



## Summary of breeding status for the Japanese Crested Murrelet

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### Abstract

The Japanese Crested Murrelet (*Synthliboramphus wumizusume*) breeds mainly on remote islands and rocks in warm waters of southern Japan and the Republic of Korea. In 1994-1995, 25 colonies were reported in Japan, with a total estimated population of about 2,500 to 3,000 breeding pairs, but no information on numbers was available for Korea. By 2017, 41 colonies (current and historical) have been reported, with a total estimated population of 2,800 to 4,100 pairs. Numbers are slightly higher than reported in 1994-1995, but this murrelet is still one of the rarest alcids in the world. Biro Island and the Izu Islands are still the two major breeding areas, but relatively large numbers are now known at Gugul Island and nearby islands in Korea. Trends in colony size are poorly known at almost all colonies due to insufficient monitoring, although 2012 surveys at Biro Island (Miyazaki Prefecture) suggest almost same population since 1994. The colony at Koyashima Island had been recovering from mass mortality inflicted by Norway rats (*Rattus norvegicus*) in 1987, but in 2009 a rat reinvasion again impacted its murrelets. Numbers at Kojima have increased since 1994. Harvesting of murrelet eggs for human consumption prior to the 1960s has become recognized as a major past impact at several colonies. Crows are becoming a major threat these days, and surf-fishermen are expected to help with keeping crow numbers low.

**Key words:** Japanese Murrelet, Crested Murrelet, *Synthliboramphus wumizusume*, colonies, surveys, breeding, population, threats, Kaminoseki

### Introduction

The Japanese Crested Murrelet breeds mainly on remote islands and rocks in warm waters of southern Japan and the Republic of Korea. Its range of distribution is very small. The study of its movements suggests that the birds stay within 1500 km of Japan, even during the non-breeding season (Yamaguchi et al. 2016). In 1994-1995, 25 colonies were reported in Japan with a total estimated population of about 2,500-3,000 breeding pairs, but no information on numbers was available for Korea (Ono 1995). Since Ono's 1995 report, no breeding population estimate of this species has been available. This paper contributes an estimate of the breeding population for every current and historical colony. It also suggests areas where better surveys are needed for the species.

### Methods

For this paper, we reviewed monitoring projects done by the Biodiversity Center of Japan (BIODIC), which started in 2004, and other projects done by individual groups with different methods.

Unfortunately, trends in colony size are poorly known at almost all colonies due to insufficient monitoring, although 2012 surveys at Biro Island suggested little change in size since 1994.

For many colonies, there is very limited information on breeding populations. We created 3 categories for estimating the size of these colonies: (a) where fewer than 5 birds or carcasses and/or only a few (1-5) eggshell fragments have been recorded, we hypothesize ca. 10-25 pairs breeding; (b) with fewer than 10 birds or carcasses and/or some (about 6 or more) egg shell fragments, we hypothesize ca. 25-50 pairs breeding; and (c) where about 20 birds or carcasses and/or some egg shell fragments, we hypothesize ca. 50-100 pairs breeding. There are some data from call counts, but it is possible that calls from some individuals were counted more than once, so records from call counts were used just for reference. Data on eggshell fragments also was just supplementary; some surveys provided numbers of eggshells, others did not.



Regarding areas where information on numbers of nests was reported but observers did not estimate the numbers of breeding murrelets, we adopted a rule to round the number up. We multiplied numbers between 1 and 9 by a factor of 10, because we suspect that the true number of nests was generally higher than reported, due to inaccessible areas that could not be surveyed.

At Shikine Island, Otsuki conducted surveys and interviewed 4 residents of this island on 13 -14 May 1995. I collected historical breeding information and the information as of 1995 for all islands that belong to the Nijijima Island group. We include this information in this paper.

We have divided the breeding range of the Japanese Murrelet into three zones, to help readers find specific colonies. Zone numbers in the text and table are all matched to zone numbers in the map of colonies (Figure 1). We estimated the present breeding population based on data observed since 2000, except for Carter et al. (2002).

There are 8 records of Japanese Murrelets from Northeastern Russia between 1959 and 2014 (Kondratyev et al. 2000, Gluschenko and Surmach 2015). In 1984, 1 juvenile was collected, but this was in July, the non-breeding season (Kondratyev et al. 2000). In 2014, 1 adult was found during the breeding period (Gluschenko and Surmach. 2015). Those data are still not enough to confirm breeding in Russia, so we did not include Russian data in this paper.

### Breeding Status for each colony

All colonies confirmed by 2017 are in Figure 1. Those colonies and a population estimate for each are in the Table (Appendix, page 30). Detailed descriptions follow for each breeding site.

#### Zone 1

**UJIMA:** This colony is located in Shimoda-shi (formerly Shimoda-cho), Shizuoka Prefecture, Japan. Two eggs were collected on 10 April 1947 (Ikeda 2001). The colony name on the first label and in the catalog was Karasu-no-shima (鴉の島), but it was corrected to Ujima (鵜島) at the Yamagata Museum after the catalog was published. There is no Karasu-no-shima in Shimoda-shi. There is the Shimoda Castle, which also has been called Ujima Castle in Shimoda Park beside Ujima quay, Shimoda-shi (SCRG). So we confirmed that these eggs were found in this area. This is the only record of eggs collected at this location.

**MIKOMOTO ISLAND:** Mikomoto Island is located 11 km from Shimoda-shi, Shizuoka Prefecture. Breeding of murrelets here has been known since 1940. In 2010, one eggshell fragment was found by the Wild Bird Society of Japan (WBSJ), and it was confirmed as Japanese Murrelet egg. This was the first record of the species at this colony since 1983 (WBSJ 2012). An artificial nest project was successful in 2016, and 5 eggshells were found at the 3 artificial nests (Asahi Shimbun Digital 2016). We determined a rough estimate of 10-25 pairs.

**NIJIJIMA ISLAND (Cape Nebu):** This is one of the Izu Islands. The main Nijijima Island is 2,284 ha and has about 2,250 inhabitants. It has four satellite islands: **Jinai Island**, **Shikine Island with Taibusa Rock**, **Hanshima Island**, and **Udone Island**. Information on murrelet breeding exists for the main Nijijima Island and 3 of its 4 satellites. On 13 -14 May 1995, Otsuki interviewed residents of Shikine Island: Mr. T. Watanabe, K. Miyakawa, and the owner of the inn Kikusui Ryokan, K. Watanabe. Otsuki collected information for all four islands belonging to the Nijijima Island group.

