



# What Is Known of Fish Diversity in the Sea of Japan? Flatfishes: A Case Study

# 6

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## Abstract

The pleuronectiform fauna in the Sea of Japan is considered as a case study exemplifying the diversity of fishes in the region. A total of 72 species plus one species complex in eight families is listed, with detailed distributional information based on voucher specimens and photographic records. A further 17 species listed in published literature are excluded from the Sea of Japan faunal list at this time, due to a lack of evidence of their occurrence. The species composition of pleuronectiform fishes changes drastically from warm-water to cold-water species along the coast of northern Japan and the east coast of the Korean Peninsula. A comparison of regional community structures in western Wakasa Bay, surveyed in the early 1970s and over 40 years later, indicated that the makeup of resident species and their abundance had changed significantly during the intervening time.

## Keywords

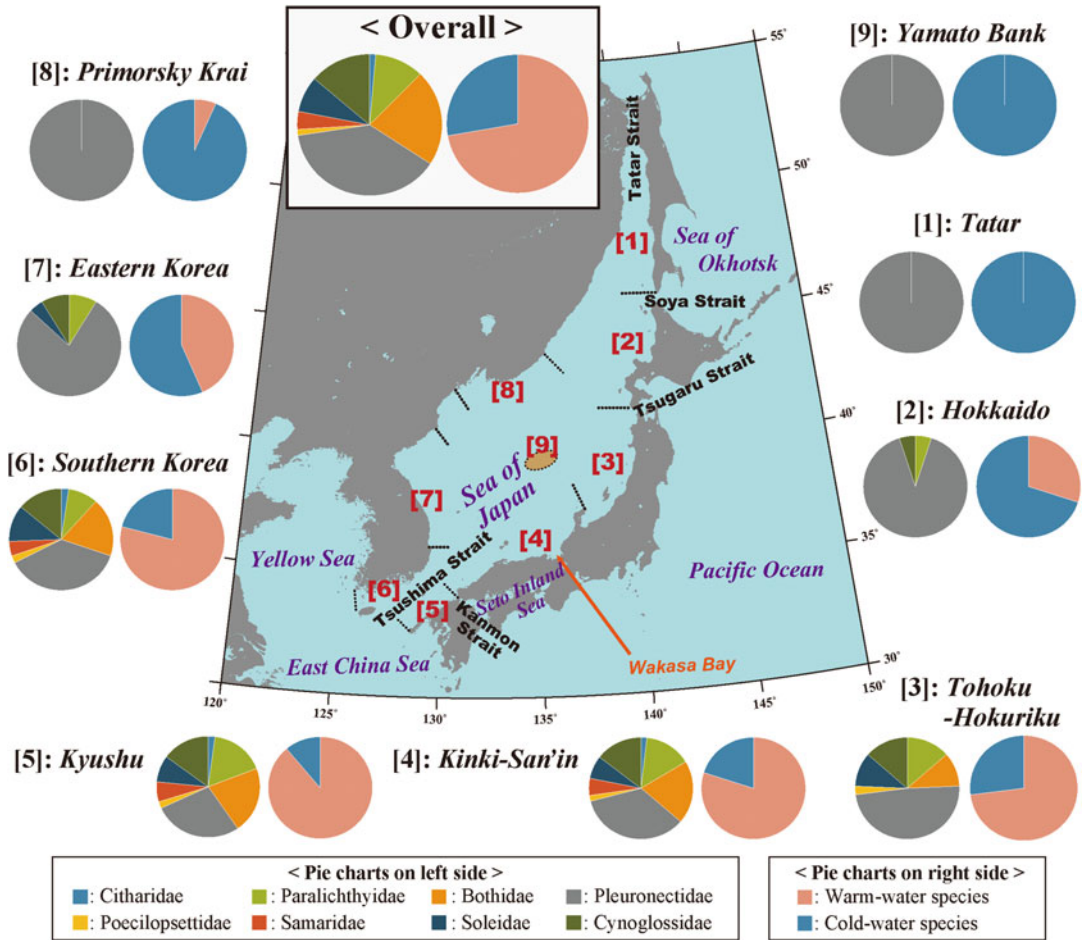
Fish fauna · Pleuronectiformes · Tsushima Warm Current · Japanese Archipelago · Korea · Russia · Vouchers · Zoogeography

## 6.1 Sea of Japan

The Sea of Japan (also called the Japan Sea) is surrounded by the eastern margin of the Eurasian Continent and the Japanese Archipelago and is connected to the adjacent water bodies (East China–Yellow seas, Pacific Ocean, and Sea of Okhotsk) through shallow narrow straits (Fig. 6.1). The water mass structure of the Sea of Japan is characterized by surface water influenced by the Tsushima Warm Current and the Liman Cold Current, and a deep layer (Japan Sea Proper Water) occurring in depths of approximately 200–300 m and deeper. The Tsushima Warm Current, a combination of a branch of the Kuroshio Current and the Taiwan Current, enters the sea through the Tsushima Strait (situated to the southwest) and flows northward along the Japanese Archipelago and the east coast of the Korean Peninsula. On the other hand, the much weaker Liman Cold Current, fed by the Amur River, flows southward along the Eurasian Continent through the Tatar (Mamiya) Strait. The Japan Sea Proper Water is generated by the subsidence of surface water in winter, spreading evenly through the deep water layers without mixing with adjacent water bodies, due to the shallowness of the connecting straits (Kawamura 1998; Gamo et al. 2014).

Because the Sea of Japan is a semi-enclosed water body, the physical environment has been influenced by a number of environmental changes (mostly associated with changing climatic

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**Fig. 6.1** Map of the Sea of Japan with flatfish species composition by family in the entire sea and each of nine areas (see text)

conditions) that have occurred in the past. These have corresponded with changing biocoenosis, with repeated mass mortality and recovery of certain marine fauna over the last 85,000 years. Many marine (especially deep-sea) species became extinct 27,000–20,000 years BP due to closure and isolation of the sea due to declining seawater levels, and the stratification of water layers, including strongly anoxic conditions caused by fresh water inflow from the land. Subsequently, a full-scale recovery of the Sea of Japan marine communities leading to their present condition, began 20,000–10,000 years BP with the inflow of the Oyashio Current from the Pacific Ocean through the Tsugaru Strait. From

ca. 10,000–8000 years BP, intermittent inflows of the Tsushima Warm Current began from the southwest, becoming continuous some 8000 years ago, resulting in the present day oceanophysical environment. Details on the physical features and geological history of the Sea of Japan are shown in such as Oba et al. (1991), Tada (1994), and Koizumi (2006).

In general, the species diversity of marine organisms inhabiting the Sea of Japan is considered to be much poorer than that in the adjacent seas (Naganuma 2000; Tyler 2002), due primarily to the short geological history (only 8000 years since formation) and physical structure of the former (e.g., small tidal range and lack of coral

reefs). Saburo Nishimura (1930–2001), an eminent Japanese biologist, published many works on the marine biology and zoogeography of the Sea of Japan, the series of publications comprising his doctoral thesis (Nishimura 1965a, b, 1966, 1968, 1969) revealing distributional aspects of marine animals in the Sea of Japan, based on a prodigious amount of data and literature information. Subsequently, zoogeography of the Sea of Japan, particularly with regard to marine fishes, was further explored from an evolutionary perspective (Nishimura 1974). Many of his findings are still considered basic to and important for the zoogeography of the Sea of Japan marine fauna.

## 6.2 Fishes of the Sea of Japan

Marine fishes are important food resources for the countries bordering the Sea of Japan, leading to many studies on fish species diversity. The first comprehensive survey of fish species diversity in the Sea of Japan originated from the USS Albatross cruise in 1906 (Nishimura 1974; Dunn 1996), a species checklist published by Snyder (1912) also including the distribution of each species in Japanese waters. A few years earlier, Schmidt (1904) had published a species list for the Russian Far East, based on Russian museum specimens. In subsequent years, researchers in Japan, Korea, and the Russian Far East have played central roles in clarifying the fish fauna of the Sea of Japan (e.g., Tanaka 1931; Kim et al. 2005; Parin et al. 2014; Kawano et al. 2014). However, because most of those studies emphasized the fish fauna of specific areas, species lists covering the entire Sea of Japan have been limited to a series of studies by the Russian Ichthyologist G. U. Lindberg and his colleagues, “Fishes of the Sea of Japan and the Adjacent Areas of the Sea of Okhotsk and the Yellow Sea, Parts 1–7” (Lindberg and Legeza 1959, 1965; Lindberg and Krasnyukova 1969, 1975, 1987; Lindberg and Fedorov 1993; Lindberg et al. 1997). Although species commonly found in the sea were listed, it became obvious that the lists were inadequate due to limited materials (old specimens in the Zoological Institute, Russian

Academy of Sciences, St. Petersburg, plus literature records).

Fish species lists for Japanese waters overall in the Sea of Japan were compiled by Kato (1956), Yoshida and Ito (1957), Tsuda (1990), Nakabo (2013), and Kawano et al. (2014). Additionally, many other species lists compiled over the same period focused on specific regions, habitats or taxa: e.g., Maeda and Tsutsui (2003) (Hokkaido); Shiogaki et al. (2004) (Aomori); Honma (2013) (Niigata); Nambu (2013) (Toyama); Sakai et al. (1991) and Yamamoto et al. (1995) (Ishikawa); Takegawa and Morino (1970), Minami et al. (1977), and Uchino et al. (1982) (Kyoto); Watanabe and Ito (1958) and Suzuki et al. (2000) (Hyogo); Moriwaki et al. (2007) (Shimane); Kawano et al. (2011), Fujiwara et al. (2018), and Sonoyama et al. (2020) (Yamaguchi); Yogo et al. (1986) and Nishida et al. (2004, 2005) (Fukuoka); Takeuchi et al. (2015) (Tsushima Island); Shinohara et al. (2011, 2014) (deep-water species in the entire sea); Tashiro et al. (2015) [*Pseudorhombus* (Paralichthyidae) of the coast of Japan]; Matsui et al. (2014) (gobioid species in Wakasa Bay); Matsunuma et al. (2019) (carangid species in Wakasa Bay and adjacent waters). Many more local lists were included in Kawano et al. (2014). In Korean waters, for example, Jordan and Metz (1913), Mori (1952), Chyung (1977), Kim et al. (2005), Kim and Ryu (2016), and Kim et al. (2020) compiled comprehensive species lists, with several additional lists compiled for Jeju Island, off the southern Korean Peninsula (e.g., Kim et al. 2009; Kim and Nakaya 2013; Kwun et al. 2017). Additionally, Ik-Soo Kim and his colleagues reviewed the taxonomy of several groups in Korean waters: e.g., Tetraodontoidei by Kim and Lee (1990); Blennioidei and Zoarcoidei by Kim and Kang (1991); Cottidae by Kim and Youn (1992); Cynoglossidae by Kim and Choi (1994); Pleuronectiformes by Kim and Youn (1994); and Percoidei by Kim et al. (2001). A considerable amount of additional information on Korean marine fishes was included in Kim et al. (2005) and Kim (2009). For Russian waters, an almost complete species list supported by a

huge amount of literature information was published by Parin et al. (2014).

Clearly, despite a comprehensive list of fish species overall in the Sea of Japan having been limited to the studies of G. U. Lindberg and his colleagues, information on regional species diversity is vast. However, the compilation of a complete species list (with distributional ranges for each species) based on representative regional lists [Kawano et al. 2014 (Japanese), Kim et al. 2005 and Kim et al. 2020 (Korean), and Parin et al. 2014 (Russia)] is hampered by the existence of many unreliable records. Even now, some species identifications and distribution in the Sea of Japan are unclear.

### 6.3 Review of the Flatfish Fauna in the Sea of Japan

Flatfishes of the order Pleuronectiformes include many commercially important species for fishery activities in Japan, including several targeted for recreational angling. Significantly, these fishes comprise a principal catch component on the Japanese coast of the Sea of Japan (MAFF 2021). Accordingly, Japanese fisheries research institutions located along the Sea of Japan coast have actively engaged in various ecological (e.g., growth, population dynamics, and biomass) and aquacultural studies.

To date, a total of 88 valid flatfish species plus one species complex, representing eight families, have been recorded from the Sea of Japan (Table 6.1; Kawano et al. 2014; Parin et al. 2014; Kim et al. 2020; Sonoyama et al. 2020). However, records for many of these are not supported by vouchers, such as museum specimens. It is anticipated that flatfishes will be an important group for studying the evolution (including biogeography) of fishes inhabiting the Sea of Japan, since the former is one of the few groups distributed throughout the entire sea. Therefore, a clear understanding of flatfish species diversity may provide significant insight for our understanding of overall fish species diversity in the sea. Notwithstanding, our knowledge of flatfish species diversity—the most fundamental

biological information—remains poor, with even the distribution of each species being poorly understood [see Nakabo 2013].

In this chapter, the flatfish fauna of the entire Sea of Japan is reviewed as a first step toward accurately understanding the process and drivers of species diversity of fishes in the Sea of Japan.

