenkurage		1	+	+	rare (5)	temperate
Phizostomeae	<i>Netrostoma setouchianum</i> (Kishinouye)	Ebikurage			+		rare (1)	temperate
Rhizostomidae	<i>Carybdea brevipedia</i> Kishinouyea	Andonkurage		+++			rare (1)	subtropical
Cepheidae	<i>Spirocodon saltator</i> (Tilastius)	Kamikurage	+			+++	rare (2)	temperate
CUBOZOA	<i>Aequorea coerulescens</i> (Brandt)	Owankurage	+				rare (1)	temperate
Cubomedusae	<i>Olinthias formosa</i> (Goto)	Hanagasakurage	+~++	+~+++	1		occasional (10)	temperate
Carybdeidae	<i>Pachycerianthus magnus</i> (Nakamoto)	Himehanaginchaku			+		rare (1)	temperate
HYDROZOA	<i>Dofleinia armata</i> Wassilieff	Sunaisoginchaku			1		rare (1)	temperate
Anthomedusae	<i>Antipathes japonica</i> Brook	Umikaramatsu		1			rare (1)	temperate
Eudendriidae								
Leptomedusae								
Aequoreidae								
Limnomedusae								
Olinthiasidae								
ANTHOZOA								
Ceriantharia								
Cerianthidae								
Actiniaria								
Actiniidae								
Anthopatharia								
Antipathidae								

+, 2-19 individuals: ++, 20-99: +++, 100 or more.

Rare, less than 8 times: occasional, 8-14: often, 15-22: frequent, 23-29: general, 30 or more.

Appendix 1. Continued		Species							Distribution area	
		Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)			
TENTACULATA										
Lobata										
Bolinopsidae	<i>Bolinopsis mikado</i> Moser	Kabutokurage		~+++	++~+++		rare (4)		temperate	
	<i>Beroe cucumis</i> Fabricius	Urukurage	+		++		rare (2)		temperate	
GASTROPODA										
Discopoda										
Xenophoridae	<i>Onustus exutus</i> (Reeve)	Kinugasagai	1~+	1~+	+	+	rare (7)		subtropical	
Naticidae	<i>Glossaulax vesicalis</i> (Philippi)	Himeisume		+	+		rare (2)		temperate	
Cassidae	<i>Semicassis bisulcata persimilis</i> Kira	Urashimagai		+	+		rare (1)		temperate	
Ficidae	<i>Ficus subintermedia</i> (d'Orbigny)	Biwagai	++	+	++~++	+	occasional (10)		subtropical	
Tonnidae	<i>Tonna sukosa</i> (Philippi)	Uzuramiyashirogai	1				rare (1)		subtropical	
Neogastropoda										
Melongenidae	<i>Hemifusus tuba</i> (Gmelin)	Tengunishi	+	+	1~+		rare (5)		subtropical	
Fasciolaridae	<i>Fusinus perplexus ferrugineus</i> Kuroda et Habe	Konaganishi	+		++		rare (2)		temperate	
Cephalaspidea	<i>Philine argentata</i> Gould	Kisewatagai	++~++	+	+	+	occasional (10)		temperate	
Pleurobranchomorpha										
Pleurobranchaeidae	<i>Pleurobranchaea japonica</i> Thiele	Umfukuro	+	+	+		rare (6)		temperate	
Nudibranchia										
Triphidae	<i>Kalinga ornata</i> Alder & Hancick	Hanadensha		+	1~+	1	rare (4)		subtropical	
	<i>Plocamopherus tilesii</i> Bergh	Hikartumiushi		+			rare (1)		temperate	
Dendrodoxidae	<i>Dendrodoxus denisoni</i> (Angas)	Miyakoumiushi	++	1			rare (2)		temperate	
Tethyidae	<i>Mebibe japonica</i> Eliot	Yamatomeribe	1~+	1~++	1~+		occasional (11)		temperate	
Arminidae	<i>Armina semperi</i> Bergh	Hosohasueramiushi		1			rare (1)		subtropical	
BIVALVIA										
Ostreoida										
Pectinidae	<i>Pecten albicans</i> (Schröter)	Itayagai	1~+	+	1~+		occasional (10)		temperate	
	<i>Anusium japonicum japonicum</i> (Gmelin)	Tsukihigai	1~+	+	1~++	1~+	often (20)		temperate	
Veneroidea	<i>Fuhvia mutica</i> (Reeve)	Torigai	+		++		rare (2)		temperate	
CEPHALOPODA										
Sepioida										
Sepiidae	<i>Sepia (Acanthosepion) lycidas</i> Gray	Kaminariika	+	1~+	~+++		rare (6)		subtropical	
	<i>Sepia (Platysepia) esculenta</i> Hoyle	Kouika	~+++	~++	~+++	~+++	fequent (24)		subtropical	
	<i>Sepia (Doratosepion) kobienis</i> Hoyle	Himekouika	1				rare (1)		temperate	
	<i>Sepia (Doratosepion) misakiensis</i> Wülker	Misakikouika	+			+	rare (3)		temperate	
	<i>Metasepia tullbergi</i> Appellöf	Hanaika	1~+	1	1	+	occasional (9)		subtropical	
	<i>Sepietta japonica</i> Sasaki	Shiryakeika			+	1~+	rare (3)		subtropical	