*Nijijima Island:* Breeding on the main Nijijima Island was reported for Cape Nebu in the 1980s (Isobe 1982, 1990). The Wild Bird Society of Japan (WBSJ 2012) confirmed 2 abandoned eggs and 2 unhatched eggs. Pellets of predatory birds that contained murrelet feathers and bones were also confirmed. WBSJ (2012) also reported there was high murrelet predation on the whole beach. Carter et al. (2002) estimated roughly 25-50 pairs on Nijijima Island.

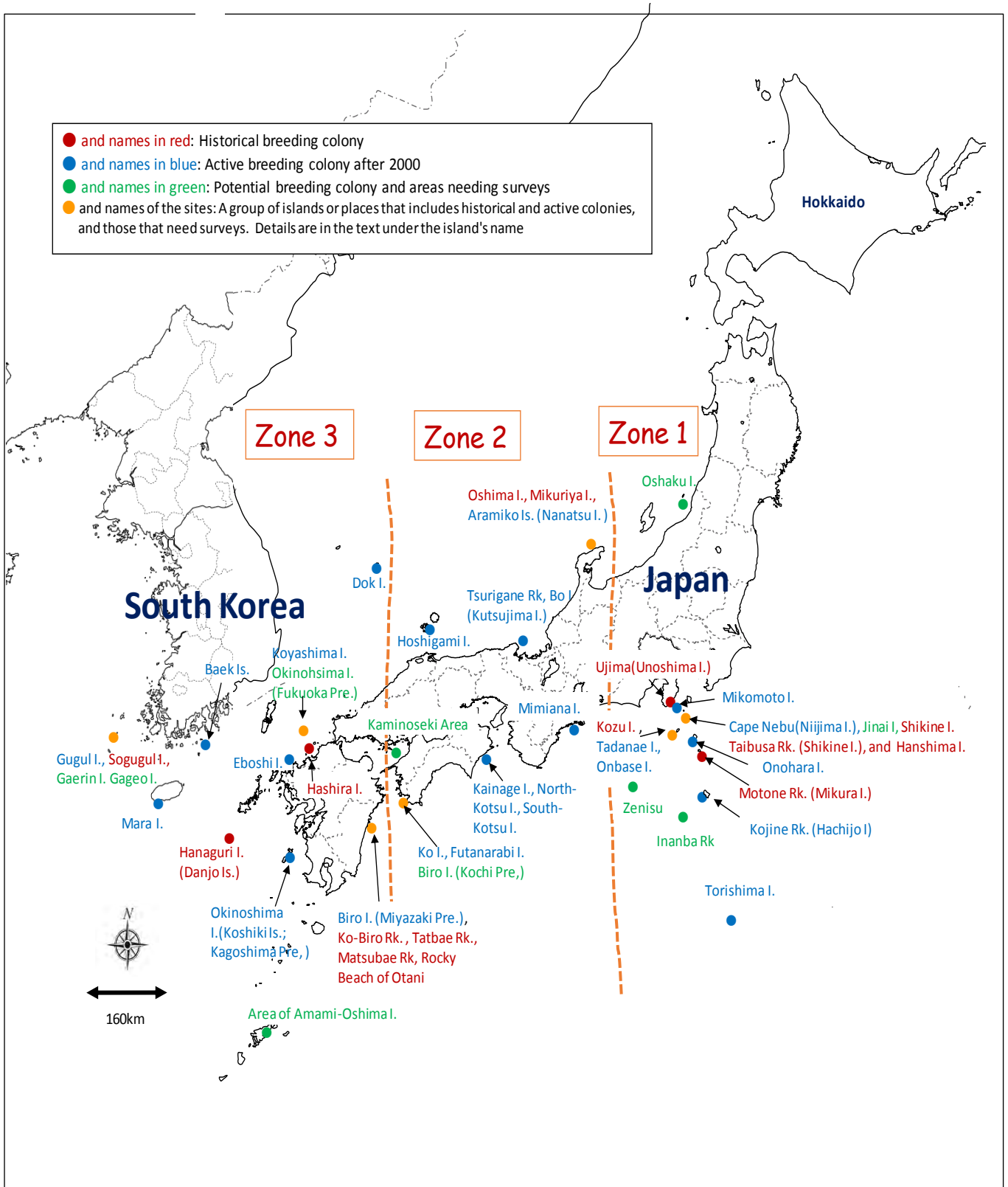


Figure 1. All breeding colonies, including historical colonies, those confirmed to be active as of 2017, and those, where better surveys are needed to confirm status.



*Shikine Island with Taibusa Rock*: Shikine Island (Figure 2) is located 3 km southwest from the south end of Niijima Island. It has about 530 inhabitants. Taibusa Rock is located 1km from the west edge of Mikawa Bay.



Figure 2. Map of historical Japanese Murrelet colony

According to T. Watanabe and the owner of the inn Kikusui Ryokan: (1) in the past, many murrelets were breeding in rock crevices in between Kanbiki Cove and Mikawa Bay; (2) Kanbiki Cove was the largest colony at Shikine Island, and there should have been at least 100-200 murrelets breeding there. Ten to fifteen pairs were also breeding on the small rock in the Kanbiki Cove. In the past when there were many murrelets, eggs were harvested as food and birds were collected as kids' toys. T. Watanabe, the owner of Kikusui Ryokan, and K. Watanabe told us there were many murrelets breeding on Taibusa Rock too. K. Miyakawa said that eggs were being harvested on this rock and he thought that there should be some breeding murrelets there. According to T. Watanabe, many murrelets used to be caught in nets that were set for flying fish (*Exocoetidae* spp.) at the entrance of Mikawa Bay. No detailed survey has been conducted at Taibusa Rock, so surveys are needed there; and a detailed survey is needed for the beaches of Kanbiki Cove. No evidence of current nesting was found by Otsuki and Ochikubo at historical nesting sites in 1995 (Carter et al. 2002).

*Hanshima Island*: This small unpopulated rock is just off Niijima Island and Japanese Murrelets appear to nest in rock crevices (Carter et al. 2002). H. Hasegawa found Japanese Murrelets nesting on this island in 1986 (Carter et al. 2002). According to T. Watanabe and the owner of Kikusui Ryokan, there used to be many murrelets, especially at Hanshima Island. The owner also said there were still 5-6 murrelets there in 1995. T. Watanabe harvested about 400 murrelet eggs in 1946. He also said that snakes at Hanshima had eaten murrelet eggs. Surveys are needed here. Carter et al. (2002) estimated roughly 25-50 pairs on Hanshima.

