

The Widespread Distribution of the Venomous and Poisonous Blue-lined Octopus *Hapalochlaena* spp., in the East/Japan Sea: Possible Effects of Sea Warming

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Abstract

The geographical distribution of the toxic blue-lined octopus (commonly known as the blue-ringed octopus), *Hapalochlaena* spp., around the East/Japan Sea was investigated. Observation records of the octopus were gathered using commercial search engines on the Internet. A questionnaire to complement and enhance the base data was conducted that targeted fishermen from areas where the octopus was most likely to occur, *i.e.*, the southeast coast and islands of Korea in the East/Japan Sea. Overall, 32 observational records of the blue-lined octopus were found from Korea and Japan. In Korea, only one record, from 2003, was found on a website; none of the 240 fishermen who participated in the questionnaire reported seeing blue-lined octopus. However, a total of 31 observations of the blue-lined octopus from 2004 to July 2010 were found from 17 different regions in the East/Japan Sea and neighboring waters in Japan. Twenty-two cases were from coastal Honshu Island, and nine were from the west coast of Kyushu Island, Japan. The northern distributional boundary of the blue-lined octopus on the Japanese coast was off Fukui Prefecture around latitude 36°10' N. Our results indicate that the blue-lined octopus is distributed extensively along the Japanese coast, at a low frequency, in the East/Japan Sea.

Key words: Blue-ringed octopus, Blue-lined octopus, *Hapalochlaena* spp., East/Japan Sea, Climate change, Internet

Introduction

Members of the octopus genus *Hapalochlaena* are characterized by small body size and iridescent blue markings on their dorsal surfaces and arms. *Hapalochlaena* is composed of three octopus species, *H. fasciata*, *H. lunulata*, and *H. maculosa*. All three are commonly called blue-ringed octopus because of their distinctive patterns of iridescent blue rings or lines, but *H. fasciata* is the blue-lined octopus, *H. lunulata* the greater blue-ringed octopus, and *H. maculosa* the lesser blue-ringed octopus (Norman, 1998).

Hapalochlaena spp. are equipped with venom in their posterior salivary glands that aids in the capture of prey, and con-

tain tetrodotoxin in their soft tissues (Sheumack et al., 1978; Williams and Caldwell, 2009). Envenomation by these species has been responsible for human fatalities and should be treated urgently (Williamson et al., 1996; Cavazzoni et al., 2008; Williams, 2010). Two people died and 85 patients were hospitalized due to the consumption of blue-ringed octopus in southern Vietnam in 2004 (Agence France-Presse, 2004).

Among the *Hapalochlaena* species, the blue-lined octopus, *H. fasciata*, is commonly found in the waters off the coast of Australia but its range extends through the Pacific Ocean north to Japan (Williamson et al., 1996). *Hapalochlaena fasciata*

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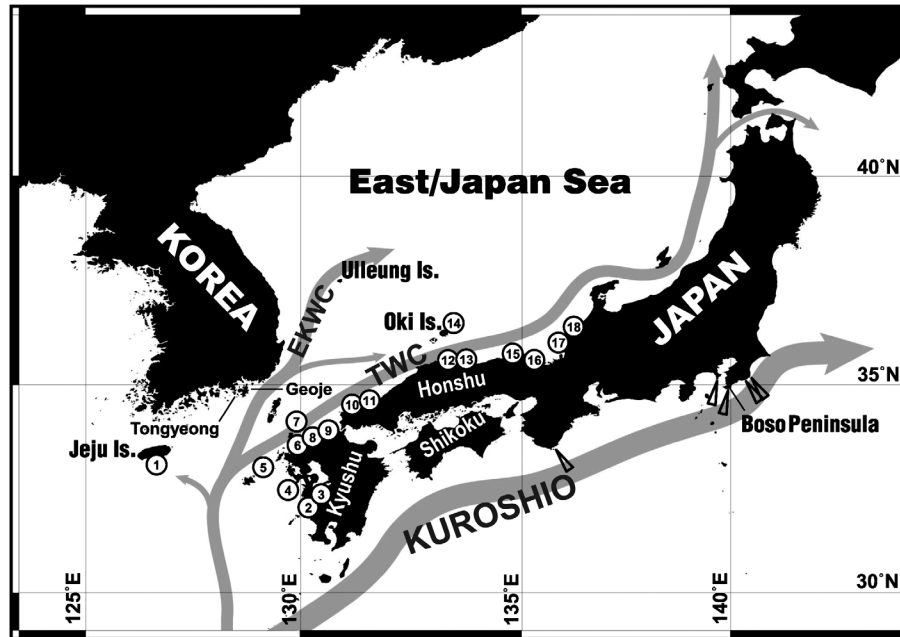