+, 2-19 individuals: ++, 20-99: +++, 100 or more.

Rare, less than 8 times: occasional, 8-14: often, 15-22: frequent, 23-29: general, 30 or more.

Appendix 1. Continued

Species		Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Sepiolidae	<i>Euprymna morsei</i> Verrill	+ ~ ++	+	+ ~ ++	+ ~ +++	often (21)	temperate
Teuthoidea							
Loliginidae	<i>Sepioteuthis lessoniana</i> (Lesson)			+		rare (3)	large area
	<i>Loligo (Heterololigo) bleekeri</i> Keferstein	+				rare (2)	temperate
	<i>Loligo (Photololigo) edulis</i> Hoyle	+	+			rare (4)	subtropical
Ommastrephidae	<i>Todarodes pacificus</i> Steenstrup	+ ~ ++				rare (2)	temperate
Octopoda							
Octopodidae	<i>Octopus vulgaris</i> Cuvier	1 ~ +	+ ~ ++	+ ~ ++		occasional (13)	large area
	<i>Octopus minor</i> Sasaki	1 ~ +	1 ~ +	1	1 ~ +	occasional (8)	temperate
	<i>Octopus ocellatus</i> Gray	1 ~ +	+ ~ ++	+	+	occasional (12)	temperate
	<i>Amphioctopus areolatus</i> De Haan	+	+			rare (3)	temperate
POLYCHAETA							
Amphinomida							
Amphinomidae	<i>Chloelia flava</i> (Pallas)	1 ~ ++	1 ~ +	1 ~ ++	1	occasional (11)	subtropical
MALACOSTRACA							
Stomatopoda							
Odontodactylidae	<i>Odontodactylus japonicus</i> (de Haan)	1 ~ +	+			rare (1)	subtropical
Harpisquillidae	<i>Harpisquilla harpax</i> (de Haan)	1 ~ +	+ ~ ++	+ ~ ++	+	occasional (8)	temperate
Squillae	<i>Oratosquilla oratoria</i> (de Haan)	+	1 ~ ++	+ ~ +++	1 ~ +	occasional (12)	temperate
Decapoda							
Penaeidae	<i>Penaeus (Marsupenaeus) japonicus</i> Bate	1 ~ +	1 ~ +	+	+	occasional (13)	large area
	<i>Penaeus (Melicertus) latissulcatus</i> Kishinouye	1 ~ +	+ ~ ++	+ ~ ++		rare (7)	subtropical
	<i>Penaeus (Penaeus) semisulcatus</i> De Haan	1 ~ +	+	+ ~ ++	+ ~ ++	often (18)	subtropical
	<i>Metapenaeus intermedius</i> (Kishinouye)			+		rare (2)	subtropical
	<i>Trachypenaeus curvirostris</i> Stimpson					rare (4)	large area
	<i>Metapenaeopsis</i> spp.	+	+ ~ ++	+ ~ ++	+	rare (6)	-
Sicyoniidae	<i>Sicyonia cristata</i> (de Haan)		1	1		rare (3)	subtropical
Alpheidae	<i>Alpheus japonicus</i> Miers	+	+		+	rare (3)	temperate
Palinuridae	<i>Ibacus ciliatus</i> (von Siebold)		+	1	+	rare (6)	subtropical
	<i>Ibacus novemdentatus</i> Gibbs	+	1 ~ +	1 ~ +	+	occasional (9)	subtropical
Diogenidae	<i>Dardanus arrosor</i> (Herbst)	+	1 ~ +	1 ~ +	+ ~ ++	occasional (11)	subtropical
	<i>Dardanus aspersus</i> (Berthold)	+	+	1 ~ ++		occasional (10)	subtropical
	<i>Diogenes edwardsii</i> (De Haan)	+	1 ~ +	+ ~ ++	+ ~ ++	rare (7)	temperate
Paguridae	<i>Spiropagurus spiriger</i> (De Haan)	+ ~ ++	+ ~ ++	+ ~ +++	+ ~ ++	occasional (13)	temperate
Porcellanidae	<i>Porcellanella picta</i> (Stimpson)	1	+	+		rare (2)	subtropical
Dromiidae	<i>Dromidopsis dormia</i> (Linnaeus)	1	1 ~ +	+		rare (1)	subtropical
	<i>Dromia dehaani</i> Rathbun	1	1 ~ +	+		rare (5)	subtropical
Latreilliidae	<i>Latreillia valida</i> De Haan		+			rare (2)	large area