#### 6.3.1 Species Checklist: What Species and Where?

A reconstructed species list based on museum specimens and photographic records is shown in Table 6.1 and Appendix. A total of 72 species plus one species-complex, all after metamorphosis, are recognized from the Sea of Japan, as follows: 27 species plus one species-complex in Pleuronectidae (37.5%), 16 species in Bothidae (22.2%), 10 species in Cynoglossidae (13.9%), eight species in Paralichthyidae (11.1%), six species in Soleidae (8.3%), three species in Samaridae (4.2%), and one species each in Citharidae and Poecilopsettidae (each 1.4%). At this time, no evidence has been found to support the occurrence of the following 17 species: *Lepidoblepharon ophthalmolepis* (Citharidae); *Pseudorhombus duplicioccellatus* (Paralichthyidae); *Arnoglossus japonicus*, *Bothus myriaster*, *Bothus pantherinus*, *Engyprosope macroptera*, and *Parabothus coarctatus* (all Bothidae); *Pleuronectes bilineatus*, *Limanda proboscidea*, and *Reinhardtius hippoglossoides* (all Pleuronectidae); *Samariscus latus* (Samaridae); *Aesopia cornuta*, *Liachirus melanospilus*, and *Soleichthys heterorhinus* (all Soleidae); and *Cynoglossus arel*, *Cynoglossus bilineatus*, and *Cynoglossus nigropinnatus* (all Cynoglossidae) (Table 6.1). The Sea of Japan is divided into nine areas, together with the characteristics of each.

The “Tatar” area, located in the northernmost part of the sea, is connected to the Sea of Okhotsk, to the north via the Tatar Strait, and to the south via the Soya (La Pérouse) Strait (Fig. 6.1). A total of only 16 flatfish species are recognized (Table 6.1; Appendix), all being pleuronectids. On the other hand, no reliable

**Table 6.1** Species list of flatfishes in the Sea of Japan

Family	Species	W/ C <sup>a</sup>	Overall Previous <sup>b</sup>	Revised	Tatar	Hokkaido	Tohoku- Hokuriku	KinKi- San'in	Kyushu	Southern Korea	Eastern Korea	Primorsky Krai	Yamato Bank	
Citharidae	<i>Lepidoblepharon ophthalmolepis</i>	W	Present					+						
	<i>Citharoides macrolepidotus</i>	W	Present	+					+					
	<i>Paralichthys olivaceus</i>	W	Present	+		+					+			
	<i>Pseudorhombus arsius</i>	W	Present	+					+					
	<i>Pseudorhombus cinnamomeus</i>	W	Present	+		+			+					
	<i>Pseudorhombus duplisciocellatus</i>	W	Present											
	<i>Pseudorhombus oculocirris</i>	W	Present	+			+		(+)					
	<i>Pseudorhombus oligodon</i>	W	Present	+					+					
	<i>Pseudorhombus pentophthalmus</i>	W	Present	+					+			+		
	<i>Tarphops elegans</i>	W	Present	+										
Bothidae	<i>Tarphops oligolepis</i>	W	Present	+			+							
	<i>Arnoglossus japonicus</i>	W	Present											
	<i>Arnoglossus polycephalus</i>	W	Present	+										
	<i>Arnoglossus tenuis</i>	W	Present	+										
	<i>Arnoglossus yamanakai</i>	W	Present	+					+					
	<i>Asterorhombus intermedius</i>	W	Present	+										
	<i>Bothus myriaster</i>	W	Present											
	<i>Bothus pantherinus</i>	W	Present											
	<i>Crossorhombus kanekonis</i>	W	Present	+										
	<i>Crossorhombus kobensis</i>	W	Present	+										
	<i>Engyprosoon grandisquama</i>	W	Present	+										

(continued)

Table 6.1 (continued)

Family	Species	W/ C <sup>a</sup>	Overall		Tatar	Hokkaido	Tohoku- Hokuriku	Kinki- San'in	Kyushu	Southern Korea	Eastern Korea	Primorsky Krai	Yamato Bank
			Previous <sup>b</sup>	Revised									
	<i>Engyprosopon longipelvis</i>	W	Present	+			+						
	<i>Engyprosopon macroptera</i>	W	Present			+							
	<i>Engyprosopon multispinosa</i>	W	Present	+				+	(+)				
	<i>Japonolaeops dentatus</i>	W	Present	+				+		+			
	<i>Kamoharaiia megastoma</i>	W	Present	+						+			
	<i>Laeps kitaharae</i>	W	Present	+				+	(+)	+			
	<i>Parabothus kiensis</i>	W	Present	+						+			
	<i>Parabothus coarctatus</i>	W	Present										
	<i>Psettina iijimae</i>	W	Present	+				+	(+)				
	<i>Psettina tozana</i>	W	Present	+				+	+	+			
	<i>Tosarhombus octoculatus</i>	W		+					+				
Pleuronectidae	<i>Acanthopsetta nadeshnyi</i>	C	Present	+	+	+	+	+			+	+	+
	<i>Atheresthes evermanni</i>	C	Present	+				+					
	<i>Cleisthenes pinetorum</i>	C	Present	+	+	+	+	+	+	+	+	+	
	<i>Clidoderma asperrimum</i>	C	Present	+	+	+	+	+	(+)	+	+	+	
	<i>Dexistes rikuzenius</i>	W	Present	+				+	(+)	+	+		
	<i>Eopsetta grigorjewi</i>	W	Present	+				+	+	+	+		
	<i>Glyptocephalus kitaharae</i>	W	Present	+				+	(+)	+			
	<i>Glyptocephalus stelleri</i>	C	Present	+	+	+	+	+	+	+	+	+	+
	<i>Hippoglossoides dubius</i>	C	Present	+	+	+	+	+			+	+	+
	<i>Hippoglossoides elassodon/robustus</i>	C	Present	+	+	+							



Table 6.1 (continued)

Family	Species	W/ C <sup>a</sup>	Overall		Tatar	Hokkaido	Tohoku- Hokuriku	Kimki- San'in	Kyushu	Southern Korea	Eastern Korea	Primorsky Krai	Yamato Bank
			Previous <sup>b</sup>	Revised									
Soleidae	<i>Aesopia comuta</i>	W	Present										
	<i>Aseraggodes kaianus</i>	W	Present	+						+			
	<i>Aseraggodes kobensis</i>	W	Present	+			+	+	(+)	+			
	<i>Brachirus annularis</i>	W	Present	+						+			
	<i>Liachirus melanospilus</i>	W	Present										
	<i>Heteromycteris japonica</i>	W	Present	+			+	+	(+)				
	<i>Pseudaesopis japonica</i>	W	Present	+			+	+	(+)	+	+		
	<i>Soleichthys heterorhinos</i>	W	Present										
	<i>Zebrias zebrinus</i>	W	Present	+			+	+	(+)	+			
	<i>Cynoglossus abbreviatus</i>	W	Present	+									
	<i>Cynoglossus arel</i>	W	Present										
	<i>Cynoglossus bilineatus</i>	W	Present										
	<i>Cynoglossus interruptus</i>	W	Present	+			+	+		+			
	<i>Cynoglossus itinus</i>	W	Present	+									
	<i>Cynoglossus joyneri</i>	W	Present	+			+	+	+	+	+		
	<i>Cynoglossus nigropinnatus</i>	W	Present										
<i>Cynoglossus ochiaii</i>	W	Present	+			+	+		(+)				
<i>Cynoglossus robustus</i>	W	Present	+						+	+			
<i>Cynoglossus semilaevis</i>	W	Present	+						+	+			
<i>Paraplagusia japonica</i>	W	Present	+			+	+	+	+	+			
<i>Symphurus longirostris</i>	W	Present	+			+	+						
<i>Symphurus orientalis</i>	W	Present	+										
Total number of species <sup>c</sup>		89	73	16	19	37	55	47	43	23	15	3	

+, records supported by vouchers such as museum specimens and/or photos

(+), records lacking vouchers, but distribution presumed based on occurrence in adjacent water body (including East China Sea)

<sup>a</sup>W warm-water species mainly distributed in Kuroshio waters, C cold-water species mainly in Oyashio waters

<sup>b</sup>Data from Kawano et al. (2014), Parin et al. (2020), and Sonoyama et al. (2020)

<sup>c</sup>Including *Hippoglossoides elassodon/Hippoglossoides robustus* species complex if recorded from area



records exist for the following species, all included in this area by Parin et al. (2014): *Atheresthes evermanni*, *Eopsetta grigorjewi*, *Hippoglossus stenolepis*, *Limanda aspera*, *Microstomus achne*, *Platichthys bicoloratus*, *Reinhardtius hippoglossoides*, *Verasper moseri*, and *Verasper variegatus* (all Pleuronectidae).

The “Hokkaido” area, located in the northeastern part of the sea, is connected to the Sea of Okhotsk in the north via the Soya Strait and to the Pacific Ocean in the south via the Tsugaru Strait (Fig. 6.1). A total of 19 species in three families are recognized (Table 6.1; Appendix), 17 in Pleuronectidae (90%), and one each in Paralichthyidae and Cynoglossidae (each 5%). Despite being included in Kawano et al. (2014), records for the following species could not be confirmed: *Pseudorhombus pentophthalmus* and *Tarphops oligolepis* (Paralichthyidae); *Atheresthes evermanni*, *Dexistes rikuzenius*, *Glyptocephalus kitaharae*, *Lepidopsetta billineata*, *Liopsetta pinnifasciata*, *Pleuronectes quadrituberculatus*, *Pseudopleuronectes obscurus*, *Reinhardtius hippoglossoides*, *Verasper moseri*, and *Verasper variegatus* (all Pleuronectidae); and *Pseudaesopis japonica* (Soleidae).

The “Tohoku-Hokuriku” area, the eastern to southern part of the sea, is connected to the Pacific Ocean in the north via the Tsugaru Strait (Fig. 6.1). A total of 37 species in six families (about half of all species) are recognized herein (Table 6.1; Appendix): 18 species in Pleuronectidae (48.6%), five species each in Cynoglossidae and Paralichthyidae (each 13.5%), four species each in Bothidae and Soleidae (each 10.8%), and one species in Poecilopsettidae (2.7%). Records of the following species, included in Kawano et al. (2014), could not be confirmed: *Lepidoblepharon ophthalmolepis* (Citharidae); *Tarphops elegans* (Paralichthyidae); *Arnoglossus tenuis*, *Crossorhombus kobensis*, *Engyprosopon grandisquama*, and *Psettina tosana* (all Bothidae); *Atheresthes evermanni*, *Hippoglossoides elassodon* species complex, *Hippoglossus stenolepis*, *Lepidopsetta billineata*, *Liopsetta pinnifasciata*, *Reinhardtius*

*hippoglossoides*, and *Verasper moseri* (all Pleuronectidae); *Samariscus japonicus* (Samaridae); *Aesopia cornuta* (Soleidae); and *Cynoglossus robustus* (Cynoglossidae).

The “Kinki-San’in” area, located in the south to southwestern part of the sea, is connected to the Seto Inland Sea in the west via the Kanmon Strait (Fig. 6.1). A total of 55 species in six families (about three-fourths of all species) are recognized herein (Table 6.1; Appendix): 19 species in Pleuronectidae (34.5%), 11 species in Bothidae (20.0%), eight species each in Cynoglossidae and Paralichthyidae (each 14.5%), four species in Soleidae (7.3%), three species in Samaridae (5.5%), and one species each in Citharidae and Poecilopsettidae (each 1.8%). Records of the following species included in Kawano et al. (2014) could not be confirmed: *Lepidoblepharon ophthalmolepis* (Citharidae); *Pseudorhombus dupliocellatus* (Paralichthyidae); *Arnoglossus japonicus*, *Bothus pantherinus*, *Bothus myriaster*, *Engyprosopon macroptera*, and *Parabothus coarctatus* (all Bothidae); *Lepidopsetta bilineata*, *Pseudopleuronectes schrenki*, and *Reinhardtius hippoglossoides* (all Pleuronectidae); *Samariscus latus* (Samaridae); *Aesopia cornuta*, *Aseraggodes kaianus*, *Liachirus melanospilus*, and *Soleichthys heterorhinos* (all Soleidae); and *Cynoglossus arel*, *Cynoglossus bilineatus*, and *Cynoglossus nigropinnatus* (all Cynoglossidae).

The “Kyushu” area, located in the southernmost part of the sea, is connected to the Seto Inland Sea in the east via the Kanmon Strait (Fig. 6.1). Because specimens examined by the author and voucher specimens supporting published lists were much fewer than for the other Japanese areas, the present species list for this area includes many presumptive species (Table 6.1). A total of 47 species (including 23 presumptive) in eight families are included, as follows: 13 species in Pleuronectidae (27.7%), 10 species in Bothidae (21.3%), eight species in Paralichthyidae (17.0%), seven species in Cynoglossidae (14.9%), four species in Soleidae (8.5%), three species in Samaridae (6.4%), and one species each in Citharidae and Poecilopsettidae (each 2.1%) (Table 6.1; Appendix). Despite being listed by Kawano et al. (2014)

and Takeuchi et al. (2015), records of the following species could not be confirmed: *Arnoglossus japonicus* (Bothidae), *Aesopia cornuta* and *Aseraggodes kaianus* (Soleidae), and *Cynoglossus arai* (Cynoglossidae).

The “Southern Korea” area, forming the southernmost part of the sea together with the Kyushu area, is connected to both the East China and Yellow seas (Fig. 6.1). Based on published lists supported by voucher specimens (e.g., Lindberg and Fedorov 1993; Kim and Youn 1994; Kim and Ryu 2016), a total of 43 species in eight families are recognized herein (Table 6.1; Appendix): 16 species in Pleuronectidae (37.2%), eight species in Bothidae (18.6%), six species in Cynoglossidae and (14.0%), five species in Soleidae (11.6%), four species in Paralichthyidae (9.3%), two species in Samaridae (4.7%), and one species each in Citharidae and Poecilopsettidae (each 2.3%). Records could not be confirmed for the following species: *Pseudorhombus oculocirris* and *Tarphops elegans* (Paralichthyidae); *Arnoglossus japonicus*, *Bothus myriaster*, *Crossorhombus kobensis*, and *Psettina ijimae* (all Bothidae); *Lepidopsetta mochigarei*, *Pseudopleuronectes obscurus*, and *Verasper moseri* (all Pleuronectidae); *Aesopia cornuta* and *Heteromycteris japonica* (Soleidae); and *Cynoglossus gracilis* (Cynoglossidae).