Fig. 1. Geographical distribution of the blue-lined octopus observed in the East/Japan Sea and adjacent waters and the general pattern of surface currents in the sea and neighboring waters. Acute angled triangles indicate geographical distribution of the blue-lined octopus along the Pacific coast of Honshu Island, Japan (from Kubodera, 1994). The localities of circled numbers correspond to the place numbers in Table 1. TWC, Tushima Warm Current; EKWC, East Korean Warm Current.

was distributed north to the southern islands of the Japanese coast until the 1970s (Hashimoto, 1977), but the distributional boundary of the species moved northward to the Boso Peninsula (refer to Fig. 1) on the Pacific Coast of Honshu Island in the 1990s (Kubodera, 1994). Incidentally, a specimen of *H. fasciata* was found at the Oki Islands, Japan, in the East/Japan Sea in 2005 (Kohtsuka, 2006) and it was suggested that the octopus could have migrated into the East/Japan Sea.

Biotic and abiotic factors may influence the distribution of marine organisms (Kolar and Rahel, 1993; Bhattacharjee et al., 2009) and the distribution of cephalopods, including octopuses, can be affected by environmental factors (Boyle, 1990; Semmens et al., 2004; Pierce et al., 2008; Leite et al., 2009). Water temperature has a fundamental effect on physiological processes and the maintenance of homeostasis in aquatic animals (Venables et al., 1978; Hoegh-Guldberg and Bruno, 2010), and it is probably one of the most important factors influencing the distribution of octopuses (Collins, 2002; Ché-dia et al., 2010). Recent sea warming could cause a shift in the distribution of marine organisms from low-latitude regions toward the poles (Walther et al., 2002; Parmesan and Yohe, 2003; Perry et al., 2005). The East/Japan Sea is one of the most rapidly warming large marine ecosystems in the world (Belkin, 2009), and its warming is expected to cause migration of marine organisms from subtropical waters. Spread of the blue-lined octopus from adjacent subtropical water into the

East/Japan Sea could be a significant threat to Koreans and Japanese because the organism possesses a powerful toxin. Furthermore, coastal residents along the East/Japan Sea have no experience with the dangers of this species of octopus. Estimating the geographical distribution of the blue-lined octopus would be useful for public safety. However, there are very few published reports on the geographical distribution of the blue-lined octopus in the East/Japan Sea, except for one specimen that was found on Oki Island, Japan (Kohtsuka, 2006).

Although direct survey techniques, such as visual surveys and fishing data, are more effective for estimating the spatial distribution of octopuses (Pierce and Guerra, 1994; Hill and Wilkinson, 2004; Leite et al., 2009), these methods require extensive field research and funding. We hypothesized that, because Internet use is widespread and there is common access to the Internet in Korea and Japan (International Telecommunication Union, 2010), information on websites may be used as basic data for a large-scale distribution survey of an organism.

In this study, we conducted a survey to determine the geographical distribution of the blue-lined octopus using Internet search engines and a questionnaire. Individual observation records of the blue-lined octopus were gathered from websites in Korea and Japan, and every datum was used to create a large-scale geographical distribution map in the East/Japan Sea.

