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山口県響灘における小型定置網の漁獲物

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Sea off Yamaguchi Prefecture, JapanHiroyuki Doi¹, Teppei Kushimoto¹, Takayuki Sonoyama¹, Toshiaki Ishibashi¹,
Masato Nishikawa² and Harumi Sakai^{3†}

Abstract: Aquatic animals fished by 297 operations of a set net at the Hibiki-nada Sea off Yamaguchi Prefecture, Japan, were investigated in all seasons from 2002 through 2010. A total of 410 species including 3 reptiles, 1 chordate, 294 fishes (FS) and 112 invertebrates (IV) were caught. Among them, 242 FS and 100 IV were judged as rare (caught in less than 60 times), 28 FS and 8 IV as occasional (60 to 118 times), 9 FS and 2 IV as often (119 to 178 times), 8 FS and 1 IV as frequent (179 to 237 times), and 7 FS and 1 IV as general (more than 237 times) species. One hundred and one (101) FS and 29 IV were caught in all seasons, 170 FS and 78 IV were in spring, 201 FS and 77 IV were in summer, 207 FS and 55 IV were in autumn, and 185 FS and 64 IV were in winter. From distributional point of view, 118 FS and 43 IV were subtropical species, 108 FS and 60 IV were temperate region species, and 68 FS and 9 IV were large areal (widely distributed) species.

Key words: set net fishery, fish, invertebrate, rare species, by-catch, seasonal change

緒 言

定置網や底びき網は、釣り漁業や特定の魚群を狙った巻網漁業などより漁獲選択性が比較的に低く、低利用魚介類の混獲を免れない一方で生物相の調査等では有効な手段といえる^{1,2)}。響灘を含む山口県日本海域に出現した魚類は39目197科870種³⁾、特記生物として魚類245種、無脊椎動物140種、脊索動物4種、爬虫類4種におよぶことがすでに知られているが^{4,5)}、実際に漁獲される魚類の季節的変動や多寡については必ずしも明らかとは言えない。そこで著者らは山口県の響灘で操業される小型底びき網の漁獲生物調査を実施し、脊索動物、魚類および無脊椎動物合計

317種の出現と季節変動を明らかにした²⁾。しかし、漁獲選択性が低いとは言えその結果はあくまでも底びき網操業水域の範囲内のことであり、他の漁法の結果も検討する必要がある²⁾。本調査研究は、8年以上にわたって同海域に設置された小型定置網漁に同乗し、漁獲される魚介類の周年変動等に関する基盤データを得、小型底びき網の漁獲生物と合わせて本海域の水産資源の特徴を明らかにすることを目的とした。

材料及び方法

本調査の定置網は、下関市豊浦町室津地先 (Fig. 1, 北

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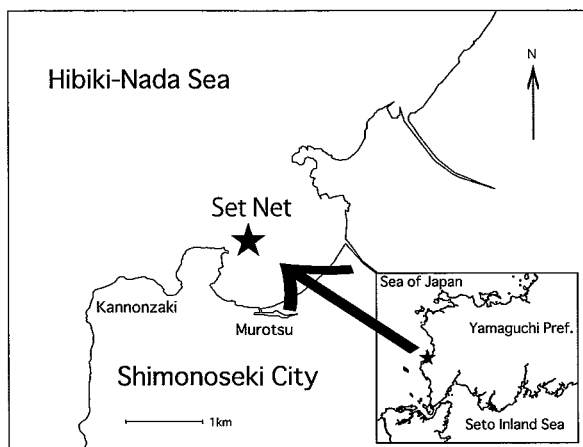


Fig. 1. Map showing the Hibiki-nada Sea area where set net fishing was operated (star, 34° 8' 38" N, 130° 53' 20" E).

緯 34° 8' 38", 東経 130° 53' 20") の水深 12m から 16m に設置された一段落網である。垣網の長さは約 300 m (200 間), 垣網の目合は約 18–30 cm (6 寸目から 1 尺), 運動場の目合は約 12 cm (4 寸目), 箱網は縦約 37.5 m (25 間) 横約 22.5 m (15 間), 箱網の目合は約 4.3 cm (8 節) と約 2.7 cm (12 節) の 2 種類であった。操業日に漁船一隻 (総トン数 4.0 トン) に同乗して日の出前後に漁場に到着するように出港し, 網揚げは午前中に実施した。

調査は 2002 年 1 月から 2010 年 3 月の間の周年にわたり, 春期 84 回, 夏期 78 回, 秋期 69 回, 冬期 66 回の合計 297 回実施した (Table 1)。

漁獲物は可能な限り船上で同定し, おおよその漁獲量を記録したが, 同定困難な種は持ち帰り, 分類群ごとに図鑑等の専門書⁶⁻¹⁷⁾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*, クロメバル *S. ventriosus*, シロメバル *S. cheni* に区別されているが⁶⁾, 船上で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. として扱うこととした。

大雨による増水のあとに河川から流され, 定置網に入網したものと考えられる淡水魚類のギンブナ *Carassius* sp., ドジョウ *Misgurnus anguillicaudatus*, ブルーギル *Lepomis macrochirus macrochirus*, オオクチバス *Micropterus salmoides* および金庫網内のアジ類, イワシ類を捕食するために魚網内に入り, 脱出できなかったものと考えられる鳥類のウミウ *Phalacrocorax filamentosus*, ウミアイサ *Mergus serrator* は解析から除外した。

資料の整理・解析方法は概ね前報²⁾と同様である。すなわち, 出現したそれぞれの種について, 既報^{2, 18)}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 網揚げ時の漁獲数を 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。また, 調査回数 297 回に対する出現頻度は, 稀 (rare, 59 回以下), やや稀 (occasional, 60–118 回), 普通 (often, 119–178 回), やや頻繁 (frequent, 179–237 回), 頻繁 (general, 238 回以上) の 5 段階に区分した。さらに, 分類群ごとの専門書⁶⁻¹⁷⁾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^{7, 19)}, 南方系種 (sub-tropical 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。

調査期間約 8 年間にわたる魚種組成の変化を知る目的で, 前期 (2002–2005) と後期 (2006–2010) に分けて種数を比較した。さらに前期と後期の調査回数から出現期待回数を求めることにより, 各種の出現回数を前期と後期で比較した (χ^2 検定)。

調査期間における水温比較には, 下関市立しものせき水

Table 1. Sampling numbers at a set net in Hibiki-nada Sea, Yamaguchi Prefecture, from 2002 through 2010

	Winter		Spring			Summer			Autumn			Winter	Total
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	
2002	2	1	3	4	3	3	3	3	4	3	3	3	35
2003	3	3	3	3	4	4	3	3	3	3	3	3	38
2004	3	3	3	3	3	3	3	3	3	3	3	3	36
2005	3	3	3	3	0	4	3	3	3	3	3	3	34
2006	3	3	3	3	3	3	3	3	3	3	3	3	36
2007	4	4	3	6	4	3	4	3	4	3	3	2	43
2008	2	3	3	3	6	4	3	4	4	3	0	0	35
2009	0	3	3	5	6	6	1	3	2	3	1	2	35
2010	2	2	1	0	0	0	0	0	0	0	0	0	5
Total	22	25	25	30	29	30	23	25	26	24	19	19	297

族館において測定している関門海峡の水温資料を用いた。

結果及び考察

2002年から2010年にかけての水温は、2006年2月が平均水温10.0℃と最も低く、2009年8月が平均水温28.3℃と最も高く、年間の平均水温は18.7℃であった（Fig. 2）。

漁獲された生物は、魚類294種（複合種1種含む）、無脊椎動物112種、脊索動物1種、爬虫類3種であった（Appendix 1）。無脊椎動物の内訳は、刺胞動物18種、有櫛動物6種、軟体動物42種、環形動物2種、節足動物28種、棘皮動物16種であった。

稀種は魚類242種、無脊椎動物100種、やや稀種は魚類28種、無脊椎動物8種、普通種は魚類9種、無脊椎動物2種、やや頻繁種は魚類8種、無脊椎動物1種、頻繁種は魚類7種、無脊椎動物1種であった（Table 2）。多くの種が稀にしか漁獲されず、逆に頻繁種は、アカエイ

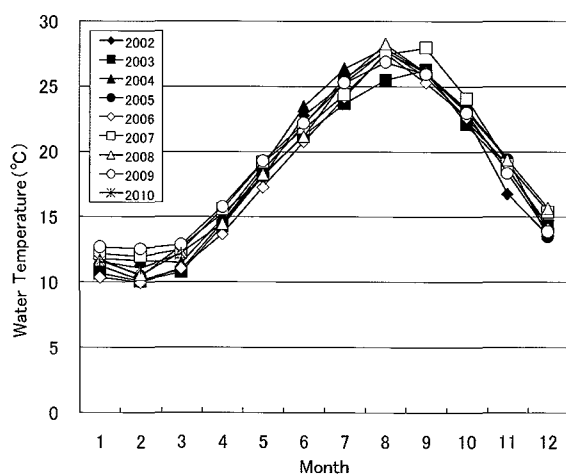


Fig. 2. Monthly change of average water temperature at the Kanmon Strait from 2002 through 2010, monitored by the Shimonoseki Marine Science Museum.

Table 2. Numbers of species collected by the set net fishing in Hibiki-nada Sea from 2002 through 2012, 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	
FISH						
Subtropical sp.	104	9	3	1	1	118
Temperate sp.	85	12	2	4	5	108
Large areal sp.	53	7	4	3	1	68
INVERTEBRATE						
Subtropical sp.	41	0	2	0	0	43
Temperate sp.	54	6	0	0	0	60
Large areal sp.	5	2	0	1	1	9

Dasyatis akabei, マアジ *Trachurus japonicus*, マダイ *Pagrus major*, ヒラメ *Paralichthys olivaceus*, カワハギ *Stephanolepis cirrhifer*, ヒガンフグ *Takifugu pardalis*, コモンフグ *Takifugu poecilonotus*, アオリイカ *Sepioteuthis lessoniana* の8種で、いずれも重要な漁獲対象種であった。生物地理学的には、魚類では、南方系118種（40.2%）、温帯性108種（36.7%）、広域分布68種（23.1%）であった。無脊椎動物では、南方系43種（38.4%）、温帯性60種（53.6%）、広域分布9種（8.0%）であった。

魚類47種、無脊椎動物14種、爬虫類2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。魚類は、シロザメ *Mustelus griseus*, ホコサキ *Carcharhinus maculoti*, ホシエイ *Dasyatis matsubarae*, イセゴイ *Megalops cyprinoides*, ソトイワシ *Albula* sp., アミウツボ *Gymnothorax minor*, オオイワシ *Thryssa baelama*, サケ *Oncorhynchus keta*, チゴダラ *Physiculus japonicus*, ヤリヒゲ *Coelorinchus multispinulosus*, ワヌケフウリュウオ *Malthopsis annulifera*, トゲヨウジ *Syngnathoides biaculeatus*, ハナタツ *Hippocampus sindonis*, タケノコメバル *Sebastes oblongus*, ハナミノカサゴ *Pterois volitans*, ソコホウボウ *Pterygotrigla hemisticta*, オニカナガシラ *Lepidotrigla kishinouyei*, キホウボウ *Peristedion orientale*, オオクチシナギ *Stereolepis doederleini*, ヒメスミクイウオ *Synagrops philippiensis*, スジイシモチ *Apogon cookii*, アカアマダイ *Branchiostegus japonicus*, リュウキュウヨロイアジ *Carangoides hedlandensis*, リュウグウノヒメ *Pterycombus petersii*, ゴマフエダイ *Lutjanus argentimaculatus*, マツダイ *Lobotes surinamensis*, ヒゲソリダイ *Haplogeny nigrispinnis*, ハマフエフキ *Lethrinus nebulosus*, ヨメヒメジ *Upeneus tragula*, チョウチョウウオ *Chaetodon auripes*, オキゴンベ *Cirrhilichthys aureus*, アカタチ *Acanthocephala krusensternii*, ツバメコノシロ

Polydactylus plebius, コブダイ *Semicossyphus reticulatus*, カミナリベラ *Stethojulis interrupta terina*, シロウオ *Leucopsarion petersii*, ニセカンランハギ *Acanthurus dussumieri*, オオメカマス *Sphyrna forsteri*, ホソカマス *Sphyrna helleri*, スマ *Euthynnus affinis*, ツノウシノシタ *Aesopia cornuta*, ギマ *Triacanthus biaculeatus*, キタマクラ *Canthigaster rivulata*, マフグ *Takifugu porphyreus*,

シッポウフグ *Torquigener brevipinnis*, カナフグ *Lagocephalus inermis*, ネズミフグ *Diodon hystrix* であった。無脊椎動物は、ヒゼンクラゲ *Rhopilema hispidum*, フサウミコップ *Clytia languida*, ツヅミクラゲ *Aegina rosea*, カズラガイ *Phalium (Bezoardicella) flammiferum*, ホウズキフシエラガイ *Berthellina citrina*, ミヤコウミウシ *Dendrodoris denisoni*, ミミイカダマシ *Sepiadarium kochii*, タコブネ *Argonauta hians*, ウミケムシ *Chloeia flava*, ヒダビル *Trachelobdella okae*, クマエビ *Penaeus (Penaeus) semisulcatus*, ヤマトホンヤドカリ *Pagurus japonicus*, トラフカラッパ *Calappa lophos*, コシダカウニ *Mespilia globulus* であった。爬虫類では、アカウミガメ *Caretta caretta* とヒロオウミヘビ *Laticauda laticaudata* であった。