The “Eastern Korea” area is defined herein as the east coast of the Korean Peninsula, north of Pohang (Fig. 6.1). On the basis of literature covering the Southern Korea area, a total of 24 species (including two presumptive) in eight families are recognized (Table 6.1; Appendix): 19 species in Pleuronectidae (79.2%), two species each in Cynoglossidae and Paralichthyidae (8.3%), and one species in Soleidae (4.2%). A fauna of flatfishes in this area is characterized by mostly pleuronectids with a small number of other families. Records could not be confirmed for the following species: *Bothus myriaster* (Bothidae); *Lepidopsetta billineata*, *Liopsetta pinnifasciata*, and *Verasper moseri* (all Pleuronectidae); and *Aseraggodes kobensis* (Soleidae).

The “Primorsky Krai” area, in the northwestern part of the sea (Fig. 6.1), is characterized by a

relatively low flatfish diversity, comprising only 15 species (all in Pleuronectidae) (Table 6.1; Appendix). Despite being included in the comprehensive list given by Parin et al. (2014), records could not be confirmed for the following species: *Paralichthys olivaceus* (Paralichthyidae); *Eopsetta grigorjewi*, *Hippoglossus stenolepis*, *Microstomus achne*, *Platichthys bicoloratus*, *Pleuronectes quadrituberculatus*, *Pleuronichthys* spp., *Pseudopleuronectes yokohamae* (all Pleuronectidae); and *Cynoglossus itinus* and *Symphurus orientalis* (Cynoglossidae).

The “Yamato Bank” area, located in the central Sea of Japan, is an underwater mountain range (236 m depth at its shallowest) comprising the Yamato Bank and seamounts scattered in deep water off the southern Yamato Bank (Fig. 6.1). Only three pleuronectid species, also listed in Shinohara et al. (2011) on the basis of museum specimens, are recognized herein (Table 6.1; Appendix).

### 6.3.2 Faunal Characteristics

It is well established that the community structures of shallow-water fishes in the Sea of Japan change drastically between southern Hokkaido and northern Tohoku, and off the east coast of the Korean Peninsula (e.g., Nishimura 1965a; Kafanov et al. 2000), due to the influence of environmental factors, such as the path of the Tsushima Warm Current flowing from the south, the path of the North Korean Cold Current flowing along the continental coast, and different climatic conditions. Additionally, these and other environmental factors have also resulted in a wide transition zone of warm- and cold-water fishes, especially along the coast of Honshu Island, Japan. There are various theories about a zooogeographic boundary for fishes in the Sea of Japan [see Nishimura 1965a; Kafanov et al. 2000].

Similar patterns can be seen in the species diversity of flatfishes. Warm-water species (e.g., Bothidae, Cynoglossidae, Paralichthyidae, and a few species of Pleuronectidae) are dominant in

the *Kyushu*, *Kinki-San'in*, *Tohoku-Hokuriku*, and *Southern Korea* areas, which are strongly influenced by the Tsushima Warm Current, whereas a less diverse fauna, comprising mostly cold-water species (Pleuronectidae), dominate the *Eastern Korea*, *Primorsky Krai*, and *Tatar* areas (all strongly influenced by cold water currents), and the *Hokkaido* area (Tsushima Warm Current flows along the coast but exposed to a cold climate). In addition, a gradual shift in fauna from warm- to cold-water species, and vice versa, has been observed in the waters between the *Kinki-San'in* (20% and 80%, respectively) and *Tohoku-Hokuriku* (27% and 73%, respectively) areas (Fig. 6.1). A comparison of the fauna of these areas based on more fine-scaled data should result in clearer transition patterns being observed.

Although some pleuronectid species, such as *Cleisthenes pinetorum*, *Clidoderma asperrimum*, *Glyptocephalus stelleri*, and *Pseudopleuronectes herzensteini*, are distributed throughout the Sea of Japan (Table 6.1), most have a more or less limited distribution, toward to the north (warm-water species) or south (cold-water species). Interestingly, the distributional limits vary among species, even if closely related. For example, the abundant bothid *Engyprosonon multisquama* is widely distributed from Kyushu to Tohoku on the Japanese coast, whereas the congeners *E. grandisquama* and *E. longipelvis* are less common and have a northern limit not extending beyond the Noto Peninsula (Appendix). Such small but significant differences in distribution patterns may provide clues to understanding the evolution of fishes in the Sea of Japan.

The reconstructed flatfish faunal list resulting from this most recent assessment of species has a certain similarity to the lists proposed by previous studies, notwithstanding the unsupported records for 17 species (see above). The occurrence of such species in the Sea of Japan should remain questionable until confirmed by voucher specimens—which treatment should also apply to the distributional ranges for each of the recognized species.

### 6.3.3 Temporal Changes in Flatfish Community Structures in Wakasa Bay

Minami et al. (1977) conducted a benthic sledge survey from June 1971 to October 1972 to investigate the benthic fish community in the western part of Wakasa Bay (also called Tango Sea), located on the southern coast of the Sea of Japan (*Kinki-San'in* area) (Fig. 6.1). Recently, the author and colleagues conducted a similar survey (from April 2014 to March 2018) in approximately the same areas as those previously surveyed (off the mouth of the Yura River in depths of 5–60 m). A comparison of the overall results of the two survey programs found an increase in the number of flatfish species from 14 in 1971–1972 to 18 in 2014–2018 (Table 6.2). Among the new records, the paralichthyid *Pseudorhombus oligodon* was particularly notable, having been commonly collected during the later surveys. Additionally, significant fluctuations in abundance were also noted for the cynoglossid *Cynoglossus joyneri* (ca. 100 individuals in 1971–1972 vs. <5 in 2014–2018) and the soleid *Aseraggodes kobensis* (1 in 1971–1972 vs. >50 in 2014–2018).

The paralichthyid *Tarphops oligolepis* is small-sized species mainly inhabiting sandy coastal shores. Because of its abundance, some fundamental biological studies on the species had been undertaken in the Tango Sea [e.g., Minami 1983 (early life history); Kamisaka et al. 1999 (reproductive biology)]. However, the species inexplicably disappeared from the sandy beach (<10 m depth) off the Yura River during 2013–2015 (Tashiro et al. 2017). Although a small number of individuals have been recorded from that area since summer 2016, the cause of this phenomenon is still unclear.

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## 6.4 Conclusion

In recent years, there has been a shift in the community structure of fishes in the Sea of Japan, with an increase in numbers of southern

**Table 6.2** Flatfishes collected during benthic sledge surveys in western Wakasa Bay in 1971–1972 and 2014–2018

Family	Species	1971–1972	2014–2018
Paralichthyidae	<i>Paralichthys olivaceus</i>	+	+
	<i>Pseudorhombus cinnamomeus</i>	+	
	<i>Pseudorhombus oculocirris</i>		+
	<i>Pseudorhombus oligodon</i>		+
	<i>Pseudorhombus pentophthalmus</i>	+	+
	<i>Tarphops elegans</i>	+	
	<i>Tarphops oligolepis</i>	+	+
Bothidae	<i>Arnoglossus tenuis</i>		+
	<i>Engyprosopon multisquama</i>		+
Pleuronectidae	<i>Glyptocephalus kitaharae</i>	+	
	<i>Platichthys bicoloratus</i>	+	+
	<i>Pseudopleuronectes yokohamae</i>	+	+
	<i>Pleuronichthys lighti</i>	+	+
Soleidae	<i>Aseraggodes kobensis</i>		+
	<i>Heteromycteris japonica</i>	+	+
	<i>Pseudaesopis japonica</i>		+
	<i>Zebrias zebrinus</i>		+
Cynoglossidae	<i>Cynoglossus interruptus</i>	+	+
	<i>Cynoglossus itinus</i>		+
	<i>Cynoglossus joyneri</i>	+	+
	<i>Cynoglossus robustus</i>	+	
	<i>Paraplagusia japonica</i>	+	+

Data for 1971–1972 from Minami et al. (1977)

species (warm-water species). Although a causal relationship with global warming has sometimes been suggested (Nishida et al. 2005; Kawano et al. 2014), dispersal linked to expanded distribution may be a natural consequence of evolving species, and most neritic fishes inhabiting adjacent seas can actively or passively enter the Sea of Japan without difficulty. In fact, many incidental cases of warm-water species in the Sea of Japan have been recorded over the years (e.g., Nishimura 1965a; Tashiro et al. 2017; Matsunuma et al. 2019). Because of the young age of the Sea of Japan, thereby resulting in “unexplored” waters, it is likely that some species have been trying to establish viable populations in the sea for a long time. Accordingly, there may be little meaning in discussing changes in community structure and species diversity related to global warming, based on simple comparisons of species numbers. However, the community structure of fishes in the Sea of Japan may have changed over the past few decades as a result of human activities, including not only direct causes

such as overfishing and coastal development but also land-based activities. In order to maintain fish species diversity in the Sea of Japan and continue with associated applied research, the overall fish fauna needs to be identified and confirmed as soon as possible.

This review has adopted a relatively negative view of published fish species lists unsupported by voucher specimens, due to the necessity for scientific research to be “reproducible”. On the other hand, such studies have summarized a very large amount of information from a wide range of sources and have stimulated an interest in species diversity among many subsequent researchers, including myself.

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and Education Agency); Shunsuke Noguchi, Yutaka Kumaki, and crew of *R/V Heian-maru* (Kyoto Institute of Oceanic and Fisheries Science); Nozomu Muto (Tokai University); Gento Shinohara and Masanori Nakae (National Museum of Nature and Science, Tsukuba); Yoshitaka Uchida (Yamaguchi Prefectural Fisheries Research Center); Mitsuo Honma (F. Wave, Sado); staff of Miyazu Energy Research Center Aquarium, staff of JF Kyoto, and Graham S. Hardy (Wangarei, New Zealand).

## Appendix: Checklist of Flatfishes in the Sea of Japan

The systematic arrangement of families follows Nakabo (2013). Scientific names generally follow Nakabo (2013), except for Pleuronectidae, which follow Vinnikov et al. (2018). Specimens examined by the author are deposited at the Kyoto University, Kyoto and Maizuru (FAKU), the Hokkaido University Museum, Hakodate (HUMZ), the National Museum of Nature and Science, Tsukuba (NSMT), and the Seikai National Fisheries Research Institute (SNFR) (see original publications for cited vouchers shown in double quotation marks). Standard length is abbreviated as SL.

### Order Pleuronectiformes

#### Family Citharidae

*Citheroideus macrolepidotus* Hubbs, 1915 [Japanese name: **Kokebirame**] (Fig. 6.2a)

**Kinki-San'in**: FAKU 138113, 106.4 mm SL, off Mishima I., Yamaguchi, 15 June 2015; >5 additional specimens deposited in FAKU and SNFR [see also Shinohara et al. 2011 (“ZIN 45093,” Fukui)]. **Kyushu**: FAKU 134665, 95.2 mm SL, off Tsushima I., Nagasaki, October 30, 2011; two additional specimens deposited in FAKU. **Southern Korea**: See Kim and Ryu (2016) (e.g., “PKU 281–286,” off Jeju I.).

#### Family Paralichthyidae

*Paralichthys olivaceus* (Temminck and Schlegel, 1846) [Japanese name: **Hirame**] (Fig. 6.2b)

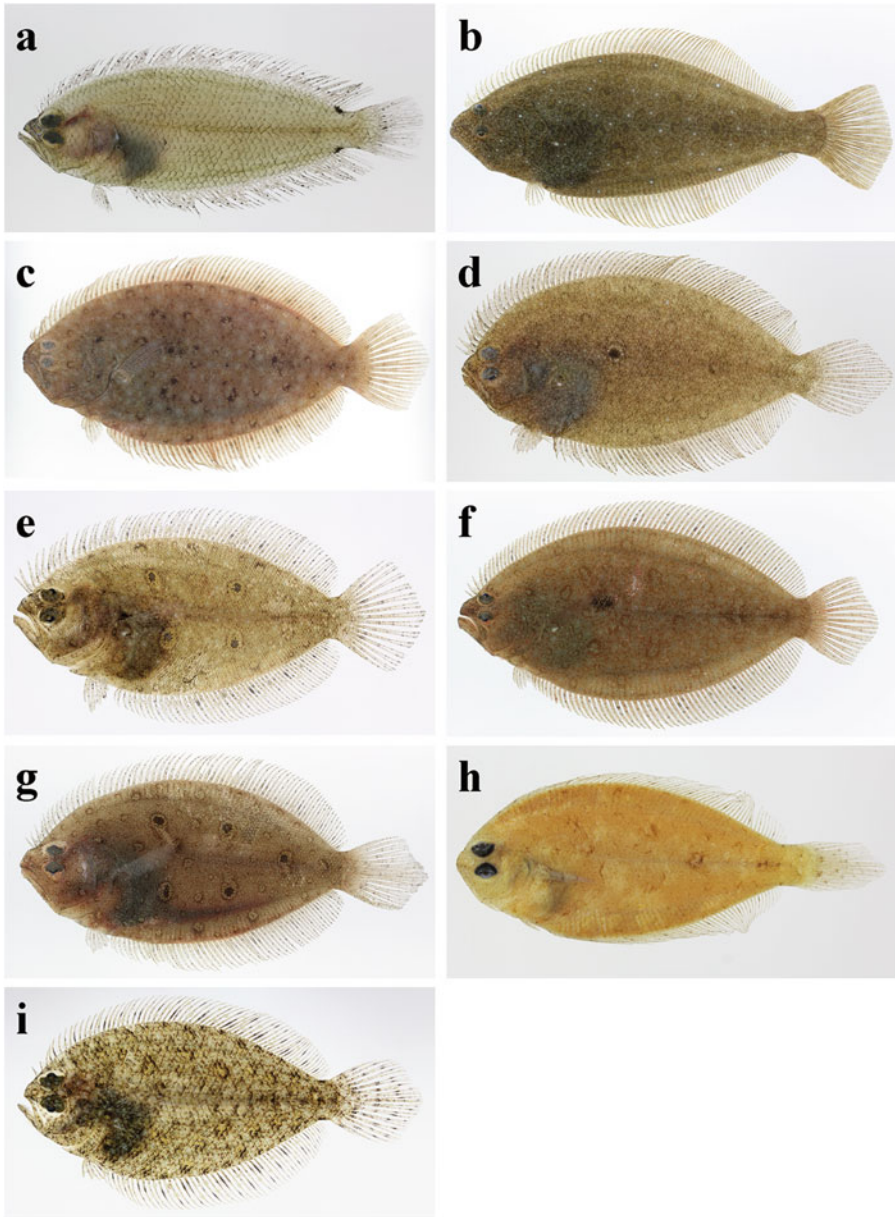
**Hokkaido**: HUMZ 96446, 201.3 mm SL, Ishikari Bay, Hokkaido, 14 September 1982; >10 additional specimens deposited in HUMZ. **Tohoku-Hokuriku**: NSMT-P 73321, two specimens, 127.9–177.8 mm SL, Akita, October 16, 1931; and four additional specimens deposited in HUMZ. **Kinki-San'in**: FAKU 136969, 160.7 mm SL, Wakasa Bay, Kyoto, March 4, 2015; and >10 additional specimens deposited in FAKU and HUMZ. **Kyushu**: FAKU 137390, 227.9 mm SL, off Genkai I., Fukuoka, 18 April 2015; >5 additional specimens deposited in FAKU and NSMT. **Southern Korea**: See Kim and Ryu (2016) (e.g., “PKU 6511,” Yeosu). **Eastern Korea**: See Lindberg and Fedorov (1993) (“ZIN 12378,” Wonsan) and Kim and Ryu (2016) (e.g., “PKU 56317–56325,” Sokcho).