Materials and Methods

Study area

The East/Japan Sea is a semi-enclosed marginal sea surrounded by Korea, Japan, and Russia. It is connected to the adjacent ocean by shallow straits. Warm water originating from a branch of the Kuroshio Current, which is a strong warm current in the western North Pacific Ocean, flows into the East/Japan Sea through the Korea/Tsushima Strait and flows out through the other straits (Cho and Kim, 2000; Kim et al., 2001; Taegue et al., 2006; Na et al., 2009). The Northwest Pacific Ocean, especially the East/Japan Sea, the East China Sea, and the Kuroshio Current, are the most rapidly warming marine environments in the world (Belkin, 2009). We designated the East/Japan Sea and adjacent waters as the survey area to determine changes in the distributional range of the blue-lined octopus in relation to climate change.

Data collection

Four commercially available internet search engines were used to find records on the Internet. Daum (<http://www.daum.net/>), Google Korea (<http://www.google.co.kr/>), Naver (<http://www.naver.com/>), and Yahoo! Korea (<http://kr.yahoo.com/>) were used for Korean information; goo (<http://www.goo.ne.jp/>), Google Japan (<http://www.google.co.jp/>), MSN (<http://jp.msn.com/>), and Yahoo! Japan (<http://www.yahoo.co.jp/>) were used for Japanese information. The same search terms were entered in the search engines. Two words in the Korean language were entered at the same time in the Korean search engines because there is no common name for the blue-lined octopus (or the blue-ringed octopus) in Korea. One word (*Dok* in Korean) meant toxin, poison or venom, and the other word (*Muneo*, *Jukkumi*, or *Nakji* in Korean) meant octopus. We also searched for “*Hapalochlaena*,” “blue-ringed octopus,” and “blue-lined octopus” in English on the Korean websites. In contrast, the common Japanese name of the blue-lined octopus is *Hyomondako* (Kubodera, 1994) and this was entered in the Japanese search engines. Among the results from Japan, information found from the prefectures along the west coast of Kyushu Island and Honshu Island, Japan (such as Kumamoto, Nagasaki, Saga, Fukuoka, Yamaguchi, Shimane, Tottori, Hyogo, Kyoto, and Fukui) was included. Regardless of the source (*i.e.*, the government, the press, and private records, including scuba divers), all information was included. If the record was not complete, either lacking an observation date or place-name, the data were excluded. Overlapping information was considered to be a single case. The individual observation data were collected discontinuously from July 2009 to August 2010.

Questionnaire administered to fishermen

Korean fishermen living on the southeast coast of Korea, such as Tongyeong and Geoje, and Ulleung Island located in the East/Japan Sea, were surveyed during July and August 2010. The questionnaire participants were 145 fishermen from Tongyeong, 53 fishermen from Geoje, and 42 fishermen from Ulleung Island. Before starting the survey, we explained, with photographs, the general characteristics of the blue-lined octopus including body size, change in body color and the brilliant iridescent blue lines or blue rings.

Results

Internet reports of sightings of the blue-lined octopus around the East/Japan Sea are listed in Table 1; the locations were marked on a map and their geographical distribution is shown in Fig. 1. The circled numbers in Fig. 1 correspond to the place numbers in Table 1.

Overall, via the Internet, 32 sightings of the blue-lined octopus were found from 18 different regions in Korea and Japan. In Korea, there was some information on *Hapalochlaena* spp. on the Internet, but an actual record of the organism was found at only one website. The pictures taken at Jeju Island, Korea, in 2003 were from a solitary observation. The octopus in the picture taken at Jeju Island was recorded as *H. fasciata* on the website. Questionnaires to complement and enhance the base data targeted fishermen. However, none of the 240 fishermen questioned had observed a blue-lined octopus. Furthermore, none of the questionnaire participants knew that the blue-lined octopus existed or that an octopus can be dangerous.

In Japan, a total of 31 observation records of the blue-lined octopus were found on the Internet. Twenty-two cases were from the East/Japan Sea coast of Honshu Island, and nine cases were from the west coast of Kyushu Island (Table 2). The blue-lined octopus was first recorded along the Japanese coast of the East/Japan Sea in Maizuru Bay in 2004 (number 16 in Table 1 and Fig. 1). After this observation, the octopus was found in various regions on the East/Japan Sea side of Japan. The northern distributional boundary of the blue-lined octopus in the East/Japan Sea was off Sakai, Fukui Prefecture, Japan (around latitude 36°10' N). Based on information from four websites, the blue-lined octopus was observed 14 times on Omi Island (numbers 11 to 24 in the Appendix 1), Yamaguchi Prefecture, located on the southwest coast of Honshu, Japan (number 10 in Fig. 1). Although observed depths and water temperatures were not recorded in every case, the blue-lined octopus was found to a maximum depth of 19 m and in a water temperature range of 12–18°C. Furthermore, a blue-lined octopus, while brooding her eggs, was photographed four times on Omi Island from February to April 2009. These observations provide evidence of reproduction of the octopus in the East/Japan Sea. The blue-lined octopus was observed in all months of the year except September and October, but was found most frequently in April around the East/Japan Sea

