Bulletin of the Kagoshima Prefectural Museum（31）：59 ～ 65，2012

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要　旨

以前に公表された奄美大島や周辺域からのウミヘビ類２種（アオマダラウミヘビ，トゲウミヘビ）の記録に対し，再検討を加えた。これらの記録を含む報告書の執筆者からの情報にもとづいて，ウミヘビ類の標本を多く保管する研究機関を中心に，報告書中に挙げられている証拠標本の所在を探索したが発見できなかった。鹿児島県立博物館にそれぞれ小宝島産アオマダラウミヘビ，奄美大島産トゲウミヘビとして収蔵されていた上記の記録より新しい２液浸標本については，形態形質を詳細に調べたところいずれも同定が間違っており，前者は異常に体の大きなヒロオウミヘビ（全長1403㎜），後者はクロガシラウミヘビないしマダラウミヘビであることがわかった。トゲウミヘビの記録のもとになった標本が実際には，太短い体型，腹面に届かず環状にならない胴部の暗帯，といった形態的特徴を本種と共有し，最近になって奄美近海にも生息することが確認されたクロボシウミヘビであったことも考えられる。アオマダラウミヘビの奄美大島や小宝島を含む中琉球近海での生息，トゲウミヘビの日本領内での生息は，いずれもきわめて疑わしく，今後も慎重に産地記録と同定の信頼できる標本にもとづいて検討してゆく必要がある。

Abstract

Previously published records of elapid sea snakes, *Laticauda colubrina* and *Lapemis curtus* (= *Lap. hardwickii*), from Amamioshima Island and adjacent regions of the central Ryukyus, southern Japan, were readdressed. Current locations of voucher specimens, which had been referred to in the original records, could not be detected even through an extensive survey of institutional sea snake collections by considering information from the author of those records. Detailed morphological examination of two more recent, ethanol-preserved specimens deposited in the Kagoshima Prefectural Museum, of which one was catalogued as *Lat. colubrina* from Kodakarajima Island of the central Ryukyus and the other as *Lap. curtus* from Amamioshima Island, revealed that both identifications are erroneous with the former actually representing extraordinarily huge-bodied *Lat. laticaudata* (1403 ㎜ in total length) and the latter *Hydrophis melanocephalus* or *H. cyanocinctus*. It is probable that the specimen, on which the original record of *Lap. curtus* had been made, actually belonged to *H. ornatus*, another sea snake species, recently recognized from the Amami region, because this species shares several character states, such as stout body-shape and incomplete dark annuli on body, exclusively with *Lap. curtus*. Occurrences of *Lat. colubrina* in the central Ryukyus and *Lap. curtus* anywhere in the Japanese territory are both quite dubious, needing careful verifications on the basis of voucher materials with reliable locality data and taxonomic identifications.

INTRODUCTION

Shallow waters around the Ryukyu Archipelago, southwestern Japan, is known to represent, through the effect of warm sea current (Kuroshio) and mild terrestrial climate, the northernmost extremity of tropical marine environment, which embraces various organismal

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lineages largely or exclusively shared with shallow waters of lower latitudes, such as Southeast Asia and Oceania (Tsuchiya et al., 2006). This seems to be particularly true with sea snake fauna, which consists of multiple species around the Ryukyu Archipelago (e.g., Mishima, 1983; Toriba, 1994; Ota and Masunaga, 2005): there are also several records of sea snakes from mainland Japan, but these are usually attributed to occasional strays from the south (e.g., *Laticauda semifasciata*: Ota, 1995; *Hydrophis melanocephalus*: Masunaga et al., 2005) or from pelagic habitats (*Pelamis platura*: Ota and Masunaga, 2005).

Despite such interesting geographic location of the Ryukyu Archipelago, however, many of the previous records of sea snakes from this region suffer ambiguity in terms of species involved by lacking description or visual demonstration of taxonomic characters in voucher materials (specimens, photographs, etc.). Verification of each of those records by reexamining corresponding voucher is therefore strongly desired. We have reinvestigated records of two apparently rare sea snakes, *Laticauda colubrina* and *Lapemis curtus*, from Amamioshima Island and adjacent waters.

