

Change in the subtidal reef fish assemblage at Kuchierabu-jima Island, southern Japan, between 1972 and 2005

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30 Abstract

31	Change in the subtidal reef fish assemblage at Kuchierabu-jima Island, southern Japan, since the 1970s
32	was investigated using an underwater visual census in October 2005. A comparison of this survey to
33	data from 1972 revealed that the frequencies of species that had either increased, remained stable, or
34	declined in abundance were dependent on the geographic range category and the major feeding guild.
35	Temperate herbivorous fishes had noticeably declined in abundance, while subtropical carnivorous
36	species had increased. We discuss causes of the change in the reeffish assemblage from the aspect of
37	water temperature, loss of macroalgal beds, and anthropogenic impacts.
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- 39 Keywords Climate change, Isoyake, Reef fishes, Range shift, Kuroshio Current
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41 Introduction

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Changing species distributions are one of the most pervasive effects of global warming on natural 43 44ecosystems (Pecl et al. 2017). The influence of climate warming on the marine ecosystem is relatively 45well studied for the Pacific and Atlantic oceans, including the North Sea and Mediterranean Sea (e.g. 46Barry et al. 1995; Holbrook et al. 1997; Perry et al. 2005; Fodrie et al. 2010; Vergés et al. 2014). 47Recently, warming-associated changes have been identified for various marine taxa, such as corals and 48seaweeds along the coasts of Japan (e.g. Kurihara et al. 2011; Nagai et al. 2011; Yamano et al. 2011; Tanaka et al. 2012; Vergés et al. 2014; Kumagai et al. 2018). Among subtidal reef fishes, warm-4950adapted species that were not recorded in the past have been recently detected at various sites in Japan (Nakazono 2002; Nishida et al. 2005; Masuda 2008; Tawa and Takegaki 2009; Sakai et al. 2010). 5152However, previous studies did not evaluate the change quantitatively because almost all the studies lacked comparative historical data on fish species abundance, particularly since the 1960s and 1970s. 5354One exceptional case in Japanese water is the reefs of Kuchierabu-jima Island, where underwater visual census efforts documented subtidal reef fish assemblages, including not only commercially 5556important fishes, using quantitative data available in the 1970s (Gushima and Murakami 1977, 1978). This oceanic volcanic island in the East China Sea is part of the Osumi Islands and lies approximately 5758550 km north of the Ryukyu Islands and in close proximity to the Kuroshio Current. Biogeographical classification of the Osumi Islands describes the location as near the boundary between areas of 5960 temperate to subtropical waters for shallow rocky-reef fishes and subtropical waters for shallow coral-61 and rocky-reef fishes (Nakabo 2002, 2013). Over the past 100 years the southern part of the East 62 China Sea, where Kuchierabu-jima Island is located, has shown increases in sea surface temperatures 63 of 1.14°C and 1.45°C for annual and winter temperatures, respectively (Japan Meteorological Agency 2011). In addition, the disappearance or decline of seaweed beds (a phenomenon known as 'isoyake'), 64 including Sargassaceae species, has been reported in the coastal waters of Kagoshima Prefecture, to 65 which Kuchierabu-jima Island belongs (Tanaka 2011). Seaweeds are an important food resource for 66 67 some species of reef fish (Gushima 1981; Sano et al. 1984). Therefore, the disappearance of seaweed beds may also affect assemblages of reef fishes-herbivorous species may decline in abundance as 68 69 compared with carnivorous species, including benthivorous or zooplanktivorous fishes.

To better understand how the subtidal reef fish assemblages at Kuchierabu-jima Island have changed over recent decades, we conducted an underwater visual census in October 2005 and compared our results with a census conducted in October 1972 (Gushima and Murakami 1977, 1978). Specifically, we investigated whether subtropical fishes that are otherwise distributed mainly in southern waters had increased, while temperate species that are otherwise distributed mainly in northern waters had decreased in abundance on the island's reefs. Concurrently, we investigated whether herbivorous species showed a decline in abundance as compared with carnivorous species.

- 77
- 78 Materials and methods
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80 Underwater visual census. The fish assemblages on reefs at Kuchierabu-jima Island (30°27'N,

81 130°11′E) were surveyed in October 2005 (Fig. 1), through a visual census on the shallow rocky reefs in Honmura Bay, following the methods of Gushima and Murakami (1977, 1978). A band transect 82 $(500 \times 6 \text{ m})$ was placed at three different depth intervals, at 1–5 m, 5–10 m, and 10–20 m, in the 83 western part of the bay. The placement of these transects was based on a map provided in the previous 84 85 censuses by Gushima and Murakami (1977). The substrates in the census area mainly comprised rocks, boulders, and sand. Each band transect was censused three times, between 11:00 and 14:00 h. 86 87 The identity and abundance of fish species observed within the transects were recorded, with fish identification based on the pictorial keys of Nakabo (2002). The census methods in 2005 differed from 88 89 those of 1972 in some points. The visual census in the earlier study was conducted by snorkeling (swimming speed ~16.7 m/min: Gushima and Murakami [1977]), whereas the 2005 census used 90 91SCUBA (swimming speed ~4.9–6.7 m/min). SCUBA was chosen because snorkeling was not feasible 92for counting fish along the deep transect line and under conditions of turbidity.

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94 Data analyses. The fish species composition recorded in October 2005 was compared with that 95 reported for October 1972 (Gushima and Murakami 1978). Species reported in the previous study 96 included some that either could not be identified or were possibly misidentified; these species were 97 revised to correspond to the present study where possible (Table S1). Furthermore, bottom-dwelling 98 species (e.g. members of the Serranidae and Synodontidae), strictly sheltered or territorial species (e.g.

99 Pomacentridae), and nocturnally active species (e.g. Holocentridae, Apogonidae) were excluded from 100 the data collected in 2005 because these fishes were not counted in 1972. In addition, *Halichoeres* 101 orientalis and Scarus chameleon were excluded from the 2005 survey data because they had only been 102taxonomically named since the publication of Gushima and Murakami (1978). Furthermore, pelagic 103 species (e.g. Carangidae, Sphyraenidae) were omitted from both datasets for the analysis (Table 1). 104 In addition, seaweeds were surveyed by placing 1 x 1 m quadrats every 50 m along each fish 105survey transect. Each quadrat was photographed and the area of cover of leafy and fleshy algae was 106 then visually estimated from the photographs. The leafy and fleshy algae included large-sized 107 seaweeds and many small-sized seaweeds excluding filamentous algae and coralline algae. We took a 108 total of 33 photos but lost 2 photos because of a camera problem.

109The degree of similarity of fish assemblages at each depth interval in 1972 and 2005 was 110 calculated using the Bray-Curtis similarity coefficient based on the number of individuals of each species. We predicted that the abundance of low-latitude species had increased, whereas high-latitude 111 112species had decreased in response to general warming trends. To determine whether the direction of change in species abundance is related to geographic range categories, we categorized the observed 113114 fish species as temperate (including warm-temperate) or subtropical, based on fish distribution data from Nakabo (2013) and the online resource FishBase (Froese and Pauly 2018). The observed species 115116were further categorized according to one of three major feeding guilds: herbivores (feed mainly on plants or detritus), carnivores (feed mainly on animals), and omnivores, based on Gushima (1981), 117118Tribble (1982), Okamura and Amaoka (1997), and FishBase (Froese and Pauly 2018); this was especially done to evaluate the effect of seaweed forest depletion on the reef fish assemblage. Thus, 119 120we defined a total of six categories: temperate herbivore (TH), temperate carnivore (TC), temperate 121omnivore (TO), subtropical herbivore (SH), subtropical carnivore (SC), and subtropical omnivore (SO). An 'increased species' was defined as one that had increased in abundance at least five-fold as 122123compared with its estimated abundance in 1972. A 'declined species' was defined as one that had 124decreased in abundance by at least one-fifth since 1972. All other species were defined as stable. 125We compared the frequencies of the increased species/declined species/stable species among the 126six categories using Fisher's exact test. The statistical analysis was conducted using R version 3.5.3 (R 127Core Team 2019).