Table 1. List of internet records of the blue-lined octopus: observed regions and dates around the East/Japan Sea

Place No.	Country	Observed region	Observed date	Depth (m)	Water temp. (°C)	Finder or confirmer
1	Korea	Mun Islet, Seoguipo, Jeju	Aug. 7, 2003	4	-	Confirmed by a researcher
2	Japan	Ushibuka, Kumamoto	Jan. 9, 2005	-	17	Private record
3	"	Tashikita, Kumamoto	Apr. 8, 2010	-	-	Confirmed by a researcher
4	"	Nomozaki, Nagasaki	May 12, 2010	-	-	Private record
5	"	Goto Islands, Nagasaki	Apr. 12, 2009	-	-	Confirmed by an officer
6	"	Kakara Island, Karatsu, Saga	Jul. 6, 2010	3-4	-	Confirmed by a government officer
7	"	Iki Island, Nagasaki	Jun. 23, 2010	-	-	Confirmed by a government officer
8	"	Hakada Bay, Fukuoka	Apr. 17, 2004	-	14	Private record
	"	"	Nov. 30, 2009	-	-	Confirmed by a government officer
9	"	Fukutsu, Fukuoka	Dec. 20, 2006	-	15	Private record
10	"	Omi Island, Nagatoshi, Yamaguchi	Jan. 29, 2005	-	-	Private record
	"	"	Dec. 20, 2007	-	16	Private record
	"	"	Mar. 15, 2008	-	13	Private record
	"	"	Apr. 13, 2008	-	14	Private record
	"	"	Apr. 23, 2008	-	-	Private record
	"	"	Dec. 3, 2009	-	18	Private record
	"	"	Feb. 3, 2009	-	14	Private record
	"	"	Feb. 5, 2009	-	14	Private record
	"	"	Feb. 28, 2009	-	14	Private record (breeding)
	"	"	Mar. 8, 2009	-	13	Private record (breeding)
	"	"	Apr. 4, 2009	-	14	Private record (breeding)
	"	"	Apr. 11, 2009		15-16	Private record (breeding)
	"	"	May 8, 2009	-	17	Private record
	"	"	Mar. 14, 2009	-	12	Private record
11	"	Hagi, Yamaguchi	Jan. 27, 2008	-	13.3	Private record
12	"	Mihokan, Matsue, Shimane	May 20, 2008	-	-	Confirmed by a researcher
13	"	Yurihama, Tottori	Dec. 5, 2006	2-3	-	Collected by a researcher
14	"	Okinoshima Island, Shimane	Aug. 24, 2005	19		Article (15)
15	"	Takeno, Toyooka, Hyogo	Apr. 4, 2010	7	-	Private record
16	"	Maizuru Bay, Kyoto	Mar. 17, 2004	-	-	Collected by a researcher
17	"	Takasu, Fukui	Nov. 9, 2009	-	-	Confirmed by a researcher
18	"	Mikuni, Sakai, Fukui	Jun. 18, 2010	15	-	Confirmed by a researcher

The place number is represented as a circled number in Fig. 1.

Table 2. Number of blue-lined octopus observed cases by month on the coast of the East/Japan Sea and adjacent waters

Sea	Region	Month												Sum
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
East/Japan Sea	Honshu Is. (Japan)	2	3	4	5	2	1	-	1	-	-	1	3	22
Adjacent water	Jeju Is. (Korea)	-	-	-	-	-	-	-	1	-	-	-	-	1
	Kyushu Is. (Japan)	1	-	-	3	1	1	1	-	-	-	1	1	9
Sum		3	3	4	8	3	2	1	2	-	-	2	4	32

(Table 2). We found that the blue-lined octopus was distributed extensively around the East/Japan Sea side of Japan. To the best of our knowledge, this is the first report on the large-scale geographical distribution of the blue-lined octopus around the East/Japan Sea.