*Pseudorhombus arsius* (Hamilton, 1822) [Japanese name: **Tenjikugarei**] (Fig. 6.2c)

**Kinki-San'in**: FAKU 136988, 285.3 mm SL, Kunda Bay, Miyazu, Kyoto, March 7, 2015. **Kyushu**: FAKU 137382, 166.2 mm SL, off Meinohama, Fukuoka, April 19, 2015; >10 additional specimens deposited in FAKU.

*Pseudorhombus cinnamoneus* (Temminck and Schlegel, 1846) [Japanese name: **Ganzoubirame**] (Fig. 6.2d)

**Tohoku-Hokuriku**: HUMZ 62207, 224.9 mm SL, off Sado I., Niigata, September 23, 1976. **Kinki-San'in**: FAKU 137408, 91.1 mm SL, Wakasa Bay, Kyoto, 2011–2012 (detailed data unknown); >5 additional specimens deposited in FAKU and HUMZ. **Kyushu**: FAKU 101780, 183.1 mm SL, off Tsushima I., Nagasaki, July 31, 1973. **Southern Korea**: See Lindberg and Fedorov (1993) (“ZIN 23735,” Busan) and Kim and Ryu (2016) (e.g., “PKU 8598,” Namhae).



**Fig. 6.2** Families Citharidae and Paralichthyidae. (a) *Citheroides macrolepidotus*, FAKU 138113; (b) *Pseudorhombus oligodon*, FAKU 136982; (c) *Paralichthys olivaceus*, FAKU 136969; (d) *Pseudorhombus arsius*, FAKU 136988; (e) *Pseudorhombus cinnamoneus*, FAKU 137408; (f) *Pseudorhombus oculocirris*, FAKU 145574; (g) *Pseudorhombus pentophthalmus*, FAKU 136887; (h) *Tarphops elegans*, FAKU 145534, preserved condition; (i) *Tarphops oligolepis*, FAKU 144933

*Pseudorhombus oculocirris* Amaoka, 1969  
[Japanese name: Heraganzoubirame]  
(Fig. 6.2e)

*Tohoku-Hokuriku*: See Honma et al. (1990) (“photo,” Kashiwazaki, Niigata). *Kinki-San’in*: FAKU 145574, 62.5 mm SL, off Maizuru, Kyoto, September 25, 2017; >10 additional specimens deposited in FAKU. **Remarks**: Records of this species based on voucher specimens from Southern Korea by Lee and Lee (2007) need to be reexamined.

*Pseudorhombus oligodon* (Bleeker, 1854)  
[Japanese name: Nan’yougareil] (Fig. 6.2f)

*Kinki-San’in*: FAKU 136982, 196.9 mm SL, Maizuru Bay, Maizuru, Kyoto, March 12, 2015; >10 additional specimens deposited in FAKU. *Kyushu*: FAKU 137491, 204.1 mm SL, off Meinohama, Fukuoka, April 19, 2015; one additional specimen deposited in FAKU.

*Pseudorhombus pentophthalmus* Günther, 1862 [Japanese name: Tamaganzoubirame]  
(Fig. 6.2g)

*Tohoku-Hokuriku*: FAKU 137085, two specimens, 70.3–73.9 mm SL, Tsugaru, Aomori, September 5, 2000; >10 additional specimens deposited in FAKU and HUMZ. *Kinki-San’in*: FAKU 136887, 149.9 mm SL, Wakasa Bay, Kyoto, February 2015; >10 additional specimens in FAKU, HUMZ, and SNFR. *Kyushu*: FAKU 114739–114741, three specimens, 99.1–126.3 mm SL, off Nokonoshima I., Fukuoka, 27 September 1981; three additional specimens deposited in FAKU. *Southern Korea*: See Lindberg and Fedorov (1993) (“ZIN 23825,” Busan) and Kim and Ryu (2016) (e.g., “PKU 3264–3267,” Yeosu). *Eastern Korea*: See Kim and Youn (1994) (“CNUC 19681,” Pohang).

*Tarphops elegans* Amaoka, 1969  
[Japanese name: Yumearamegareil] (Fig. 6.2h)

*Kinki-San’in*: FAKU 145534, 72 mm SL, off Hamada, Shimane, July 25, 1973; >10 additional specimens deposited in FAKU.

*Tarphops oligolepis* (Bleeker, 1858–1859)  
[Japanese name: Aramegareil] (Fig. 6.2i)

*Tohoku-Hokuriku*: FAKU 137086, nine specimens, 33.5–56.0 mm SL, off Ajigasawa, Aomori, September 5, 2000; >10 additional specimens deposited in FAKU and HUMZ. *Kinki-San’in*: FAKU 144933, 52.2 mm SL, off Maizuru, Kyoto, May 22, 2017; >10 additional specimens deposited in FAKU and SNFR. *Kyushu*: FAKU 101548, 33.1 mm SL, off Tsushima I., Nagasaki, 1973–1974 (detailed data unknown); three additional specimens deposited in NSMT. *Southern Korea*: See Kim et al. (2009) (“MRIC 2927,” Jeju I.).

### Family Bothidae

*Arnoglossus polyspilus* (Günther, 1880)  
[Japanese name: Nan’youdarumagareil]

*Kinki-San’in*: See Sonoyama et al. (2020) (“SNFR 11126,” off Yamaguchi). *Southern Korea*: See Kim et al. (2010) (“JNU 20040618,” off Jeju I.).

*Arnoglossus tenuis* Günther, 1880  
[Japanese name: Nagadarumagareil]  
(Fig. 6.3a)

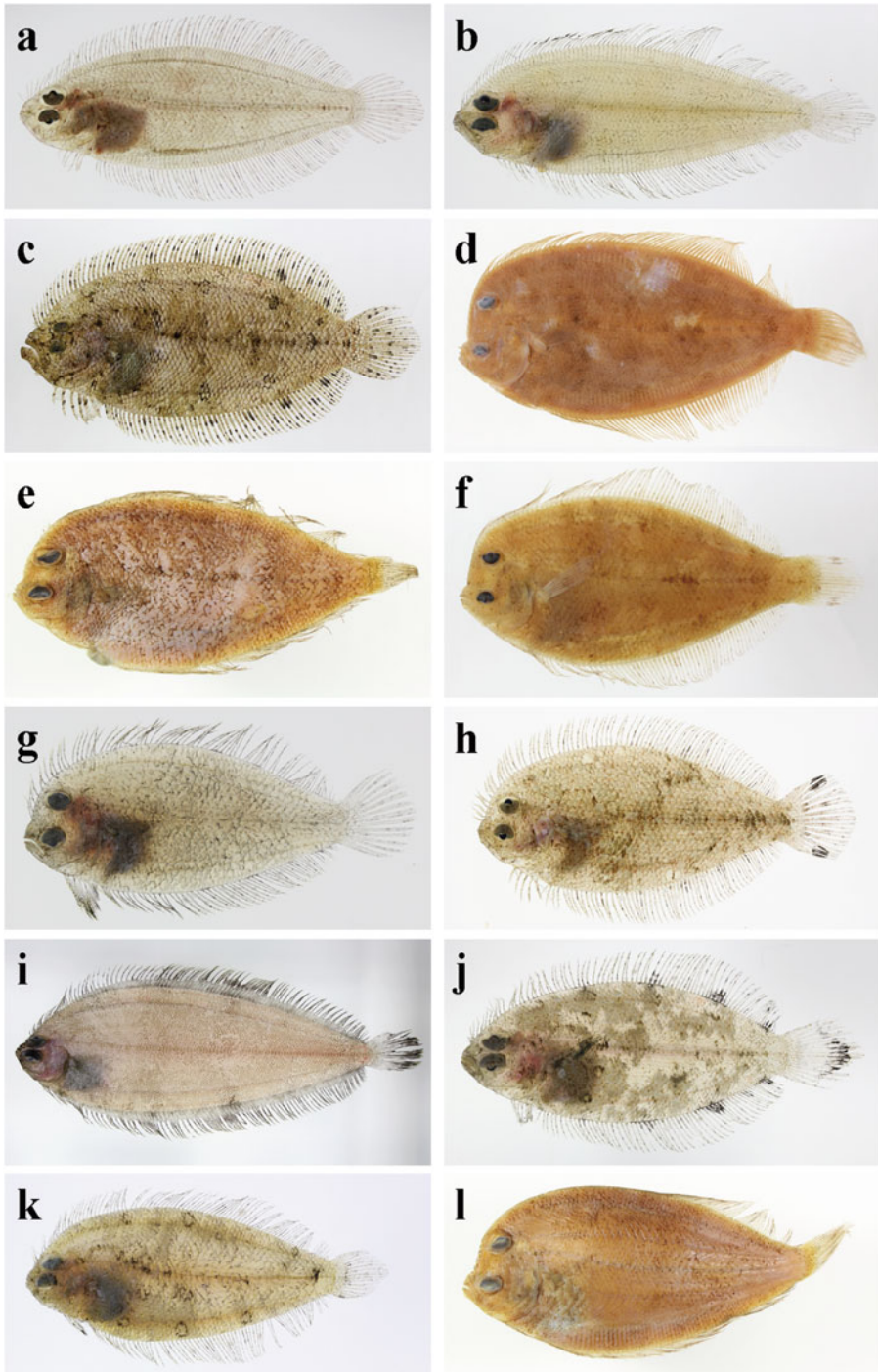
*Kinki-San’in*: FAKU 141371, Maizuru Bay, Kyoto, May 26, 2016; FAKU 134821, three specimens, 60.1–73.8 mm SL, off Senzaki, Yamaguchi, October 6, 2011; >10 additional specimens deposited in FAKU and HUMZ.

*Arnoglossus yamanakai* Fukui, Yamada and Ozawa, 1988 [Japanese name: Tohkainagadarumagareil] (Fig. 6.3b)

*Kinki-San’in*: FAKU 136241, 40.4 mm SL, off Ine, Kyoto, September 10, 2014; FAKU 145489, 99.7 mm SL, off Oumi-jima I., Yamaguchi, June 20, 2017; one additional specimen deposited in FAKU. *Kyushu*: FAKU 134667, 95.0 mm SL, off Tsushima I., Nagasaki, November 28, 2008.

*Asterorhombus intermedius* (Bleeker, 1865)  
[Japanese name: Seitenbirame] (Fig. 6.3c)

*Tohoku-Hokuriku*: HUMZ 231988, 29.5 mm SL, off Sado I., Niigata, September 16, 2020.



**Fig. 6.3** Family Bothidae. (a) *Arnoglossus tenuis*, FAKU 141371; (b) *Arnoglossus yamanakai*, FAKU 145489; (c) *Asterorhombus intermedius*, FAKU 144467; (d) *Crossorhombus kanekonis*, FAKU S198, preserved condition; (e) *Crossorhombus kobensis*, NSMT-P 94323, preserved condition; (f) *Engyprosopon grandisquama*,

FAKU 145532, preserved condition; (g) *Engyprosopon longipelvis*, FAKU 138918; (h) *Engyprosopon multisquama*, FAKU 143517; (i) *Laeops kitaharae*, FAKU 136454; (j) *Psettina iijimae*, FAKU 136867; (k) *Psettina tosana*, FAKU 138915; (l) *Tosarhombus octoculatus*, NSMT-P 94322, preserved condition



***Kinki-San'in***: FAKU 144467, 137 mm SL, Miyazu Bay, Kyoto, April 20, 2017 [see also Fujiwara et al. 2018 (“KAUM-I. 97427,” off Yamaguchi)]. ***Southern Korea***: See Han et al. (2012) (e.g., “JNU 20090605,” off Jeju I.).