129 Results

Our recalculation of data of Gushima and Murakami (1978) revealed that a total of 2,819 individuals, 131132representing 57 fish species from 19 families, had been recorded in October 1972 (Table 1). The 10-133most-abundant species (in descending order of abundance) were: Acanthurus nigrofuscus, Calotomus 134japonicus, Naso unicornis, Parupeneus spilurus, Girella leonina, Scarus rivulatus, Scarus schlegeli, 135Scarus forsteni, Prionurus scalprum, and Scarus rubroviolaceus (Table 1). Of these, four are 136considered temperate species (*Ca. japonicus*, *Pa. spilurus*, *Gi. leonina*, and *Pr. scalprum*). 137In October 2005, a total of 3,292 individuals, representing 110 fish species from 21 families, were observed. The 10-most-abundant species (in descending order of abundance) were: Ac. nigrofuscus, 138139Cirrhilabrus cvanopleura, Chaetodon auripes, Thalassoma lutescens, Zanclus cornutus, Sc. forsteni, 140Parupeneus multifasciatus, Acanthurus olivaceus, Coris gaimard, and Co. dorsomacula (Table 1). All 141 these except for Ch. auripes (temperate species) are considered subtropical species. Only two species (Ac. nigrofuscus and Sc. forsteni) were shared between the 1972 and 2005 records. One wrasse species 142143observed in 2005 (Ci. cyanopleura) was not recorded in 1972. The similarities between 1972 and 2005 144tended to be smaller with increasing depth (1-5 m: 0.41; 5-10 m: 0.26; 10-20 m: 0.07). 145The fish species composition in 1972 mainly consisted of subtropical species but included some temperate species. Of the 57 species observed in October 1972, 6, 9, 1, 19, 19, and 3 species were 146147categorized as TH, TC, TO, SH, SC, and SO, respectively. However, all TH (6 species), 67% of TC (6 species), all TO (1 species), and 47% of SH (9 species) had decreased in abundance, whereas 84% of 148149SC (16 species) and 67% of SO (2 species) had either not increased or changed in abundance (Fig. 2). 150The ratio was significantly different among these categories (Fisher's exact probability test, p < 0.01). Of 26 declined species, 19 species were not even recorded in 2005, which included 4 species among 151the 10-most-abundant species in 1972: Ca. japonicus (TH), Pa. spilurus (TC), Gi. leonina (TH), and 152Pr. scalprum (TH) (Table 1). In addition, of 110 species observed in 2005, 71 were not recorded in 153October 1972, and 63 were not recorded in other months of 1972 as well (Table 1). Of the 71 species 154not recorded in the earlier survey, 55 (77%), 7 (10%), 4 (6%), 4 (6%), and 1 (1%) were categorized as 155SC, SH, SO, TC, and TO, respectively. 156

- Leafy and fleshy algae were distributed in all three transect lines of October 1972. Mean algal
 coverage was 26%, 40%, and 38% at depths of 1–5 m, 5–10 m, and 10–20 m, respectively. However,
- 159 no leafy and fleshy algae were observed in all transect lines in October 2005 (0% coverage).
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161 Discussion

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163This study shows that the composition of the reef fish assemblage at Honmura Bay, Kuchierabu-jima 164 Island has noticeably changed between 1972 and 2005. Of the 10-most-abundant species in each 165census, only two species were shared between the 1972 and 2005 records. Furthermore, 71 species 166were recorded only in 2005. The method of the present study differed in some respects from that of the 167previous surveys by Gushima and Murakami (1977, 1978). Especially, the underwater visual census 168was conducted using snorkeling in 1972, while the effort in 2005 used SCUBA. This difference will have affected the detection of some fishes, especially small-sized species (e.g. Ci. cvanopleura, 169170Pseudocheilinus hexataenia), which are less easily observed by snorkeling than by SCUBA in deeper water. Similarities between 1972 and 2005 tended to be smaller with depth, which indicate that 171172difference in methodology would have affected the results. However, we confirmed that not only some large-sized species (e.g. Ca. japonicus, Na. unicornis) but also some small-sized species (e.g. 173174Thalassoma cupido, Stethojulis interrupta terina) showed a decline in abundance (Table 1). Furthermore, even in the shallow lines, where the influence of the method would be small, the 175176similarity between 1972 and 2005 was considerably small. Thus, we consider that the reef fish 177assemblages have indeed changed at Kuchierabu-jima Island, though the differences in the census 178methods would also have influenced the findings.

Of the 10-most-abundant species recorded in 1972, four species (*Ca. japonicus, Pa. spilurus, Gi. leonina*, and *Pr. scalprum*) were not observed in 2005. However, three of these (*Pa. spilurus, Gi. leonina*, and *Pr. scalprum*) were confirmed by specimen sampling at Kuchierabu-jima Island in the 2010s (Kimura et al. 2017). In addition, we conducted an investigation of seafood utilization from Kuchierabu-jima Island in 2009 and confirmed that *Pr. scalprum* and *Gi. leonina* were both used as a local food resource (Shimizu et al. unpublished data). Therefore, even though the populations of the three species confirmed in the 2010s seem to have been maintained at the island, the populations have 186 likely declined since the 1970s, at least in Honmura Bay.

187 In contrast, *Ca. japonicus* was not recorded by sampling in the 2010s (Kimura et al. 2017). In 188 2005, we observed only three individuals of *Calotomus* sp., which all appeared to be juveniles, thus 189 they could not be confirmed as *Ca. japonicus* or *Ca. carolinus*. Furthermore, we determined that, in 190 2009, people on Kuchierabu-jima Island generally had little opportunity to consume *Ca. japonicus*, 191although this fish had been caught and consumed there in the 1970s (Shimizu et al. unpublished data). 192Therefore, we suppose that Ca. japonicus may be at risk of extinction at Kuchierabu-jima Island, 193 which lies near the southern edge of its distribution range in Japan, though the species was observed spawning in 1986 and 1987 (Shibuno et al. 1994). Kumagai et al. (2018) infer a poleward shift in the 194195distribution of *Ca. japonicus* in Japan based on data regarding the deforestation of temperate 196 macroalgal communities as a consequence of overgrazing by this fish.

197 Overall, the subtropical fish species recorded in 1972 tended to show an increase or no change in 198abundance, while the temperate species tended to have declined. In addition, 93% of the fishes 199recorded only in 2005 were subtropical species. Furthermore, all four species that were among the 10-200most-abundant in 1972 but were not recorded in 2005 (i.e. Ca. japonicus, Pa. spilurus, Gi. leonina, Pr. 201scalprum), are temperate species. This change corresponds with predictions about the influence of 202climate warming on species composition in ecosystems. In the southern part of the East China Sea, 203which includes the location of this island, the average annual and winter sea surface temperatures have 204increased between 1972 and 2005 (Fig. 3). Rising winter water temperatures correlate to a significant 205change in fish assemblages in many areas (Masuda 2008; Figueira and Booth 2010). Therefore, ocean 206 warming would be a plausible cause of the shift in the observed reef fish abundance.

207We found a notable decrease in the abundance of herbivorous fish species compared with that of 208carnivorous fish species regardless of their geographic range categories. Gushima and Murakami (1977, 1978) observed luxuriant macroalgal beds composed of species in the family Sargassaceae, 209210between May and August, in the early 1970s (Fig. S1a-d.). However, similar macroalgal beds were not observed in the 2000s (Terada and Suzuki 2011; N. Shimizu, T. Kadota, Y. Sakai, M. Tsuboi, and 211212B. Barros, personal observation) (Fig. S1e-g). The macroalgal beds had apparently already disappeared from the island's reefs by the early 1980s (T. Shibuno, personal communication). Thus, 213214the decline of sargassum beds would have affected the subtidal reef fish assemblage. Evidence

215supporting this association is that the two species with the greatest decline in abundance (Ca. 216japonicus, Na. unicornis) at Kuchierabu-jima Island are reported to feed on macroalgae such as Sargassaceae species (Gushima 1981). Furthermore, we could not confirm the presence of even small-217218sized leafy and fleshy seaweeds in October 2005, although small-sized seaweeds such as Asparagopsis 219taxiformis were confirmed in the spring of 2009 (Terada and Suzuki 2011). In the 1970s, small-sized 220seaweeds were reported to remain after autumn (Gushima and Murakami 1977, 1978; Gushima 1981) 221and to serve as an important feeding site for not only herbivorous fish but also carnivorous fish 222(Gushima 1981). These included fish species with greatly reduced abundance (herbivores: Scarus 223ghobban, Sc. schlegeli, Sc. rivulatus, Pr. scalprum; carnivores: Pa. spilurus, Th. cupido, Stethojulis 224interrupta terina). In addition, macroalgal seaweed beds function as nurseries for juveniles in several 225fish families, such as the labrids, acanthurids, and mullids (Fulton et al. 2020; James and Whitfield 2262023). Although few studies have revealed change in a fish assemblage associated with the loss of 227seaweeds in Japan, great declines in the abundance of Pr. scalprum and Th. cupido were reported after 228the loss of macroalgal beds at Tanoura on the south coast of Shikoku Island (Nakamura 2018). The decline of macroalgal beds along the coast of Japan could be related with the increase in coastal water 229230temperatures (Tanaka et al. 2012; Kumagai et al. 2018; Japan Fisheries Agency 2021; Kiyomoto et al. 2312021). Thus, marine warming can affect fish assemblages not only directly but also indirectly.

232Several alternative hypotheses might explain the change we observed in the subtidal reef fish 233community between 1972 and 2005. Anthropogenic impacts especially should be considered. The 234population of Kuchierabu-jima Island has always been relatively small and is declining (427 and 147 inhabitants in the years 1970 and 2002, respectively: Yakushima Town Office at Kuchierabu-jima 235236Island, personal communication); additionally, the island is more than 60 km from the heavily 237populated Kyushu Island. Therefore, Kuchierabu-jima Island should be less affected by anthropogenic impacts like pollution, eutrophication, and overharvesting. However, the breakwater at Honmura Bay, 238239located inshore from our transects, was extended from 40 m to 250 m in the intervening 33 years 240between surveys. In addition, a quarry near Honmura Bay has operated for over 20 years. These 241disturbances could have exerted some influence on the reef fish assemblage via changes in the hydrological effect and turbidity. Furthermore, natural phenomena such as tropical storms also 242influence subtidal reef fish populations (Lassig 1983). The frequency of typhoons that passed near 243

Kuchierabu-jima Island was higher in the period 2002–2005 than in 1969–1972 (Japan Meteorological
Agency 2019).