Discussion

Usefulness of the Internet for a large-scale distribution survey of the blue-lined octopus

The Internet is a widespread source of information and its use is prevalent in Korea and Japan. In 2008, the percentage of households with access to the Internet in Korea and Japan was 94.3% and 79.8%, respectively (International Telecommunication Union, 2010). Many observation records of the blue-lined octopus around the East/Japan Sea were gathered via the Internet. The Internet search method used here is not comparable to common systematic fisheries survey methods, such as fishing data or visual survey techniques (Pierce and Guerra, 1994; Hill and Wilkinson, 2004; Leite et al., 2009). A systematic survey of the blue-lined octopus over wide geographical regions is not easy because of its small size and because its skin color makes it almost invisible. Moreover, collection of accurate fishing data is difficult because there is no commercial fishery for the blue-lined octopus (Norman, 1998) and very little is known about its population density in specific areas. The results of our survey may not be sufficient as part of a public safety program, although they can provide useful information to warn of possible food poisoning or bites.

Through this study, we proved the usefulness of the Internet for a large-scale survey of the blue-lined octopus. In many cases, the date and place of observation or photos taken in the field of the blue-lined octopus were gathered. Species-specific features of the blue-lined octopus, such as iridescent blue lines on the dorsal mantle, can be observed in most of the octopus photos posted on the Internet. Country-specific commercial search engines were used in Korea and Japan. Some records were found by all search engines, while others were found only by some search engines. Several search engines were needed because different search engines provided different results. Similar results have been reported by other investigators who have compared the usefulness of Internet search engines for finding health information (Wu and Li, 1999; Merion et al., 2000).

Geographical distribution of the blue-lined octopus around the East/Japan Sea and factors affecting its distribution

The blue-lined octopus is found along the Pacific Coast of Honshu Island and the southern islands of Japan (Kubodera, 1994), but very little is known about the geographical distribu-

tion of the octopus on the East/Japan Sea coast of the country. Global warming is expected to cause migration of the blue-lined octopus from existing habitats, much the same as for fish (Walther et al., 2002; Parmesan and Yohe, 2003; Perry et al., 2005; Dulvy et al., 2008). Evidence of the spread of this octopus in the East/Japan Sea and adjacent waters was gathered in Korea and Japan. There was little evidence to suggest that this octopus occupies the Korean coast of the East/Japan Sea, contrary to expectations. However, considerable evidence supporting the existence of blue-lined octopus in the East/Japan Sea was collected from Japan. In addition to the records listed in Table 1, more data that lacked objective evidence, such as an observation date or location, were excluded from the Japan data. The excluded data did not affect the northern distributional boundary of the species because most of the incomplete data were obtained from regions south of southwestern Honshu Island, Japan.

We found four photos of a blue-lined octopus brooding eggs taken at Yamaguchi, Japan, on a website. This is obvious evidence that the blue-lined octopus is reproducing in the southern East/Japan Sea. We suggest that the southern East/Japan Sea has become a favorable reproductive environment for the blue-lined octopus. Brooding blue-lined octopuses were found at water temperatures between 13°C and 16°C (Table 1). Tranter and Augustine (1973) reported that the embryonic development time of the blue-lined octopus was about 2 months at seawater temperatures of 20.8–22.5°C. The embryonic developmental period of *Haplochlæna* spp. is temperature dependent: the higher the water temperature, the shorter the developmental period (Overath and von Boletzky, 1974). It is presumed that the embryonic development period of the blue-lined octopus at 13–16°C will extend beyond 2 months.