MATERIALS AND METHODS

Laticauda colubrina.-This oviparous species is reportedly broadly distributed in tropical shallow waters of Pacific and Indian Oceans (Smith, 1926; McCarthy, 1986), although a large part of its southern Pacific range may actually be ascribed to those of other cryptic species revalidated or newly described through recent taxonomic studies (Heatwole et al., 2005; Cogger and Heatwole, 2006).

In East Asia, *Lat. colubrina* has been recorded from Taiwan and the southern Ryukyus (Yaeyama and Miyako Island Groups) on the basis of voucher specimens clearly showing a combination of characters unique to the species (Maki, 1931; Ota et al., 1985). With respect to more northern areas, such as the central and northern Ryukyus, Mishima (1961, 1965) first published a specimen-based record: he referred to two *Lat. colubrina* obtained on 5 March 1961 at Kominato Coast of Nase, Amamioshima Island, as by-catches of a fish-net (Mishima, 1965). However, he did not mention of any taxonomic characters of these specimens or of the place of their deposition. Obviously just by following Mishima's record (i.e., without referring to any additional voucher material), most subsequent authors, such as Nakamura and Uéno (1963), have regarded shallow waters of the Amami Group, central Ryukyus, as a range of the species. To the present, however, no additional specimens of *Lat. colubrina* have actually been reported there, except for the one collected on 1 October 1980 from Kodakarajima Island (a small islet ca. 80 km N of Amamioshima Island; known as a nesting site of two other *Laticauda* species, *Lat. laticaudata* and *Lat. semifasciata*: Ota and Okada, 2003), identified as *Lat. colubrina* by Eiichi Nakamoto, and deposited in the Kagoshima Prefectural Museum (KPM) as REO-158 (Ideguchi, 1992). Because *Laticauda* species much resemble each other (Maki, 1931; McCarthy, 1986), verifications of identifications of those voucher materials referred to by those previous authors (Mishima, 1961, 1965; Ideguchi, 1992) are essential for further biogeographical studies, as well as conservation activities (Ota and Okada, 2003; Ota and Masunaga, 2005).

Lapemis curtus.-This viviparous species is also broadly distributed in tropical shallow waters of the Indian Ocean and western Pacific (Smith, 1926; Gritis and Voris, 1990; Golay et al., 1993). Although two species. *Lap. curtus* and *Lap. hardwickii* had long been recognized for the genus (e.g., Smith, 1926) with the latter being applied to East Asian populations (Stejneger, 1907; Maki, 1931; Nakamura and Uéno, 1963; Tu and Stringer, 1973; Toriba, 1994), Gritis and Voris (1990) synonymized the latter to the former on the basis of morphological data from a large series of specimens from various localities. Most recent authors have therefore been following this account (e.g., Zhao and Adler, 1993; Rassmussen et al., 2011: but see Golay et al. [1993] and Leviton et al. [2003] for different taxonomic arrangements).

In East Asia, *Lapemis hardwickii* surely occurs in southern Taiwan (Maki, 1931; Tu and Stringer, 1973). In his famous work "Fauna Japonica. Reptilia", Schlegel (1837) also mentioned of this species with an illustration, but as he admitted by himself, Japanese origin of the specimen, on which general introduction and illustration were prepared, is quite dubious (also see Stejneger [1907]). Several recent authors implicitly or explicitly refer to *Lap. curtus* (or *hardwickii*: see above) as a component of the Japanese sea snake fauna, but mostly without referring to any concrete voucher materials (e.g.,

Nakamura and Uéno, 1963; Golay et al., 1993): Only Mishima (1961, 1965) mentioned of a single *Lapemis* by-catch of fish-net on 13 May 1960 at Kominato Coast of Naze, Amamioshima Island, but without giving any information regarding, or pictures showing, states of taxonomic characters in this specimen. Furthermore, we detected another sea snake specimen (RE 981-03) in the Zoological Collection of KPM, which had been collected on 20 May 1981 at Wase, Sumiyo Village, Amamioshima Island, and catalogued as *Lap. hardwickii* following an identification by Eiichi Nakamoto.