Kuchierabu-jima Island is located near a marine biogeographic zone boundary (Nakabo 2002, 2462472013). Biogeographic transition zones where abiotic and biotic conditions allow for the interactions of organisms from different geographical origins are experiencing rapid changes in the marine realm 248249(Horta e Costa et al. 2014; Troast et al. 2020). In addition, sea surface temperatures are increasing more rapidly in the southern part of the East China Sea (~1.14°C per century) than the global mean of 2502510.51°C per century (Japan Meteorological Agency 2011). Therefore, the ecological response to rising water temperatures could be relatively evident in the waters around Kuchierabu-jima Island. Recently, 252Kimura et al. (2014) showed a considerable change in the species composition of a tide pool fish 253assemblage at Kuchierabu-jima Island, between 1990 and 2011, by specimen sampling. Further studies 254255will reveal the change of reef fish fauna at Kuchierabu-jima Island in more detail.

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264

265 **Declarations**

266 **Conflicts of interest** The authors declare that they have no conflict of interest

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268 Ethics approval This study complied with the current laws of Japan and the guidelines of269 the Ichthyological Society of Japan.

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272 **References**

- Barry JP, Baxter CH, Sagarin RD, Gilman SE (1995) Climate-related, long-term faunal changes in a
 California rocky intertidal community. Science 267: 672–675
- Figueira WF, Booth DJ (2010) Increasing ocean temperatures allow tropical fishes to survive
 overwinter in temperate waters. Glob Chang Biol 16: 506–516
- Fodrie FJ, Heck KL, Jr, Powers SP, Graham WM, Robinson KL (2010) Climate-related, decadal-scale
 assemblage changes of seagrass-associated fishes in the northern Gulf of Mexico. Glob Chang
 Biol 16: 48–59
- Froese R, Pauly D (2018) FishBase. http://www.fishbase.org. Accessed 20 November 2018
- Fulton CJ, Berkström C, Wilson SK, Abesamis RA, Bradley M, Åkerlund C, Barrett LT, Bucol AA,
- 282 Chacin DH, Chong-Seng KM, Coker DJ, Depczynski M, Eggertsen L, Eggertsen M, Ellis D,
- 283 Evans RD, Graham NAJ, Hoey AS, Holmes TH, Kulbicki M, Leung PTY, Lam PKS, van Lier
- J, Matis PA, Noble MM, Pérez-Matus A, Piggott C, Radford BT, Tano S, Tinkler P (2020)
- Macroalgal meadow habitats support fish and fisheries in diverse tropical seascapes. Fish Fish
 286 21: 700–717
- Gushima K (1981) Study on the feeding ecology of reef fishes in Kuchierabu Island. Journal of the
 Faculty of Applied Biological Science, Hiroshima University 20: 35–63 (in Japanese with
 English abstract)
- Gushima K, Murakami Y (1977) Species composition of the reef fishes at Honmura bay of Kuchierabu
 Island. Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima University 16:
 107–114 (in Japanese with English abstract)
- Gushima K, Murakami Y (1978) Vertical zonation of reef fishes at Honmura bay of Kuchierabu Island.
 Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima University 17: 175–189
- 295 (in Japanese with English abstract)
- Holbrook SJ, Schmitt RJ, Stephens JS, Jr (1997) Changes in an assemblage of temperate reef fishes
 associated with a climate shift. Ecol Appl 7: 1299–1310
- Horta e Costa B, Assis J, Fanco G, Erzini K, Henriques M, Goncalves EJ, Caselle JE (2014).
- Tropicalization of fish assemblages in temperature biogeographic transition zones. Mar Ecol
 Prog Ser 504: 241–252

- James NC, Whitfield AK (2023) The role of macroalgae as nursery areas for fish species within coastal seascapes. Cambridge Prisms: Coastal Futures 1: e3, 1–10
- Japan Meteorological Agency (2011) http://www.data.kishou.go.jp/kaiyou/shindan/index.html.
 Accessed 7 December 2011
- 305 Japan Meteorological Agency (2020) Taihu keiro zu.
- 306 https://www.data.jma.go.jp/fcd/yoho/typhoon/route_map/bstv2005.html. Accessed 23 April
 307 2020
- Japan Fisheries Agency (2021) Isoyake Taisaku Guideline 3rd edition, 247p
- Kimura Y, Wanishi A, Sakai Y, Hashimoto H, Gushima K (2014) Fish fauna of rocky tide pools at
 Kuchierabu-jima Island, southern Japan. Fauna Ryukyuana 11: 1–7 (in Japanese with English
 abstract)
- 312 Kimura Y, Hibino Y, Miki R, Minetoma T, Koeda K (2017) Field guide to fishes of Kuchinoerabu-jima
- Island in the Osumi Group, Kagoshima, southern Japan. The Kagoshima University Museum,
 Kagoshima (in Japanese)
- Kiyomoto S, Yamanaka H, Yoshimura T, Yatsuya K, Shao H, Kadota T, Tamaki A (2021) Long-term
 change and disappearance of Lessoniaceae marine forests off Waka, Ikishima Island,
- 317 northwestern Kyushu, Japan. Nippon Suisan Gakkaishi 87: 642–651 (in Japanese with English
 318 abstract)
- Kumagai NH, Molinos JG, Yamano H, Takao S, Fujii M, Yamanaka Y (2018) Ocean currents and
 herbivory drive macroalgae-to-coral community shift under climate warming. Proc Natl Acad
 Sci USA 115: 8990–8995
- Kurihara T, Takami H, Kosuge T, Chiba S, Iseda M, Sasaki T (2011) Area-specific temporal changes
 of species composition and species-specific range shifts in rocky-shore mollusks associated
 with warming Kuroshio Current. Mar Biol 158: 2095–2107
- Lassig BR (1983) The effects of a cyclonic storm on coral reef fish assemblages. Environ Biol Fishes
 9: 55–63
- Masuda R (2008) Seasonal and interannual variation of subtidal fish assemblages in Wakasa Bay with reference to the warming trend in the Sea of Japan. Environ Biol Fishes 82: 387–399
- 329 Nagai S, Yoshida G, Tarutani K (2011) Change in species composition and distribution of algae in the

330 coastal waters of western Japan. In: Casalegno S (ed) Global warming impacts-case studies on 331the economy, human health, and on urban and natural environments. InTech Open Access Publisher, Rijeka, Croachia, pp 209–236 332333 Nakabo T (2002) Fishes of Japan with pictorial keys to the species, English ed. Tokai University Press, 334Tokyo 335Nakabo T (2013) Fishes of Japan with pictorial keys to the species, 3rd ed. Tokai University Press, 336 Kanagawa (in Japanese) 337Nakamura Y (2018) Climate-induced changes in seaweeds and their associated fish fauna. 338 Aquabiology 236: 220–225 (in Japanese with English abstract) 339 Nakazono A (2002) Fate of tropical reef fish juveniles that settle to a temperate habitat. Fish Sci 68: 340127-130 341Nishida T. Nakazono A, Oikawa S, Matsui S (2005) Changes of the coastal fish fauna in the Chikuzen sea according to rise of sea water temperature in recent years. Science Bulletin of the Faculty 342343of Agriculture, Kyushu University 60: 187–201 (in Japanese with English abstract) Okamura O, Amaoka K (1997) Sea fishes of Japan. YAMA-KEI publishers, Tokyo (in Japanese) 344345Pecl GT, Araújo MB, Bell JD, Blanchard J, Bonebrake TC, Chen IC, Clark TD, Colwell RK, Danielsen F, Evengård B, Falconi L, Ferrier S, Frusher S, Garcia RA, Griffis RB, Hobday AJ, 346 347Janion-Scheepers C, Jarzyna MA, Jennings S, Lenoir J, Linnetved HI, Martin VY, McCormack PC, McDonald J, Mitchell NJ, Mustonen T, Pandolfi JM, Pettorelli N, Popova E, 348349Robinson SA, Scheffers BR, Shaw JD, Sorte CJB, Strugnell JM, Sunday JM, Tuanmu MN, Vergés A, Villanueva C, Wernberg T, Wapstra E, Williams SE (2017) Biodiversity 350351redistribution under climate change: Impacts on ecosystems and human wellbeing. Science 355: eaai9214 352Perry AL, Low PJ, Ellis JR, Reynolds JD (2005) Climate change and distribution shifts in marine 353354fishes. Science 308: 1912–1915 R Core Team (2019) R: A language and environment for statistical computing. R foundation for 355statistical computing, Vienna, Austria 356Sakai Y, Ochi Y, Tsuboi M, Kadota T, Shimizu N, Shoji J, Matsumoto K, Mabuchi K, Kuniyoshi H, 357Ohtsuka S, Hashimoto H (2010) Fish fauna of shallow waters of Aki Nada, Seto Inland sea, 35813