Although biotic and abiotic factors affect the distribution of octopuses in the natural environment (Mather, 1982; Boyle, 1990; Collins, 2002; Semmens et al., 2004; Pierce et al., 2008; Leite et al., 2009; Chédia et al., 2010), the geographical distribution of the blue-lined octopus in the southern part of Japan is strongly influenced by the Kuroshio Current (Kubodera, 1994). The East/Japan Sea is also influenced by the Tsushima Warm Current, which is a branch of the Kuroshio Current. The distribution of the blue-lined octopus around the East/Japan Sea most likely corresponds to the flow of the Tsushima Warm Current along the Japanese coast (Fig. 1). The Tsushima Warm Current flows into the East/Japan Sea through the Korea/Tsushima Strait and then separates into two or three branches. One branch, called the East Korean Warm Current, flows along the east coast of Korea and one branch flows along the Japanese coast, while the offshore branch is seasonally variable (Kawabe, 1982; Cho and Kim, 2000). Southeast regions, such as Tongyeong, Geoje, and Ulleung Island in Korea, are also influenced by the Tsushima Warm Current, but no evidence of blue-lined octopus was collected from either Internet searches or questionnaires administered to local fishermen. Although the Tsushima Warm Current flows along the coasts of both

Korea and Japan, there was a considerable difference in the distribution of the blue-lined octopus between the countries. We suggest that either the blue-lined octopus has received little attention in Korea or that there is another factor interrupting its settlement along the Korean coast.

The spread of the blue-lined octopus via water currents would be difficult because the octopus produces relatively large eggs and lacks a planktonic stage in its life history (Tranter and Augustine, 1973; Kubodera, 1994). Nevertheless, blue-lined octopus were found in large regions around the East/Japan Sea. This means that a part of the East/Japan Sea and adjacent waters may have changed to provide a suitable habitat for the blue-lined octopus, which originated in tropical and subtropical waters. The East/Japan Sea and the East China Sea around Korea and Japan are rapidly warming large marine ecosystems (Kim et al., 2001; Belkin, 2009). The net sea surface temperature increase in the East/Japan Sea and the East China Sea between 1982 and 2006 was 1.09°C and 1.22°C, respectively (Belkin, 2009). The widespread distribution of the blue-lined octopus in the East/Japan Sea, originating from tropical or subtropical waters, is presumed to be caused by sea warming that occurred over a long period. Generally, pelagic species, especially fishes, are more sensitive to environmental change (including climate change) than benthos and demersal fish (Hiscock et al., 2004; Megrey et al., 2009; Rijnsdorp et al., 2009). Although the blue-lined octopus is a demersal species, the octopus was found at the relatively high northern latitude of 36°10' N. We suggest that sea warming has contributed to a slow northward shift in the distribution of the blue-lined octopus. Models predict that the surface water temperature in the East/Japan Sea will be 1–6°C warmer in 2060 than at present (Murazaki et al., 2005). If the East/Japan Sea continues to warm, the blue-lined octopus will likely become more widespread, including along the Korean coast, especially along the southeast coast of the Korean Peninsula where it is significantly affected by the Tsushima Warm Current.

Recent sea warming is expected to cause migration of marine organisms from adjacent subtropical waters to the East/Japan Sea. As we expected, the blue-lined octopus is widely distributed along the Japanese coast around the East/Japan Sea. Expansion of the range of the poisonous and venomous blue-lined octopus may increase human health risks. Invasion of the blue-lined octopus into the East/Japan Sea will increase concerns over health and food safety in Korea and Japan. Health and food safety authorities should educate the public on preventing food poisoning or envenomation by the blue-lined octopus.

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Appendix 1. Summary of records' source of the blue-lined octopus observed around the East/Japan Sea