季節を通じて周年出現した種は魚類 101 種, 無脊椎動物 29 種におよんだ。春期に出現した魚類は 170 種, 無脊椎動物 78 種, 夏期に出現した魚類は 201 種, 無脊椎動物 77 種, 秋期に出現した魚類は 207 種, 無脊椎動物 55 種, 冬期に出現した魚類は 185 種, 無脊椎動物 64 種で, 魚類は秋期が最も出現種数が多く, 無脊椎動物では春期が最も多かった。逆に出現種数が少なかった季節は魚類では春期, 無脊椎動物では秋期であった。秋期はアジ類, タチウオなどの魚類がまとまって大量に入網することが多く, 箱網が回遊性の魚種で満杯となるといっばうで無脊椎動物の入網が減じた可能性も考えられる。

春期のみ出現は魚類 18 種と無脊椎動物 11 種, 夏期のみ出現は魚類 22 種と無脊椎動物 10 種, 秋期のみ出現は魚類 21 種と無脊椎動物 6 種, 冬期のもの出現は魚類 16 種と無脊椎動物 6 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, 冬期のクロメジナ *Girella leonine*, 冬期のカツオ *Katsuwonus pelamis*, 夏期のオヨギイソギンチャク *Blolceroides mcmurricchi*, 春期のドフラインクラゲ *Nemopsis dofleini*, ヤクチクラゲ *Sugiura chengshanense* およびヘンゲクラゲ *Lampea pancerina*, 秋期のツノクラゲ *Leucothea japonica*, 春期のベイカ *Loliolus beka* が挙げられる。

山口県日本海域に出現が確認されている魚類 870 種³⁾のうち, 約 34%に相当する種が本調査で確認された。特記的な魚類 245 種^{4,5)}のうち約 42%に相当する 103 種, 無脊椎動物

Table 3. Numbers of species collected by the set net and trawl net²⁾ fishings in Hibiki-nada Sea, and common and total species numbers of both nets, shown by the distribution area from subtropical to large areal species

Distribution area	Set net	Trawl net ²⁾	Common	Total
FISH				
Subtropical sp.	118	70	40	148
Temperate sp.	108	91	58	141
Large areal sp.	68	43	31	80
INVERTEBRATE				
Subtropical sp.	43	42	24	61
Temperate sp.	60	62	30	92
Large areal sp.	8	7	4	11

2) Doi et al. (2014).

140 種^{4,5)}のうち, 約 16%に相当する 22 種が本調査で確認された。それ以外の種は, 定置網には入網しにくいもののこの海域でも生息する種が多いものと考えられる。

定置網および底びき網²⁾における総出現種数および共通出現種数の地理的区分の内訳を Table 3 に示した。総出現種数は魚類 369 種 (複合種 1 種含む), 無脊椎動物 166 種 (複合種 1 種含む), 脊索動物 2 種, 爬虫類 3 種であった。魚類の地理的区分による内訳は, 南方系 148 種 (40.1%), 温帯性 141 種 (38.2%), 広域分布 80 種 (21.7%) であった。総出現種の無脊椎動物の地理的区分による内訳は, 南方系 61 種 (37.2%), 温帯性 92 種 (56.1%), 広域分布 11 種 (6.7%) であった。定置網, 底びき網の共通種は魚類 129 種 (複合種 1 種含む), 無脊椎動物 58 種であった。共通種の魚類の地理的区分による内訳は, 南方系 40 種 (31%), 温帯性 58 種 (45%), 広域分布 31 種 (24%) となった。共通種の無脊椎動物の地理的区分による内訳は, 南方系 24 種 (41.4%), 温帯性 30 種 (51.7%), 広域分布 4 種 (6.9%) であった。

本調査結果を鳥取県浦富¹⁹⁾, 九州北部沿岸の津屋崎²⁰⁾ および長崎県野母崎²¹⁾と比較してみると, 北から南にかけて南方系魚類の割合が漸次的に増加することが示された (Table 4)。この傾向は定置網と底びき網の種数を合算しても同様であった。広域分布魚種が他の海域では 10%未

Table 4. Coastal fish species composition in % as shown by the distribution area from subtropical, temperate, and large areal species, from Nagasaki (Nomozaki²¹⁾, Fukuoka (Tsuyazaki²⁰⁾, Yamaguchi (Hibiki-nada), and Tottori (Tottori¹⁹⁾) Prefectures

Distribution area	Nomozaki ²¹⁾	Tsuyazaki ²⁰⁾	Hibiki-nada			Tottori 19)
			Set net	Trawl net ²⁾	Total	
Subtropical sp.	63.0	49.8	40.2	34.3	40.1	37.9
Temperate sp.	28.7	42.2	36.7	44.6	38.2	53.1
Large areal sp.	8.3	8.0	23.1	21.1	21.7	9.0

2) Doi et al. (2014); 19) Wada et al. (2014); 20) Nishida (2008); 21) Tawa and Takegaki (2009).

Table 5. Comparison of collected times in the set net fishing at Hibiki-nada Sea, Yamaguchi Prefecture, between the former (2002–2005) and latter (2006–2010) halves of the surveyed period from 2002 through 2010 (total 297 samplings) in the species that showed significant difference between the former and latter halves (χ^2 test)

Scientific name	Japanese name	Collected times		Expected times		Total times	χ^2 value	p	Distribution area
		Former half	Latter half	Former half	Latter half				
FISH									
Former half < Latter half									
<i>Urolophus aurantiacus</i>	Hirataei	4	19	11.1	11.9	23	8.715	0.003	subtropical
<i>Myliobatis tobijei</i>	Tobiei	38	81	57.3	61.7	119	12.533	0.000	subtropical
<i>Cypselurus hiraii</i>	Hosotobiuo	20	38	27.9	30.1	58	4.338	0.037	large area
<i>Lateolabrax japonicus</i>	Suzuki	77	114	92.0	99.0	191	4.695	0.030	temperate
<i>Girella punctata</i>	Mejina	35	58	44.8	48.2	93	4.118	0.042	temperate
<i>Pleuronectes yokohamae</i>	Makogarei	3	11	6.7	7.3	14	4.004	0.045	temperate
Former half > Latter half									
<i>Sphyrna zygaena</i>	Shirosyumokuzame	13	3	7.7	8.3	16	7.022	0.008	large area
<i>Ophisurus macrorhynchus</i>	Dainanumihebi	13	4	8.2	8.8	17	5.462	0.019	subtropical
<i>Konosirus punctatus</i>	Konoshiro	75	24	47.7	51.3	99	30.228	0.000	large area
<i>Saurida elongata</i>	Tokageeso	53	13	31.8	34.2	66	27.333	0.000	temperate
<i>Trachinocephalus myops</i>	Okieso	13	1	6.7	7.3	14	11.209	0.001	subtropical
<i>Fistularia petimba</i>	Akayagara	31	18	23.6	25.4	49	4.485	0.034	large area
<i>Fistularia commersonii</i>	Aoyagara	30	11	19.7	21.3	41	10.283	0.001	temperate
<i>Chelidonichthys spinosus</i>	Houbou	31	15	22.1	23.9	46	6.823	0.009	large area
<i>Onigocia spinosa</i>	Onigochi	13	5	8.7	9.3	18	4.179	0.041	subtropical
<i>Priacanthus macracanthus</i>	Kintokidai	24	6	14.4	15.6	30	12.191	0.000	temperate
<i>Rachycentron canadum</i>	Sugi	17	7	11.6	12.4	24	4.947	0.026	large area
<i>Parapristipoma trilineatum</i>	Isaki	40	17	27.4	29.6	57	11.078	0.001	temperate
<i>Pennahia argentata</i>	Shirogisu	48	29	37.1	39.9	77	6.210	0.013	temperate
<i>Pempheris schwenkii</i>	Minamihatanpo	19	2	10.1	10.9	21	15.071	0.000	subtropical
<i>Abudefduf vaigiensis</i>	Oyabichya	25	8	15.9	17.1	33	10.076	0.002	subtropical
<i>Kyphosus vaigiensis</i>	Isuzumi	21	10	14.9	16.1	31	4.767	0.029	temperate
<i>Parajulis poecileptera</i>	Kyuusen	41	24	31.3	33.7	65	5.803	0.016	temperate
<i>Parablennius yatabei</i>	Isoginpo	9	2	5.3	5.7	11	4.995	0.025	temperate
<i>Petroscirtes breviceps</i>	Nijiginpo	49	32	39.0	42.0	81	4.945	0.026	subtropical
<i>Prionurus scalprum</i>	Nizadai	59	38	46.7	50.3	97	6.244	0.012	temperate
<i>Auxis thazard thazard</i>	Hirasouda	16	3	9.1	9.9	19	9.897	0.002	large area
<i>Heteromycteris japonica</i>	Sasaushinoshita	13	2	7.2	7.8	15	8.914	0.003	temperate
<i>Aluterus monoceros</i>	Usubahagi	30	17	22.6	24.4	47	4.630	0.031	large area
<i>Paramonacanthus oblongus</i>	Yosogi	44	26	33.7	36.3	70	6.066	0.014	subtropical
<i>Lagocephalus spadiceus</i>	Shirosabafugu	39	23	29.9	32.1	62	5.407	0.020	large area
INVERTEBRATE									
Former half < Latter half									
<i>Bolinopsis mikado</i>	Kabutokurage	20	41	29.4	31.6	61	5.766	0.016	temperate
<i>Aplysia kurodai</i>	Amefurashi	4	29	15.9	17.1	33	17.156	0.000	temperate
<i>Dolabella auricularia</i>	Tatsunamigai	1	16	8.2	8.8	17	12.164	0.000	temperate
<i>Plocamopherus tilesii</i>	Hikariumiushi	13	41	26.0	28.0	54	12.536	0.000	temperate
<i>Sepia (Dorotosepion) kubiensis</i>	Himekouika	0	20	9.6	10.4	20	18.571	0.000	temperate
<i>Loliolus japonica</i>	Jindouika	0	12	5.8	6.2	12	11.143	0.001	temperate
<i>Moroteuthis loembergi</i>	Kagiika	0	16	7.7	8.3	16	14.857	0.000	temperate
<i>Liocarcinus corrugatus</i>	Shiwagazami	0	13	6.3	6.7	13	12.071	0.001	subtropical
<i>Astropecten polyacanthus</i>	Togemomijigai	6	17	11.1	11.9	23	4.4838	0.0342	subtropical
Former half > Latter half									
<i>Nemopilema nomurai</i>	Echizenkurage	23	12	16.9	18.1	35	4.326	0.038	temperate
<i>Fisimus perplexus ferrugineus</i>	Konaganishi	64	37	48.6	52.4	101	9.369	0.002	temperate
<i>Thysanoteuthis rhombus</i>	Sodeika	12	3	7.2	7.8	15	6.096	0.014	subtropical
<i>Dardanus aspersus</i>	Akaboshiyadokari	23	12	16.9	18.1	35	4.326	0.038	subtropical
<i>Diogenes edwardsii</i>	Togetsunoyadokari	26	12	18.3	19.7	38	6.256	0.012	temperate

Table 6. Number of increased or decreased species from the former samplings (2002–2005) to the latter samplings (2006–2010) of the surveyed period from 2002 through 2010 collected by the set net fishing in Hibiki-nada Sea, Yamaguchi Prefecture, shown by the distribution area from subtropical to large areal species

	Subtropical sp.	Temperate sp.	Large areal sp.	Total
FISH				
Increased	2	3	1	6
Decreased	7	10	8	25
INVERTEBRATE				
Increased	2	7	0	9
Decreased	2	3	0	5

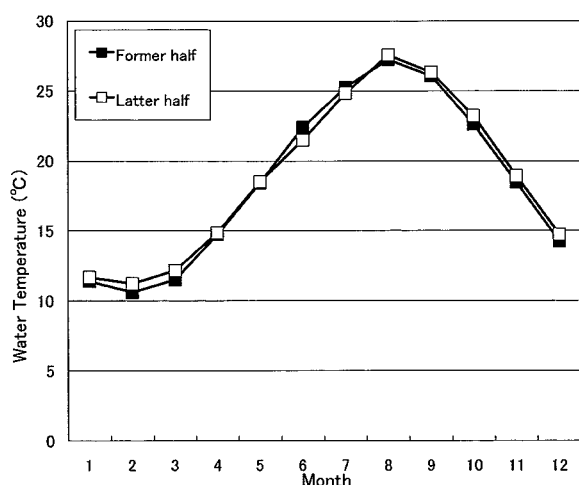


Fig. 3. Comparison of monthly change of average water temperature between 2002-2005 and 2006-2010, calculated from the data in Fig. 2.