Methods. -We examined external diagnostic characters in specimens deposited in KPM as *Lat. colubrina* and *Lap. hardwickii* and compared the resultant data with information regarding corresponding character states of those respective species appearing in literature. Definitions of characters followed Maki (1931) and Ota et al. (1986). To detect and examine voucher specimens of the two species referred to by Mishima (1961, 1965), one of us (HO) directly contacted and communicated with Dr. Shogi Mishima, the author of those publications, who had retired from his research position already.

RESULTS

Figure 1 shows the specimen deposited in KPM as *Laticauda colubrina* from Kodakarajima Island (REO-158). This was a large female preserved in ethanol, 1280 ㎜ in snout-vent length (SVL). Tail was intact and measured 123 ㎜ in length (TL), thus making total length of this specimen 1403 ㎜ . Rostral shield was not divided horizontally, and there were two prefrontals. Supralabial and infralabial shields were seven and six, respectively, and temporal formula was 1+2 on both sides. There were two pairs of elongate chin-shields forming a longitudinal row, of which the anterior pair was separated from the mental shield by the first supralabial pair. Dorsal scales were thoroughly smooth, in 19 rows on the neck and most portion of the body, but reduced to form 17 rows just before cloaca. Ventral scutes were distinctly broader than the adjacent body scales as in most terrestrial snakes, 245 in number when counted from the one immediately posterior to the posterior chin-shields, and 237 when counted following Dowling's (1951) system. There was no longitudinal median keel throughout the ventral surface of body. Anal scute was medially divided. The number of subcaudal scales was 34. The supralabial region was entirely dark in coloration. Body and tail had dark bands forming complete annuli against the light bluish ground color, and their numbers were 42 on the body and three on the tail, respectively. The width of a dark band, 4--4.5 dorsal scales' length in the neck, 3.5-4 dorsal scales' length in the midbody, and 4-5 scales' length just before cloaca, were consistently greater than that of a lighter interspaces (2 scales' length in the neck, 1.5-2 scales' length in the midbody, and 2-3 scales' length just before cloaca).

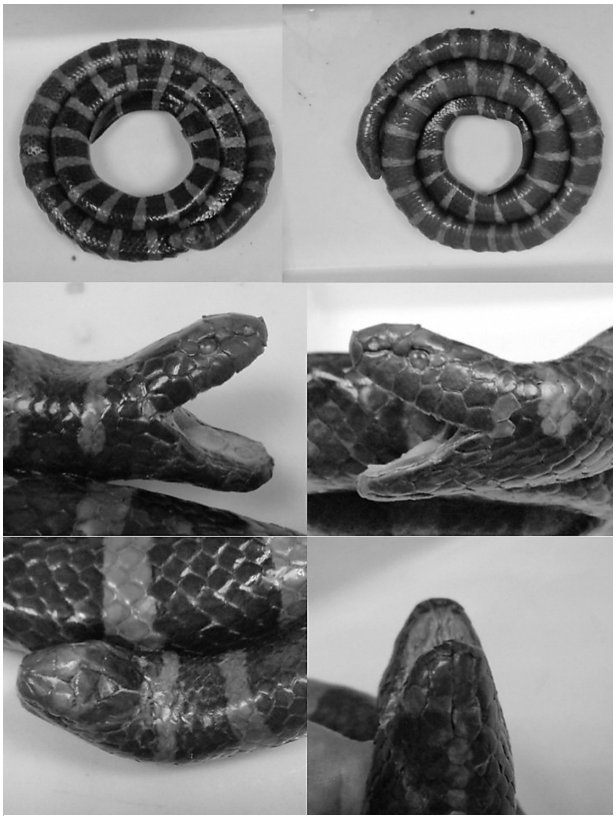

Figure 1. Specimens deposited in the Kagoshima Prefectural Museum as *Laticauda colubrina* from Kodakarajima Island, central Ryukyus, Japan (REO-158). Above: dorsal (left) and ventral (right) views of whole body. Middle: right (left) and left (right) lateral views of head. Below: dorsal (left) and ventral (right) views of head.