- Japan. Journal of the Graduate School of Biosphere Science, Hiroshima University 49:7-20359 360 (in Japanese with English abstract) Sano M, Shimizu M, Nose Y (1984) Food habits of teleostean reef fishes in Okinawa Island, southern 361Japan. The University Museum, The University of Tokyo, Bulletin 25: 1–128 362363 Shibuno T, Ogata S, Hashimoto H, Gushima K (1994) Reproductive behavior of the parrotfish, 364 Calotomus japonicus, at Kuchierabu-jima. Journal of the Faculty of Applied Biological Science, Hiroshima University 33: 37–41 (in Japanese with English abstract) 365366 Tanaka T (2011) A review of the barren ground phenomenon and the recovery of seaweed communities in Kagoshima, southern Japan. Bulletin of Kagoshima Prefectural Fisheries 367 368 Technology and Development Center 1: 13–18 (in Japanese with English abstract) 369Tanaka K, Taino S, Haraguchi H, Prendergast G, Hiraoka M (2012) Warming off southwestern Japan 370 linked to distributional shifts of subtidal canopy-forming seaweeds. Ecol Evol 2: 2854–2865 Tawa A, Takegaki T (2009) Fish fauna in the coastal area of Nomozaki, Nagasaki. Bulletin of Faculity 371372of the Fisheries, Nagasaki University 90: 9–18 (in Japanese with English abstract) 373Terada R, Suzuki T (2011) Preliminary study of benthic marine algae from Kuchinoerabu Island, 374Kagohsima, Japan. Kagoshima Research Center for the Pacific Islands Occasional Papers 51: 69–75 (in Japanese with English abstract) 375Tribble GW (1982) Social organization, patterns of sexuality, and behavior of the wrasse Coris 376 dorsomaculata at Miyake-jima, japan. Environ Biol Fishes 7: 29-38 377378Troast B, Paperno R, Cook GS (2020) Multidecadal shifts in fish community diversity across a dynamic biogeographic transition zone. Diversity and Distribution 26: 93-107 379380 Vergés A, Steinberg PD, Hay ME, Poore AG, Campbell AH, Ballesteros E, Heck KL, Jr., Booth DJ, 381Coleman MA, Feary DA, Figueira W, Langlois T, Marzinelli EM, Mizerek T, Mumby PJ, Nakamura Y, Roughan M, van Sebille E, Gupta AS, Smale DA, Tomas F, Wernberg T, Wilson 382
 - 383 SK (2014) The tropicalization of temperate marine ecosystems: climate-mediated changes in
- herbivory and community phase shifts. Proc R Soc B 281: 20140846
- Yamano H, Sugihara K, Nomura K (2011) Rapid poleward range expansion of tropical reef corals in
 response to rising sea surface temperatures. Geophys Res Lett 38: L04601
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388	Figure	legends
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Fig. 1 Map of Japan and adjacent waters showing the location of the study site, Honmura Bay onKuchierabu-jima Island.

392

Fig. 2 Rates of the declined fish species (*black*), stable species (*gray*), and increased species (*white*) in
relation to their geographic ranges and trophic categories.

395

Fig. 3 Annual and winter water temperatures in the northern part of the East China Sea, from 1972 to
2005, based on 3-year running averages (*closed squares*). Redrawn from data provided by the Japan
Meteorological Agency (2011).

399

400 Fig. 4 Underwater photographs taken around Kuchierabu-jima Island in the 1970s and 2000s, at: (a)

401 Honmura Bay, on the southern coast of the island, in May 1971, and (b) in August 1971; (c) Nishiura

402 Bay, on the northern coast of the island, in August 1972; (d) Nishiura Bay in October 1972, and (e)

403 Honmura Bay in May 2012; (f) Nishiura Bay in May 2006, and (g) in September 2005; and (h)

404 Honmura Bay in October 2004. Dense seaweed beds were observed from spring to summer (**a**-**c**) but

405 were not in autumn in the early 1970s (d). On the other hand, no dense seaweed beds were observed in

406 2000s. Allows in photograph **d** indicate stems of Sargassaceae species.

- **Table 1** List of reef fish species and their abundance in the 1972 survey of Gushima and Murakami
- 409 (1978) and the 2005 survey (present study) at Kuchierabu-jima Island, southern Japan

		Abund	ance	Relative change in	Geographic range	
Scientific name	Japanese name	Oct. 1972	Oct. 2005	abundance between 1972 and 2005	and trophic groups category	Reason
Dasyatidae Neotygon kuhlii*	Yakko-ei		2			1
Muraenidae Echidna nebulosa*	Kumo-ustubo		1			1
Synodontidae <i>Synodus</i> sp.*			29			1
Holocentridae						
Myripristis sp.*			9			1
Neoniphon sammara*	Ukeguchi-ittoudai		2			1
Sargocentron	Sumitsuki-kanoko		10			1
<i>melanospilos*</i>	Sumasuki kuloko		12			1
A short and the			45			1
Aulostomidae	Hera-vagara	0	3	Not recorded in 1972 ^a	SC	
Fistulariidaa	Hera-yagara	0	5		50	
Fistularia commersonii	Ao-yagara	5	6	1.20	TC	
Serranidae						
Belonoperca	Yami-suzuki		1			1
chabanaudi* Cephalopholis miniata*	Yukata-hata		12			1
Cephalopholis	Niii hoto		5			1
urodeta*	INIJI-Hata		5			
Epinephelus fasciatus*	Aka-hata		6			1
Epinephelus merra*	Kanmon-hata		5			1
Grammistes	Nunosarashi		2			1
sexlineatus*	IV 1 1		-			1
Plectropomus laevis* Plectropomus	Kokunan-ara		1			1
leopardus*	Suji-ara		1			1
Pseudanthias pascalus*	Hanagoi		124			1
Variola albimarginata*	Ojiro-bara-hata		4			1
Variola louti*	Bara-hata		7			1
Pseudochromidae						I
Labracinus cyclophthalmus*	Megisu		54			1
Apogonidae						
Apogon aureus*	Aosuji-tenjikudai		31			1
Cheilodipterus	Ryūkyū-yarai-		27			1
macrodon* Cheilodipterus quinquelineatus*	Ishimochi Yarai-ishimochi		5			1
Malacanthidae						
Malacanthus latovittatus	Kitsune-amadai	0	1	Not recorded in 1972 ^a	SC	
Carangidae						
<i>Seriola dumerili</i> * Carangidae spp.*	Kanpachi		1 51			3 3

Lutjanidae					
Lutjanus gibbus	Hime-fuedai	1	1	1.00	SC
Lutjanidae sp.		1	0	Not recorded in 2005	SC
Macolor niger	Madara-tarumi	0	2	Not recorded in 1972 ^a	SC
Haemulidae					
Plectorhinchus picus	Ajia-koshōdai	0	2	Not recorded in 1972 ^a	SC
Plectorhinchus vittatus	Musuji -koshōdai	0	3	Not recorded in 1972 ^a	SC
Nemipteridae					
Scolopsis bilineata	Futasuji -tamagashira	0	13	Not recorded in 1972 ^a	SC
Lethrinidae					
Gymnocranius sp.	Tama-meichi	0	2	Not recorded in 1972 ^a	SC
Lethrinus nebulosus	Hama-fuefuki	18	0	Not recorded in 2005	TC
Monotaxis grandoculis	Yokoshima -kurodai	0	3	Not recorded in 1972 ^a	SC
Mullidae					
Mulloidichthys vanicolensis	Akahimeji	0	1	Not recorded in 1972 ^a	SC
Parupeneus crassilabris	Futasuji-himeji	1	0	Not recorded in 2005	SC
Parupeneus ciliatus	Hōrai-himeji	0	12	Not recorded in 1972 ^a	TC
Parupeneus cyclostomus	Marukuchi -himeji	0	6	Not recorded in 1972 ^a	SC
Parupeneus indicus	Koban-himeji	9	12	1.33	SC
Parupeneus multifasciatus	Ojisan	76	150	1.97	SC
Parupeneus pleurostigma	Ryūkyū-himeji	0	6	Not recorded in 1972 ^a	SC
Parupeneus spilurus	Okina-himeji	186	0	Not recorded in 2005	TC
Mullidae spp.		6	1	0.17	
Pempheridae					
Pempheris sp.*	Ryūkyū-hatanpo		5		
Chaetodontidae					
Chaetodon argentatus	Kagami -chōchōuo	0	14	Not recorded in 1972	SO
Chaetodon auriga	Toge-chōchōuo	18	5	0.28	SC
Chaetodon auripes	Chōchōuo	27	225	8.33	TC
Chaetodon kleinii	Mizore -chōchōuo	0	28	Not recorded in 1972 ^a	ТО
Chaetodon lineolatus	Nise-fūrai -chōchōuo	1	0	Not recorded in 2005	SC
Chaetodon lunula	Chōhan	0	6	Not recorded in 1972 ^a	SC
Chaetodon melannotus	Akebono -chōchōuo	0	9	Not recorded in 1972 ^a	SC
Chaetodon plebeius	Sumitsuki -tonosamadai	0	1	Not recorded in 1972 ^a	SC
Chaetodon speculum	Tonosamadai	0	2	Not recorded in 1972 ^a	SC
Chaetodon trifascialis	Yarikatagi	0	1	Not recorded in 1972 ^a	SC
Chaetodon unimaculatus	Itten-chōchōuo	0	3	Not recorded in 1972 ^a	SC
Chaetodon vagabundus	Fūrai-chōchōuo	0	14	Not recorded in 1972	SC
Forcipiger flavissimus	Fue-yakkodai	0	4	Not recorded in 1972 ^a	SC