満であるのに対して本調査では、約 23%と高い値を示した。これは、ほかの調査が沿岸の潜水調査等に基づいていることに対して、本調査の定置網や前報²⁾の底びき網等の漁獲特性にも起因するものと考えられる。

調査期間のうち 2002 年から 2005 年までを前期、2006 年から 2010 年までを後期とし、種数を比較すると、魚類では前期 264 種、後期 236 種、無脊椎動物では前期 87 種、後期 91 種であった。さらに出現回数を前期と後期で比較した (χ^2 検定, $p < 0.05$)。有意差が認められた種は魚類では 31 種、無脊椎動物では 14 種であった (Table 5)。その内訳は、魚類では 6 種が後期に有意に増加、25 種が減少、無脊椎動物では 9 種が増加、5 種が減少しており (Table 6)、全体の種数の増減を反映していた。前期と後期の月別の平均気温を比較すると (Fig. 3)、温度差は有意ではないものの 6、7 月以外では後期の方が若干高温の傾向にあった。しかし、特に亜熱帯性種の増加や温帯性種の減少などの傾向は無く、全体的に魚類が減少し、無脊椎動物が増加していた。広島湾と安芸灘の境界に位置する鹿島では 8 目 24 科 50 種の魚類を確認されているが²⁰⁾、瀬戸内海の浅海魚類相調査においても魚類群集における亜熱帯性種への移行が必ずしも進行しているわけではないと報告されている。

今後、同様の調査を巻網や籠漁などの他漁法においても行い、さらに幼魚や成魚の出現動向について踏み込んだ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いくものと考えられる。また、本海域において定置網や底びき網によって漁獲される生物の多くは稀に漁獲されるものであった。そのほとんどは食

用に適さないか通常の流通経路には載らない種であろうと思われる。今後、そのような低利用資源の有効利用を図ることや、そもそもそれらの漁獲を避ける漁法の開発は、資源を無駄にしないためにも益々重要となるであろう。

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Appendix 1. List of animals caught by the set net fishing in Hibiki-nada Sea, Yamaguchi Prefecture, from 2002 through 2010

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
MYXINI																		
Myxiniformes																		
Myxinidae	<i>Eptatretus burgeri</i> (Girard)	Nutaunagi		+			0	1	0	0	0	0	0	0	0		rare (1)	temperate
CHONDRICTHYES																		
Carcharhiniformes																		
Scyliorhinidae	<i>Scyliorhinus torazame</i> (Tanaka)	Torazame	+				0	0	0	0	2	0	0	0	0		rare (2)	large area
Carcharhiniformes																		
Triakidae	<i>Mustelus manazo</i> Bleeker	Hoshizame	1	1	1~+		0	1	3	0	1	2	0	5	0		rare (12)	temperate
	<i>Mustelus griseus</i> Pietschmann	Shirozame			1		0	0	1	0	0	0	0	0	0		rare (1)	temperate
	<i>Hemitriakis japonica</i> (Müller and Henle)	Eirakubuka			1		0	0	0	1	0	1	0	0	0		rare (2)	subtropical
Carcharhinidae	<i>Carcharhinus macloiti</i> (Müller and Henle)	Hokosaki			1		0	0	0	0	1	0	0	0	0		rare (1)	subtropical
	<i>Carcharhinus brachyurus</i> (Günther)	Kuroherimejiro		1		1	0	0	0	1	1	0	0	0	0		rare (2)	subtropical
	<i>Carcharhinus falciformis</i> (Müller and Henle)	Kurotogarizame		1			1	0	0	1	0	0	0	0	0		rare (2)	subtropical
Sphyrnidae	<i>Sphyrna zygaena</i> (Linnaeus)	Shirosyumokuzame		1~+	1~+		4	5	3	1	2	1	0	0	0		rare (16)	large area
	<i>Sphyrna lewini</i> (Griffith and Smith)	Akasyumokuzame	1		1~+		0	0	0	0	0	2	1	1	0		rare (4)	large area
Rhinobatiformes																		
Rhinobatidae	<i>Rhinobatos hynnicephalus</i> Richardson	Komonsakatazame	1~+	1~+	1~+		8	4	4	6	8	7	6	4	0		rare (47)	temperate
Platyrrhinidae	<i>Platyrrhina tangi</i> (Iwatsuki, Zhang and Nakaya)	Uchiwazame	1~+	1~+	1~+	1~+	8	8	12	6	8	9	11	9	1		occasional (72)	temperate
Torpediniformes																		
Torpedinidae	<i>Narke japonica</i> (Temminck and Schlegel)	Sibireei	+	1			1	1	0	0	0	1	1	0	0		rare (4)	temperate
Rajiformes																		
Rajidae	<i>Okamejei kanojei</i> (Müller and Henle)	Komonkasube	1		1	1	0	3	1	0	3	2	0	1	0		rare (10)	temperate
Myliobatiformes																		
Urolophidae	<i>Urolophus aurantiacus</i> Müller and Henle	Hirataei	1~+	1~+	1	1	1	2	0	1	6	7	4	2	0		rare (23)	subtropical
Dasyatidae	<i>Dasyatis matsubarae</i> Miyosi	Hoshiei		1			0	0	0	1	0	0	0	0	0		rare (1)	temperate
	<i>Dasyatis akajei</i> (Müller and Henle)	Akaei	1~+	+++	+++	+++	25	34	32	30	36	44	35	34	5		general (275)	subtropical
Gymnuridae	<i>Gymnura japnica</i> (Temminck and Schlegel)	Tsubakuroei	1~+	1~+	1~+	1	8	6	10	6	9	12	8	10	0		occasional (69)	subtropical
Myliobatidae	<i>Myliobatis tobijei</i> Bleeker	Tobiei	1~+	1~+	1~+	1~+	7	10	10	11	17	21	18	25	0		often (119)	subtropical
	<i>Aetobatus narutobiei</i> White, Furumitsu and Yamaguchi	Narutobiei	1~+	1~+	1~+	1~+	13	4	10	3	8	7	15	2	0		occasional (62)	subtropical
	<i>Aetobatus narinari</i> (Euphrasen)	Madaratobiei		1	+		0	1	0	0	0	2	1	0	0		rare (4)	subtropical
OSTEICTHYES																		
Elopiformes																		
Elopidae	<i>Elops hawaiiensis</i> Regan	Karaiwashi			1	1	0	1	1	0	0	0	0	0	0		rare (2)	subtropical
Megalopidae	<i>Megalops cyprinoides</i> (Broussonet)	Isegoi			1		0	0	0	1	0	0	0	0	0		rare (1)	subtropical
Albuliformes																		
Albulidae	<i>Albula</i> sp.	Sotoiwashi			1		0	0	1	0	0	0	0	0	0		rare (1)	subtropical
Anguilliformes																		
Muraenidae	<i>Gymnothorax minor</i> (Temminck and Schlegel)	Amiutsubo			1		0	0	1	0	0	0	0	0	0		rare (1)	subtropical
Ophichthidae	<i>Ophisurus macrorhynchus</i> Bleeker	Dainanumihebi	1~+	1~+	1~+	1	5	2	1	5	2	1	0	1	0		rare (17)	subtropical
	<i>Ophichthus altipennis</i> (Kaup)	Hotateumihebi	1~+	1~+	1~+	1	10	6	1	3	8	7	5	7	0		rare (47)	temperate
Congridae	<i>Conger myriaster</i> (Brevoort)	Maanago	1~+	1~+	1~+	1~+	3	9	14	11	12	13	11	9	0		occasional (82)	large area
Muraenesocidae	<i>Muraenesox cinereus</i> (Forsskål)	Hamo	1				0	0	0	1	0	0	1	3	0		rare (5)	large area
Clupeiformes																		
Clupeidae	<i>Etrumeus teres</i> (De Key)	Urumeiwashi	++++	++++	++++		3	11	9	7	5	8	10	9	0		occasional (62)	large area
	<i>Spratelloides gracilis</i> (Temminck and Schlegel)	Kibinago	++++	++++	++++	++++	8	3	12	14	6	4	13	13	0		occasional (73)	subtropical
	<i>Sardinops melanostictus</i> (Temminck and Schlegel)	Maiwashi	1~+	1~+	1~+	1	2	5	0	1	8	4	2	0	0		rare (22)	large area
	<i>Sardinella zunasi</i> (Bleeker)	Sappa		1	1	+++	0	1	0	1	1	0	1	0	0		rare (4)	large area
	<i>Konosirus punctatus</i> (Temminck and Schlegel)	Konoshiro	+++	1~+	1~+	1~+	25	24	14	12	7	8	6	3	0		occasional (99)	large area
Engraulidae	<i>Engraulis japonica</i> Temminck and Schlegel	Katakuchiwashi	++++	++++	++++	++++	22	26	27	25	31	39	21	23	0		frequent (214)	large area
	<i>Thryssa baelama</i> (Forsskål)	Ooiwashi	1				0	0	1	0	0	0	0	0	0		rare (1)	subtropical
Siluriformes																		
Plotosidae	<i>Plotosus japonicus</i> (Yoshino and Kishimoto)	Gonzui	++++	++++	+++	++++	21	28	29	27	15	44	22	21	2		frequent (209)	subtropical

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix 1. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
Salmoniformes																		
Plecoglossidae	<i>Plecoglossus altivelis altivelis</i> (Temminck and Schlegel)	Ayu	++					0	1	0	2	0	0	0	0	0	rare (3)	temperate
Salmonidae	<i>Oncorhynchus keta</i> (Walbaum)	Sake				1		1	0	0	0	0	0	0	0	0	rare (1)	temperate
	<i>Oncorhynchus masou masou</i> (Brevoort)	Sakuramasu	1			1		0	1	0	1	1	0	0	0	0	rare (3)	temperate
Stomiiformes																		
Sternoptychidae	<i>Maurolicus japonicus</i> Ishikawa	Kyuurieso	+			1		0	0	0	0	1	0	1	0	0	rare (2)	large area
Aulopiformes																		
Synodontidae	<i>Saurida elongata</i> (Temminck and Schlegel)	Tokageeso	1~+	1~++	1~++	1~+		18	9	13	13	5	8	0	0	0	occasional (66)	temperate
	<i>Saurida macrolepis</i> Tanaka	Maeso	1	1~+	1~++	1~+		3	6	1	2	4	2	7	8	0	rare (33)	subtropical
	<i>Saurida wanieso</i> Shindo and Yamada	Wanieso		1~+	+			1	4	2	0	0	0	0	0	0	rare (7)	subtropical
	<i>Trachinocephalus myops</i> (Forster)	Okieso	1~+	1~+	1~+	1		7	2	2	2	0	0	0	1	0	rare (14)	subtropical
Lampridiformes																		
Trachipteridae	<i>Desmodema polystictum</i> (Ogilby)	Furisodeuo	1~+	1~+				1	2	3	0	1	1	0	0	0	rare (8)	large area
	<i>Trachipterus ishikawae</i> Jordan and Snyder	Sakegashira	+	1~+				1	4	0	0	2	1	1	1	0	rare (10)	temperate
Regalecidae	<i>Regalecus russelii</i> (Cuvier)	Ryuuguunotsukai	1					0	1	0	0	0	1	0	0	0	rare (2)	large area
Gadiformes																		
Moridae	<i>Physiculus japonicus</i> Hilgendorf	Chigodara	1					1	0	0	0	0	0	0	0	0	rare (1)	large area
Macrouridae	<i>Coelorinchus multispinulosus</i> Katayama	Yarihige	1					0	0	0	0	1	0	0	0	0	rare (1)	large area
Lophiiformes																		
Lophiidae	<i>Lophius litulon</i> (Jordan)	Kiankou	1					0	0	0	0	2	0	1	0	1	rare (4)	large area
Antennariidae	<i>Histrio histrio</i> (Linnaeus)	Hanaokoze	1~+	1~+	+			4	1	4	3	2	1	2	1	0	rare (18)	subtropical
	<i>Antennarius striatus</i> (Shaw)	Kaeruan kou		+	1			0	1	0	0	0	1	0	0	0	rare (2)	large area
Ogcocephalidae	<i>Malthopsis annulifera</i> Tanaka	Wanukefuryuuuo		+				1	0	0	0	0	0	0	0	0	rare (1)	subtropical
Beryciformes																		
Holocentridae	<i>Ostichthys japonicus</i> (Cuvier)	Ebisudai	1			1		0	1	1	1	0	0	0	0	0	rare (3)	subtropical
Monocentridae	<i>Monocentris japonica</i> (Houttuyn)	Matsukasauo		1~+	1~+	1		2	3	1	0	1	0	1	1	0	rare (9)	large area
Zeiformes																		
Zeidae	<i>Zenopsis nebulosa</i> (Temminck and Schlegel)	Kagamidai	1	1				0	2	0	1	0	0	0	0	0	rare (3)	large area
	<i>Zeus faber</i> Linnaeus	Matoudai	1~+	1~+	1	1~+		3	7	5	5	3	9	6	5	1	rare (44)	subtropical
Gasterosteiformes																		
Fistulariidae	<i>Fistularia petimba</i> Lacepède	Akayagara	1	+~++	1~+++	1~++		15	10	1	5	0	5	2	11	0	rare (49)	large area
	<i>Fistularia commersonii</i> Rüppell	Aoyagara		+	1~+++	+		14	11	3	2	1	1	1	8	0	rare (41)	temperate
Macroramphosidae	<i>Macroramphosus sagifue</i> Jordan and Starks	Sagifue	1	1		1		0	1	1	0	2	0	2	0	0	rare (6)	large area
Syngnathidae	<i>Syngnathus schlegelii</i> Kaup	Youjiuo	1	1	1	1~+		5	2	3	1	1	2	1	0	1	rare (16)	temperate
	<i>Syngnathoides biaculeatus</i> (Bloch)	Togeyouji		1				0	0	0	0	1	0	0	0	0	rare (1)	subtropical
	<i>Hippocampus coronatus</i> Temminck and Schlegel	Tatsunootoshigo	1	1	1~+	1		1	7	1	1	1	1	2	1	2	rare (17)	temperate
	<i>Hippocampus sindonis</i> Jordan and Snyder	Hanatsatsu				1		0	0	0	0	0	1	0	0	0	rare (1)	temperate
Mugiliformes																		
Mugilidae	<i>Mugil cephalus cephalus</i> Linnaeus	Bora	1~+	1~+++	1~++	1~+		11	7	10	8	7	9	8	5	0	occasional (65)	large area
Atheriniformes																		
Atherinidae	<i>Hypoatherina valenciennei</i> (Bleeker)	Tougorouiwashi	1	1		+		0	2	0	0	1	0	0	0	0	rare (3)	subtropical
Beloniformes																		
Hemiramphidae	<i>Hyporhamphus sajori</i> (Temminck and Schlegel)	Sayori	1~+++	1~+	1~++	1~+		2	5	5	1	7	4	3	2	0	rare (29)	temperate
Exocoetidae	<i>Hirundichthys oxycephalus</i> (Bleeker)	Hosooatobi		+				0	0	0	0	0	0	0	1	0	rare (1)	subtropical
	<i>Cypselurus hiraii</i> Abe	Hosotobiuo	+~+++	+~+++	1~++			12	0	0	8	11	12	10	5	0	rare (58)	large area
	<i>Cypselurus doederleini</i> (Steindachner)	Tsukushitobouo	1~+++	+~+++	+			0	13	10	0	8	0	13	12	0	rare (56)	large area
Belonidae	<i>Ablennes hians</i> (Valenciennes)	Hamadatsu		1~+	1			2	0	0	3	1	0	0	0	0	rare (6)	large area
	<i>Strongylura anastomella</i> (Valenciennes)	Datsu	1	1~+	1~+			2	6	2	3	1	5	2	1	0	rare (22)	large area
	<i>Tylosurus crocodilus crocodilus</i> (Péron and Lesueur)	Okizayori		1~+	1~+	1		3	0	3	4	1	2	2	0	0	rare (15)	subtropical
Scomberesocidae	<i>Cololabis saira</i> (Brevoort)	Sanma	1	1	1	+~+++		1	2	3	4	1	1	2	0	0	rare (14)	large area