*Udone Island*: This island is located 4.5 km north from Niijima Island. The most current record was by L. Ochikubo in 1995. Carter et al. (2002) estimated roughly 50-100 pairs on this island. Surveys are needed here.

When counting numbers of active colonies after 2000, we do not include Hanshima and Udone Islands due to the lack of obvious signs of breeding on these islands. We agree, however, that the total number of pairs estimated by Carter et al. (2002) for the Niijima islands group is still valid.

**KOZU ISLAND**: This is one of the Izu Islands. Its area is about 1,837 ha and it has about 1,870 inhabitants. Kozu Island has two satellite islands: **Onbase Island** and **Tadanae Island**. The owner of the inn “Mansakumar” told H. Hasegawa that there were many breeding murrelets where the harbor is located now, and people often used to harvest eggs there (H. Hasegawa, pers. comm.). M. Namie (1889) had been surprised to find seabird eggs for dinner, and he bought some. Namie also asked children to get adult birds, and those children brought a few adults next morning. There are no recent reports of breeding on Kozu Island.

*Tadanae Island*: It is located 1 km from east side of Kozu Island. There are 2 small islets, called “Rikuno-Tadanae” and “Oki-no-Tadanae”. Breeding of murrelets is confirmed at Oki-no-Tadanae. The most



current record was for 2014 (BIODIC 2015). Three nests (1 nest with incubating adult, 2 nests with only eggs) were found on 3 May 2014. As a result of call counts, 799 were recorded between 19:30 on 2 May 2014, and 01:00 on 3 May 2014. No nest surveys have been conducted at Riku-no-Tadanae, because it is inaccessible due to steep rocks (WBSJ 2012). Carter et al. (2002) roughly estimated 100-300 pairs from former counts of 110 birds in the water around both Tadanae Islands by K. Ono in 1991 (Ono 1993), WBSJ in 1992 (WBSJ 1993), and their own study in 1993 and 1994 (Carter and de Forest 1993, 1994a, b; Carter et al. 1994; WBSJ 1994). We consider that the estimate by Carter et al. (2002) is still valid, based on the recorded calls.

*Onbase Island:* Onbase Island is located 4 km southwest of Kozu Island. There are 2 large rocks. Breeding of murrelets is confirmed on the north rock. The most current breeding record was by BIODIC in 2014 (BIODIC 2015). Two murrelet carcasses and 2 eggshells were also found on 15 September 2014. During a spotlight survey, WBSJ had a maximum count of 630 murrelets at dawn on 23 April 2015 (Tajiri et al. 2016). Carter et al. (2002) roughly estimated 75-150 pairs at Onbase, and we consider that this estimate is still valid.

**ONOHARA ISLAND or Sanbondake: Onohara Island** is located 10 km west of Miyake Island, in the Izu Islands. Onohara Island includes 8 small rocks, and Japanese Murrelets breed only at **Koyasune Rock** (WBSJ 2010). During the latest observation in 2009, 12 nests (9 incubating and 3 abandoned) were confirmed (WBSJ 2010). Carter et al. (2002) roughly estimated 75-100 pairs in 1994, and we consider that this estimate is still valid.

**MOTONE ROCK:** Motone is a small rock next to Mikura Island, one of the Izu Islands. There was a translation error in H. Carter's description of Motone. H. Hasegawa was quoted as saying that he found a Japanese Murrelet nest there in 1985 or 1986 (Carter et al. 2002). Here is the correct information from H. Hasegawa (pers. comm.): At the end of the 1970s, he heard from islanders of Mikura Island that they used to go to Motone Rock to collect eggs. The rocks of Motone Island collapsed, and the seabed between Motone Rock and Mikura Island became shallow, sometimes even exposed above the water. Probably mice invaded Motone Rock and Japanese Murrelets disappeared. Hasegawa surmised that no breeding occurs on Motone Rock now, but that breeding should have occurred there until the 1960s. Surveys are needed here.

**KOJINE ROCK:** Kojine is a small rock off Hachijo Island, one of the Izu Islands. In 1993, Ono did detailed studies on 5 nests (Ono 1993). He found another 10 nests in inaccessible areas and observed 19 murrelet families departing. A total breeding population of 20-30 pairs was estimated (Carter et al. 2002). The latest observations were in 2014 (BIODIC 2015). Evidence of breeding was confirmed by three nests (1 nest with eggs and 2 nests with hatched eggshells). Given the similar numbers of nests found in 1993 and 2014, we concluded that an estimate of 20-30 pairs is still valid for this colony.

**TORISHIMA ISLAND:** Torishima Island is in the Izu Islands; it is a single isolated volcanic island with an area of 4.8 km<sup>2</sup>. On 2 April 1994, H. Hasegawa collected the shells of 2 Japanese Murrelet eggs near Cape Tsubame (H. Hasegawa, pers. comm.). Hasegawa confirmed those were hatched eggshells based on the shell membranes. In 2000, one dead murrelet was collected at Torishima Island with an egg in its oviduct (Tsurumi et al. 2001). The latest observations were in 2014. Japanese Murrelets were recorded several times by motion-activated census cameras, on 28 February 2014 and on 1 and 3 March (BIODIC 2015). In 2015, H. Hasegawa said he still heard murrelets calling, and he suggested that some should be breeding on Torishima Island. Carter et al. (2002) roughly estimated 10-25 pairs on the island. Detailed breeding surveys are needed here.

## Zone 2

**NANATSU ISLANDS:** This group is located 24 km from the Noto Peninsula, Ishikawa Prefecture, Japan. Breeding of murrelets was first recorded at **Oshima Island** in 1974 (Higuchi 1986), and in 1984, breeding was confirmed at **Mikuriya Island** and **Aramiko Island** (WBSJI 2006). This area is known as the northernmost confirmed breeding colony of the Japanese Murrelet. Breeding at Aramiko Island was



confirmed in 2005 (WBSJI 2006), but it apparently had stopped by 2005 at two other islands, Oshima Island and Mikuriya Island (Nakamura 2004, WBSJI 2006)

*Aramiko Island* (WBSJI 2006): In May 1997, 2 adult carcasses, 1 chick carcass, and 2 abandoned eggs were recorded. Signs of predation by rats were found on the adult carcasses here. In 2005, a survey to confirm breeding was conducted at all three islands. Breeding evidence (fragments from 1 hatched eggshell and 1 probable depredated eggshell fragment) were found only at Aramiko Island. We roughly estimate a minimum of 10-25 breeding pairs. More surveys are needed for all 3 Nanatsu Islands.