Heniochus chrysostomus	Minami -batatatedai	0	2	Not recorded in 1972 ^a	SC	
Heniochus varius	Tsuno	0	5	Not recorded in 1072^{a}	SC	
Tientocnus varias	-hatatatedai	0	5	Not recorded in 1972	30	
Pomacanthidae						
Apolemichthys trimaculatus	Shiten-yakko	0	10	Not recorded in 1972	SC	
Centropyge bispinosa*	Ruri-yakko		2			1
Centropyge ferrugata*	Akahara-yakko		21			1
Centropyge tibicen*	Abura-yakko		21			1
Centropyge vrolikii*	Namera-yakko		192			1
Paracentropyge venusta*	Sumire-yakko		1]
imperator	-kinchakudai	0	26	Not recorded in 1972 ^a	SC	
Pomacanthus semicirculatus	Sazanami-yakko	2	28	14.00	SO	
Pygoplites diacanthus	Nishiki-yakko	0	4	Not recorded in 1972 ^a	SC	
Cirrhitidae						
Paracirrhites forsteri*	Hoshi-gonbe		3			1
Pomacentridae	C					
Abudefduf notatus*	Iso-suzumedai		1			1
Abudefduf	Rokusen-		0			1
sexfasciatus*	suzumedai		8			
Abudefduf vaigiensis*	Oyabiccha		202			1
Amphiprion clarkii*	Kumanomi		139			1
Chromis chrysurus*	Amami-suzumedai		397			I
Chromis margaritifer*	suzumedai		81			1
Chromis weberi*	Takasago-		61			1
Chromis nanthumus*	suzumedai Mon suzumodoi		5			1
Chromis xaninurus [*] Chrosiptera coanea*	Ruri-suzumedai		1			1
Chrysiptera cyanea Chrysiptera rex*	Remon-suzumedai		2			1
	Senaki-ruri-		-			-
Chrysipiera starcki*	suzumedai		Z			I
Dascyllus reticulatus*	Futasuji-ryūkyū- suzumedai Mitauboshi lauro		14			1
trimaculatus*	suzumedai		141			1
Neoglyphidodon nigroris*	Hirenaga- suzumedai		994			1
Plectroglyphidodon dickii*	Ishigaki-suzumedai		3			1
Plectroglyphidodon lacrymatus*	Rurihoshi- suzumedai		159			1
Pomacentrus bankanensis*	Megane-suzumedai		59			1
Pomacentrus coelestis*	Sora-suzumedai		276			1
Pomacentrus lepidogenys*	Asado-suzumedai		6			1
Pomacentrus	Nagasaki- suzumedai		3			1
Pomacentrus vaiuli*	Kuro-megane-		36			1
Stegastes snn *	suzumedai		122			1
Pomacentridae sp.*			1			1
Kynhosidae						
Kyphosus vaigiensis	Isuzumi	37	3	0.08	TH	
Microcanthidae			2			
Microcanthus	Kagokakidai	4	0	Not recorded in 2005	TC	