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix 1. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
Perciformes																		
Sebastidae	<i>Sebastes marmoratus</i> (Cuvier)	Kasago	1~+	1~+	1~+	1~+	3	2	4	0	2	1	3	5	0		rare (20)	temperate
	<i>Sebastes schlegelii</i> Hilgendorf	Kurosoi	1			1	0	2	1	0	0	1	1	0	0		rare (5)	temperate
	<i>Sebastes</i> spp.	Mebaru	+~+++	1~+++	1~+	+~+++	15	22	20	15	23	31	19	22	5		often (172)	temperate
	<i>Sebastes oblongus</i> Günther	Takenokomebaru	1				0	1	0	0	0	0	0	0	0		rare (1)	temperate
Scorpaenidae	<i>Pterois lunulata</i> Temminck and Schlegel	Minokasago	1~+	1~+	1~++	+~++	16	14	17	14	11	21	17	13	1		often (124)	subtropical
	<i>Pterois volitans</i> (Linnaeus)	Hanaminokasago		1			0	0	0	1	0	0	0	0	0		rare (1)	subtropical
Apistidae	<i>Apistus carinatus</i> (Bloch and Schneider)	Hachi	1	1	1		1	1	4	1	2	0	0	0	0		rare (9)	subtropical
Tetrarogidae	<i>Hypodytes rubripinnis</i> (Temminck and Schlegel)	Haokoze	1~+	1~+	1~+	1~+	4	7	5	1	1	6	2	1	4		rare (31)	subtropical
Synanceiidae	<i>Inimicus japonicus</i> (Cuvier)	Oniokoze	1	1	1	1	0	2	1	3	3	0	4	0	0		rare (13)	subtropical
	<i>Minous monodactylus</i> (Bloch and Schneider)	Himeokoze	1	1	1	1	0	1	0	1	1	1	1	1	0		rare (6)	subtropical
	<i>Pterygotrigla hemisticta</i> (Temminck and Schlegel)	Sokohoubou	1				1	0	0	0	0	0	0	0	0		rare (1)	subtropical
Triglidae	<i>Chelidonichthys spinosus</i> (McClelland)	Houbou	1	1~++	1~+	1~+	5	12	8	6	5	4	1	5	0		rare (46)	large area
	<i>Lepidotrigla kishinouyei</i> Snyder	Onikanagashira				1	1	0	0	0	0	0	0	0	0		rare (1)	subtropical
	<i>Lepidotrigla microptera</i> Günther	Kanagashira	1	1			0	0	2	0	0	0	1	0	0		rare (3)	large area
Peristediidae	<i>Peristedion orientale</i> Temminck and Schlegel	Kihoubou				1	0	1	0	0	0	0	0	0	0		rare (1)	temperate
Platycephalidae	<i>Platycephalus</i> sp.2	Magochi	1	1	1		0	1	0	1	0	1	0	1	0		rare (4)	temperate
	<i>Rogadius asper</i> (Cuvier)	Matsubagochi		1	1		0	0	2	0	0	0	0	1	0		rare (3)	subtropical
	<i>Inegocia japonica</i> (Cuvier)	Tokagegochi		1~+	1	+	1	0	3	2	0	2	0	0	0		rare (8)	subtropical
	<i>Ratabulus megacephalus</i> (Tanaka)	Hanamegochi		1	+	1	5	0	0	1	0	0	0	0	0		rare (6)	temperate
	<i>Onigocia spinosa</i> (Temminck and Schlegel)	Onigochi	+	1~+	1	1	3	6	0	4	2	1	1	1	0		rare (18)	subtropical
	<i>Thysanophrys celebica</i> (Bleeker)	Celebesugochi				1	0	0	0	0	0	0	1	1	1		rare (2)	subtropical
Lateolabracidae	<i>Lateolabrax latus</i> Katayama	Hirasuzuki	1~+	+	1~++	1~++	5	6	3	3	4	6	10	5	0		rare (42)	temperate
	<i>Lateolabrax japonicus</i> (Cuvier)	Suzuki	1~+	1~+	1~+	1~+	23	19	18	17	24	36	29	23	2		frequent (191)	temperate
	<i>Lateolabrax maculatus</i> (McClelland)	Tairikusuzuki	1~+		+		0	4	2	0	0	0	2	0	0		rare (8)	subtropical
Polyprionidae	<i>Stereolepis doederleini</i> Lindberg and Krasnyukova	Ookuchiishinagi		1			1	0	0	0	0	0	0	0	0		rare (1)	large area
Acropomatidae	<i>Synagrops philippiensis</i> (Günther)	Himesumikuiuo	1				0	1	0	0	0	0	0	0	0		rare (1)	subtropical
Serranidae	<i>Epinephelus septemfasciatus</i> (Thunberg)	Mahata		1~+	1~+	+	5	2	6	5	3	2	10	4	0		rare (37)	subtropical
	<i>Epinephelus akaara</i> (Temminck and Schlegel)	Kijihata		1	1		1	0	0	0	2	0	0	1	0		rare (4)	large area
	<i>Epinephelus bruneus</i> Bloch	Kue	1	1	1	1	1	3	1	2	1	2	0	1	0		rare (11)	subtropical
	<i>Epinephelus awoara</i> (Temminck and Schegel)	Aohata			1		1	0	1	0	1	0	2	0	0		rare (5)	subtropical
Priacanthidae	<i>Cookeolus japonicus</i> (Cuvier)	Chikamekintoki		1		1	0	0	0	0	0	2	0	0	0		rare (2)	subtropical
	<i>Priacanthus macracanthus</i> Cuvier	Kintokidai	1	+	1~++	1~+	11	8	2	3	1	0	4	1	0		rare (30)	temperate
Apogonidae	<i>Apogon semilineatus</i> Temminck and Schlegel	Nenbutsudai	+~+++	+~+++	+~+++	+~+++	26	30	25	22	24	33	25	25	0		frequent (210)	temperate
	<i>Apogon doederleini</i> Jordan and Snyder	Oosujiishimochi			1	1	0	0	1	1	0	0	0	0	0		rare (2)	subtropical
	<i>Apogon cookii</i> Macleay	Sujiishimochi		1			0	1	0	0	0	0	0	0	0		rare (1)	subtropical
	<i>Apogon niger</i> Döderlein	Kuroishimochi		1	1	1~+	3	0	0	3	0	1	3	1	1		rare (12)	subtropical
	<i>Apogon lineatus</i> Temminck and Schlegel	Tenjikudai	1		1	1	0	0	0	0	2	1	0	0	0		rare (3)	large area
Branchiostegidae	<i>Branchiostegus japonicus</i> (Houtuy)	Akaamadai	1				0	0	0	0	1	0	0	0	0		rare (1)	temperate
Scombroptidae	<i>Scombrops boops</i> (Houtuy)	Mutsu	1~+++	+~+++	+~+++	1~+++	26	31	28	24	22	25	21	21	0		frequent (198)	large area
Echeneidae	<i>Echeneis naucrates</i> Linnaeus	Kobanzame		1~+		1	1	1	1	1	1	1	0	1	0		rare (7)	large area
Rachycentridae	<i>Rachycentron canadum</i> (Linnaeus)	Sugi	+	1~+	1~+	1	1	6	8	2	4	2	1	0	0		rare (24)	large area
Coryphaenidae	<i>Coryphaena hippurus</i> Linnaeus	Shiira	1	+~++	+~++	+++	3	0	1	5	0	2	1	2	0		rare (14)	large area
Carangidae	<i>Elagatis bipinnulata</i> (Quoy and Gaimard)	Tsumuburi		+	1	1	1	1	1	1	2	0	1	0	0		rare (6)	subtropical
	<i>Seriolina nigrofasciata</i> (Rüppell)	Aiburi	+		1~+	+	3	0	1	2	0	1	0	0	0		rare (7)	subtropical
	<i>Seriola quinqueradiata</i> Temminck and Schlegel	Buri	1~++	1~+++	+~+++	1~+++	29	25	23	23	31	25	19	27	5		frequent (207)	temperate
	<i>Seriola lalandi</i> Valenciennes	Hiramasa	1~++	1~+++	1~++	1~++	4	8	3	1	6	17	10	5	0		rare (54)	large area
	<i>Seriola rivoliana</i> Valenciennes	Hirenagakanpachi			1	1	0	1	0	0	0	3	0	0	0		rare (4)	subtropical
	<i>Seriola dumerili</i> (Risso)	Kanpachi	1~+	+~+++	+~+++	+	16	6	18	15	10	13	11	12	0		occasional (101)	temperate
	<i>Trachurus japonicus</i> (Temminck and Schlegel)	Maaji	+~+++	+~+++	+++	+~+++	33	37	36	28	36	44	35	34	5		general (288)	temperate
	<i>Megalaspis cordyla</i> (Linnaeus)	Oniaji		+	1~+	1	2	1	1	0	0	1	1	0	0		rare (6)	subtropical
	<i>Scomberoides tol</i> (Cuvier)	Minamiikeatsuo			1~+		0	1	1	1	0	0	0	0	0		rare (3)	subtropical