**KUTSUJIMA ISLANDS:** This area is located 25 km from Maizuru Port, Kyoto Prefecture, Japan. It is divided into two islands: **Tsurigane Rock** and **Bo Island**.

*Tsurigane Rock* (BIODIC 2014): In April 2013, 12 nests were confirmed on Tsurigane Rock. A rough estimate of 20 pairs was determined. This rock is very steep and it is difficult to survey its entire area. There may be more nests in inaccessible areas.

*Bo Island* (BIODIC 2014): In April 2013, 1 nest on Bo Island was confirmed. Calls were counted between 19:30 on 27 April 2013 and 04:34 on 28 April, with the result of 456 calls. Based on the single nest that was recorded, we roughly estimated 10 pairs on this island.

**MIMIANA ISLAND:** Mimiana Island is located 5 km from Kii-Nagashima Island, Mie Prefecture, Japan. In 1969, the number of nests was estimated as 100-200 (Kurata 1971, Hirai and Nishimura 2014b). In 2014, H. Horiuchi, who does monitoring outsourced by the Ministry of the Environment for this area, re-estimated nest numbers at fewer than 100 murrelets (50 pairs), suggesting that the breeding population has decreased (Hirai and Nishimura 2014a). A detailed breeding survey is needed here.

**KO ISLAND:** This island is located 700 m from Kashiwa Island, Kochi Prefecture, Japan. Nests are mainly concentrated on the grassy south side of the island. BIODIC estimated the number of nests in this area as 330 (BIODIC 2015). BIODIC also found 9 nests in the rock crevices on the south edge of the island. Four carcasses of adults and 46 depredated eggs were also found. No information on the cause of carcasses and predation was available, but the Large-billed Crow (*Corvus macrorhynchos*) and the Black Kite (*Milvus migrans*) were suggested as potential predators (BIODIC 2015). Based on the number of the nests, we estimated 340 breeding pairs for this island.

**FUTANARABI ISLAND:** This island is located 1.6 km north-northeast from Okinoshima Island, Kochi Prefecture, Japan. Twenty-one signs of Japanese Murrelet breeding were found by BIODIC members (BIODIC 2015). They also counted calls at night, with a result of 1,901 calls between 19:30 (22 April 2014) and 04:30 (23 April 2014). We roughly estimated 30 pairs; we consider that this estimate is valid, based on the call count.

**KAINAGE ISLAND AND KOTSU ISLANDS:**

**Kainage Island** is located 1 km north from Oshima Island, Mugi-cho, and **Kotsu Island** is located about 1 km east of Teba Island, Mugi-cho, Tokushima Prefecture, Japan (Fig. 3). T. Tanaka informed us that the Japanese Murrelet breeds on these islands (pers. comm.).

*Kainage Island:* According to information from T. Tanaka (pers. comm.), murrelets breed on this island. No further information is available for this colony.

*Kotsu Island:* It consists of 2 small islands, **North Kotsu Island** and **South Kotsu Island**. Murrelets breed on both islands, the majority on South Kotsu Island.

No detailed survey has been conducted in this area. Surveys are needed for all 3 islands (Kainage Island and the 2 Kotsu Islands).



Figure 3. Map of Kotsu Island and Kainage Island in Tokushima Prefecture

There is ferry service between Mugi-cho and Teba Island, Tokushima. On the ferry route, T. Tanaka counted 150-200 murrelets on 4 April and 200-300 murrelets on 22 April 2015, after 17:00 (pers. comm.) Tanaka counted in the circled area in Fig. 3. According to the Tokushima Shimbun web site (2017), T. Harada said that more than 400 murrelets are visible in the water in the evening if weather and sea conditions are good. However, no detailed description of distribution was available in the article. The Tokushima red list says there should be fewer than 1000 adults in Tokushima (Tokushima Prefecture 2010). Murrelets are observed off the coast of the southern part of the prefecture, such as Mugi-cho (Tokushima Prefecture 2001).

Based on H. Harada (Tokushima Shimbun 2017) and the Tokushima red list, these islands have a total population of at least 400, probably 1000 murrelets. At-sea captures at Biro Island showed that 59% of murrelets had brood patches (Carter et al. 2013); therefore we suspect that there are 236-590 breeding murrelets (118-295 pairs) in the Kotsu-Kainage area. Some photographers chartered boats to take photographs of Japanese Murrelets (T. Tanaka pers. comm.).

**HOSHIGAMI ISLAND:** This island is a part of the Oki Islands, Shimane Prefecture, Japan, and is one of MOE's seabird monitoring sites. In 2009, BIODIC confirmed 9 nests on this island. They extrapolated from the nest count using murrelet nesting densities to estimate the total number of nests at 45 (BIODIC 2010, 2014, Sato et al. 2016). In 2011 and 2014, 3 nests were confirmed outside of the BIODIC monitoring area by Sato et al. (2016). Based on those estimates and additional nests, we roughly estimated 50 breeding pairs.

### Zone 3

**KOYASHIMA ISLAND:** It is located 1 km south of Okinoshima Island, Fukuoka Prefecture, Japan. Heavy egg harvesting of Japanese Murrelets occurred before 1960 (Kuroki 1963, Kuroki et al. 1966). Okinoshima Island, Koyashima Island, and surrounding rocks were designated as a world heritage site in 2017. BIODIC found 11 nests on the island in April 2016, and they also estimated 30 individuals from a call count on 1 May 2016 (BIODIC 2017). Takeishi et al. estimated breeding populations at Koyashima at just over 32 (Takeishi et al., page 106 in this booklet). Based on the number of nests and the estimate of Takeishi and others we agreed on 11-32 breeding pairs for Koyashima Island. Rat impacts on murrelets have been confirmed in Japan only at this island. On 29 April 1987, 145 carcasses of the Japanese Murrelet were found in the dense grass (*Carex wahuensis*) and 414 murrelets were estimated to have died (Takeishi 1987). In 1974, the Environment Agency had estimated 204 breeding pairs (Environment Agency 1975), and it was clear that almost all of the breeding population was killed in 1987. Researchers couldn't find any Japanese Murrelets (Takeishi et al. 2012b). Fukuoka Prefecture conducted rat eradication in June-August 1987 and February 1988. They continued eradication every April until 1999, during which time murrelets increased slightly on the island. In 2009 a second small rat invasion occurred and the murrelet population was damaged again. (See also Takeishi et al., page 106 in this booklet).