***Crossorhombus kanekonis* (Tanaka, 1918)**  
[**Japanese name: Kanekodarumagarei**]  
(Fig. 6.3d)

***Kyushu***: FAKU S198, 145.8 mm SL, off Tsushima I., Nagasaki, summer of 1973.

***Crossorhombus kobensis* (Jordan and Starks, 1906)**  
[**Japanese name: Kobedarumagarei**]  
(Fig. 6.3e)

***Kyushu***: NSMT-P 94323, 107.3 mm SL, off Tsushima I., Nagasaki, July 1987; two additional specimens deposited in NSMT.

***Engyprosopon grandisquama* (Temminck and Schlegel, 1846)**  
[**Japanese name: Darumagarei**] (Fig. 6.3f)

***Kinki-San'in***: FAKU 145532, 106 mm SL, off Hamada, Shimane, 1970s; >10 additional specimens deposited in FAKU [see also Sonoyama et al. 2020 (e.g., “HH Pi 812,” off Shimonoseki, Yamaguchi)]. ***Kyushu***: FAKU S199, 96.0 mm SL, off Tsushima I., Nagasaki, summer of 1973; three additional specimens in FAKU and NSMT. ***Southern Korea***: See Lee and Choi (2010) (“KNUM 2670,” off Tongyeong, Gyeongsangnam-do).

***Engyprosopon longipelvis* Amaoka, 1969**  
[**Japanese name: Himedarumagarei**]  
(Fig. 6.3g)

***Kinki-San'in***: FAKU 132825, 35.0 mm SL, off Ine, Kyoto, November 5, 2010; FAKU 138918, 50.7 mm SL, off Oumi-jima I., Yamaguchi, July 30, 2015; >10 additional specimens deposited in FAKU.

***Engyprosopon multisquama* Amaoka, 1963**  
[**Japanese name: Chikamedarumagarei**]  
(Fig. 6.3h)

***Tohoku-Hokuriku***: HUMZ 136030, 45.0 mm SL, off Sakata, Yamagata, September 14, 1994;

two additional specimens deposited in HUMZ. ***Kinki-San'in***: FAKU 143517, 74.2 mm SL, Miyazu, Kyoto, December 29, 2016; >10 additional specimens deposited in FAKU [see also Sonoyama et al. 2020 (“SNFR 12551,” Nagato, Yamaguchi)].

***Japonolaeops dentatus* Amaoka, 1969**  
[**Japanese name: Hinadarumagarei**]

***Kinki-San'in***: See Sonoyama et al. (2020) (“SNFR 11178,” off Yamaguchi). ***Southern Korea***: See Kim et al. (2011) (e.g., “JNU 304-1-3,” Jeju I.).

***Kamoharaia megastoma* (Kamohara, 1936)**  
[**Japanese name: Wanigarei**]

***Southern Korea***: See Jang et al. (2018) (“NIFS00003,” off Jeju I.).

***Laeops kitaharae* (Smith and Pope, 1906)**  
[**Japanese name: Yarigarei**] (Fig. 6.3i)

***Tohoku-Hokuriku***: SNFR 18878, 63.4 mm SL, off Niigata, August 28, 2012. ***Kinki-San'in***: FAKU 136454, 133.6 mm SL, off Ine, Kyoto, November 20, 2014; FAKU 134689, 96.2 mm SL, off Nagato, Yamaguchi, October 7, 2011; >10 additional specimens deposited in FAKU and HUMZ. ***Southern Korea***: See Kim and Ryu (2016) (e.g., “PKU 23130,” off Jeju I.).

***Parabothus kienensis* (Tanaka, 1918)**  
[**Japanese name: Kishudarumagarei**]

***Southern Korea***: See Kim et al. (2009) as *Parabothus kinesis* [sic] (“MRIC 1627,” Jeju I.).

***Psettina ijimae* (Jordan and Starks, 1904)**  
[**Japanese name: Iijimadarumagarei**]  
(Fig. 6.3j)

***Tohoku-Hokuriku***: FAKU 132892, 45.5 mm SL, off Murakami, Niigata, December 5, 2012. ***Kinki-San'in***: FAKU 136867, 45.4 mm SL, off Maizuru, Kyoto, January 21, 2015; FAKU 133191, 84.9 mm SL, off Hagi, Yamaguchi, April 6, 2011; >5 additional specimens deposited in FAKU and SNFR.

***Psettina tosana* Amaoka, 1963** [Japanese name: Tosadarumagarei] (Fig. 6.3k)  
***Kinki-San'in***: FAKU 136873, 55.3 mm SL, off Maizuru, Kyoto, January 21, 2015; FAKU 138915, 86.3 mm SL, off Cape Kawajiri, Yamaguchi, July 30, 2015; >10 additional specimens deposited in FAKU and SNFR.  
***Kyushu***: FAKU 57354, 63.8 mm SL, off Tsushima I., Nagasaki, July 17, 1990; five additional specimens deposited in FAKU.  
***Southern Korea***: See Lee and Lee (2007) (“BKNU 2241–2242,” off Saryang I.).

***Tosarhombus octoculatus* Amaoka, 1969** [Japanese name: Yatsumedarumagarei] (Fig. 6.3l)  
***Kyushu***: NSMT-P 94322, 108.8 mm SL, off Tsushima I., Nagasaki, July 1987.

#### Family Pleuronectidae

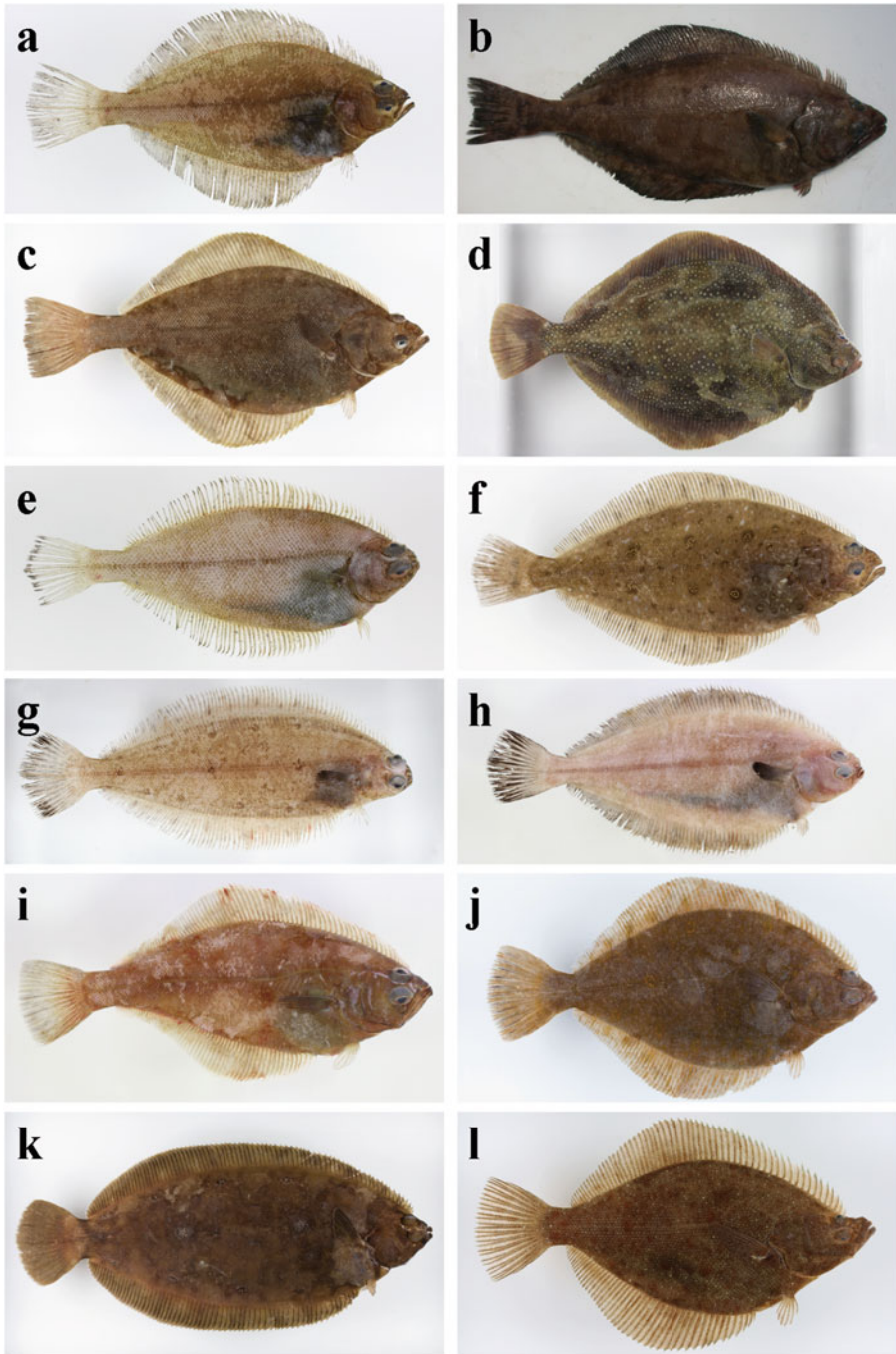
***Acanthopsetta nadeshnyi* Schmidt 1904** [Japanese name: Urokomegarei] (Fig. 6.4a)  
***Hokkaido***: HUMZ 42778, 224.5 mm SL, off Okushiri I., Hokkaido, June 6, 1975; >10 additional specimens deposited in HUMZ.  
***Tohoku-Hokuriku***: FAKU 141021, 181.8 mm SL, off Itoigawa, Niigata, April 5, 2016; >10 additional specimens deposited in FAKU and HUMZ.  
***Kinki-San'in***: FAKU 36270–36272, three specimens, 188.1–237.6 mm SL, off Kami, Hyogo, December 19–21, 1968.  
***Eastern Korea***: See Kim and Ryu (2016) (e.g., “PKU 6250–6252,” Goseong, Gangwon) and Voronina and Volkova (2019) (e.g., “ZIN 12339,” East Korea Bay).  
***Primorsky Krai***: See Voronina and Volkova (2019) (e.g., “ZIN 12343,” Vladivostok).  
***Tatar***: See Shinohara et al. (2011) (e.g., “ZIN 45190,” 51°30'N, 140°45'E).  
***Yamato Bank***: HUMZ 53804, 201.4 mm SL, 39°16.7'N, 135°2.7'E, May 31, 1976.

***Atheresthes evermanni* Jordan and Starks, 1904** [Japanese name: Aburagarei] (Fig. 6.4b)  
***Kinki-San'in***: NSMT-P 76630, 438.5 mm SL, Shinonsen, Hyogo, April 9, 2007.  
***Eastern***

***Korea***: See Park et al. (2020) (e.g., “NFRDI-FI-IS-0008430,” Goseong, Gangwon).

***Cleisthenes pinetorum* Jordan and Starks, 1904** [Japanese name: Souhachi] (Fig. 6.4c)  
***Hokkaido***: HUMZ 231163, 299.7 mm SL, Esashi, Hokkaido, May 16, 2020; >10 additional specimens deposited in HUMZ.  
***Tohoku-Hokuriku***: HUMZ 59119, 141.9 mm SL, off Sado I., Niigata, September 23, 1976; >10 additional specimens deposited in FAKU and HUMZ.  
***Kinki-San'in***: SNFR 15990, 165.9 mm SL, off Mishima I., Yamaguchi, May 27, 1995; >10 additional specimens deposited in FAKU, HUMZ, and SNFR.  
***Kyushu***: See Shinohara et al. (2011) (“NSMT-P 66141,” off Tsushima I., Nagasaki).  
***Southern Korea***: See Kim and Ryu (2016) (e.g., “PKU 54331–54385,” Yeosu).  
***Eastern Korea***: See Kim and Ryu (2016) (e.g., “PKU 51337–51349,” Goseong, Gangwon) and Voronina and Volkova (2019) (e.g., “ZIN 12363,” Wonsan).  
***Primorsky Krai***: See Voronina and Volkova (2019) (“ZIN 12361,” Vladivostok).  
***Tatar***: See Shinohara et al. (2011) (“ZIN 45084,” 51°16'N, 142°10'E) and Voronina and Volkova (2019) (“ZIN 12362,” Kholmsk).

***Clidoderma asperrimum* (Temminck and Schlegel, 1846)** [Japanese name: Samegarei] (Fig. 6.4d)  
***Hokkaido***: HUMZ 97169, off Yoichi, Hokkaido, October 22, 1982.  
***Tohoku-Hokuriku***: See Uozu Aquarium (2014) (“photo,” off Toyama).  
***Kinki-San'in***: FAKU 139321, 370.1 mm SL, off Kyotango, Kyoto, October 16, 2015; >5 additional specimens deposited in FAKU [see also Sonoyama et al. 2020 (“KPM-NR 198290 (photo only),” off Hagi, Yamaguchi)].  
***Southern Korea***: See Kim and Ryu (2016) (e.g., “PKU 54131–54139,” Tongyeong).  
***Eastern Korea***: See Kim and Ryu (2016) (e.g., “PKU 8304–8305,” Sokcho).  
***Primorsky Krai***: See Ivankova (2007) (“TINRO-tsentr P-172,” 43°57'4"N, 135°59'9"E).  
***Tatar***: See Lindberg and Fedorov (1993) (e.g., “ZIN 45582,” Moneron I.).