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix 1. Continued

			Round number of individuals				Collected times										Frequency (total times)	Distribution area
Family	Scientific name	Japanese name	Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
Leiognathidae	<i>Decapterus macrosoma</i> Bleeker	Moro	1		+	1	0	1	1	0	0	0	0	0		rare (3)	subtropical	
	<i>Decapterus maruadsi</i> (Temminck and Schlegel)	Maruaji	1~++	++	++	++	6	14	17	17	10	15	14	18	0	occasional (111)	subtropical	
	<i>Decapterus muroadsi</i> (Temminck and Schlegel)	Muroaji			1~+		1	1	0	1	1	1	0	0	0	rare (5)	subtropical	
	<i>Selar crumenophthalmus</i> (Bloch)	Meaji		1~+	1~++	+	3	1	6	6	3	3	2	3	0	rare (27)	large area	
	<i>Alectis ciliaris</i> (Bloch)	Itohikiaji	1	1~+	1~+	1~+	11	8	3	11	10	4	6	4	0	rare (57)	large area	
	<i>Caranx sexfasciatus</i> Quoy and Gaimard	Gingameaji			1	+	1~+	1	1	1	1	2	0	0	0	rare (6)	subtropical	
	<i>Pseudocaranx dentex</i> (Bloch and Schneider)	Shimaaji				1		0	0	1	1	0	0	0	0	rare (2)	subtropical	
	<i>Kaiwarinus equula</i> (Temminck and Schlegel)	Kaiwari	1~++	++	++	++	++	12	11	12	10	9	8	9	17	0	occasional (88)	large area
	<i>Carangoides ferdau</i> (Forsskål)	Kurohiraaji			+	1~+		1	1	0	0	0	2	0	0	0	rare (4)	subtropical
	<i>Carangoides orthogrammus</i> (Jordan and Gilbert)	Nanyoukaiwari				+	+	0	0	0	0	1	1	0	0	0	rare (2)	subtropical
	<i>Carangoides hedlandensis</i> (Whitley)	Ryuukyuyoroiaji			1			0	0	0	0	1	0	0	0	0	rare (1)	subtropical
	<i>Carangoides chrysophrys</i> (Cuvier)	Hishiyoroiaji				1~+	1	0	2	1	0	0	0	1	1	0	rare (5)	subtropical
	<i>Nuclequula nuchalis</i> (Temminck and Schlegel)	Hiiragi			+		1	1	1	0	0	0	0	0	0	0	rare (2)	temperate
	<i>Equulites rivulatus</i> (Temminck and Schlegel)	Okihiragi		++	++		1	0	2	2	1	0	1	2	4	0	rare (12)	temperate
Bramidae	<i>Brama dussumieri</i> Cuvier	Himeshimagatsuo	1	1			0	0	0	0	0	2	0	0	0	rare (2)	subtropical	
	<i>Brama japonica</i> Hilgendorf	Shimagatsuo				1	1	5	0	0	0	1	0	0	0	rare (7)	large area	
	<i>Pterycombus petersii</i> (Hilgendorf)	Ryuuguunohime				1	0	1	0	0	0	0	0	0	0	rare (1)	large area	
Lutjanidae	<i>Emmelichthys struhsakeri</i> Heemstra and Randall	Rousokuchibiki		1	1		0	0	0	0	0	0	0	2	0	rare (2)	subtropical	
	<i>Lutjanus ophuysenii</i> (Bleeker)	Yokosujifuedai		1	1		1	0	1	1	0	0	1	0	0	rare (4)	subtropical	
	<i>Lutjanus argentimaculatus</i> (Forsskål)	Gomafuedai				1	0	0	1	0	0	0	0	0	0	rare (1)	subtropical	
Caesionidae	<i>Pterocaesio trilineata</i> Carpenter	Issentakasago				1	0	1	0	0	0	0	0	2	0	rare (3)	subtropical	
	<i>Pterocaesio diagramma</i> (Bleeker)	Takasago		1	1	+	1	1	1	0	0	0	0	0	0	rare (3)	subtropical	
Lobotidae	<i>Lobotes surinamensis</i> (Bloch)	Matsudai		1			1	0	0	0	0	0	0	0	0	rare (1)	large area	
Gerreidae	<i>Gerres equulus</i> (Temminck and Schlegel)	Kurosagi	1	1~+	1~+	+	7	2	0	7	1	2	4	6	0	rare (29)	temperate	
	<i>Parapristipoma trilineatum</i> (Thunberg)	Isaki	1~+	1~++	1~++	1~+	15	14	2	9	4	10	1	2	0	rare (57)	temperate	
	<i>Hapalogenys nigripinnis</i> (Schlegel in Temminck and Schlegel)	Higesoridai		1			1	0	0	0	0	0	0	0	0	rare (1)	temperate	
	<i>Hapalogenys sennin</i> Iwatsuki and Nakabo	Higedai	1				2	0	0	0	0	1	0	0	0	rare (3)	temperate	
	<i>Diagramma picta</i> (Thunberg)	Korodai		1	1~+		0	1	1	0	0	1	3	1	0	rare (7)	subtropical	
	<i>Plectorhinchus cinctus</i> (Temminck and Schlegel)	Kosyoudai	1~++	1~++	1~+	1~+	10	13	10	11	12	17	15	11	0	occasional (99)	subtropical	
	<i>Rhabdosargus sarba</i> (Forsskål)	Hedai	1~+	1~++	1~+	1~+	16	7	4	1	3	3	12	7	0	rare (53)	large area	
	<i>Acanthopagrus schlegelii</i> (Bleeker)	Kurodai	1~++	1~+	1~+	1~+	8	16	19	13	11	24	14	18	0	often (123)	large area	
	<i>Acanthopagrus latus</i> (Houttuyn)	Kichinu	1		1~+	1~+	1	2	0	1	3	3	2	1	0	rare (13)	subtropical	
	<i>Pagrus major</i> (Temminck and Schlegel)	Madai	1~++	++	++	++	++	29	34	32	29	32	43	34	34	5	general (272)	temperate
	<i>Eyynnys tumifrons</i> (Temminck and Schlegel)	Chidai	1	1~+	++	+	0	6	1	2	0	0	1	0	0	rare (10)	large area	
	<i>Gymnocranius griseus</i> (Temminck and Schlegel)	Meichidai		1	1		1	0	0	0	0	0	1	0	0	rare (2)	subtropical	
	<i>Lethrinus genivittatus</i> Valenciennes	Itofuefuki	1	+	1~++	1~+	8	2	2	3	3	1	2	1	0	rare (22)	subtropical	
	<i>Lethrinus nebulosus</i> (Forsskål)	Hamaefuefuki		1			0	0	0	0	0	1	0	0	0	rare (1)	subtropical	
Sciaenidae	<i>Nibea albiflora</i> (Richardson)	Koichi			++	1	0	0	0	1	0	1	0	0	0	rare (2)	subtropical	
	<i>Pennahia argentata</i> (Houttuyn)	Shiroguchi			1~++	+	1	2	2	5	2	5	0	0	0	rare (17)	temperate	
Sillaginidae	<i>Sillago japonica</i> Temminck and Schlegel	Shirogisu	1~+	1~++	1~+	1~+	14	8	19	7	13	10	4	2	0	rare (77)	temperate	
Mullidae	<i>Upeneus tragula</i> Richardson	Yomehimeji		1			0	0	1	0	0	0	0	0	0	rare (1)	subtropical	
	<i>Upeneus japonicus</i> (Houttuyn)	Himeji		1~+	1~+	1	4	1	4	0	3	1	2	2	0	rare (17)	temperate	
	<i>Parupeneus ciliatus</i> (Lacepède)	Houraihimeji		1	1~+	1	2	1	0	3	0	1	1	0	0	rare (8)	temperate	
Pempheridae	<i>Parapriacanthus ransonneti</i> Steindachner	Kinmemodoki	1~+	+		++	0	0	2	0	0	3	0	0	0	rare (5)	subtropical	
	<i>Pempheris japonica</i> Döderlein	Tsumagurohatanpo			1~+	1~+	1	2	1	0	0	1	1	1	0	rare (7)	subtropical	
	<i>Pempheris schwenkii</i> Bleeker	Minamihatanpo	+		1~+	++	5	3	6	5	0	2	0	0	0	rare (21)	subtropical	
Chaetodontidae	<i>Heniochus acuminatus</i> (Linnaeus)	Hatatatedai			1~+	1	3	4	0	0	0	0	1	1	0	rare (9)	subtropical	
	<i>Heniochus diphreutes</i> Jordan	Murehatatatedai			1	1	0	0	0	0	0	0	3	0	1	rare (4)	subtropical	
	<i>Chaetodon auripes</i> Jordan and Snyder	Chyouchyuuou				1	0	0	1	0	0	0	0	0	0	rare (1)	subtropical	
Pomacanthidae	<i>Chaetodontoplus septentrionalis</i> (Temminck and Schlegel)	Kinchyakudai		1	1		1	3	0	0	0	0	0	1	0	rare (5)	temperate	
Pentacerotidae	<i>Evisτίας acutirostris</i> (Temminck and Schlegel)	Tengudai	1~+			1	2	2	3	1	2	3	2	2	0	rare (17)	large area	
Cirrhitidae	<i>Cirrhitichthys aureus</i> (Temminck and Schlegel)	Okigonbe		1			0	1	0	0	0	0	0	0	0	rare (1)	subtropical	
Cheilodactylidae	<i>Goniistius zonatus</i> (Cuvier)	Takanohadai	1		1	1~+	0	0	3	1	3	1	1	0	0	rare (9)	temperate	