**HASHIRA ISLAND:** It is located 700 m northeast of Genkai-to, Fukuoka Prefecture, Japan. Breeding of murrelets was known on the island until 1974; Tsuchiya recorded 24 breeding pairs (Environment Agency 1978). Since this report, no survey has been done in this area. In the 1978 report of the Environment Agency,



the author introduced interesting comments by fishermen. Some fishermen said that they had never threatened the murrelets, because fishing with plenty of murrelets had good results. Surveys are needed here.

**EBOSHI ISLAND:** Eboshi Island is a small uninhabited island of about 1 ha, located between Iki Island (Nagasaki Prefecture) and Itoshima Peninsula (Fukuoka Prefecture). The breeding population at Eboshi Island in 2012 was about 25-30 pairs (Takeishi et al. 2012a. For more details, see Okabe et al, page 86 in this booklet). Periodic monitoring projects are needed here.

**HANAGURI ISLAND:** This is part of Danjo Islands, located 150 km from the west part of Nagasaki Prefecture.

*Hanaguri Island:* In 1977, breeding of murrelets was confirmed on the north and south sides of Hanaguri Island. At the north side of the island, eggshell fragments and bones were recorded at least 15 locations, so 30 pairs were roughly estimated by the Environment Agency (1978). No information was available on causes of death for the carcasses. No surveys for murrelets have been conducted since 1977, so surveys targeted for murrelets are needed here.

**BIRO ISLAND and SURROUNDING ISLANDS:** **Biro Island** is located about 7 km from Kadogawa port, Kadogawa, Miyazaki Prefecture, Japan. This is the world's largest Japanese Murrelet colony. Until the early 1970s, people harvested murrelet eggs at **Tatebae Rock** (20 m north from Biro Island) and on Biro Island itself (Otsuki 2013). S. Hamada confirmed historical breeding records at **Matsubae Rock** (2.4 km north from Biro Island), **Kobiro Rock** (200 m north from Biro Island), and at **the rocky Beach of the Otani area** in the eastern part of Kadogawa town (see also Hamada, page 126 in this booklet).

*Biro Island, Kobiro Rock, and Tatebae Rock:* In 2011 and 2012, the JMPST implemented an at-sea nocturnal spotlight survey technique for Japanese Murrelets at these locations (Whitworth et al. 2012, Carter et al. 2013). Whitworth et al. estimated the breeding population as 853 to 1,297 for this entire area (D. Whitworth, unpublished data). Intensive nest searches were conducted by MBRG at Biro Island (Whitworth et al. 2014), but nesting was not confirmed at Kobiro Rock and Tatebae Rock. During JMPST spotlight projects in 2011 and 2012, many murrelets were recorded around Kobiro Rock and Tatebae Rock (Whitworth et al. 2012, Carter et al. 2013). Surveys are needed to confirm murrelets breeding on those 2 islands. Surveys are also needed for Matsubae Rock and the rocky beaches of Otani in Kadogawa-cho, following up on Hamada's historical information (see also Hamada, page 126 in this booklet).

**KOSHIKI ISLANDS:** **Okinoshima Island** is one of the Koshiki Islands, located 38 km west of the port city of Ichiki-kushikino, Kagoshima Prefecture, Japan. Six adult carcasses and eggshell fragments were found at 2 rock crevices there during bird surveys in 2005-2007 by F. Mizoguchi (Mizoguchi 2007). No information was available on causes of death for the carcasses. We roughly estimated 25-50 breeding pairs on this island. More surveys are needed here.

**DOK ISLAND:** Dok Island is roughly 87 km east from the east coast of Ulleung Island, South Korea. In late May of 2005, one dead adult and one fledgling Japanese Murrelet were found at a rock at 37° 14' 5.4" N, 131° 51' 33.9" E (Kwon and Yoo 2005). No information was available on causes of death for the carcasses. We roughly estimated a minimum of 10-25 breeding pairs. More detailed surveys are needed here.

**GUGUL, SOGUGUL, AND GAERIN ISLAND:** **Gugul Island** is located on the southwestern tip of the South Korea. **Sogugul Island** is located 250 m west and **Gaerin Island** is 600m east of Gugul Island. The environment of those 3 islands is very similar. Gugul Island is the only known breeding site where Ancient (*S. antiquus*) and Japanese Murrelets co-occur (Park et al. 2012). The Japanese Murrelet part of this population was estimated as 430 breeding pairs by Park et al. (see also Park et al., page 67 in this booklet).

There is an old breeding record of the Japanese Murrelet for Sogugul Island (Won 1984). Breeding of murrelets was confirmed for both Sogugul Island and Gaerin Island in 2011, but the breeding species were not determined (C. Park, unpublished data). Both Japanese and Ancient Murrelets were observed around





those two islands during the nocturnal spotlight surveys, so we suspect that both species breed on those 2 islands, and there are indications that Japanese Murrelets nest there (presence of birds on the nearby water during the spotlight surveys; Won 1984). However, we did not count those islands as active breeding colonies of Japanese Murrelets after 2000, due to lack of recent confirmation. More detailed surveys are needed for Sogugul and Gaerin Islands.

In 2012, Park and others conducted a spotlight survey around all 3 islands and got a maximum count of 623 murrelets, including both Ancient and Japanese Murrelets (Park et al. 2012). The number of Japanese Murrelets breeding at Sogugul and Gaerin Islands together was estimated from this count, based on the ratio of the two species caught in mist nets on Gugul Island. Based on their spotlight count and other Gugul Island surveys, Park et al. judged that another 160 pairs of Japanese Murrelets (and 180 pairs of Ancient Murrelets) may be nesting on those two islands (C. Park, unpublished data).

**BAEK ISLANDS:** The Baek Islands are located 30 km east of Geomun Island, South Korea. This area includes Sangbaek Islands (including **Geobuk-bawi Rock**) and **Habaek Islands**. Park and others visited the Baek Islands 3 times in 2011-2012 (Park et al. 2013). Some dead Japanese Murrelets were found on Geobuk-bawi Rock in August 2011, and surveys indicated that the Norway Rat is the major threat there. In April 2012, they counted 23 Japanese Murrelets next to Sangbaek Islands and Habaek Islands during a spotlight count at night. They also found 2 failed nests on Geobuk-bawi Rock. Park and others conducted another spotlight survey in March and May of 2016; the maximum spotlight count was roughly 350 (C. Park, unpublished data). We roughly estimate 100 breeding pairs. This number may be an underestimate.