+, 2-19 individuals; ++, 20-99; +++, 100 or more.

Rare, less than 8 times; occasional, 8-14; often, 15-22; frequent, 23-29; general, 30 or more.

## Appendix 1. Continued

	Species	Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Dorippidae	<i>Dorippe sinica</i> Chen	Kimengani	+ ~ ++	+ ~ ++	+ ~ +++	1 ~ ++	often (18)	temperate
	<i>Paradorippe granulata</i> (De Haan)	Samehadahikegani		1			rare (2)	temperate
Calappidae	<i>Calappa lophos</i> (Herbst)	Torafukarappa		+	+		rare (6)	subtropical
	<i>Calappa philargius</i> (Linnaeus)	Meganekarappa		1	+		rare (4)	subtropical
Leucosiidae	<i>Arcania undecimspinosa</i> De Haan	Juuchitogekobushi		1 ~ +			rare (2)	temperate
	<i>Myra fugax</i> (Fabricius)	Tenagakobushi	1 ~ +	+	+ ~ ++	1 ~ ++	often (16)	temperate
	<i>Leucosia anatum</i> (Herbst)	Tsunonagakobushi		+	+		rare (1)	subtropical
	<i>Urnalana haematostica</i> (Adams & White)	Askahoshikobushi		1	1		rare (1)	subtropical
Majidae	<i>Phalangopus hystrix</i> (Miers)	Ashinagatsunogani	1 ~ +	+ ~ ++	+	+	occasional (9)	subtropical
	<i>Hyastenus diacanthus</i> (De Haan)	Tsunogani	+	+ ~ ++	+	+	often (15)	subtropical
	<i>Leptomithrax edwardsii</i> (de Haan)	Koshimagani		+	+	1	rare (3)	temperate
Parthenopidae	<i>Parthenope (Platylambrus) valida</i> De Haan	Hishigani	+ ~ ++	+	+ ~ ++		occasional (11)	subtropical
Corystidae	<i>Jonas distincta</i> (De Haan)	Higegani		+	+		rare (3)	temperate
Portunidae	<i>Liocarcinus corrugatus</i> (Pennant)	Shiwagazami	1				rare (1)	subtropical
	<i>Ovalipes punctatus</i> (de Haan)	Hiratsumegani	+	+			rare (4)	temperate
	<i>Portunus (Portunus) triuberulatus</i> (Miers)	Gazami	1	+ ~ ++	1 ~ +	1 ~ +	rare (7)	temperate
	<i>Portunus (Portunus) pelagicus</i> (Linnaeus)	Taiwangazami		1 ~ ++	1 ~ ++		rare (3)	subtropical
	<i>Portunus (Portunus) sanguinolentus</i> (Herbst)	Janomegazami		+ ~ ++	+ ~ ++	+	rare (5)	subtropical
	<i>Portunus haani</i> (Stimpson)	Ibogazami	1	+ ~ ++	+ ~ ++		rare (7)	temperate
	<i>Charybdis (Charybdis) japonica</i> (A. Milne Edwards)	Ishigani		+	+		rare (2)	temperate
	<i>Charybdis (Charybdis) ferriata</i> (Linnaeus)	Shimaishigani	1				rare (1)	subtropical
	<i>Charybdis (Charybdis) miles</i> (De Haan)	Akaishigani	+	+ ~ ++	+ ~ ++	+ ~ +++	often (17)	temperate
	<i>Charybdis (Goniohellemus) truncata</i> (Fabricius)	Hirohaishigani	+ ~ ++	+++	+ ~ +++	+ ~ +++	occasional (13)	temperate
	<i>Charybdis (Goniohellemus) bimaculata</i> (Miers)	Futahoshiishigani		+ ~ ++	+		rare (3)	subtropical
	<i>Thalamita sima</i> H. Milne Edwards	Futahabentsukegani		+	+		rare (2)	temperate
Xanthidae	<i>Liagore rubromaculata</i> (De Haan)	Benihoshimanjugani	1 ~ +	+ ~ ++	+	+	occasional (8)	temperate
	<i>Demania scaberrima</i> (Walker)	Urokoougani		+	+	+	rare (4)	subtropical
Goneplacidae	<i>Carcinoplax vestita</i> (De Haan)	Kebukaenkougani	+			+	rare (4)	temperate
	<i>Carcinoplax longimana</i> (De Haan)	Enkougani	+	1 ~ +	+	+	occasional (8)	large area
CRINOIDEA								
Comatulida								
Comasteridae	<i>Oxycomanthus japonicus</i> (Müller)	Nipponumishida		+			rare (2)	temperate
ASTEROIDEA								
Platyasterida								
Luidiidae	<i>Luidia maculata</i> Müller et Troschel	Yatusdesumahitode	+ ~ ++	+	+	+	occasional (8)	subtropical
	<i>Luidia quinaria</i> von Martens	Sumahitode	+	+	+	+	occasional (11)	temperate