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix 1. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
Cepolidae	<i>Acanthocephala krusensternii</i> (Temminck and Schlegel)	Akatachi	1				0	0	0	0	1	0	0	0	0	0	rare (1)	temperate
Embiotocidae	<i>Ditrema temminckii temminckii</i> Bleeker	Umitanago	1~+	1~++	1~+	1~+	1	12	11	8	9	25	4	6	0		occasional (76)	temperate
Pomacentridae	<i>Chromis fumeus</i> (Tanaka)	Matsubasuzumedai		+			0	0	1	1	0	0	0	0	0		rare (2)	subtropical
	<i>Chromis notata</i> (Temminck and Schlegel)	Suzumedai	+	1~+	+		0	2	1	0	2	0	0	0	0		rare (5)	temperate
Teraponidae	<i>Abudefduf vaigiensis</i> (Quoy and Gaimard)	Oyabichya		1~+	1~+	1~+	13	6	2	4	0	3	4	1	0		rare (33)	subtropical
	<i>Terapon jarbua</i> (Forsskal)	Kotohiki				1	0	0	2	0	0	0	0	0	1		rare (3)	temperate
	<i>Terapon theraps</i> Cuvier	Himekotohiki			1		0	0	0	0	1	0	1	0	0		rare (2)	temperate
	<i>Rhynchopelates oxyrhynchus</i> (Temminck and Schlegel)	Shimaisaki	1~+	1~++	1~+		5	4	3	3	2	1	1	4	0		rare (23)	temperate
Scorpididae	<i>Labracoglossa argentiventris</i> Peters	Takabe		1	1~+	1	3	3	5	4	0	2	1	0	0		rare (18)	temperate
Oplegnathidae	<i>Oplegnathus fasciatus</i> (Temminck and Schlegel)	Ishidai	1~++	~++	~++	+	4	5	5	1	1	1	5	0			rare (23)	temperate
	<i>Oplegnathus punctatus</i> (Temminck and Schlegel)	Ishigakidai	+	1~+	1~+	1	18	20	17	17	23	23	24	19	0		often (161)	subtropical
Kyphosidae	<i>Kyphosus vaigiensis</i> (Quoy and Gaimard)	Isuzumi	1	1~+	1~+	1~+	7	4	2	8	3	2	4	1	0		rare (31)	temperate
	<i>Kyphosus bigibbus</i> Lacepède	Notoisuzumi				+	1	0	0	0	0	0	0	0			rare (1)	temperate
Microcanthidae	<i>Microcanthus strigatus</i> (Cuvier)	Kagokakidai	1	1~+	1~+	1~+	5	5	3	1	2	2	0	2	0		rare (20)	subtropical
Girellidae	<i>Girella punctata</i> Gray	Mejina	1~++	1~++	1~+	1~++	5	6	11	13	16	18	17	7	0		occasional (93)	temperate
	<i>Girella leonina</i> (Richardson)	Kuromejina				~++	0	2	0	0	0	1	0	0	0		rare (3)	temperate
Centrolophidae	<i>Hyperoglyphe japonica</i> (Döderlein)	Medai	1~+	1		1~+	2	0	4	0	0	1	0	0	0		rare (7)	large area
	<i>Psenopsis anomala</i> (Temminck and Schlegel)	Ibodai	1~+	1~++	1~++	1~++	4	8	3	1	8	2	3	3	0		rare (32)	large area
Stromateidae	<i>Pampus punctatissimus</i> (Temminck et Schlegel)	Managatsuo			1~++	1	0	1	0	1	0	0	0	2	0		rare (4)	temperate
Nomeidae	<i>Psenes pellucidus</i> Lütken	Hanabirauo	1	1~+		1	0	0	1	0	1	1	2	0	1		rare (6)	subtropical
Polynemoidei	<i>Polydactylus plebeius</i> (Broussonet)	Tsubamekonoshiro			1		0	0	0	0	0	1	0	0	0		rare (1)	subtropical
Labridae	<i>Choerodon azurio</i> (Jordan and Snyder)	Ira		1	1		1	0	0	0	1	0	0	0	0		rare (2)	subtropical
	<i>Semicossyphus reticulatus</i> (Valenciennes)	Kobudai	1				0	0	0	0	0	0	0	0	1		rare (1)	subtropical
	<i>Pteragogus aurigarius</i> (Richardson)	Ohagurobera	1	1~+	1	1	5	3	2	3	2	0	1	4	1		rare (21)	temperate
	<i>Pseudolabrus sieboldi</i> Mabuchi and Nakabo	Hoshisananohabera	1	1~+	1~+	1~+	3	2	0	2	1	0	1	4	0		rare (13)	temperate
	<i>Pseudolabrus eoethinus</i> (Richardson)	Akasasanohabera		1~+			1	1	0	0	0	0	0	1	0		rare (3)	temperate
	<i>Suezichthys gracilis</i> (Steindachner and Döderlein)	Itobera			+		0	0	1	0	0	0	0	0	0		rare (1)	subtropical
	<i>Stethojulis interrupta terina</i> Jordan and Snyder	Kaminaribera		1			0	0	0	0	0	0	0	1	0		rare (1)	subtropical
	<i>Parajulis poecileptera</i> (Temminck and Schlegel)	Kyuusen	1	1~++	1~+	1	13	9	9	10	9	5	5	5	0		occasional (65)	temperate
	<i>Halichoeres tenuispinis</i> (Günther)	Honbera		1~+	1		0	5	1	3	0	0	4	0	0		rare (13)	temperate
Scaridae	<i>Scarus ovifrons</i> Temminck et Schlegel	Aobudai		1	1~+		0	0	1	0	0	0	0	0	0		rare (3)	subtropical
Hexagrammidae	<i>Hexagrammos agrammus</i> (Temminck and Schlegel)	Kujime	1~+	1		1~+	2	1	0	4	4	0	2	1	0		rare (14)	temperate
	<i>Hexagrammos otakii</i> Jordan and Starks	Ainame	1~+			1	1	0	1	0	0	2	0	0	0		rare (4)	temperate
Cottidae	<i>Pseudoblennius cotooides</i> (Richardson)	Asahianahaze	1~+	1~+	1~+		0	0	1	5	3	1	6	3	0		rare (19)	temperate
	<i>Pseudoblennius percoides</i> Günther	Anahaze	1~+	1~+	1~+	1~+	7	10	8	10	8	5	7	5	3		occasional (63)	temperate
Liparidae	<i>Liparis tanakaie</i> (Gilbert and Burke)	Kusauo	1		1~+	1~+	5	5	2	4	9	3	1	0	0		rare (29)	large area
Stichaeidae	<i>Chirolophis japonicus</i> Herzenstein	Fusaginpo			+		0	0	0	0	0	0	2	0	0		rare (2)	large area
	<i>Dictyosoma burgeri</i> van der Hoeven	Dainanginpo	1~+		1		0	5	1	3	0	0	4	0	0		rare (13)	temperate
	<i>Zoarchias major</i> Tomiyama	Ookazunagi	+			+	0	0	0	0	0	0	0	1	0		rare (3)	temperate
Pholidae	<i>Pholis nebulosa</i> (Temminck and Schlegel)	Ginpo	1~+	1~+	1	1~++	6	6	9	4	9	12	5	8	1		occasional (60)	temperate
Pinguipedidae	<i>Paraperis pulchella</i> (Temminck and Schlegel)	Toragisu		1~+	1~+		1	0	0	0	1	1	0	1	0		rare (4)	temperate
Ammodytidae	<i>Ammodytes personatus</i> Girard	Ikanago	++~++	+		++	0	4	2	2	3	0	0	0	0		rare (11)	temperate
Uranoscopidae	<i>Uranoscopus chinensis</i> Guichenot	Kibiremishima		1	1	1	0	1	3	1	0	0	0	1	0		rare (6)	temperate
Tripterygiidae	<i>Enneapterygius theostomus</i> (Jordan and Snyder)	Hebiginpo	+				1	0	0	0	0	0	0	0	0		rare (1)	subtropical
Blenniidae	<i>Parablennius yatabei</i> (Jordan and Snyder)	Isoginpo	+	+	+	1~+	3	0	3	3	0	0	0	2	0		rare (11)	temperate
	<i>Petroscirtes breviceps</i> (Valenciennes)	Nijiginpo	+	1~++	~++	1~++	13	15	10	11	7	11	9	5	0		occasional (81)	subtropical
Callionymidae	<i>Repomucenus huguenini</i> (Bleeker)	Yarinumeri	1	1~+	1~+	1	2	6	5	1	6	1	3	1	2		rare (27)	temperate
	<i>Repomucenus valenciennesi</i> (Temminck and Schlegel)	Hatatatanumeri	1	+	1	1	0	2	0	0	0	0	0	2	0		rare (4)	temperate
	<i>Repomucenus curvicornis</i> (Valenciennes)	Nezumigochi	1~+	1	1~+	1~+	4	0	5	4	0	9	0	0	0		rare (22)	temperate
Gobiidae	<i>Leucopsarion petersii</i> Hilgendorf	Shirouo	1				0	0	1	0	0	0	0	0	0		rare (1)	temperate
	<i>Sagamia geneionema</i> (Hilgendorf)	Sabihaze	1~+	1~+	1~+	1~+	3	5	3	6	8	10	2	1	0		rare (38)	temperate
	<i>Pterogobius virgo</i> (Temminck and Schlegel)	Nishikihaze	+	1			0	0	1	1	5	3	0	0	0		rare (10)	temperate
	<i>Pterogobius zonoleucus</i> Jordan and Snyder	Chyagara		++	+		0	0	0	1	1	0	0	0	0		rare (2)	temperate

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix I. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times								Frequency (total times)	Distribution area	
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009			2010
Ephippidae	<i>Acanthogobius flavimanus</i> (Temminck and Schlegel)	Mahaze				1~+	0	1	0	0	1	0	0	0	0	rare (2)	temperate
	<i>Chaenogobius annularis</i> Gill	Agohaze		+			1	0	0	0	0	0	0	0	0	rare (1)	temperate
	<i>Platax teira</i> (Forsskål)	Tsubameuo	1	1	1~+	1~+	4	1	2	2	2	3	2	1	0	rare (17)	large area
Scatophagidae	<i>Scatophagus argus</i> (Linnaeus)	Kurohoshimanjyuudai		+		1	1	0	0	0	0	1	0	0	0	rare (2)	subtropical
Siganidae	<i>Siganus fuscescens</i> (Houttuyn)	Aigo	1~++	+~+++	+~+++	+~+++	19	21	22	22	25	24	22	21	0	often (176)	large area
Acanthuridae	<i>Prionurus scalprum</i> Valenciennes	Nizadai	1	+~+++	1~+++	+~++	14	11	16	18	14	9	5	10	0	occasional (97)	temperate
Lstiophoridae	<i>Naso unicornis</i> (Forsskål)	Tenguhagi			+	1	1	1	0	0	0	0	0	0	0	rare (2)	subtropical
	<i>Acanthurus dussumieri</i> Valenciennes	Nisekanranhagi				1	0	0	0	1	0	0	0	0	0	rare (1)	subtropical
	<i>Istiophorus platypterus</i> (Shaw)	Basyoukajiki		1~++	1~+		1	0	0	3	0	2	0	1	0	rare (7)	large area
Sphyraenidae	<i>Sphyraena forsteri</i> Cuvier	Oomekamasu				1	0	0	0	1	0	0	0	0	0	rare (1)	large area
Trichiuridae	<i>Sphyraena pinguis</i> Günther	Akakamasu	1~++	1~++	+~+++	1~+++	14	16	13	12	12	19	5	22	0	occasional (113)	temperate
	<i>Sphyraena helleri</i> Jenkins	Hosokamasu				1	0	1	0	0	0	0	0	0	0	rare (1)	subtropical
	<i>Sphyraena japonica</i> Bloch and Schneider	Yamatokamasu	+	+~+++	+~+++	+	8	9	5	10	9	7	8	6	0	occasional (62)	subtropical
Scombridae	<i>Trichiurus japonicus</i> Temminck and Schlegel	Tachiuo	1~+	1~++	+~+++	1~+++	11	16	16	20	17	15	17	13	2	often (127)	large area
Scombridae	<i>Scomber japonicus</i> Houttuyn	Masaba	+~+++	+~+++	+~+++	1~+++	18	11	14	14	18	20	15	17	0	often (127)	large area
	<i>Scomber australasicus</i> Cuvier	Gomasaba				+	0	0	0	0	1	0	0	0	0	rare (1)	large area
	<i>Auxis thazard thazard</i> (Lacepède)	Hirasouda		1~+	+~+++	+~+++	10	1	1	4	1	2	0	0	0	rare (19)	large area
Pleuronectiformes	<i>Auxis rochei rochei</i> (Risso)	Marusouda		+~+++	+~++	1~++	0	1	4	4	3	1	1	1	0	rare (15)	large area
	<i>Thunnus orientalis</i> (Temminck and Schlegel)	Kuromaguro				+	0	0	0	0	0	1	1	1	0	rare (3)	large area
	<i>Euthymus affinis</i> (Cantor)	Suma			1		0	0	1	0	0	0	0	0	0	rare (1)	subtropical
Pleuronectidae	<i>Katsuwonus pelamis</i> (Linnaeus)	Katsuo				+~++	0	1	1	0	0	0	0	0	0	rare (2)	subtropical
	<i>Scomberomorus niphonius</i> (Cuvier)	Sawara	1~++	1~+	1~+++	1~+++	11	10	12	14	10	16	14	13	2	occasional (102)	large area
	<i>Paralichthys olivaceus</i> (Temminck and Schlegel)	Hirame	1~+	1~++	+~++	1~++	28	27	30	26	31	38	27	30	3	general (240)	temperate
Bothidae	<i>Engyproson grandisquama</i> (Temminck and Schlegel)	Darumagarei	1	1			1	0	0	1	0	0	0	0	0	rare (2)	subtropical
Pleuronectidae	<i>Pleuronichthys cornutus</i> (Temminck and Schlegel)	Meitagarei	1~+	1~+	1	1	2	1	1	2	4	1	2	5	0	rare (18)	temperate
Soleidae	<i>Hippoglossoides pinetorum</i> (Jordan and Starks)	Souhachi	+			1	0	0	0	0	4	0	0	0	0	rare (4)	temperate
	<i>Kareius bicoloratus</i> (Basilewsky)	Ishigarei	1~+		+	1~+	0	2	1	2	4	0	2	0	0	rare (11)	temperate
	<i>Pleuronectes yokohamae</i> Günther	Makogarei	1~+			1~+	0	1	1	1	4	0	3	3	1	rare (14)	temperate
Cynoglossidae	<i>Heteromyceter japonica</i> (Temminck and Schlegel)	Sasaushinoshita	1	1~+	+	+	3	5	4	1	0	1	1	0	0	rare (15)	temperate
	<i>Aesopia cornuta</i> Kaup	Tsunoushinoshita			1		1	0	0	0	0	0	0	0	0	rare (1)	subtropical
	<i>Zebrias zebrinus</i> (Temminck and Schlegel)	Shimaushinoshita	1~+	1~+	1~+	1	7	1	1	0	1	1	0	1	0	rare (12)	temperate
Tetraodontiformes	<i>Paraplagusia japonica</i> (Temminck and Schlegel)	Kuroushinoshita	1	1~+	+	1	5	3	1	0	1	1	3	1	0	rare (15)	temperate
	<i>Cynoglossus itinus</i> (Snyder)	Minamiakashitabirame		1~+	1~+	1~+	1	0	2	2	3	1	0	1	0	rare (10)	temperate
	<i>Triacanthus biaculeatus</i> (Bloch)	Gima			1		0	0	0	0	1	0	0	0	0	rare (1)	large area
Balistidae	<i>Canthidermis maculata</i> (Bloch)	Amimongara			1	++	0	0	0	1	0	1	0	0	0	rare (2)	large area
Monacanthidae	<i>Aluterus monoceros</i> (Linnaeus)	Usubahagi		1~+	1~++	1~+	1	4	9	16	4	6	4	2	1	rare (47)	large area
Ostraciidae	<i>Aluterus scriptus</i> (Osbeck)	Soushihagi		1~+	1~+		1	1	1	2	1	1	2	0	0	rare (9)	subtropical
	<i>Rudarius ercodes</i> Jordan and Fowler	Amimehagi	1~++	+~+++	+~+++	+~+++	7	13	9	13	3	23	11	6	0	occasional (85)	temperate
	<i>Thamnaconus modestus</i> (Günther)	Umazurahagi	1~++	+~+++	+~+++	+~+++	23	22	17	16	8	17	14	16	0	often (133)	temperate
Tetraodontidae	<i>Chaetodermis penicilligera</i> (Cuvier)	Higehagi				1	0	0	2	0	0	1	0	0	0	rare (3)	subtropical
	<i>Stephanolepis cirrhifer</i> (Temminck and Schlegel)	Kawahagi	1~++	+~+++	+~+++	1~+++	27	37	32	24	30	30	30	30	2	general (242)	temperate
	<i>Paramonacanthus oblongus</i> (Temminck and Schlegel)	Yosogi	1~+	1~+	1~+	1~+	9	12	10	13	3	13	8	2	0	occasional (70)	subtropical
Tetraodontidae	<i>Lactoria cornuta</i> (Linnaeus)	Kongoufugu			1	1	0	0	0	1	1	0	0	0	0	rare (2)	subtropical
	<i>Ostracion immaculatum</i> Temminck and Schlegel	Hakofugu	1~+	1~+	1~+	1~+	15	19	17	13	11	12	8	10	0	occasional (105)	temperate
	<i>Canthigaster rivulata</i> (Temminck and Schlegel)	Kitamakura		1			0	0	0	1	0	0	0	0	0	rare (1)	subtropical
Tetraodontidae	<i>Takifugu pardalis</i> (Temminck and Schlegel)	Higanfugu	+~++	+~++	1~+	+~++	26	33	28	29	27	40	26	26	5	general (240)	large area
	<i>Takifugu snyderi</i> (Abe)	Syousaifugu	+~++	+~++	1~++	+~++	12	24	24	33	27	22	23	32	5	frequent (202)	temperate
	<i>Takifugu vermicularis</i> (Temminck and Schlegel)	Nashifugu	1~+	1~+	1	1~+	0	2	6	0	4	1	7	3	0	rare (23)	temperate
Tetraodontidae	<i>Takifugu porphyreus</i> (Temminck and Schlegel)	Mafugu			1		0	0	1	0	0	0	0	0	0	rare (1)	temperate
	<i>Takifugu poecilonotus</i> (Temminck et Schlegel)	Komonfugu	++~+++	+~+++	+~++	+~+++	20	38	36	34	34	44	35	34	5	general (280)	temperate
	<i>Takifugu xanthopterus</i> (Temminck and Schlegel)	Shimafugu	1				2	0	2	0	0	0	1	0	0	rare (5)	temperate