**MARA ISLAND:** Mara Island is about 7 kilometers off Jeju Island's southwest coast, South Korea. **Mara Island** is also a popular tourist attraction. According to the Jeju Weekly (2017), scientists estimated 200 breeding pairs of Japanese Murrelets. S. Chan heard that at least 30 murrelets are killed by cats every year (S. Chan, pers. comm.). For more information, see Park et al., page 67 in this booklet. Surveys are needed here.

### Potential breeding sites

Here are potential breeding sites of Japanese Murrelets that are not mentioned above or in the Appendix table, page 30 (they are on the map, Fig. 1). Confirmation of breeding will require landing on those islands and conducting a survey for nests (active or abandoned), eggshell fragments, or adults (including carcasses).

**JINAI ISLAND (Zone 1):** This island is off Niijima Island, one of the Izu Islands. WBSJ conducted a spotlight survey, and 304 murrelets were counted on 23 April 2015 (Tajiri 2016). WBSJ (2013) also found 3 chicks in the water on the west side of Jinai Island between 18:00 (6 May) and 01:04 (7 May). The presence of chicks around the island at night suggests a high probability of breeding.

**OSHAKU ISLAND (Zone 1):** This island is a satellite of Tobishima Island, Yamagata Prefecture, Japan, from which it is 1.4 km to the west. JMPST conducted spotlight surveys around Tobishima Island and Oshaku Island in late April 2014. Five Japanese murrelets were recorded during the survey (Hasebe 2017). After this news, one photographer chartered a boat to take photographs of Japanese Murrelets (K. Yanagawa pers. comm.).

**ZENISU (Zone 1):** This is one of the Izu Islands and is located 70 km south from Cape Irozaki, Shizuoka Prefecture. WBSJ conducted a night survey on the water on 4 and 5 May 2011, during which they heard calls of murrelets (WBSJ 2012).

**INANBA ROCK (Zone 1):** It is a part of the Izu Islands and is located 35 km southwest from Mikura Island. WBSJ conducted a daytime survey from boats on 4 and 5 May 2011. Fourteen murrelets were observed within 1 km of Inanba Rock (WBSJ 2012).



**AREA of KAMINOSEKI (Zone 2):** This area is in Yamaguchi Prefecture, Japan. This is only area in the world where we can see Japanese Murrelets throughout the year, and it may be a very important resource for them (see also Takahsima et al., page 54 in this booklet).

**OKINOSHIMA ISLAND (Fukuoka Prefecture, Zone 3):** It is located 1 km north of Koyashima Island, Fukuoka Prefecture, Japan. JMPST conducted spotlight surveys around Okinoshima Island in 2012 and 2014. Some murrelets in the water were observed between the north and northeast sides of the island in both years (Takeishi et al. 2012b, Takeishi et al. 2014), and one departing family was found in the same area on 26 April 2014 during the spotlight survey (Figure 4; Takeishi et al. 2014). The presence of chicks around the island at night suggests a high probability of breeding.

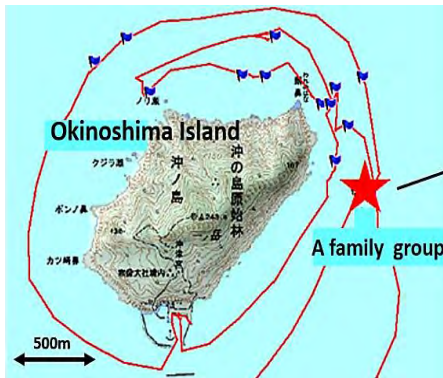


Figure 4. Departing family of Japanese Murrelets during the spotlight survey around Okinoshima Island on 26 April 2014. The line is the survey route. (Japanese Murrelet photo: M. Takeishi)

**BIRO ISLAND (Kochi Prefecture, Zone 3):** This island is located 2.5 km southwest from Kojima, Kochi prefecture, Japan. According to S. Sato, he and his colleagues conducted spotlight surveys on 21 March 2015. They recorded 10 murrelets around the island. Timing of the survey was slightly early; more murrelets are likely to have been counted in April (S. Sato pers. comm.).

**AREA of AMAMI-OSHIMA (Zone 3):** One downy chick was found at Amani-Oshima Island (28° 22' N, 129° 29' E), in Kagoshima Prefecture, Japan. The chick is presumed to have departed from the nest shortly before it was found; this indicates a possible breeding colony nearby (Iwami et al. 2016).

**GAERIN ISLAND (Zone 3):** This island is 600m east of Gugul Island. The environment of this islands is very similar to Gugul Island and Sogugul Island. We did not count Gaerin Island as an active breeding colony of Japanese Murrelet after 2000, but we still include it for estimating the breeding population of Sogugul and Gaerin Islands together (see page 22 in this paper). The presence of lots of murrelets during spotlight surveys in 2012 suggests a high possibility of breeding.

**GAGEO ISLAND (Zone 3):** It is located 2.5 km southeast from Gugul Island in South Korea. During spotlight surveys by Whitworth and others (Whitworth and Carter 2012), 5 murrelets were recorded around Gageo Islands. Landing surveys are needed to confirm breeding.

### Corrections to the checklist of Japanese Birds, 7<sup>th</sup> revised edition

Two islands in this checklist (The Ornithological Society of Japan, 2012) are incorrectly identified as breeding colonies of the Japanese Murrelet.

**OKINOSHIMA ISLAND (Fukuoka Prefecture, Zone 3):** Okinoshima Island is introduced as a breeding colony, but there has been no definitive breeding evidence for the Japanese Murrelet. A nearby island, Koyashima, has Japanese Murrelets, and it is referred to as “Okonoshima · Kokashima” in Japan. Therefore people may have misunderstood Okinoshima as a breeding colony, but it has no record of breeding.



**MOTONE ROCK (Zone 1):** Motone is also introduced as a breeding colony. As we describe above for Mikura Island and Motone Rock (page 19), no murrelets are believed to have bred there since the 1970s.