+, 2–19 individuals: ++, 20–99; +++, 100 or more.

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## Appendix 1. Continued

Species	Japanese name	Spring	Summer	Autumn	Winter	frequency (actual times)	Distribution area
Paxillosida							
Astropectinidae	<i>Astropecten scoparius</i> Valenciennes	++	+~++	+		rare (6)	temperate
	<i>Astropecten polyacanthus</i> Müller et Troschel	+~++	1~++	++		occasional (8)	subtropical
	<i>Ctenopleura fisheri</i> Hayashi		+			rare (1)	temperate
Valvatida							
Ophiasteridae	<i>Heteronardoa carinata</i> (Koehler)		1~+			rare (1)	subtropical
Goniasteridae	<i>Stellaster equestris</i> (Retzius)		1~+			rare (3)	temperate
Spinulosida							
Asterimidae	<i>Asterina pectinifera</i> Müller et Troschel	1~+	1~+	+~++		occasional (14)	temperate
ECHINOIDEA							
Echinoidea							
Tennopleuridae	<i>Tennopleurus toreumaticus</i> (Leske)	+~++	1~+	+		rare (6)	temperate
Strongylocentrotida	<i>Pseudocentrotus depressus</i> (A. Agassiz)				1	rare (1)	temperate
Echinometridae	<i>Anthocidaris crassispina</i> (A. Agassiz)			+		rare (1)	temperate
HOLOTHUROIDEA							
Aspidochirotid							
Holothuriidae	<i>Holothuria (Selenkothuria) moebii</i> (Ludwing)	+			+	rare (2)	temperate
	<i>Holothuria (Thymitosycia) decorata</i> von Marenzeller	1	+	+	1	rare (5)	temperate
Stichopodidae	<i>Apostichopus japonicus</i> (Selenka)	1~++	+	+	+~+++	often (21)	temperate
ASCIDIACEA							
Pleurogona							
Pyuridae	<i>Halocynthia roretzi</i> (Drasche)	+	+	+		rare (4)	temperate

+, 2-19 individuals: ++, 20-99: +++, 100 or more.

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