strigatus

Girella leoninaKuro-megina1780Not recorded in 2005THLabridaAnampses coeruloppunctatusBuchi-susuki-bera13372.85SCAnampses geographicusMushi-bera22512.50SCAnampses rovisitiHoshi-susuki-bera014Not recorded in 1972*SCBodianus scallarisSumitsuki-bera03Not recorded in 1972*SCBodianus scallarisSumitsuki-bera06Not recorded in 1972*SCChelinus chlorourus -mochinou06Not recorded in 1972*SCChelinus trilobanus -mochinou03Not recorded in 1972*SCCherodon azurioIra10Not recorded in 1972*SCChristiga0261Not recorded in 1972*SCCorris dorsonaculaSuj-bera085Not recorded in 1972*SCCoris dorsonaculaSuj-bera085Not recorded in 1972*SCCoris dorsonaculaSuj-bera012Not recorded in 1972*SCAdalchoeres malacobirNishifi-kyūšen05Not	Girellidae					
LabridueAnampses caeruleoputetatusBuchi-susuki-bera13372.85SCAnampses cegeraphicasMushi-bera22512.50SCAnampses melagridasHokuro-bera014Not recorded in 1972'SCBodianus axillarisSumitsuki-bera03Not recorded in 1972'SCBodianus mesothoracKesagake-bera08Not recorded in 1972'SCBodianus mesothoracKesagake-bera03Not recorded in 1972'SCCheilinus chlorourus-mochinouo03Not recorded in 1972'SCCheilinus trilobatus-mochinouo03Not recorded in 1972'SCCorristaria00Not recorded in 1972'SCCirrihidarus084Not recorded in 1972'SCCoris ayagulaKamuri-bera263.00SCCoris ayagulaKamuri-bera085Not recorded in 1972'SCCoris darsonaculaSuji-bera02Not recorded in 1972'SCGomphosus variusKugi-bera012Not recorded in 1972'SCHalichoeresNishiki-kyūsen013Not recorded in 1972'SCGomphosus variusNishiki-kyūsen014Not recorded in 1972'SCGomphosus variusNishiki-kyūsen014Not recorded in 1972'SCHalichoeresInazuma-bera014Not recorded in 1972' <td< td=""><td>Girella leonina</td><td>Kuro-mejina</td><td>178</td><td>0</td><td>Not recorded in 2005</td><td>TH</td></td<>	Girella leonina	Kuro-mejina	178	0	Not recorded in 2005	TH
Anampses carrilogumentatusBuchi-susuki-bera13372.85SCAnampses geographicusMushi-bera22512.50SCAnampses neise geographicusMushi-bera014Not recorded in 1972*SCAnampses to sitiiHokuto-bera03Not recorded in 1972*SCBoldamus avallarisSumisuki-bera03Not recorded in 1972*SCBoldamus avallarisSumisuki-bera06Not recorded in 1972*SCCheilinus chlorourus -mochinouo06Not recorded in 1972*SCCheilinus trilobatus -mochinouo03Not recorded in 1972*SCCheilinus trilobatus -consineur -mochinouo06Not recorded in 1972*SCCoris dorsonaculaSuji-bera084Not recorded in 1972*SCCoris dorsonaculaSuji-bera084Not recorded in 1972*SCCoris dorsonaculaSuji-bera0105Not recorded in 1972*SCCoris dorsonaculaSuji-bera012Not recorded in 1972*SCCoris dorsonaculaSuji-bera013Not recorded in 1972*SCCoris dorsonaculaSuji-bera012Not recorded in 1972*SCCoris dorsonaculaSuji-bera012Not recorded in 1972*SCGomphosus variusKugi-bera012Not recorded in 1972*SCBalchoeresNishiki-kyūse	Labridae					
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Bodianus mesothoraxKesagak-bera08Not recorded in 1972*SCCheilinus chlorourusAkaten06Not recorded in 1972*SCCheilinus trilobatus-mochinouo03Not recorded in 1972*SCChoerodon aurioIra10Not recorded in 1972*SCChoerodon aurioIra10Not recorded in 1972*SCCirrhilabrusKuroberi-itobiki0261Not recorded in 1972*SCCoris dorsomaculaSuji-bera085Not recorded in 1972*SCCoris dorsomaculaSuji-bera085Not recorded in 1972*SCCoris dorsomaculaSuji-bera031Not recorded in 1972*SCCoris dorsomaculaSuji-bera031Not recorded in 1972*SCCoris dorsomaculaSuji-bera031Not recorded in 1972*SCHalichoeresNishiki-kyūsen05Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera022Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SC </td <td>Bodianus axillaris</td> <td>Sumitsuki-bera</td> <td>0</td> <td>3</td> <td>Not recorded in 1972^a</td> <td>SC</td>	Bodianus axillaris	Sumitsuki-bera	0	3	Not recorded in 1972 ^a	SC
Cheilinus chlorourus Cheilinus trilobatus mochinouoAkaten ochinouo06Not recorded in 1972*SCCheilinus trilobatus mochinouomochinouo03Not recorded in 1972*SCChoerodon azurio irritilabrus evanopleura -bera10Not recorded in 1972*SCCirritilabrus evanopleura -bera084Not recorded in 1972*SCCoris aygula Coris aygulaKuroheri-itobiki temminckii084Not recorded in 1972*TCCoris aygula Coris aygulaKumuri-bera263.00SCCoris aygula Coris aygulaKumuri-bera085Not recorded in 1972*SCCoris aygula Coris aygulaKumuri-bera02Not recorded in 1972*SCEpibulus insidiatorGichi-bera02Not recorded in 1972*SCHalichoeres horiudnuusNishiki-kyüsen05Not recorded in 1972*SCHalichoeres halichoeres marginatusKanoko-bera07Not recorded in 1972*SCHalichoeres horiudnus halchoeresMunaten-bera044Not recorded in 1972*SCHalichoeres halichoeres metanoshiInazuma-bera014Not recorded in 1972*SCHalichoeres horiudnus horiesShima -tarekuchi-bera022Not recorded in 1972*SCHalichoeres horiudnus amutasShima -tarekuchi-bera022Not recorded in 1972*SC <td>Bodianus mesothorax</td> <td>Kesagake-bera</td> <td>0</td> <td>8</td> <td>Not recorded in 1972^a</td> <td>SC</td>	Bodianus mesothorax	Kesagake-bera	0	8	Not recorded in 1972 ^a	SC
Cheilinus trilobatusInstana nochinouo03Not recorded in 1972ªSCChoerodon azurioIra10Not recorded in 2005TCCirrhilabrusIrohkii-bera0261Not recorded in 1972ªSCCirrhilabrusItohiki-bera084Not recorded in 1972ªSCCoris aygulaKammuri-bera263.00SCCoris aygunaKammuri-bera085Not recorded in 1972ªSCCoris aysunaGichi-bera02Not recorded in 1972ªSCCoris ayuriusKugi-bera031Not recorded in 1972ªSCGomphosus variusKugi-bera011Not recorded in 1972ªSCHalichoeres hornulanusNishiki-kyūsen05Not recorded in 1972ªSCHalichoeres hornulanusTokara-bera012Not recorded in 1972ªSCHalichoeres marginatusInazuma-bera014Not recorded in 1972ªSCHalichoeres manuchirInazuma-bera08Not recorded in 1972ªSCHalichoeres meluosusInazuma-bera014Not recorded in 1972ªSCHalichoeres meluosusSima022Not recorded in 1972ªSCHalichoeres meluosusSima022Not recorded in 1972ªSCHalichoeres meluosusSima022Not recorded in 1972ªSCHalichoeres meluosusSima <t< td=""><td>Cheilinus chlorourus</td><td>Akaten -mochinouo Mitsuba</td><td>0</td><td>6</td><td>Not recorded in 1972^a</td><td>SC</td></t<>	Cheilinus chlorourus	Akaten -mochinouo Mitsuba	0	6	Not recorded in 1972 ^a	SC
Choerodon azurio CirritilabrusIra10Not recorded in 2005TCCirritilabrusKuroheri-itohiki eyanopleuraHoris0261Not recorded in 1972*SCCirritilabrusItohiki-bera084Not recorded in 1972*TCCoris aygulaKanmuri-bera263.00SCCoris dorsomaculaSuji-bera085Not recorded in 1972*SCCoris diarnardTsuyu-bera151036.87SCEpibulus insidiatorGichi-bera02Not recorded in 1972*SCGomphosus variusKugi-bera031Not recorded in 1972*SCHalichoeresTokara-bera012Not recorded in 1972*SCHalichoeresTokara-bera07Not recorded in 1972*SCHalichoeresMunaten-bera044Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresTsuki-bera08Not recorded in 1972*SCHalichoeresTsuki-bera08Not recorded in 1972*SCHalichoeresTsuki-bera022Not recorded in 1972*SCHalichoeresTsuki-bera022Not recorded in 1972*SCHalichoeresTsuki-bera022Not recorded in 1972*SCLabichoeresSomewake-bera05Not recorded in 1972*SC <td< td=""><td>Cheilinus trilobatus</td><td>-mochinouo</td><td>0</td><td>3</td><td>Not recorded in 1972^a</td><td>SC</td></td<>	Cheilinus trilobatus	-mochinouo	0	3	Not recorded in 1972 ^a	SC
Cirrhilabrus cyanopleura cyanopleura icheraKuroheri-itohiki ibera0261Not recorded in 1972ªSCCirrhilabrus temminckiiItohiki-bera084Not recorded in 1972ªTCCoris aygulaKannuri-bera263.00SCCoris dorsomaculaSuji-bera085Not recorded in 1972ªSCCoris aygulardTsuyu-bera151036.87SCCoris aygunardGichi-bera031Not recorded in 1972ªSCEpibulus insidiatorGichi-bera031Not recorded in 1972ªSCHalichoeres biocellaturaNishiki-kyūsen05Not recorded in 1972ªSCHalichoeres hortulanusTokara-bera012Not recorded in 1972ªSCHalichoeres marginatusKanoko-bera07Not recorded in 1972ªSCHalichoeres malanochirInazuma-bera014Not recorded in 1972ªSCHalichoeres maluatusNunaten-bera08Not recorded in 1972ªSCHalichoeres maluatusNunaten-bera014Not recorded in 1972ªSCHalichoeres maluatusNumera-bera02Not recorded in 1972ªSCHalichoeres amulatusNumera-bera014Not recorded in 1972ªSCHalichoeres amulatusNumera-bera02Not recorded in 1972ªSCHalichoeres amulatusSuma-bera014 </td <td>Choerodon azurio</td> <td>Ira</td> <td>1</td> <td>0</td> <td>Not recorded in 2005</td> <td>TC</td>	Choerodon azurio	Ira	1	0	Not recorded in 2005	TC
cyanopleura cyanopleura-bera0201Not recorded in 1972502Coris dorsomacula Coris dorsomacula Suji-bera084Not recorded in 1972*TCCoris dorsomacula Coris dorsomacula Suji-bera085Not recorded in 1972*SCCoris dorsomacula Suji-bera02Not recorded in 1972*SCCoris dorsomacula Suji-bera031Not recorded in 1972*SCCoris dorsomacula Suji-bera031Not recorded in 1972*SCHalichoeres IndichoeresNishiki-kyūsen05Not recorded in 1972*SCHalichoeres Indichoeres IndichoeresTokara-bera07Not recorded in 1972*SCHalichoeres Indichoeres Indichoeres Indichoeres IndichoeresMunaten-bera044Not recorded in 1972*SCHalichoeres Indichoeres Indichoeres IndichoeresMunaten-bera014Not recorded in 1972*SCHalichoeres Indichoeres IndichoeresShima -tarekuchi-bera08Not recorded in 1972*SCHalichoeres IndichoeresShima -tarekuchi-bera08Not recorded in 1972*SCHalichoeres IndichoeresShima -tarekuchi-bera022Not recorded in 1972*SCHalichoeres IndichoeresShima -tarekuchi-bera022Not recorded in 1972*SCHalichoeres Indogymnosus annudatusShiro-tasuki-bera05Not recorded in 1972* <t< td=""><td>Cirrhilabrus</td><td>Kuroheri-itohiki</td><td>0</td><td>261</td><td>Not recorded in 1972^a</td><td>SC</td></t<>	Cirrhilabrus	Kuroheri-itohiki	0	261	Not recorded in 1972 ^a	SC
leminuch coris aygulaKanmuri-bera263.00SCCoris gaimardSuji-bera085Not recorded in 1972*SCCoris gaimardTsuyu-bera151036.87SCEpibulus insidiatorGichi-bera02Not recorded in 1972*SCGomphosus variusKugi-bera031Not recorded in 1972*SCHalichoeresNishki-kyūsen05Not recorded in 1972*SCHalichoeresTokara-bera07Not recorded in 1972*SCHalichoeresMunaten-bera044Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresTsuki-bera8Not recorded in 1972*SCHologymnosusShima08Not recorded in 1972*SCLabroides bioloorSomewake-bera022Not recorded in 1972*SCLabroides bioloorSomewake-bera05Not recorded in 1972*SCLabroides bioloorSomewake-bera05Not recorded in 1972*SCLabroides bioloorSomewake-bera01Not recorded in 1972*SCLabroides bioloorSomewake-bera01Not recorded in 1972*SCLabroides bioloor<	cyanopleura Cirrhilabrus	-bera Itohiki-bera	0	84	Not recorded in 1972 ^a	TC
Coris dorsomaculaSuji-bera085Not recorded in 1972ªSCCoris gainardTsuyu-bera151036.87SCEpibulus insidiatorGichi-bera02Not recorded in 1972ªSCGomphosus variusKugi-bera031Not recorded in 1972ªSCHalichoeresNishiki-kyūsen05Not recorded in 1972ªSCHalichoeresTokara-bera012Not recorded in 1972ªSCHalichoeresKanoko-bera07Not recorded in 1972ªSCHalichoeresMunaten-bera044Not recorded in 1972ªSCHalichoeresInazuma-bera014Not recorded in 1972ªSCHalichoeresInazuma-bera08Not recorded in 1972ªSCHalichoeresInazuma-bera08Not recorded in 1972ªSCHalichoeresTsuki-bera8SSCHalichoeresShima08Not recorded in 1972ªSCHologymnosusNamera-bera1460.43SCLabroides bicolorSomewake-bera05Not recorded in 1972ªSCLabroides bicolorSomewake-bera01Not recorded in 1972ªSCLabroides bicolorSomewake-bera01Not recorded in 1972ªSCMacropharyngodonNedoguro-bera14848.00SCMacropharyngodonSejiro-nodoguro01Not	temminckii Coris avgula	Kanmuri-bera	2	6	3.00	SC
Coris gainardTsuyu-bera15103Forefore an IP12DecCoris gainardTsuyu-bera151036.87SCEpibulus insidiatorGichi-bera02Not recorded in 1972 ^a SCGomphosus variusKugi-bera031Not recorded in 1972 ^a SCHalichoeresNishiki-kyūsen05Not recorded in 1972 ^a SCHalichoeresTokara-bera012Not recorded in 1972 ^a SCHalichoeresKanoko-bera07Not recorded in 1972 ^a SCHalichoeresMunaten-bera044Not recorded in 1972 ^a SCHalichoeresInazuma-bera014Not recorded in 1972 ^a SCHalichoeresInazuma-bera08Not recorded in 1972 ^a SCHalichoeresInazuma-bera08Not recorded in 1972 ^a SCHalichoeresInazuma-bera08Not recorded in 1972 ^a SCHologymnosusShima08Not recorded in 1972 ^a SCLabroides bicolorSomewake-bera022Not recorded in 1972 ^a SCLabroides dinidiatusShiro-tasuki-bera012Not recorded in 1972 ^a SCLabroides dinidiatusShiro-tasuki-bera012Not recorded in 1972 ^a SCLabroides dinidiatusSeijro-nodoguro012Not recorded in 1972 ^a SCMacropharyngodonSeijro-nodoguro01No	Coris dygada Coris dorsomacula	Suii-bera	2	85	Not recorded in 1972 ^a	SC
Enhilts insidiatorGichi-bera011111111Epibults insidiatorGichi-bera031Not recorded in 1972*SCHalichoeresNishiki-kyūsen05Not recorded in 1972*SCHalichoeresTokara-bera012Not recorded in 1972*SCHalichoeresTokara-bera07Not recorded in 1972*SCHalichoeresMunaten-bera044Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera014Not recorded in 1972*SCHalichoeresInazuma-bera08Not recorded in 1972*SCHalichoeresShima08Not recorded in 1972*SCHologynnosusShiro-tasuki-bera08Not recorded in 1972*SCAnnulatusNamera-bera1460.43SCHologynnosusShiro-tasuki-bera05Not recorded in 1972*SCLabroides bicolorSomewake-bera05Not recorded in 1972*SCLabroides dimidiatusTako-bera01Not recorded in 1972*SCMacropharyngodonSejiro-nodoguro01Not recorded in 1972*SCMacropharyngodonSejiro-nodoguro01Not recorded in 1972*SCOxycheilinusTako-bera01Not recorded in 1972* <td>Coris gaimard</td> <td>Tsuvu-bera</td> <td>15</td> <td>103</td> <td>6.87</td> <td>SC</td>	Coris gaimard	Tsuvu-bera	15	103	6.87	SC
And the second	Epibulus insidiator	Gichi-bera	0	2	Not recorded in 1972 ^a	SC
Halichoeres biocellatusNishiki-kyūsen05Not recorded in 1972ªSCHalichoeres hortulanusTokara-bera012Not recorded in 1972ªSCHalichoeres marginatusKanoko-bera07Not recorded in 1972ªSCHalichoeres melanochirMunaten-bera044Not recorded in 1972ªSCHalichoeres melanochirInazuma-bera014Not recorded in 1972ªSCHalichoeres nebulosusInazuma-bera014Not recorded in 1972ªSCHalichoeres orientalis*Tsuki-bera08Not recorded in 1972ªSCHologymnosus annulatusShima -tarekuchi-bera08Not recorded in 1972ªSCHologymnosus annulatusNamera-bera1460.43SCHologymnosus annulatusNamera-bera1460.43SCHologymnosus annulatusNiro-tasuki-bera022Not recorded in 1972ªSCLabroides bicolorSomewake-bera05Not recorded in 1972ªSCLabroides bicolorSomewake-bera012Not recorded in 1972ªSCMacropharyngodon 	Gomphosus varius	Kugi-bera	0	31	Not recorded in 1972 ^a	SC
DiocentalityTokara-bera012Not recorded in 1972SCHalichoeres marginatusKanoko-bera07Not recorded in 1972aSCHalichoeres melanochirMunaten-bera044Not recorded in 1972aSCHalichoeres melanochirInazuma-bera014Not recorded in 1972aSCHalichoeres nebulosusInazuma-bera014Not recorded in 1972aSCHalichoeres orientalis*Tsuki-bera08Not recorded in 1972aSCHalichoeres orientalis*Shima -tarekuchi-bera08Not recorded in 1972aSCHologymnosus annulatusNamera-bera1460.43SCHologymnosus annulatusShiro-tasuki-bera022Not recorded in 1972aSCLabroides bicolorSomewake-bera05Not recorded in 1972aSCLabroides dimidiatus era-bera01848.00SCMacropharyngodon nelegris bimaculatusSejiro-nodoguro -bera01Not recorded in 1972aSCOxycheilinus hexateeniaHohosuji -onochinouo01Not recorded in 1972aSCStethojulis bimaculatusAkaobi-bera39671.72SCStethojulis binaculatusKaminari-bera2240.19TCStethojulis interrupta terina interrupta terinaKaminari-bera221.00SCStethoj	Halichoeres	Nishiki-kyūsen	0	5	Not recorded in 1972 ^a	SC
horiulanusJokala Cela012Not recorded in 19725CHalichoeres marginatusMunaten-bera07Not recorded in 1972*SCHalichoeres mebulosusInazuma-bera014Not recorded in 1972*SCHalichoeres orientalis*Inazuma-bera014Not recorded in 1972*SCHalichoeres orientalis*Tsuki-bera8SSCHologymnosus annulatusNamera-bera08Not recorded in 1972*SCHologymnosus annulatusNamera-bera1460.43SCHologymnosus annulatusNamera-bera022Not recorded in 1972*SCLabroides bicolorSomewake-bera05Not recorded in 1972*SCLabroides dimidiatus -beraHon-somewake -bera23618.00SCMacropharyngodon negrosensis -bera-bera01Not recorded in 1972*SCMacropharyngodon sejiro-nodoguro orycheilinus bimaculatusTako-bera01Not recorded in 1972*SCOxycheilinus bimaculatusHohosuji01Not recorded in 1972*SCStethojulis bimaculatusAkaobi-bera39671.72SCStethojulis bimaculatusKaminari-bera2211.00SCStethojulis bimaculatusKaminari-bera221.00SCStethojulis bimaculatusNise-mochinouo03Not r	biocellatus Halichoeres	Tokara-bera	0	12	Not recorded in 1972	SC
marginatusHaloko-otra07Not recorded in 1972SCHalichoeres melanochirInazuma-bera044Not recorded in 1972*SCHalichoeres orientalis*Inazuma-bera014Not recorded in 1972*SCHalichoeres orientalis*Tsuki-bera88Hemigymnus fasciatusShima 	hortulanus Halichoeres	Kanoko-bera	0	7	Not recorded in 1972	SC
Halichoeres melanochirMunaten-bera044Not recorded in 1972 ^a SCHalichoeres nebulosusInazuma-bera014Not recorded in 1972 ^a SCHalichoeres orientalis*Tsuki-bera8Hemigymnus fasciatusShima 	marginatus Hali da sura	Kanoko-bera	0	1		50
Hallchoores nebulosusInazuma-bera014Not recorded in 1972aSCHalichoores orientalis*Tsuki-bera88Hemigymnus fasciatus-tarekuchi-bera08Not recorded in 1972aSCHologymnosus annulatusNamera-bera1460.43SCHologymnosus 	melanochir Lalichoaneg	Munaten-bera	0	44	Not recorded in 1972 ^a	SC
Halichoeres orientalis*Tsuki-bera8Henigymnus fasciatusShima -tarekuchi-bera08Not recorded in 1972aSCHologymnosus annulatusNamera-bera1460.43SCHologymnosus 	nebulosus	Inazuma-bera	0	14	Not recorded in 1972 ^a	SC
Hemigymnus fasciatusShima -tarekuchi-bera08Not recorded in 1972aSCHologymnosus annulatusNamera-bera1460.43SCHologymnosus doliatusShiro-tasuki-bera022Not recorded in 1972aSCLabroides bicolorSomewake-bera05Not recorded in 1972aSCLabroides dimidiatusHon-somewake -bera23618.00SCMacropharyngodon meleagrisSejiro-nodoguro -bera14848.00SCOxycheilinus bimaculatusTako-bera01Not recorded in 1972aSCOxycheilinus bimaculatusHonsuiji01Not recorded in 1972aSCOxycheilinus bimaculatusHohsuiji01Not recorded in 1972aSCOxycheilinus bimaculatusHohsuiji01Not recorded in 1972aSCOxycheilinus bimaculatusHohsuiji01Not recorded in 1972aSCOxycheilinus bimaculatusHohsuiji01Not recorded in 1972aSCOxycheilinus bimaculatusHohsuiji03Not recorded in 1972aSCStethojulis bandanensisAkaobi-bera39671.72SCStethojulis bindatensisKaminari-bera155.00SCStethojulis strigiventer Harasuji-bera155.00SCStethojulis trilineata Oni-bera22211.00SCSt	Halichoeres orientalis*	Tsuki-bera		8		
Hologymnosus annulatusNamera-bera1460.43SCHologymnosus doliatusShiro-tasuki-bera022Not recorded in 1972aSCLabroides bicolorSomewake-bera05Not recorded in 1972aSCLabroides dimidiatusHon-somewake -bera23618.00SCMacropharyngodon 	Hemigymnus fasciatus	Shima -tarekuchi-bera	0	8	Not recorded in 1972 ^a	SC
Hologymnosus doliatusShiro-tasuki-bera022Not recorded in 1972aSCLabroides bicolorSomewake-bera05Not recorded in 1972aSCLabroides dimidiatus -beraHon-somewake -bera23618.00SCMacropharyngodon 	Hologymnosus annulatus	Namera-bera	14	6	0.43	SC
Labroides bicolorSomewake-bera05Not recorded in 1972aSCLabroides dimidiatusHon-somewake -bera23618.00SCMacropharyngodon meleagrisNodoguro-bera14848.00SCMacropharyngodon negrosensisSejiro-nodoguro 	Hologymnosus doliatus	Shiro-tasuki-bera	0	22	Not recorded in 1972 ^a	SC
Labroides dimidiatusHon-somewake -bera23618.00SCMacropharyngodon meleagrisNodoguro-bera14848.00SCMacropharyngodon Sejiro-nodoguro 	Labroides bicolor	Somewake-bera	0	5	Not recorded in 1972 ^a	SC
Macropharyngodon meleagrisNodoguro-bera14848.00SCMacropharyngodon negrosensisSejiro-nodoguro -bera012Not recorded in 1972aSCOxycheilinus bimaculatusTako-bera01Not recorded in 1972aSCOxycheilinus bimaculatusHohosuji -mochinouo01Not recorded in 1972aSCOxycheilinus digramma hexataeniaHohosuji -mochinouo01Not recorded in 1972aSCStethojulis bandanensisNise-mochinouo03Not recorded in 1972aSCStethojulis interrupta terina interrupta terinaKaminari-bera2140.19TCStethojulis strigiventer thalassoma cupidoNishiki-bera7730.04TCThalassomaSenasuji-bera022Not recorded in 1972aSC	Labroides dimidiatus	Hon-somewake -bera	2	36	18.00	SC
Macropharyngodon negrosensisSejiro-nodoguro -bera012Not recorded in 1972aSCOxycheilinus bimaculatusTako-bera01Not recorded in 1972aSCOxycheilinus 	Macropharyngodon meleagris	Nodoguro-bera	1	48	48.00	SC
Oxycheilinus bimaculatusTako-bera01Not recorded in 1972aSCOxycheilinus digramma -mochinouoHohosuji 	Macropharyngodon negrosensis	Sejiro-nodoguro -bera	0	12	Not recorded in 1972 ^a	SC
Oxycheilinus digrammaHohosuji -mochinouo01Not recorded in 1972aSCPseudocheilinus hexataeniaNise-mochinouo03Not recorded in 1972aSCStethojulis bandanensisAkaobi-bera39671.72SCStethojulis interrupta terinaKaminari-bera2140.19TCStethojulis strigiventerHarasuji-bera155.00SCStethojulis trilineataOni-bera22211.00SCThalassoma cupidoNishiki-bera7730.04TCThalassoma022Not recorded in 1972aSC	Oxycheilinus bimaculatus	Tako-bera	0	1	Not recorded in 1972 ^a	SC
Pseudocheilinus hexataeniaNise-mochinouo03Not recorded in 1972aSCStethojulis bandanensisAkaobi-bera39671.72SCStethojulis interrupta terinaKaminari-bera2140.19TCStethojulis strigiventerHarasuji-bera155.00SCStethojulis trilineataOni-bera22211.00SCThalassoma cupidoNishiki-bera7730.04TCThalassoma022Not recorded in 1972aSC	Oxycheilinus digramma	Hohosuji -mochinouo	0	1	Not recorded in 1972 ^a	SC
Stethojulis bandanensisAkaobi-bera39671.72SCStethojulis interrupta terinaKaminari-bera2140.19TCStethojulis strigiventerHarasuji-bera155.00SCStethojulis trilineataOni-bera22211.00SCThalassoma cupidoNishiki-bera7730.04TCThalassoma022Not recorded in 1972aSC	Pseudocheilinus hexataenia	Nise-mochinouo	0	3	Not recorded in 1972 ^a	SC
Stethojulis interrupta terinaKaminari-bera2140.19TCStethojulis strigiventerHarasuji-bera155.00SCStethojulis trilineataOni-bera22211.00SCThalassoma cupidoNishiki-bera7730.04TCThalassomaSenasuji-bera022Not recorded in 1972aSC	Stethojulis bandanensis	Akaobi-bera	39	67	1.72	SC
Stethojulis strigiventerHarasuji-bera155.00SCStethojulis trilineataOni-bera22211.00SCThalassoma cupidoNishiki-bera7730.04TCThalassoma022Not recorded in 1972aSC	Stethojulis interrupta terina	Kaminari-bera	21	4	0.19	TC
Stethojulis trilineataOni-bera22211.00SCThalassoma cupidoNishiki-bera7730.04TCThalassomaSenasuji-bera022Not recorded in 1972aSC	Stethojulis strigiventer	Harasuji-bera	1	5	5.00	SC
Thalassoma cupidoNishiki-bera7730.04TCThalassomaSenasuji-bera022Not recorded in 1972aSC	Stethojulis trilineata	Oni-bera	2	22	11.00	SC
ThalassomaSenasuji-bera022Not recorded in 1972aSC	Thalassoma cupido	Nishiki-bera	77	3	0.04	TC
	Thalassoma	Senasuji-bera	0	22	Not recorded in 1972 ^a	SC