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix 1. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
	<i>Takifugu stictonotus</i> (Temminck and Schlegel)	Gomafugu	1~+	1~+		1~+	1	5	5	5	6	6	3	3	0	rare (34)	temperate	
	<i>Takiugu niphobles</i> (Jordan and Snyder)	Kusafugu	+~++	1~+++	1~+	1~++	14	29	27	24	26	29	22	22	1	frequent (194)	large area	
	<i>Takifugu rubripes</i> (Temminck and Schlegel)	Torafugu	1	1~+	1~+	1~+	1	4	5	0	1	4	1	1	0	rare (17)	temperate	
	<i>Torquigener brevipinnis</i> (Regan)	Sippoufugu			1		0	0	1	0	0	0	0	0	0	rare (1)	subtropical	
	<i>Arothron firmamentum</i> (Temminck and Schlegel)	Hoshifugu				1~+	0	1	3	1	2	3	0	1	0	rare (11)	subtropical	
	<i>Lagocephalus inermis</i> (Temminck and Schlegel)	Kanafugu				1	0	0	0	0	0	0	0	0	1	rare (1)	temperate	
	<i>Lagocephalus gloveri</i> Abe and Tabeta	Kurosabafugu		1			0	0	0	2	0	0	0	0	0	rare (2)	subtropical	
	<i>Lagocephalus spadiceus</i> (Richardson)	Shirosabafugu	1	1~++	1~++	1~+	11	13	9	6	2	9	10	2	0	occasional (62)	large area	
	<i>Lagocephalus scleratus</i> (Gmelin)	Senninfugu	1		1		0	1	0	0	0	0	1	0	0	rare (2)	subtropical	
	<i>Diodon holocanthus</i> Linnaeus	Harisenbon	+~+++	1	1~+	1~+++	13	5	16	4	7	17	10	18	4	occasional (94)	subtropical	
	<i>Diodon hystrix</i> Linnaeus	Nezumifugu				1	1	0	0	0	0	0	0	0	0	rare (1)	subtropical	
SCYPHOZOA																		
Semaestomeae																		
Pelagiidae	<i>Chrysaora pacifica</i> (Goette)	Akakurage	+~+++	+~+++		+~+++	13	18	13	15	12	11	15	18	2	occasional (117)	temperate	
	<i>Pelagia noctiluca</i> (Forsskål)	Okikurage	+~+++	+~++			4	2	1	0	0	3	4	1	0	rare (15)	subtropical	
Ulmariidae	<i>Aurelia aurita</i> (Linnaeus)	Mizukurage	+~+++	+~+++	+~+++	+~+++	20	34	23	14	23	25	24	22	1	frequent (186)	large area	
Phizostomeae																		
Rhizostomidae	<i>Rhopilema hispidum</i> Vanhöffen	Hizenkurage		1			0	0	0	0	0	1	0	0	0	rare (1)	temperate	
	<i>Nemopilema nomurai</i> (Kishinouye)	Echizenkurage		+	+~+++	+~++	7	8	2	6	8	0	0	4	0	rare (35)	temperate	
Cepheidae	<i>Rhopilema esculentum</i> Kishinouye	Bizenkurage		1~+	1~+	1	0	3	0	1	2	2	1	1	0	rare (10)	temperate	
	<i>Netrostoma setouchianum</i> (Kishinouye)	Ebikurage		1~++	1~+		0	2	0	1	0	1	0	4	0	rare (8)	temperate	
ANTHOZOA																		
Actiniaria																		
Boloceroiidae	<i>Bolocerooides mcmurrici</i> (Kwietniewski)	Oyogiisogintyaku		+++			0	0	0	0	0	0	0	2	0	rare (2)	subtropical	
CUBOZOA																		
Cubomedusae																		
Carybdeidae	<i>Carybdea brevipedalia</i> Kishinouye	Andonkurage		+~+++	++~+++	1	7	7	2	9	8	6	1	3	0	rare (43)	subtropical	
HYDROZOA																		
Anthomedusae																		
Bougainvilliidae	<i>Nemopsis doleini</i> Mass	Dofurainkurage	+~+++				0	1	0	1	0	0	0	0	0	rare (2)	temperate	
Eudendriidae	<i>Spirocodon saltator</i> (Tilesius)	Kamikurage	+~+++			+~+++	5	7	6	0	8	5	0	0	0	rare (31)	temperate	
Porpitidae	<i>Porpita porpita</i> Linnaeus	Ginkakurage		++	+~+++		0	2	1	0	0	0	0	0	0	rare (3)	subtropical	
Leptomedusae																		
Aequoreidae	<i>Aequorea coerulescens</i> (Brandt)	Owankurage	+~+++			+~++	7	7	7	0	9	9	7	8	0	rare (54)	temperate	
	<i>Aequorea macrodactyla</i> (Brandt)	Hitomoshikurage	1	+			0	0	0	0	0	0	0	2	0	rare (2)	temperate	
Campanulariidae	<i>Clytia languida</i> (A.Agassiz)	Fusaumikoppu	1				0	0	0	0	0	0	0	1	0	rare (1)	temperate	
Sugiuridae	<i>Sugiura chengshanense</i> (Ling)	Yakuchikurage	+++				0	0	0	0	0	0	0	1	0	rare (1)	temperate	
Limnomedusae																		
Olindiasidae	<i>Olindias formosa</i> (Goto)	Hanagasakurage	+~++	1~++	1	1	3	1	5	5	3	0	10	6	0	rare (33)	temperate	
Narcomedusae																		
Aeginidae	<i>Aegina rosea</i> Eschscholtz	Tudumikurage	1				0	0	0	0	0	0	0	1	0	rare (1)	large area	
TENTACULATA																		
Cestida																		
Cestidae	<i>Cestum veneris</i> Lesueur	Obikurage	+	+			1	0	0	0	0	2	0	3	0	rare (6)	large area	
Bolinopsidae	<i>Bolinopsis mikado</i> Moser	Kabutokurage	+++	++~+++	+++	++~+++	3	6	11	0	12	11	6	9	3	occasional (61)	temperate	
Lampeidae	<i>Lampea pancerina</i> (Chun)	Hengekurage	+++				0	0	2	0	0	0	0	0	0	rare (2)	temperate	
Leucotheidae	<i>Leucothea japonica</i> Komai	Tsunokurage			+++		0	0	0	0	0	0	0	1	0	rare (1)	subtropical	
Ocyropsidae	<i>Ocyropsis maculata</i> (Rang)	Tyokurage	+~+++		++		1	0	0	0	0	3	0	2	0	rare (6)	subtropical	
Nuda																		
Beroidae	<i>Beroe cucumis</i> Fabricius	Urikurage	+~+++	+~++		++~+++	5	6	6	6	7	8	7	1	0	rare (46)	temperate	

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.

Appendix 1. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
GASTROPODA																		
Vetigastropoda																		
Turrid inidae	<i>Turbo cornutus</i> Lightfoot	Sazae	1~+	1~+		1~+	4	6	4	3	3	0	0	0	0		rare (20)	temperate
Discopoda																		
Strombidae	<i>Strombus (Doxander) japonicus</i> Reeve	Shidorogai		1		1	1	0	1	0	1	0	0	0	0		rare (3)	temperate
Cassidae	<i>Phalium (Bezoardicella) flammiferum</i> (Röding)	Kazuragai				1	1	0	0	0	0	0	0	0	0		rare (1)	temperate
Ficidae	<i>Ficus subintermedia</i> (d'Orbigny)	Biwagai			1~+		0	0	0	2	0	0	0	0	0		rare (2)	subtropical
Neogastropoda																		
Melongenidae	<i>Hemifusus tuba</i> (Gmelin)	Tengunishi		+		1	0	1	0	2	0	0	0	0	0		rare (3)	subtropical
Fascioliariidae	<i>Fisinus perplexus ferrugineus</i> Kuroda et Habe	Konaganishi	1~+	1~+	1~++	1~+	17	11	21	15	2	12	9	14	0		occasional (101)	temperate
Aplysiomorpha																		
Aplysiidae	<i>Aplysia juliana</i> Quoy & Gaimard	Amakusaamefurashi	+~++	+		+	11	13	13	12	11	16	21	21	0		occasional (118)	large area
	<i>Aplysia kurodai</i> (Baba)	Amefurashi	1~++	1~+	1	+~++	1	0	0	3	3	12	11	3	0		rare (33)	temperate
	<i>Bursatella leachii leachii</i> de Blainville	Fureritogeamefurashi				1~+	2	0	0	0	0	0	0	0	0		rare (2)	subtropical
	<i>Dolabella auricularia</i> (Lightfoot)	Tatsunamigai	1~+	1~+	1~+	1	0	1	0	0	0	3	2	10	1		rare (17)	temperate
Pleurobranchomorpha																		
Pleurobranchaeidae	<i>Pleurobranchaea japonica</i> Thiele	Umifukurou	1~+	1~+		+	2	1	0	2	0	1	0	1	0		rare (7)	temperate
Pleurobranchidae	<i>Berthellina citrina</i> (Rüppell & Leuckart)	Houzukiumieragai		1			0	0	0	0	1	0	0	0	0		rare (1)	subtropical
Thecosomata																		
Cymbuliidae	<i>Corolla intermedia</i> (Tesch)	Uchiwakantenkamegai		+			1	0	0	0	0	0	0	0	0		rare (1)	subtropical
Nudibranchia																		
Triophidae	<i>Plocamopherus tilesii</i> Bergh	Hikariumiushi	1~+	1~+		1~+	8	2	2	1	7	21	5	8	0		rare (54)	temperate
Dorididae	<i>Homoiodoris japonica</i> Bergh	Yamatoumiushi	+				0	0	0	0	0	6	0	0	0		rare (6)	temperate
	<i>Platydoris speciosa</i> (Abraham)	Kumogataumiushi		1~+			1	0	0	0	0	1	0	1	0		rare (3)	subtropical
Dendrodorididae	<i>Dendrodoris arborescens</i> (Collingwood)	Kuroshitanashiumiushi	+	1~+			2	1	0	1	0	0	0	1	0		rare (5)	large area
	<i>Dendrodoris denisoni</i> (Angas)	Miyakoumiushi		1			0	0	1	0	0	0	0	0	0		rare (1)	temperate
	<i>Melibe papillosa</i> (de Fillippi)	Meribeumiushi	1~+	+	1	+	0	1	1	1	2	3	0	0	0		rare (8)	subtropical
BIVALVIA																		
Ostreoida																		
Pectinidae	<i>Amusium japonicum japonicum</i> (Gmelin)	Tsukihigai	1			1	1	0	0	0	0	0	1	0	0		rare (2)	temperate
CEPHALOPODA																		
Sepioida																		
Sepiidae	<i>Sepia (Acanthosepion) lycidas</i> Gray	Kaminariika	1~+	1~+	1		4	6	3	6	5	5	7	2	0		rare (38)	subtropical
	<i>Sepia (Platysepia) esculenta</i> Hoyle	Kouika	+~++	1~+	1~++	1~++	12	24	23	18	18	27	21	18	2		often (163)	subtropical
	<i>Sepia (Doratosepion) kobeensis</i> Hoyle	Himekouika	1~+	1	1	1~+	0	0	0	0	0	12	3	4	1		rare (20)	temperate
	<i>Sepia (Doratosepion) misakiensis</i> Wülker	Misakikouika	1~+			1	0	0	0	0	0	1	1	2	1		rare (5)	temperate
	<i>Metasepia tullbergi</i> Appellöf	Hanaika	1	1~+			5	1	2	1	0	2	2	0	0		rare (13)	subtropical
	<i>Sepiella japonica</i> Sasaki	Shiriyakeika	1~++	1~++	1~+	1~+	7	10	6	3	1	16	10	2	2		rare (57)	subtropical
Sepiariidae	<i>Sepiadarium kochii</i> Steenstrup	Mimiikadamashi	1				0	0	0	0	0	1	0	0	0		rare (1)	subtropical
Sepiolidae	<i>Euprymna morsei</i> (Verrill)	Mimiika	1~+	1~+	+	+~++	4	13	5	8	8	6	4	3	0		rare (51)	temperate
Teuthoida																		
Loliginidae	<i>Sepioteuthis lessoniana</i> Lesson	Aoriika	1~++	+~+++	1~+++	+~+++	26	32	35	28	30	39	35	30	1		general (256)	large area
	<i>Loliolus japonica</i> Hoyle	Jindouika	+~++		1~+		0	0	0	0	0	8	3	1	0		rare (12)	temperate
	<i>Loliolus beka</i> Sasaki	Beika	++				2	0	0	0	0	0	0	0	0		rare (2)	temperate
	<i>Loligo bleekeri</i> Kefenstein	Yariika	+~+++	+		+~+++	5	16	9	8	14	16	9	9	4		occasional (90)	temperate
	<i>Loligo edulis</i> Hoyle	Kensakiika	+~+++	1~++	1~+++	+~+++	16	27	16	27	22	30	18	20	1		often (177)	subtropical
Onychoteuthidae	<i>Moroteuthis loenbergeri</i> Ishikawa & Wakiya	Kagiika	1~+	1~+	1	1	0	0	0	0	4	7	3	2	0		rare (16)	temperate
Thysanoteuthidae	<i>Thysanoteuthis rhombus</i> Troschel	Sodeika	+	1~+	1~+	1~+	6	2	3	1	0	2	0	1	0		rare (15)	subtropical
Ommastrephidae	<i>Todarodes pacificus</i> Steenstrup	Surumeika	+~+++	+~+++		1~+++	7	15	16	11	13	19	17	11	0		occasional (109)	temperate
	<i>Ommastrephes bartramii</i> (Lesueur)	Akaika			+		0	0	0	0	2	0	0	0	0		rare (2)	subtropical
Octopoda																		
Octopodidae	<i>Octopus vulgaris</i> Cuvier	Madako	1~+	1~+	1~+	1~+	6	13	9	14	16	11	8	19	1		occasional (97)	large area
	<i>Octopus ocellatus</i> Gray	Iidako	1~+	1	1	1	1	0	0	1	1	2	1	1	0		rare (7)	temperate