No.	Observed date	Observed place	Information sources (address)	Accessed date
1	Aug. 7, 2003	Mun Islet, Seoguipo, Jeju	http://microseashell.com/bbs/view.php?id=Cephalopoda&page=1&sn1=&divpage=1&sn=off&ss=on&sc=on&select_arrange=headnum&desc=asc&no=11	Jul. 16, 2009
2	Jan. 9, 2005	Ushibuka, Kumamoto	http://www.blue-earth.co.jp/sealog/sealog.cgi?mode=&pass=&log=200501	Apr. 8, 2010
3	Apr. 8, 2010	Tashikita, Kumamoto	http://bbs1.aimix-z.com/gbbs.cgi?room=33kai&page=25	Jul. 22, 2010
4	May 12, 2010	Nomozaki, Nagasaki	http://ootorimaru.com/mt-mobile/archives/cat2/	Aug. 9, 2010
5	Apr. 12, 2009	Goto Islands, Nagasaki	http://official.shinkamigoto.net/index.php?itemid=705	Apr. 8, 2010
6	Jul. 6, 2010	Kakara Island, Karatsu, Saga	http://www.city.tosu.lg.jp/1812.htm	Aug. 9, 2010
7	Jun. 23, 2010	Iki Island, Nagasaki	http://www.nishinippon.co.jp/nnp/item/180207	Jul. 22, 2010
8	Apr. 17, 2004	Hakada Bay, Fukuoka	http://www.kunitomi-div.com/ours/diving/log/2004/04log14.htm	Apr. 8, 2010
9	Nov. 30, 2009	"	http://www.nishinippon.co.jp/nnp/item/169950	Apr. 8, 2010
10	Dec. 20, 2006	Fukutsu, Fukuoka	http://blog.f-diving.net/index.php?blogid=3907&archive=2006-12	Apr. 8, 2010
11	Jan. 29, 2005	Omi Is. Nagatoshi, Yamaguchi	http://www.sea-again.net/sea2/divlog/div05/divlog05012904.htm	Apr. 8, 2010
12	Dec. 20, 2007.	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2007/12/index.html	Aug. 12, 2010
13	Mar. 15, 2008	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2008/03/index.html	Aug. 12, 2010
14	Apr. 13, 2008	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2008/04/index.html	Aug. 12, 2010
15	Apr. 23, 2008	"	http://goma-mongara.net/webL/fish/hyoumondaiko.htm	Apr. 8, 2010
16	Dec. 3, 2008	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2008/12/index.html	Aug. 12, 2010
17	Feb. 3, 2009	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/02/index.html	Aug. 12, 2010
18	Feb. 5, 2009	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/02/index.html	Aug. 12, 2010
19	Feb. 28, 2009	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/02/index.html	Aug. 12, 2010
20	Mar. 8, 2009	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/03/index.html	Aug. 12, 2010
21	Apr. 4, 2009	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/04/index.html	Aug. 12, 2010
22	Apr. 11, 2009	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/04/index.html	Aug. 12, 2010
23	May 8, 2009	"	http://www.vox-plus.com/scuba_blog/0508.php	Aug. 8, 2010
24	Mar. 14, 2010	"	http://dijisanpo.blog.ocn.ne.jp/seaagain/2009/04/index.html	Aug. 12, 2010
25	Jan. 27, 2008	Hagi, Yamaguchi	http://www.umizoh.com/nikki08/0801gatu.html	Apr. 8, 2010
26	May 20, 2008	Mihokan, Matsue, Shimane	http://www.pref.tottori.lg.jp/dd.aspx?itemid=271034	Apr. 8, 2010
27	Dec. 5, 2006	Yurihama, Tottori	http://db.pref.tottori.jp/Press2.nsf/0/2eaca01b8485eff14925723d003ede60?OpenDocument	Apr. 8, 2010
28	Aug. 24, 2005	Okinoshima Island, Shimane	http://jglobal.jst.go.jp/public/20090422/200902268867007223	Jul. 22, 2010
29	Apr. 4, 2010	Takeno, Toyooka, Hyogo	http://sankei.jp.msn.com/life/trend/100413/trd1004130130000-n1.htm	Jul. 22, 2010
30	Mar. 17, 2004	Maizuru Bay, Maizuru, Kyoto	http://www.maipress.co.jp/kako/04nen3gatutpx.html	Apr. 8, 2010
31	Nov. 9, 2009	Takasu, Fukui	http://www.nature.museum.city.fukui.fukui.jp/gallery/gallery.html	Apr. 8, 2010
32	Jun. 18, 2010	Mikuni, Sakai, Fukui	http://osaka.yomiuri.co.jp/animal/genre8/20100622-OYO8T00386.htm	Aug. 9, 2010