hardwicke						
Thalassoma lunare	Otome-bera	0	8	Not recorded in 1972	SC	
Thalassoma lutescens	Yamabuki-bera	11	200	18.18	SC	
Labridae spp.		10	33	3.30		
Scaridae						
Calotomus japonicus	Budai	265	0	Not recorded in 2005	TH	
Calotomus sp.		0	3	Not recorded in 1972 ^a		
Chlorurus bowersi	Ōmon-hage -budai	0	1	Not recorded in 1972 ^a	SH	
Chlorurus	Nan'yō-budai	5	11	2.20	SH	
Chlorurus oedema	Kobu-budai	1	0	Not recorded in 2005	SH	
Chlorurus sordidus	Hage-budai	4	6	1.50	SH	
Scarus chameleon*	Kamereon-budai		6			2
Sagnus fastinus	Tsukinowa	12	1	0.08	сц	
scarus jesuvus	-budai	12	1	0.08	зп	
Scarus forsteni	Ichimonji-budai	119	151	1.27	SH	
Scarus frenatus	Amime-budai	5	7	1.40	SH	
Scarus ghobban	Hi-budai	40	0	Not recorded in 2005	TH	
Scarus hypselopterus	Kibire-budai	0	15	Not recorded in 1972 ^a	SH	
Scarus niger	Buchi-budai	0	5	Not recorded in 1972	SH	
Scarus ovifrons	Ao-budai	12	0	Not recorded in 2005	TH	
Scarus prasiognathos	Nishiki-budai	150	0	Not recorded in 2005	SH	
Scarus rivulatus	Suji-budai	158	8	0.05	SH	
Scarus rubroviolaceus	Naga-budai	88	45	0.51	SH	
Scarus schlegeli	Obi-budai	140	4	0.03	SH	
Scandae spp.		155	152	0.99		
Pinguipedidae						
Parapercis	Wanuke-toragisu		15			1
Parapercis pacifica*	Oguro-toragisu		11			1
	Oguro-wiagisu		11			1
Ерпіррібае		1	0	N. (1.1. 2005	0.0	
Platax orbicularis	Nan yo-tsubameuo	1	0	Not recorded in 2005	30	
Siganidae						
Siganus spinus	Ami-aigo	56	0	Not recorded in 2005	SH	
Siganus spp.		22	21	0.95		
Zanclidae						
Zanclus cornutus	Tsunodashi	5	158	31.60	SO	
Acanthuridae						
Acanthurus	Nico konronhogi	67	20	0.58	сц	
dussumieri	Nise-Kalifalinagi	07	39	0.58	511	
Acanthurus lineatus	Nijihagi	5	2	0.40	SH	
Acanthurus mata	Hira-niza	12	0	Not recorded in 2005	SH	
Acanthurus nigricans	Megane -kurohagi	8	0	Not recorded in 2005	SH	
Acanthurus nigrofuscus	Naga-niza	451	361	0.80	SH	
Acanthurus olivaceus	Montsukihagi	29	109	3.76	SH	
Acanthurus pyroferus	Kuroguchi-niza	0	2	Not recorded in 1972 ^a	SH	
Acanthurus	Kurohagi	0	3	Not recorded in 1972 ^a	SO	
Ctenochaetus striatus	Sazanamihagi	0	12	Not recorded in 1972	SH	
Naso horacanthur	Tenguhagi	ů N	24	Not recorded in 1070	<u>ес</u>	
waso nexacaninus	-modoki	U	20	1101 ICOIUCU III 1972"	sc	
Naso lituratus	Miyako	0	16	Not recorded in 1972	SH	
Naso unicornis	-œngunagi Tenguhagi	259	34	0.13	SH	
Prionurus scalnrum	Nizadai	111	0	Not recorded in 2005	TH	
Zebrasoma scopas	Gomahagi	0	1	Not recorded in 1972 ^a	SH	