**Fig. 6.4** Family Pleuronectidae (I). (a) *Acanthopsetta nadeshnyi*, FAKU 141021; (b) *Atheresthes evermanni*, NSMT-P 76630, photo courtesy of NSMT; (c) *Cleisthenes pinetorum*, HUMZ 231163; (d) *Clidoderma asperrimum*, FAKU 139321; (e) *Dexistes rikuzenius*, FAKU 137998; (f) *Eopsetta grigorjewi*, HUMZ

230351; (g) *Glyptocephalus kitaharae*, FAKU 136872; (h) *Glyptocephalus stelleri*, FAKU 136513; (i) *Hippoglossoides dubius*, FAKU 136514; (j) *Lepidopsetta mochigarei*, HUMZ 230360; (k) *Microstomus achne*, HUMZ 230350; (l) *Myzopsetta punctatissima*, HUMZ 231164

***Dexistes rikuzenius* Jordan and Starks, 1904**  
**[Japanese name: Migigarei] (Fig. 6.4e)**

**Tohoku-Hokuriku:** HUMZ 59113, 120.3 mm SL, off Sado I., Niigata, September 23, 1976; >10 additional specimens deposited in HUMZ. **Kinki-San'in:** FAKU 137998, 145.8 mm SL, Wakasa Bay, Kyoto, June 18, 2015; SNFR 15989, 178.7 mm SL, off Mishima I., Yamaguchi, May 27, 1995; >10 additional specimens deposited in FAKU. **Southern Korea:** See Kim and Ryu (2016) (e.g., “PKU 509,” Jeju I.). **Eastern Korea:** See Kim and Ryu (2016) (“PKU 8341,” Sokcho).

***Eopsetta grigorjewi* (Herzenstein, 1890)**  
**[Japanese name: Mushigarei] (Fig. 6.4f)**

**Hokkaido:** HUMZ 230351, 270.1 mm SL, Esashi, Hokkaido, May 18, 2019; >10 additional specimens deposited in HUMZ. **Tohoku-Hokuriku:** HUMZ 52528, 138.4 mm SL, off Sado I., Niigata, March 25, 1976; >10 additional specimens deposited in FAKU and HUMZ. **Kinki-San'in:** FAKU 125497, 121.0 mm SL, Wakasa Bay, Kyoto, November 6, 1981; >10 additional specimens deposited in FAKU, HUMZ, and SNFR. **Kyushu:** FAKU 101775, 178.3 mm SL, off Tsushima I., Nagasaki, July 31, 1973; >10 additional specimens deposited in FAKU and NSMT-P. **Southern Korea:** See Kim and Ryu (2016) (e.g., “PKU 54447–54485,” Yeosu). **Eastern Korea:** See Kim and Ryu (2016) (e.g., “PKU 8238–8244,” Sokcho).

***Glyptocephalus kitaharae* (Jordan and Starks, 1904)**  
**[Japanese name: Yanagimushigarei] (Fig. 6.4g)**

**Tohoku-Hokuriku:** FAKU 139223, 151.5 mm SL, off Tsugaru, Aomori, June 12, 2015; >10 additional specimens deposited in FAKU, HUMZ, and SNFR. **Kinki-San'in:** FAKU 136872, 140.0 mm SL, Wakasa Bay, Kyoto, January 21, 2015; >10 additional specimens deposited in FAKU and HUMZ. **Southern Korea:** See Kim and Youn (1994) (“CNUC 19089,” Yeosu).

***Glyptocephalus stelleri* (Schmidt 1904)**  
**[Japanese name: Hireguro] (Fig. 6.4h)**

**Hokkaido:** HUMZ 68358, 212.5 mm SL, off Shakotan Peninsula, May 15, 1977; >10 additional specimens deposited in HUMZ. **Tohoku-Hokuriku:** FAKU 140507, 262.4 mm SL, off Niigata, February 17, 2016; >10 additional specimens deposited in FAKU and HUMZ. **Kinki-San'in:** FAKU 136513, 213.3 mm SL, off Obama, Fukui, November 22, 2014; FAKU 138149, 253.6 mm SL, off Yamaguchi, June 15, 2015; >10 additional specimens deposited in FAKU and HUMZ. **Kyushu:** See Shinohara et al. (2011) (“NSMT-P 66148,” off Tsushima I.). **Southern Korea:** See Kim and Ryu (2016) (e.g., “PKU 9917,” Ulsan). **Eastern Korea:** See Kim and Ryu (2016) (e.g., “PKU 56821–56829,” Goseong, Gangwon) and Voronina and Volkova (2019) (e.g., “ZIN 12347,” Wonsan). **Primorsky Krai:** See Voronina and Volkova (2019) (e.g., “ZIN 12352,” Vladivostok). **Tatar:** See Shinohara et al. (2011, 2014) (“ZIN 45084,” 51°16'N, 142°10'E) and Voronina and Volkova (2019) (“ZIN 12437,” Kholmsk). **Yamato Bank:** HUMZ 53776, 200.2 mm SL, 39°17.1'N, 135°3.5'E, May 29, 1976.

***Hippoglossoides dubius* Schmidt 1904**  
**[Japanese name: Akagarei] (Fig. 6.4i)**

**Hokkaido:** HUMZ 67696, 179.9 mm SL, off Shakotan Peninsula, May 18, 1977; >10 additional specimens deposited in HUMZ. **Tohoku-Hokuriku:** FAKU 140505, 308.9 mm SL, off Sado I., Niigata, February 17, 2016; >10 additional specimens deposited in FAKU and HUMZ. **Kinki-San'in:** FAKU 136514, 202.4 mm SL, off Obama, Fukui, November 22, 2014; SNFR 19410, 177.8 mm SL, off Yamaguchi, June 12, 2012; >10 additional specimens deposited in FAKU and SNFR. **Eastern Korea:** See Kim and Ryu (2016) (e.g., “PKU 9907,” Goseong, Gangwon). **Primorsky Krai:** See Shinohara et al. (2011) (e.g., “ZIN 17902,” 42°40'N, 133°00'E). **Tatar:** See Shinohara et al. (2011) (e.g., “ZIN 17906,” 51°00'N, 140°51'E) and Voronina and Volkova (2019) (e.g., “ZIN 12366,” Kholmsk). **Yamato Bank:** See Shinohara et al. (2011) (e.g.,

“HUMZ 53662,” 39°7.9′N, 135°4.6′E).  
**Remarks:** HUMZ 53662 is currently missing.

***Hippoglossoides elassodon* Jordan and Gilbert, 1880/*Hippoglossoides robustus* Gill and Townsend, 1897 [Japanese name: Umagarei/ Dorogarei]**

**Hokkaido:** See Lindberg and Fedorov (1993) as *H. robustus* (“ZIN 19157,” Otaru). **Tatar:** See Lindberg and Fedorov (1993) as *H. elassodon* (e.g., “ZIN 18533,” 58°58′N, 141°04′E), and as *H. robustus* (e.g., “ZIN 19062,” between De Kastri and Alexandrovsk). **Remarks:** Because the taxonomy of *H. elassodon* and *H. robustus* remains uncertain (Parin et al. 2014), the two species are treated herein as a species complex “*Hippoglossoides elassodon*/*Hippoglossoides robustus*.”

***Hippoglossoides stenolepis* Schmidt 1904 [Japanese name: Ohyo]**

**Hokkaido:** See Yabe et al. (1991) (e.g., “HUMZ 55902” 44°27′N, 140°19′E). **Remarks:** HUMZ 55902 is currently missing.

***Lepidopsetta mochigarei* Snyder, 1911 [Japanese name: Asabagarei] (Fig. 6.4j)**

**Hokkaido:** HUMZ 230360, 264.1 mm SL, Esashi, Hokkaido, May 18, 2019; >10 additional specimens deposited in FAKU, HUMZ, and NSMT. **Tohoku-Hokuriku:** FAKU 140071, 276.3 mm SL, off Oga, Akita, July 31, 2015; >5 additional specimens deposited in FAKU and HUMZ. **Kinki-San’in:** FAKU 100254, 296.1 mm SL, Wakasa Bay, Kyoto, 1978 (detailed date unknown); >10 additional specimens in FAKU and HUMZ. **Eastern Korea:** See Kim and Youn (1994) (e.g., “CNUC 19162,” Pohang) and Kim and Ryu (2016) (e.g., “PKU 3849,” Gangneung). **Primorsky Krai:** See Lindberg and Fedorov (1993) (e.g., “ZIN 12892,” Vladivostok). **Tatar:** See Orr and Matarese (2000) (e.g., “USNM 77126,” 47°38.2′N, 141°39.0′E). **Remarks:** *Lepidopsetta bilineata* (Ayres, 1855), closely related to *L. mochigarei*, is probably not distributed in the Sea of Japan (Orr and Matarese 2000).

***Limanda aspera* (Pallas, 1814) [Japanese name: Koganegarei]**

**Southern Korea:** See Lindberg and Fedorov (1993) (“ZIN 23847,” Busan). **Eastern Korea:** See Kim and Youn (1994) (“CNUC 19713–19714,” Pohang). **Primorsky Krai:** See Lindberg and Fedorov (1993) (e.g., “ZIN 17820,” Peter the Great Bay). **Tatar:** See Lindberg and Fedorov (1993) (e.g., “ZIN 25124,” 51°28′N, 140°58′E).

***Limanda sakhalinensis* Hubbs, 1915 [Japanese name: Karafutogarei]**

**Tatar:** See Lindberg and Fedorov (1993) (e.g., “ZIN 17833,” De Kastri).

***Liopsetta pinnifasciata* (Kner, 1870) [Japanese name: Tougarei]**

**Primorsky Krai:** See Lindberg and Fedorov (1993) (e.g., “ZIN 25516,” Vladivostok). **Tatar:** See Lindberg and Fedorov (1993) (e.g., “ZIN 19914,” Tatar Strait).

***Microstomus achne* (Jordan and Starks, 1904) [Japanese name: Babagarei] (Fig. 6.4k)**

**Hokkaido:** HUMZ 230350, Esashi, Hokkaido, September 18, 2019 [Also see Lindberg and Fedorov 1993 (“ZIN 19152,” Otaru)]. **Tohoku-Hokuriku:** HUMZ 59112, 147.5 mm SL, off Sado I., Niigata, September 23, 1976; >10 additional specimens deposited in FAKU and HUMZ. **Kinki-San’in:** FAKU 137373, 236.1 mm SL, off Sakaiminato, Tottori, April 23, 2015; >10 additional specimens deposited in FAKU and HUMZ [see also Sonoyama et al. 2020 (e.g., “KPM-NR 198989 (photo only),” off Hagi, Yamaguchi)]. **Southern Korea:** See Kim and Ryu (2016) (e.g., “PKU 5675,” off Jeju I.). **Eastern Korea:** See Kim and Ryu (2016) (e.g., “PKU 4322,” Uljin).

***Myzopsetta punctatissima* (Steindachner, 1879) [Japanese name: Sunagarei] (Fig. 6.4l)**

**Hokkaido:** HUMZ 231164, 251.3 mm SL, Esashi, Hokkaido, May 16, 2020; >10 additional specimens deposited in HUMZ. **Tohoku-Hokuriku:** NSMT-P 73354, 215.2 mm SL, off Nikaho, Akita, October 20, 1932 [see also in

Uozu Aquarium 2014 (“photo,” Toyama)]. **Kinki-San’in**: FAKU 136103, 198.1 mm SL, Wakasa Bay, Kyoto, July 16, 2014. **Southern Korea**: See Lindberg and Fedorov (1993) (“ZIN 23738,” Busan). **Primorsky Krai**: See Lindberg and Fedorov (1993) (e.g., “ZIN”). **Tatar**: See Lindberg and Fedorov (1993) (e.g., “ZIN 45642,” Tatar Strait).

***Platichthys bicoloratus* (Basilewsky, 1855)** [Japanese name: **Ishigarei**] (Fig. 6.5a)

**Hokkaido**: HUMZ 231151, 314.9 mm SL, Esashi, Hokkaido, April 12, 2020; >5 additional specimens deposited in HUMZ. **Tohoku-Hokuriku**: FAKU 140508, 275.7 mm SL, off Niigata, February 17, 2016; >10 additional specimens deposited in FAKU. **Kinki-San’in**: FAKU 137144, 311.8 mm SL, Miyazu, Kyoto, March 21, 2015; >10 additional specimens deposited in FAKU [see also Sonoyama et al. 2020 (“HH-Pi 1206,” Houhoku, Shimonoseki, Yamaguchi)]. **Southern Korea**: See Kim and Ryu (2016) (e.g., “PKU 3397–3399,” Gangjin). **Eastern Korea**: See Kim and Ryu (2016) (e.g., “PKU 20552,” Goseong, Gangwon).

***Platichthys stellatus* Pallas, 1787** [Japanese name: **Numagarei**] (Fig. 6.5b)

**Hokkaido**: HUMZ 231150, 243.7 mm SL, Esashi, Hokkaido, April 12, 2020; >10 additional specimens deposited in FAKU and HUMZ. **Tohoku-Hokuriku**: FAKU 96118, 170.4 mm SL, Ushitsu, Noto, Ishikawa, May 1, 2008; >5 additional specimens deposited in FAKU and NSMT. **Kinki-San’in**: FAKU 131762, 245.4 mm SL, Maizuru, Kyoto, February 23, 2009; >10 additional specimens deposited in FAKU. **Eastern Korea**: See Kim and Youn (1994) (e.g., “CNUC 19234–19237,” Pohang). **Primorsky Krai**: See Voronina and Volkova (2003) (e.g., “ZIN 17963,” Peter the Great Bay). **Tatar**: See Voronina and Volkova (2003) (e.g., “ZIN 19173,” De Kastri). **Remarks**: Interspecific hybrid individuals of *P. bicoloratus* and *P. stellatus* have been frequently obtained from the Sea of Japan (e.g., HUMZ 231149, 256.8 mm SL, Esashi, Hokkaido, April 12, 2020; Fig. 6.5c).