## Discussion

### *Population*

Biro Island (Miyazaki Prefecture) and the Izu Islands still remain the two major breeding areas of the Japanese Murrelet, and relatively large numbers are known at Guguldo and nearby islands in Korea. Numbers at Ko Island have increased since 1994. We can announce that colonies have been discovered recently at the Islands in Mugi-cho, including 3 individual colonies (Kainage Island and the Kotsu Islands).

By 2017, 41 colonies (current and historical) have been reported, and 25 colonies have been active since 2000. We estimate the total population since 2000 as 2,817-4,052 pairs (see Appendix). Because many observers have given estimated colony populations as a range, there is a big range for our estimate of the total population. It is reasonable to present the estimated range by rounding the numbers to the second digit, which results in a final estimate of 2,800-4,100 pairs. This estimate is a big contribution to Japanese Murrelet knowledge.

The current estimated numbers are slightly higher than reported in 1994-1995. However, this does not suggest that the population has increased; rather, it suggests that the popularity of this species in Japan has gone up. We can at least infer a major reduction in numbers of murrelets at colonies where many eggs were harvested before 1960.

Due to increased public interest and development of the internet, it is now easier to get new information on the Japanese Murrelet. But this allows us to affirm that it is still one of the rarest alcid in the world. In order to preserve this species, monitoring is important. In particular, detailed monitoring is needed at sample colonies to measure trends in colony size, investigate predator impacts, and develop restoration actions. Therefore, it is urgent that we update our information on the Japanese Murrelet, and that we develop better protections for the species.

### *Threats*

Harvesting of murrelet eggs for human consumption prior to the 1960s has become recognized as a major past impact at several major colonies, such as the Izu Islands, Koyashima Island, and Biro Island (Miyazaki Prefecture) and its surrounding areas. Direct damage of murrelets by rats has only been confirmed at Koyashima Island, where there was also a big egg harvest before 1960. Probable rat predation is also suggested at Baek Island.

Cats, dogs, and crows are becoming major threats these days. Bait left by surf-fishermen is considered to be a cause of crows visiting islands with murrelet colonies. Therefore education of fishermen is needed to continue reducing the numbers of crows. Further details on this topic are in the summary of the symposium (see Karnovsky et al., page 100 in this booklet). The presence of photographers has also been a cause for concern in the area of Oshaku Island and Mugi-cho (Kainage Island and Teba Islands). Establishing rules or regulations for those issues may be needed.

### *Areas that need surveys*

We suggested 10 locations as potential breeding sites on page 23 in this paper. Surveys are urgently needed in those areas, especially in three places (Jinai Island, Okinoshima Island (Fukuoka Prefecture), and Gaerin Island) that very likely are breeding colonies. Another 7 locations and areas where no surveys have been done for more than 40 years also need to be resurveyed.

WBSJ has been using the spotlight survey as a counting method and been counting quite a few murrelets in Izu Islands area. However, since the time of their survey corresponds to the late egg incubating period, it is difficult to compare with the estimated numbers of Biro Island. During the main stage of incubation, which is considered to be the suitable stage of the spotlight survey, it is recommended to conduct spotlight surveys with at-sea capture of murrelets, in order to confirm the portion of breeding birds based on brood patches.

Otsuki and others have started a project to monitor crows at Biro Island (Miyazaki Prefecture), where these birds are known predators on murrelets. If we want to protect Japanese Murrelets, intensive surveys targeted for predators are needed on other islands, especially in places such as Koyashima Island and Mara Island.



In recent years, non-breeding movements of the Japanese Murrelet have been revealed (Chishima et al. 2014; Yamaguchi et al. 2016; also see Yamaguchi et al., page 50 in the booklet). Those studies indicate Japanese Murrelets migrate toward the north from their breeding habitat. Although it is still unknown why those movements occur, they may be explained by ocean currents and seasonal food availability. There is an exception where murrelets occur almost year-round in waters around Kaminoseki, in the Seto Inland Sea. The significance of Kaminoseki for murrelet biology may be, in part, that the birds gather in this area to molt. Most murrelets cannot fly during the autumn molt, so they must use protected areas with plenty of food. Murrelets eat a variety of small fish and krill. Because they have very high metabolic rates, they must eat a weight of fish equal to 60 to 90% of their body weight every day. (See also Piatt and Nelson, page 33 in this booklet.) Therefore areas like Kaminoseki are critical for the species. This area needs a special project to locate the breeding colonies of the birds that gather at Kaminoseki, and to confirm the significance of the area for the murrelets.

### ***Collaborations and monitoring***

On the murrelet migration route, fishery bycatch of murrelets has been reported (Piatt and Gould 1994; also see Choi et al., page 114 in the booklet). To protect murrelets at colonies and feeding areas throughout their range, we need communication and collaboration among scientists in all murrelet-related areas.

In order to establish proper monitoring methods and survey protocols, collaboration is very important. It will be a great help to work with Pacific Seabird Group (PSG) members who have much specific knowledge and experience with respect to the Japanese Murrelet.

To protect this species, we need the collaboration of many people: local and international, governmental and nongovernmental. It is also what our co-author Harry Carter desired. As a first collaboration of scientists from all Japanese Murrelet breeding colonies, including PSG members, we held a technical meeting during the murrelet symposium in Kadogawa in March 2017. The purpose of this meeting was to find a common protocol for the spotlight survey, which is the method for counting murrelets on the water for population estimates. Details of this discussion are in the summary of the technical meeting (see Hébert, page 129 in this booklet).

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## 摘要

カンムリウミスズメ(*Synthliboramphus wumizusume*)は、主に、日本と韓国南部の温暖な海域の離島で繁殖している。1994-1995年、25カ所の繁殖地で、推定約2,500ペアから3,000ペアと報告された。しかしながら、この時点では韓国の情報は含まれていない。2017年現在、41カ所の繁殖地(現在および過去のデータ含む)で、推定約2,800ペアから4,100ペアが報告されている。1994-1995年のものと比較すると、数は、わずかに増加しているように見えるが、本種は、依然として、世界的に希少なウミスズメ類の一種である。枇榔島(宮崎県)と伊豆諸島が、いまだ2大主要繁殖地であるが、比較的大きな繁殖地が、韓国のググル島でも確認されている。モニタリングが不十分なため、2012年の枇榔島(宮崎県)の調査で、個体数規模が1994年とほぼ等しいことが示唆された以外は、殆どのコロニーで繁殖の規模は解っていない。小屋島のコロニーは、1987年のドブネズミ(*Rattus norvegicus*)による被害から、回復の途にあったが、2009年のネズミ類の再侵入により、カンムリウミスズメは、再び被害を受けた。幸島の個体数は、1994年以来、増加しているようである。1960年代以前は、数カ所のコロニーにおいて、人間による卵の採集が主要な脅威となっていたようである。現在は、カラス類が主要な脅威となりつつあり、カラス類の数を低くおさえるための釣り人の協力が期待されている。