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

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Appendix 1. Continued

Family	Scientific name	Japanese name	Round number of individuals				Collected times										Frequency (total times)	Distribution area
			Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
Tremoctopodidae	<i>Tremoctopus violaceus gracialis</i> (Eydoux & Souleyet)	Murasakidako		1	1	1	0	5	1	0	1	0	0	0	0	rare (7)	subtropical	
Argonautidae	<i>Argonauta argo</i> Linnaeus	Aoigai	1~+	1	1	1	5	5	0	0	1	2	0	1	0	rare (14)	subtropical	
	<i>Argonauta hians</i> (Lightfoot)	Takobune			1		0	0	0	0	1	0	0	0	0	rare (1)	subtropical	
POLYCHAETA																		
Amphinomida																		
Amphinomidae	<i>Chloeia flava</i> (Pallas)	Umikemushi		1			0	0	0	0	1	0	0	0	0	rare (1)	subtropical	
HIRUDINEA																		
Rhynchobdellida																		
Piscicolidae	<i>Trachelobdella okae</i> Moore	Hidabiru	1				0	0	0	0	0	0	1	0	0	rare (1)	temperate	
MALACOSTRACA																		
Decapoda																		
Penaeidae	<i>Penaeus (Marsupenaeus) japonicus</i> Bate	Kurumaebi		1			0	0	2	0	0	0	0	1	0	rare (3)	large area	
	<i>Penaeus (Melicertus) latisulcatus</i> Kishinouye	Futomizoebi	+	1~+	1~+		0	1	3	0	3	2	1	2	0	rare (12)	subtropical	
	<i>Penaeus (Penaeus) semisulcatus</i> de Haan	Kumaebi			1		0	0	0	0	1	0	0	0	0	rare (1)	subtropical	
	<i>Metapenaeopsis mogiensis</i> (Rathbun)	Mogiebi	1~+	1~+		1~+	1	5	2	9	5	6	2	0	0	rare (30)	subtropical	
	<i>Metapenaeopsis dalei</i> (Rathbun)	Kishiebi	+	1	+		0	0	0	0	2	0	0	0	1	rare (3)	temperate	
	<i>Metapenaeopsis lamellata</i> (de Haan)	Hokkokuebi	1	1		1	0	0	1	0	0	0	1	0	1	rare (3)	temperate	
Sicyonidae	<i>Sicyonia cristata</i> (de Haan)	Ishiebi	1~+	+		1	2	0	1	2	1	0	1	0	0	rare (7)	subtropical	
Palaemonidae	<i>Palaemon pacificus</i> (Stimpson)	Isosujiebi				+	1	0	0	0	0	0	0	0	0	rare (1)	large area	
Diogenidae	<i>Dardanus aspersus</i> (Berthold)	Akaboshiyadokari	1~+	1~+	1~+	1~+	10	3	6	4	3	4	3	2	0	rare (35)	subtropical	
	<i>Diogenes edwardsii</i> (de Haan)	Togetsunoyadokari	1~+	1~++	1~+	1~+	12	4	3	7	3	5	2	2	0	rare (38)	temperate	
	<i>Pagurus japonicus</i> (Stimpson)	Yamatohonyadokari	1				0	0	0	1	0	0	0	0	0	rare (1)	temperate	
	<i>Pagurus similis</i> (Ortmann)	Benihonyadokari	+	+	1	1	1	1	0	1	0	0	0	1	0	rare (4)	temperate	
Dorippidae	<i>Dorippe sinica</i> Chen	Kimengani			1		1	1	0	0	0	0	0	0	0	rare (2)	temperate	
Calappidae	<i>Calappa lophos</i> (Herbst)	Torafukarappa				1	1	0	0	0	0	0	0	0	0	rare (1)	subtropical	
	<i>Calappa philargius</i> (Linnaeus)	Meganekarappa	1		1	1	1	1	0	0	1	1	0	0	0	rare (4)	subtropical	
Leucosiidae	<i>Myra fugax</i> (Fabricius)	Tenagakobushi	1	1	1	1	0	0	2	0	0	0	0	2	0	rare (4)	temperate	
	<i>Leucosia anatum</i> (Herbst)	Tsunonagakobushi	1	1~+	1	1	0	3	1	2	0	8	0	3	0	rare (17)	subtropical	
Majidae	<i>Camposcia retusa</i> Latreille	Mokuzushoi	+				1	0	0	0	0	0	0	0	0	rare (1)	subtropical	
	<i>Pugettia quadridens quadridens</i> (de Haan)	Yotsuhamogani	+			1	2	0	0	1	0	0	0	0	0	rare (3)	temperate	
	<i>Huenia proteus</i> de Haan	Konohagani	1	1~+	1		0	0	0	0	0	2	1	1	0	rare (4)	subtropical	
	<i>Hyastenus diacanthus</i> (de Haan)	Tsunogani	1~+	1	1	1	4	3	0	1	0	1	1	0	0	rare (10)	subtropical	
Parthenopidae	<i>Parthenope (Platylambrus) valida valida</i> de Haan	Hishigani		1	1		0	0	1	0	0	1	0	0	0	rare (2)	subtropical	
Portunidae	<i>Liocarcinus corrugatus</i> (Pennant)	Shiwagazami	+	1~+			0	0	0	0	0	5	1	7	0	rare (13)	subtropical	
	<i>Portunus trituberculatus</i> (Miers)	Gazami		1	1		0	0	0	0	0	0	1	1	0	rare (2)	temperate	
	<i>Portunus pelagicus</i> (Linnaeus)	Taiwangazami		+	+		3	0	0	0	0	0	0	0	0	rare (3)	subtropical	
	<i>Portunus sanguinolentus</i> (Herbst)	Janomegazami		1~+	+	+	3	5	2	0	0	0	0	0	0	rare (10)	subtropical	
	<i>Portunus haani</i> (Stimpson)	Ibogazami	1	1	1	1	4	1	3	1	0	2	2	0	0	rare (13)	temperate	
	<i>Charybdis (Charybdis) miles</i> de Haan	Akaishigani	1~+		1		0	1	1	0	0	0	0	1	0	rare (3)	temperate	
CRINOIDEA																		
Comatulida																		
Comasteridae	<i>Oxycomanthus japonicus</i> (Müller)	Nipponumishida	1~+	1			1	2	0	1	2	0	0	1	0	rare (7)	temperate	
ASTEROIDEA																		
Platyasterida																		
Luidiidae	<i>Luidia maculata</i> Müller et Troschel	Yatsudesunahitode	1	1~+			2	1	1	0	0	0	0	1	0	rare (5)	subtropical	
	<i>Luidia quinaria</i> von Martens	Sunahitode	1~+	1~+	1	1	0	0	0	1	0	1	7	5	0	rare (14)	temperate	
Paxillosida																		
Astropectinidae	<i>Astropecten scoparius</i> Valenciennes	Momijigai	1~+	1~+	1	1	6	3	0	2	1	4	1	3	1	rare (21)	temperate	
	<i>Astropecten polyacanthus</i> Müller et Troschel	Togemomijigai	1~+	1	1~+	1	0	3	3	0	0	2	9	6	0	rare (23)	subtropical	
VALVATIDA																		
Ophidiasteridae	<i>Certonardoa semiregularis</i> Müller et Troschel	Akahitode	+	1	+		0	2	0	1	0	0	0	0	0	rare (3)	temperate	
	<i>Ophidiaster cribrarius</i> (Lütken)	Chairouhoukiboshi	1		1	1	0	2	1	1	2	2	0	0	0	rare (8)	temperate	

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

Rare, less than 60 times: occasional, 60–118; often, 119–178; frequent, 179–237; general, 238 or more.

Appendix 1. Continued

			Round number of individuals				Collected times										Frequency (total times)	Distribution area
Family	Scientific name	Japanese name	Spring	Summer	Autumn	Winter	2002	2003	2004	2005	2006	2007	2008	2009	2010			
Spinulosida																		
Asterinidae	<i>Asterina pectinifera</i> Müller et Troschel	Itomakihitode	1~+	1~++		1~+	11	10	7	9	7	5	15	12	2	occasional (78)	temperate	
Forcipulatida																		
Asteriidae	<i>Coscinasterias acutispina</i> (Stimpson)	Yatsudhitode		+			2	0	1	0	1	0	0	0	0	rare (4)	temperate	
	<i>Asterias amurensis</i> Lütken	Mahitode	1	1		1	0	2	3	2	0	0	1	0	1	rare (9)	temperate	
ECHINOIDEA																		
Echinoida																		
Strongylocentrotidae	<i>Temnopleurus toreumaticus</i> (Leske)	Sanshouuni	1		1		0	0	0	0	0	0	2	0	0	rare (2)	temperate	
	<i>Mespilia globulus</i> (Linnaeus)	Koshidakauni		1			0	0	1	0	0	0	0	0	0	rare (1)	subtropical	
Echinometridae	<i>Hemicentrotus pulcherrimus</i> (A. Agassiz)	Bafununi				+	1	0	0	0	0	0	0	0	0	rare (1)	temperate	
Spatangoida																		
Loveniidae	<i>Lovenia elongata</i> (Gray)	Hiratabunbuku	+	1~+	1~+	1~+	10	0	3	0	0	1	4	1	0	rare (19)	temperate	
HOLOTHUROIDEA																		
Aspidochirotida																		
Holothuriidae	<i>Holothuria (Thymiosycia) decorata</i> von Marenzeller	Fujinamako				1	0	0	0	0	0	0	0	0	2	rare (2)	temperate	
Stichopodidae	<i>Apostichopus japonicus</i> (Selenka)	Manamako	1~+			1~+	5	7	5	1	7	1	1	2	0	rare (29)	temperate	
THALIACEA																		
Salpida																		
Salpidae	<i>Salpa fusiformis</i> Cuvier	Togarisarupa	++~+++			+++	3	4	2	0	1	2	2	0	0	rare (14)	temperate	
REPTILIA																		
Testudines																		
Cheloniidae	<i>Chelonia mydas</i> (Linnaeus)	Aoumigame		1	1		4	1	2	0	1	2	0	0	0	rare (10)	subtropical	
	<i>Caretta caretta</i> Linnaeus	Akaumigame		1			0	0	0	0	0	0	0	1	0	rare (1)	subtropical	
Squamata																		
Elapidae	<i>Laticauda laticaudata</i> Linnaeus	Hirooumihebi			1		0	0	1	0	0	0	0	0	0	rare (1)	subtropical	

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

Rare, less than 60 times: occasional, 60–118: often, 119–178: frequent, 179–237: general, 238 or more.