***Pleuronectes quadrituberculatus* Pallas, 1814** [Japanese name: **Tsunogarei**]

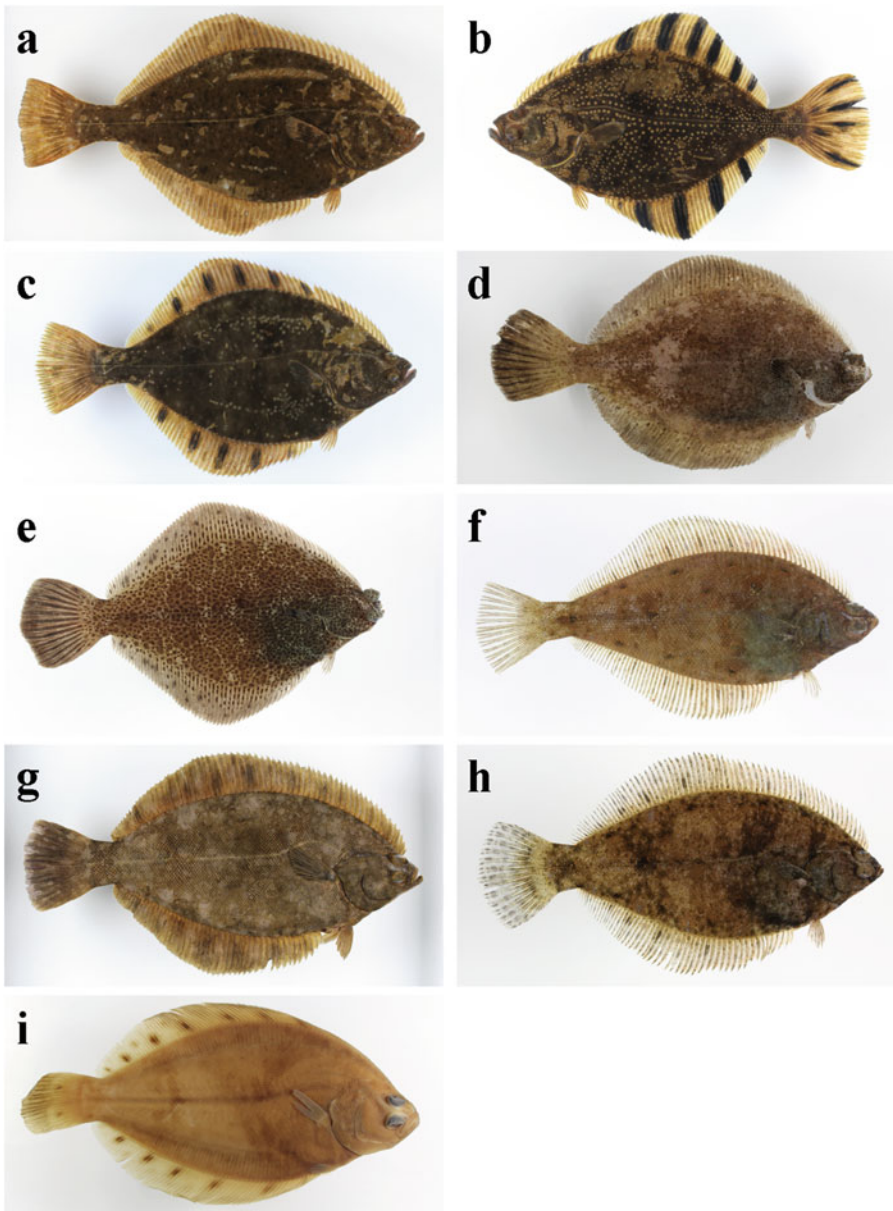
**Southern Korea**: See Kim and Youn (1994) (“CNUC 19416,” Busan). **Tatar**: See Lindberg and Fedorov (1993) (e.g., “ZIN 17996,” De Kastri).

***Pleuronichthys cornutus* (Temminck and Schlegel, 1846)** [Japanese name: **Nagaremeitagarei**] (Fig. 6.5d)

**Hokkaido**: See Suzuki et al. (2009) as paratype (“HUMZ 98252,” Yoichi, Hokkaido) and nontype (“HUMZ 109423,” Taisei, Hokkaido) of *P. japonicus*. **Tohoku-Hokuriku**: See Suzuki et al. (2009) as paratypes (e.g., “FAKU 91921,” off Niigata) and nontypes (e.g., “NMCI-P 1608,” Hanami, Noto, Ishikawa) of *P. japonicus*; >10 additional specimens deposited in FAKU and HUMZ (e.g., FAKU 132223, 146.4 mm SL, off Tsutsuishi, Niigata, October 17, 2009). **Kinki-San’in**: See Suzuki et al. (2009) as holotype (“FAKU 90216,” off Hamada, Shimane), paratypes (“FAKU 90161,” off Hamada, Shimane), and nontypes of *P. japonicus*; >10 additional specimens deposited in FAKU and SNFR (e.g., FAKU 136721, 163.4 mm SL, Wakasa Bay, Kyoto, December 2014). **Remarks**: *Pleuronichthys japonicus* Suzuki et al. 2009 was considered a junior synonym of *P. cornutus* by Yokogawa et al. (2014).

***Pleuronichthys lighti* Wu, 1929** [Japanese name: **Meitagarei**] (Fig. 6.5e)

**Tohoku-Hokuriku**: SNFR 18811, 105.6 mm SL, off Niigata, August 24, 2012 [see also Suzuki et al. 2009 as *P. cornutus* (e.g., “FAKU 91642,” off Niigata)]. **Kinki-San’in**: FAKU 137165, 173.5 mm SL, Wakasa Bay, Kyoto, March 26, 2015; >10 additional specimens deposited in FAKU, HUMZ, and SNFR [see also Suzuki et al. 2009 as *P. cornutus* (e.g., “FAKU 92140–92149,” off Hamada, Shimane)]. **Kyushu**: FAKU 137499, 177.1 mm SL, off Meinohama, Fukuoka, April 19, 2015; 3 additional specimens deposited in FAKU. **Southern Korea**: See Suzuki et al. (2009) as *P. cornutus* (e.g., “pl. 126-1 in Chyung (1977),” Yeosu). **Remarks**: The taxon



**Fig. 6.5** Family Pleuronectidae (II). (a) *Platichthys bicoloratus*, HUMZ 231151; (b) *Platichthys stellatus*, HUMZ 231150; (c) hybrid individual of *Platichthys bicoloratus* and *Platichthys stellatus*, HUMZ 231149; (d) *Pleuronichthys cornutus*, FAKU 136721; (e)

*Pleuronichthys lighti*, FAKU 137165; (f) *Pseudopleuronectes herzensteini*, FAKU 137996; (g) *Pseudopleuronectes schrenki*, HUMZ 230747; (h) *Pseudopleuronectes yokohamae*, FAKU 137040; (i) *Verasper variegatus*, NSMT-P 73272, preserved condition

treated as *P. cornutus* in Suzuki et al. (2009) was recognized as *P. lighti* by Yokogawa et al. (2014). Kim and Ryu (2016) recorded *P. japonicus* from the southern Korean region (“PKU 6238–6239,

6557–6559,” Jeju I.) after its synonymization with *P. cornutus*. A specimen photograph which they identified as *P. japonicus* is likely to have been *P. lighti*.

*Pseudopleuronectes herzensteini* (Jordan and Snyder, 1901) [Japanese name: Magareii] (Fig. 6.5f)

**Hokkaido:** HUMZ 107662, 133.6 mm SL, off Otaru, April 15, 1986; >10 additional specimens deposited in FAKU and HUMZ. **Tohoku-Hokuriku:** HUMZ 52756, 134.7 mm SL, off Sado I., Niigata, March 25, 1976; >10 additional specimens deposited in FAKU, HUMZ, and SNFR. **Kinki-San'in:** FAKU 137996, 163.2 mm SL, Wakasa Bay, Kyoto, June 18, 2015; >10 additional specimens deposited in FAKU and HUMZ [see also Sonoyama et al. 2020 ("SNFR 16005," off Yamaguchi)]. **Southern Korea:** See Kim and Youn (1994) ("CNUC 19226," Busan). **Eastern Korea:** See Kim and Ryu (2016) (e.g., "PKU 20553," Goseong, Gangwon). **Primorsky Krai:** See Voronina and Volkova (2019) ("ZIN 8730," Vladivostok). **Tatar:** See Lindberg and Fedorov (1993) (e.g., "ZIN 19072," 51°23'N, 142°00'E).

*Pseudopleuronectes obscurus* Herzenstein, 1890 [Japanese name: Kurogareii]

**Eastern Korea:** See Kim and Ryu (2016) ("PKU 8393," Sokcho). **Primorsky Krai:** See Voronina and Volkova (2019) (e.g., "ZIN 8726," Vladivostok). **Tatar:** See Lindberg and Fedorov (1993) (e.g., "ZIN 31672," Antonovo; "ZIN 19059," De Kastri).

*Pseudopleuronectes schrenki* (Schmidt 1904) [Japanese name: Kurogashiragareii] (Fig. 6.5g)

**Hokkaido:** HUMZ 230747, 271.2 mm SL, Kaminokuni, Hokkaido, August 1, 2019; >10 additional specimens deposited in FAKU, HUMZ, and NSMT. **Southern Korea:** See Kim and Youn (1994) ("CNUC 19742," Busan). **Eastern Korea:** See Kim and Youn (1994) ("CNUC 19738," Yangyang). **Primorsky Krai:** See Lindberg and Fedorov (1993) (e.g., "ZIN 17842," Posyet). **Tatar:** See Voronina and Volkova (2019) ("ZIN 12377b," Kholm'sk).

*Pseudopleuronectes yokohamae* (Günther, 1877) [Japanese name: Makogareii] (Fig. 6.5h)

**Hokkaido:** HUMZ 230359, 245.2 mm SL, Esashi, Hokkaido, May 18, 2019; >5 additional

specimens deposited in HUMZ. **Tohoku-Hokuriku:** FAKU 137076, 72.0 mm SL, Himi, Toyama, 25 June 1997; >10 additional specimens deposited in FAKU and HUMZ. **Kinki-San'in:** FAKU 137040, 136.8 mm SL, Miyazu, Kyoto, January 2015; >10 additional specimens deposited in FAKU and HUMZ. **Kyushu:** FAKU 137493, 158.4 mm SL, off Meinohama, Fukuoka, April 19, 2015; three additional specimens deposited in FAKU. **Southern Korea:** See Kim and Ryu (2016) (e.g., "PKU 7723," Namhae). **Eastern Korea:** See Kim and Ryu (2016) (e.g., "PKU 4323," Uljin).

*Verasper moseri* Jordan and Gilbert, 1898 [Japanese name: Matsukawa]

**Primorsky Krai:** See Voronina and Volkova (2003) ("ZIN 45193," 42°52'N, 132°23'E).

*Verasper variegatus* (Temminck and Schlegel, 1846) [Japanese name: Hoshi-gareii] (Fig. 6.5i)

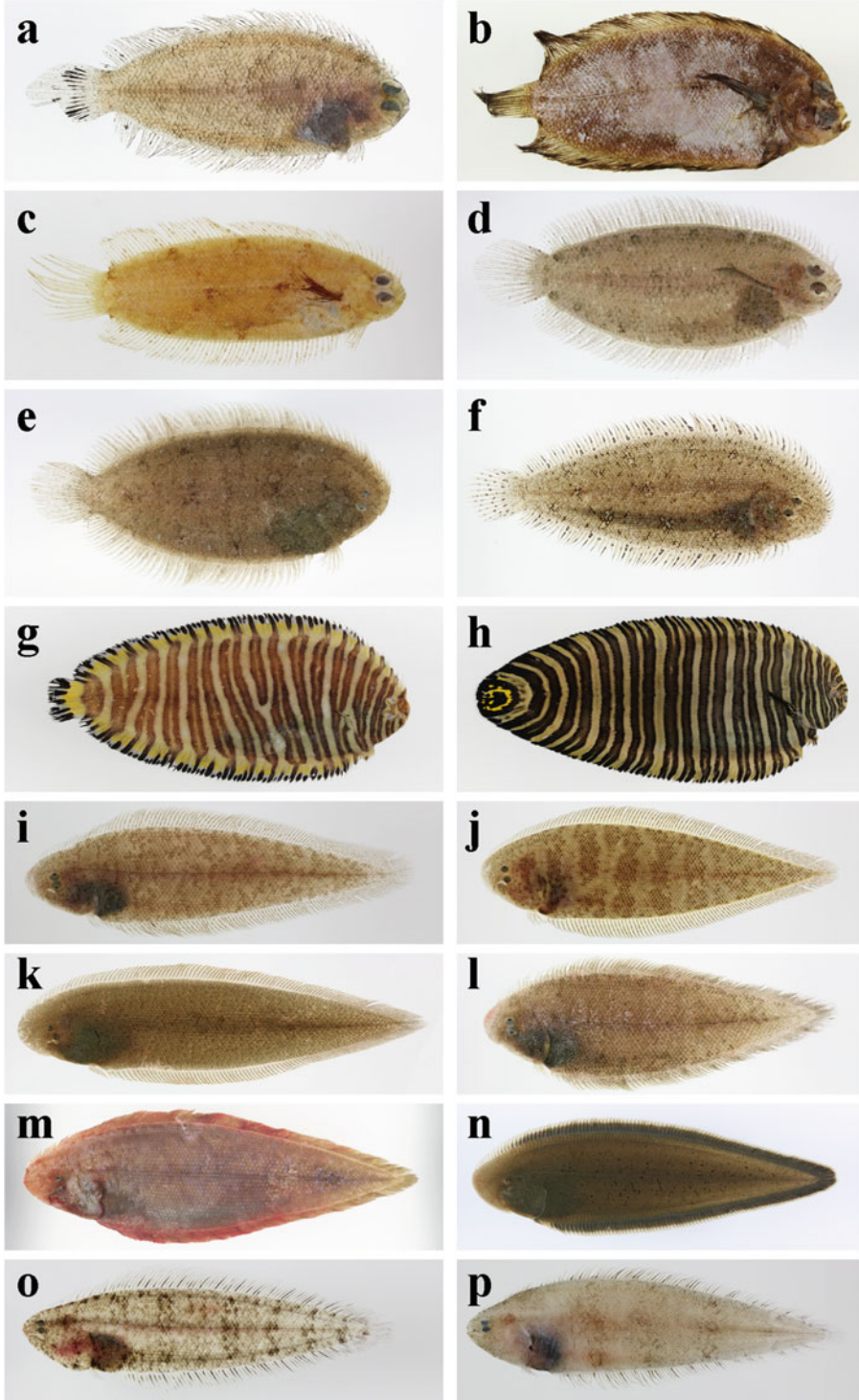
**Tohoku-Hokuriku:** NSMT-P 73272, 2 specimens, 124.8–154.1 mm SL, Oga, Akita, November 14, 1931. **Kinki-San'in:** FAKU 16975, 274.9 mm SL, Maizuru, Kyoto, November 6, 1951; three additional specimens deposited in FAKU. **Southern Korea:** See Kim and Youn (1994) (e.g., "CNUC 19623–19625," Koheung) and Lindberg and Fedorov (1993) ("ZIN 23733," Busan). **Primorsky Krai:** See Lindberg and Fedorov (1993) ("ZIN 10466," Vladivostok).