## Appendix: Summary of Japanese Murrelet breeding status

Zone No.	Island & Colony Names	Estimated no. of breeding Pairs 2000-2017	Sources	Note	
<b>1</b>	Ujima (Unoshima)	鷓島	- Ikeda (editor) 2001		
	Mikomoto I.	神子元島	~10-25 WBSJ 2012		
		Cape Nebu, (main land Nijijima)	新島 根浮崎	~10-25 Carter et al. 2002; WBSJ 2012	
		Shikine I. (Kanbiki Bay+ small rock)	式根島 神引海岸	0 Carter et al. 2002; K. Otsuki and L. Ochikubo, unpubl. data	survey needed
		Taibusa Rk. (main Shikine)	鯛房岩	- K. Otsuki and L. Ochikubo, unpubl. data	survey needed
	Nijijima Is. 新島	Hanshima I.	早島	~25-50* Carter et al. 2002; K. Otsuki and L. Ochikubo, unpubl. data	survey needed
		Udone I.	鷓渡根島	~50-100* Carter et al. 2002	more survey needed
		Kozu I. (main)	神津島	0 Namie 1889; Carter et al. 2002; H. Hasegawa, pers.comm.	
		Tadanae I.	砥苗島	100-300 Carter et al. 2002; BIODIC 2015; WBSJ 2012	
		Onbase I.	恩馳島	75-150 Carter et al. 2002; Tajiri 2016; BIODIC 2015	Max. 630 birds at dawn, 23 April 2015 (Tajiri 2016), landing survey needed
		Onohara I (Sanbondake)	大野原島 (三本嶽)	75-100 Carter et al. 2002; WBSJ 2010	
		Motone Rk.	元根	0 Carter et al. 2002; H. Hasegawa, pers.comm.	survey needed
		Kojine Rk.	小池根	20-30 Ono 1993; Carter et al. 2002; BIODIC 2015	
		Torishima I.	鳥島	~10-25 Tsurumi et al. 2001; Carter et al. 2002; BIODIC 2015	more survey needed





Zone No.	Island & Colony Names	Estimated no. of breeding Pairs 2000-2017	Sources	Note
2	Oshima I.	0	Higuchi & Tachibana 1986; WBSJI 2006	more survey needed
	Nanatsujima Is. 七ツ島	0	WBSJI 2006	more survey needed
	Aramiko I.	~10-25	WBSJI 2006	more survey needed
	Kutsujima I. 沓島	20	BIODIC 2014	12 nests were found by BIODIC
	Bo I.	10	BIODIC 2014	1 nest was found by BIODIC
	Mimiana I.	50	Kurata 1971; Hirai and Nishimura 2014a	survey needed
	Ko I.	340	BIODIC 2015	330 estimated nests in the glasses and 9 additional nests in the rock crevices by BIODIC
	Futanarabi I.	30	BIODIC 2015	21 evidences of Japanese Murrelet breeding were found by BIODIC
	Kainage I.			
	North-Kotsu I. (Nazano-hana)	118-295	T. Tanaka, pers. comm.	survey needed
	South-Kotsu I. (Sadeba)			
	Hoshigami I.	50	BIODIC 2010, 2014, Sato 2016	45 estimated nests by BIODIC(2011) and 3 nests found by Sato et al. (2016)
	Koyashima I.	11-32	Takeishi et al. page 106; BIODIC 2017	
	Hashira I.	-	Environment Agency 1978	survey needed
Eboshi I. (Fukuoka Prefecture)	~25-30	Takeishi et al. 2012a; Okabe et al. page 86	survey needed	
Hanaguri I.	-	MOE 1978	survey needed	



Zone No.	Island & Colony Names	Estimated no. of breeding Pairs 2000-2017	Sources	Note
3	Biro I.(Miyazaki Prefecture)	853-1,297	Whitworth et al. 2012; Carter et al. 2013; Otsuki 2013; D. Whitworth, unpublished data.	
	枇榔島 (宮崎県)			
	Ko-Biro Rk.	included above	Hamada page 126	survey needed
	小枇榔 (宮崎県)			
	Tatebae Rk.		Whitworth et al. 2012; Otsuki 2013	survey needed
	タテバエ (宮崎県)			
	Matsubae Rk.	-	Hamada page 126	survey needed
	マツバエ(宮崎県)			
	Rocky Beach of Otani	-	Hamada page 126	survey needed
	大谷海岸の岩場 (宮崎県)			
	Okinoshima (Part of Koshiki I. Kagoshima Prefecture)	~25-50	Mizoguchi 2007	survey needed
	沖ノ島 (鹿児島)			
Dok I.	~10-25	Kwon and Yoo 2005	more survey needed	
ドク島				
Gugul I.	430	Park et al. 2012; Park, unpubl. data		
ググル島				
So-gugul I.	160*	Won 1984; Park et al. 2012; Park, unpubl. data.	more survey needed (this estimate also includes Gaerin Island)	
ソググル島				
Baek Is.	Geobuk-bawi Rk.	100	Park et al. 2013; Park, unpubl. data	
백島				
Mara I.	マラ島	~200	S. Chan, pers. comm.	survey needed
<b>No. of Total Pairs</b>		<b>2,817-4,052</b>		
		<b>(2,800-4,100)</b>		

+ : Only spotlight data is available, - : No information available

3categories for the colonies have very limited info without any references

(a) ~10-25: less than 5 birds/carcasses, only few (1-5) eggshell(fragments) (,calls)

(b) ~25-50: less than 10 birds/carcasses, some eggshell(fragments) (,some calls at night)

(c) ~50-100: about 20 birds/carcasses, some eggshell(fragments) (, lots of calls at night)

\*: not counted as confirmed avtiv colony of Japanese Murrelet after 2000, but included for estimated breeding numbers

BIODIC: Biodiversity Center of Japan

WBSJ: Wild Bird Society of Japan

WBSJI: Wild Bird Society of Japan Ishikawa Prececture