Zebrasoma veliferum	Hirenagahagi	2	17	8.50	SH	
Sphyraenidae						
Sphyraena obtusata*	Taiwan-kamasu		20			3
Balistidae						
Balistoides conspicillum	Mongara -kawahagi	1	3	3.00	SC	
Odonus niger	Aka-mongara	0	1	Not recorded in 1972 ^a	SC	
Sufflamen bursa	Musume-hagi	0	19	Not recorded in 1972 ^a	SC	
Sufflamen chrysopterum	Tsumajiro -mongara	0	63	Not recorded in 1972 ^a	SC	
Monacanthidae						
Cantherhines dumerilii	Hakusei-hagi	0	8	Not recorded in 1972 ^a	SC	
Paraluteres prionurus	Nokogiri-hagi	0	5	Not recorded in 1972 ^a	SO	
Ostraciidae						
Ostracion cubicum	Minami -hakofugu	1	4	4.00	TC	
Ostracion immaculatus	Hakofugu	0	1	Not recorded in 1972 ^a	TC	
Tetraodontidae						
Arothron nigropunctatus	Kokuten-fugu	0	13	Not recorded in 1972 ^a	SC	
Canthigaster axiologa	Hana -kinchakufugu	0	32	Not recorded in 1972 ^a	SC	
Canthigaster rivulata	Kitamakura	3	0	Not recorded in 2005	TO	
Canthigaster valentini	Shima -kinchakufugu	0	55	Not recorded in 1972 ^a	SO	
Diodontidae						
Diodon holocanthus	Harisenbon	0	5	Not recorded in 1972 ^a	TC	
Diodon hystrix	Nezumifugu	2	0	Not recorded in 2005	SC	

Species names follow Nakabo (2013)

Bold letters in abundance indicate the 10-most-abundant species

Asterisks indicate species eliminated from the Results (see Data analysis section)

Reason for its elimination from the Results: 1, species which would not have been counted in the precious census in 1972; 2, newly described species; 3, pelagic species

The main geographic distribution and trophic groups of each species were categorized as: SC: subtropical carnivore, SH: subtropical herbivore, SO: subtropical omnivore, TC: temperate carnivore, TH: temperate herbivore, TO: temperate omnivore.

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Fig. 2



Fig. 3