## Family Poecilopsettidae

*Poecilopsetta plinthus* (Jordan and Starks, 1904) [Japanese name: Kawaragareii] (Fig. 6.6a)

**Tohoku-Hokuriku:** FAKU 135590, 91.6 mm SL, off Niigata, August 25, 2013. **Kinki-San'in:** FAKU 138112, 98.6 mm SL, off Nagato, Yamaguchi, June 15, 2015; four additional specimens deposited in FAKU and HUMZ. **Southern Korea:** See Kim and Ryu (2016) (e.g., "PKU 8599," Namhae).





**Fig. 6.6** Families Poecilopsettidae, Samaridae and Cynoglossidae. (a) *Poecilopsetta plinthus*, FAKU 138112; (b) *Plagiopsetta glossa*, NSMT-P 50613, preserved condition; (c) *Samariscus japonicus*, FAKU 58183, preserved condition; (d) *Samariscus xenicus*, FAKU 142395; (e) *Aseraggodes kobensis*, FAKU 136871; (f) *Heteromycteris japonica*, FAKU 136666; (g) *Pseudaesopis japonica*, FAKU 136720; (h) *Zebrias*

*zebrinus*, FAKU 137215; (i) *Cynoglossus interruptus*, FAKU 136977; (j) *Cynoglossus itinus*, FAKU 145198; (k) *Cynoglossus joyneri*, FAKU 141526; (l) *Cynoglossus ochiaii*, FAKU 139735; (m) *Cynoglossus robustus*, FAKU 139705; (n) *Paraplagusia japonica*, FAKU 136970; (o) *Symphurus longirostris*, FAKU 139635; (p) *Symphurus orientalis*, FAKU 145360

## Family Samaridae

*Plagiopsetta glossa* Franz, 1910

[Japanese name: Berogarei] (Fig. 6.6b)

*Kinki-San'in*: See Suzuki et al. (2000) (“OMNH-P7820,” Shinonsen, Hyogo). *Kyushu*: NSMT-P 50613, two specimens, 82.3–95.6 mm SL, off Tsushima, Nagasaki, July 1987; one additional specimen deposited in NSMT. *Southern Korea*: See Park et al. (2007) (e.g., “NFRDI 20070104-01–10,” off Jeju I.).

*Samariscus japonicus* Kamohara, 1936

[Japanese name: Tsukinowagarei] (Fig. 6.6c)

*Kinki-San'in*: FAKU 58183, 81.8 mm SL, off San'in (Yamaguchi to Tottori), July 1990; SNFR 19106, 34.2 mm SL, off Yamaguchi, June 12, 2012; two additional specimens deposited in SNFR. *Southern Korea*: See Park et al. (2007) (“NFRDI 20070104-20,” off Jeju I.).

*Samariscus xenicus* Ochiai and Amaoka, 1962

[Japanese name: Kotsukinowagarei] (Fig. 6.6d)

*Kinki-San'in*: FAKU 142395, 43 mm SL, Wakasa Bay, September 15, 2016; FAKU 134702, 43.3 mm SL, off Nagato, Yamaguchi, October 7, 2011; >10 additional specimens deposited in FAKU, HUMZ, and SNFR.

## Family Soleidae

*Aseraggodes kaianus* (Günther, 1880)

[Japanese name: Moyouushinoshita]

*Southern Korea*: See Park et al. (2007) (“NFRDI 20070104-35–37,” off Jeju I.).

*Aseraggodes kobensis* (Steindachner, 1896)

[Japanese name: Tobisasaushinoshita] (Fig. 6.6e)

*Tohoku-Hokuriku*: SNFR 118829, 88.6 mm SL, off Niigata, August 24, 2012; four additional specimens deposited in HUMZ and SNFR.

*Kinki-San'in*: FAKU 136871, 67.1 mm SL, Wakasa Bay, Kyoto, January 21, 2015; >10 additional specimens deposited in FAKU and HUMZ [see also Sonoyama et al. 2020 (e.g., “KPM-NR

198401 (photo only),” off Nagato, Yamaguchi)]. *Southern Korea*: See Kim and Ryu (2016) (e.g., “PKU 1059,” Busan).

*Brachirus annularis* Fowler, 1934

[Japanese name: Wamonushinoshita]

*Southern Korea*: See Kim et al. (2019) (“JNU 1503,” between Jeju I. and Geomundo I.).

*Heteromycteris japonica* (Temminck and Schlegel, 1846) [Japanese name: Sasaushinoshita] (Fig. 6.6f)

*Tohoku-Hokuriku*: FAKU 137088, three specimens, 23.4–68.2 mm SL, off Tsugaru, Aomori, 5 September 2000; >10 additional specimens deposited in FAKU and HUMZ. *Kinki-San'in*: FAKU 136666, 67.8 mm SL, Wakasa Bay, Kyoto, December 22, 2014; >10 additional specimens deposited in FAKU [see also Sonoyama et al. 2020 (“HH-Pi 1436,” Houhoku, Shimonoseki, Yamaguchi)].

*Pseudaesopis japonica* (Bleeker, 1860)

[Japanese name: Setoushinoshita] (Fig. 6.6g)

*Tohoku-Hokuriku*: FAKU 13804, 126.6 mm SL, off Uozu, Toyama, September 13, 1950; two additional specimens deposited in FAKU and HUMZ. *Kinki-San'in*: FAKU 136720, 114.1 mm SL, off Ine, Kyoto, December 2014; >10 additional specimens deposited in FAKU and HUMZ [see also Sonoyama et al. 2020 (“HH-Pi 2620,” off Izaki, Shimonoseki, Yamaguchi)]. *Southern Korea*: See Kim and Ryu (2016) (e.g., “PKU 7762,” Namhae). *Eastern Korea*: See Kim and Ryu (2016) (“PKU 6913,” Pohang).

*Zebrias zebrinus* (Temminck and Schlegel, 1846) [Japanese name: Shimaushinoshita] (Fig. 6.6h)

*Tohoku-Hokuriku*: HUMZ 61842, 174.5 mm SL, off Sado I., Niigata, October 19, 1976; >10 additional specimens deposited in FAKU and HUMZ. *Kinki-San'in*: FAKU 137215, 174.7 mm SL, Miyazu, Kyoto, March 29, 2015; >10 additional specimens deposited in FAKU and NSMT. *Southern Korea*: See Kim and Ryu

(2016) as *Zebrias fasciatus* (e.g., “PKU 563,” Namhae). **Remarks:** *Zebrias fasciatus* (Basilewsky, 1855) was recently synonymized with *Zebrias zebrinus* by Wang et al. (2014).

### Family Cynoglossidae

*Cynoglossus abbreviatus* (Gray, 1834) [Japanese name: Kouraiakashitabirame] **Southern Korea:** See Kim and Choi (1994) (e.g., “CNUC 18847,” Yeosu).

*Cynoglossus interruptus* Günther, 1880 [Japanese name: Genko] (Fig. 6.6i) **Tohoku-Hokuriku:** HUMZ 135405, 130.1 mm SL, off Sakata, Yamagata, August 5, 1994; >10 additional specimens deposited in HUMZ. **Kinki-San'in:** FAKU 136977, 97.8 mm SL, Wakasa Bay, Kyoto, March 9, 2015; >10 additional specimens deposited in FAKU, HUMZ, and SNFR. **Kyushu:** FAKU 137523, 103.6 mm SL, off Meinohama, Fukuoka, April 19, 2015. **Southern Korea:** See Kwun and Kim (2016) (“PKU 7469–7472,” Changwon).

*Cynoglossus itinus* (Snyder, 1909) [Japanese name: Minamiakashitabirame] (Fig. 6.6j) **Kinki-San'in:** FAKU 145198, 91 mm SL, Wakasa Bay, Kyoto, June 29, 2017; >10 additional specimens deposited in FAKU. **Kyushu:** NSMT-P 5479, 87.6 mm SL, Izumi Bay, Tsushima I., Nagasaki, August 1968.

*Cynoglossus joyneri* Günther, 1878 [Japanese name: Akashitabirame] (Fig. 6.6k) **Tohoku-Hokuriku:** FAKU 135929, 2 specimens, 47.4–52.9 mm SL, Mano Bay, Sado I., Niigata, May to July 2002; four additional specimens deposited in SNFR. **Kinki-San'in:** FAKU 141526, 137 mm SL, Wakasa Bay, Kyoto, June 8, 2016; two additional specimens deposited in FAKU and SNFR. **Kyushu:** FAKU 137406, off Genkai I., Fukuoka., 18 April 2015; >10 additional specimens deposited in FAKU. **Southern Korea:** See Kim and Choi (1994) (e.g., “CNUC 18860,” Wando). **Eastern Korea:** See Kim and

Ryu (2016) (“PKU 20555,” eastern coast off Korea).

*Cynoglossus ochiaii* Yokogawa, Endo and Sakaji, 2008 [Japanese name: Okigenko] (Fig. 6.6l)

**Tohoku-Hokuriku:** FAKU 13834, 13836, two specimens, 127.4–166.6 mm SL, off Uozu, Toyama, September 13, 1950. **Kinki-San'in:** FAKU 139735, 179 mm SL, Wakasa Bay, Kyoto, December 9, 2015; FAKU 134700, 139.9 mm SL, off Oumi-jima I., Yamaguchi, November 18, 2018; >10 additional specimens deposited in FAKU and SNFR.

*Cynoglossus robustus* Günther, 1873 [Japanese name: Inunoshita] (Fig. 6.6m) **Kinki-San'in:** FAKU 139705, 400.7 mm SL, Wakasa Bay, Kyoto, December 2, 2015; one additional specimen deposited in FAKU. **Kyushu:** FAKU 137395, 279.8 mm SL, off Genkai I., Fukuoka, April 18, 2015; three additional specimens deposited in FAKU. **Southern Korea:** See Kim and Choi (1994) (e.g., “CNUC 18853–18855,” Yeosu).

*Cynoglossus semilaevis* Günther, 1873 [Japanese name: Karaakashitabirame] **Southern Korea:** See Kim and Choi (1994) (e.g., “CNUC 19370–19375,” Yeosu).

*Paraplagusia japonica* (Temminck and Schlegel, 1846) [Japanese name: Kuroushinoshita] (Fig. 6.6n)

**Hokkaido:** HUMZ 109954, 180.0 mm SL, off Tomari, Hokkaido, November 13, 1986. **Tohoku-Hokuriku:** FAKU 137015, two specimens, 132.9–150.9 mm SL, off Akita, August 4, 1997; >10 additional specimens deposited in FAKU and HUMZ. **Kinki-San'in:** FAKU 136970, 222.1 mm SL, Wakasa Bay, Kyoto, March 4, 2015; >10 additional specimens deposited in FAKU. **Kyushu:** FAKU 137084, three specimens, 69.6–160.8 mm SL, Karatsu, Saga, April 20, 1997; one additional specimen deposited in FAKU. **Southern Korea:** See Kim and Choi (1994) (e.g., “CNUC 19173–19180,”

Yeosu). *Eastern Korea*: See Kim and Choi (1994) (e.g., “CNUC 19815,” Samcheok).

***Symphurus longirostris* Lee, Munroe and Kai, 2016 [Japanese name: Hashinagaazumagarei] (Fig. 6.6o)**

*Tohoku-Hokuriku*: FAKU 137988, 31.5 mm SL, off Niigata, March 6, 2015. *Kinki-San'in*: FAKU 139635, 42.0 mm SL, Wakasa Bay, November 17, 2015; >10 additional specimens deposited in FAKU and HUMZ [see also Sonoyama et al. 2020 (“SNFR 19821,” off Yamaguchi)].

***Symphurus orientalis* (Bleeker, 1879) [Japanese name: Azumagarei] (Fig. 6.6p)**

*Kinki-San'in*: FAKU 145360, 75.9 mm SL, off Mishima I., Yamaguchi.

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