Figure 2 shows the specimen deposited in the Zoological Collection of KPM as *Lapemis hardwickii* (=*Lap. curtus*: see above) from Wase, Sumiyo Village, Amamioshima Island (RE 981-03). This was an adult female preserved in ethanol, 1154 ㎜ in SVL. Tail was intact, 110 ㎜ in TL, thus making total length of this specimen 1264 ㎜ . Supralabial and infralabial shields were, respectively, eight and nine on both sides. There was a single temporal shield immediately posterior to a single postocular shield on the right side. On the left side, scale arrangement in the

temporal region is largely similar except for insertion of a small shield between the large temporal shield and parietal shield, making the anterior temporal number two. There were two pairs of broad chin-shields forming a longitudinal row, of which the anterior pair was separated from the mental shield by the first supralabial pair. Surfaces of dorsal scales were smooth in anterior one fourth of the body, but then gradually became carinate or rugose posteriorly, developing a more or less distinct medial keel on each of the scales covering the dorsal and lateral surfaces of, and a tubercle on each of those covering the lateroventral surface of the middle and posterior body. The number of transverse scale rows was quite variable throughout the body, ranging from 28 on the neck to 43 on the middle and posterior body. Ventral scales were minute, not in scute-like, but were still discernible from adjacent body scales. Their number was 318 irrespective of criteria for counting (see above). The number of subcaudal scales was 44. Body and tail had dark bands forming complete annuli against the light yellowish ground color, and their numbers were 43 on the body and five on the tail. The width of each band was greater than that of the light interspace around the middorsal region, but smaller than that of the latter in the lateral and ventral regions of the body.

Figure 2. Specimens deposited in the Kagoshima Prefectural Museum as *Lapemis hardwickii* (=*Lap. curtus*) from Amamioshima Island, central Ryukyus, Japan (RE 981-03). Above: dorsal view of whole body. Middle: dorsal view of head (left) and ventral view of whole body (right). Below: right (left) and left (right) lateral views of head.

One of us (HO) sent several queries to Dr. Shogi Mishima, the author of those articles that had made apparently specimen-based records of *Lat. colubrine* and *Lap. curtus* from Amamioshima Island (Mishima, 1961, 1965). He was kind enough to try recalling his memory so seriously to respond to the points raised by those queries. With respect to the two specimens referred to as *Lat. colubrina* in Mishima (1961, 1965), he was sure of his identifications but could not recall concrete character states in those specimens that indicate their allocation to *L. colubrina*. Also, he mentioned that the vouchers should have deposited in the Japan Snake Institute, Gunma Prefecture. However, we could not detect them despite kind cooperation of the staff of this institute.

With respect to the single specimen of *Lap. curtus* (Mishima, 1961, 1965), Dr. Mishima was less sure of his identification or of current location of the voucher. He remembered that the specimen looked quite distinct from other sea snakes he had encountered during the survey on Amamioshima Island, such as *H. melanocephalus* and *H. cyanocinctus*. Moreover, he felt that the specimen resembled those *Lap. curtus* specimens that had been collected in his trips to Malaysia, but with slight differences: He mentioned that he had considered those differences between the two geographically distant populations as intraspecific variations. In those and other publications of him (e.g., Mishima, 1961, 1963, 1965), he did not list *H. ornatus* at all as a member of the sea snake fauna of Amami and the vicinity despite its actual occurrence in this region (Mori, 1986; Toriba and Nakamoto, 1991). Thus, I sent him color photographs of *H. ornatus* from Okinawajima Island (the largest island of the central Ryukyus ca 210 km SW of Amamioshima Island) and *Lap. curtus* from Malaysia (Fig. 3), and asked him about the possibility that he had erroneously identified *H. ornatus* specimen to *Lap. curtus*. I also pointed out the presence of a number of external character states exclusively shared between the two species, such as the relatively stout body, absence of transverse dark bands on the ventral surface of body (so making the body annuli incomplete), and marked development of spinose tubercles on scales covering the lateroventral surface of posterior body (Smith, 1926;

Maki, 1931; Nakamura and Uéno, 1963). Dr. Mishima admitted that he did not clearly recognize *H. ornatus* and that the identification error might have been the case.

Figure 3. Fresh specimens of *Lapemis curtus* from Malaysia (above) and *Hydrophis ornatus* from Okinawajima Island (below). Courtesy of Gen Masunaga.

DISCUSSION

It is obvious from their external characteristics as described above that the original identifications of both of those two KPM specimens are erroneous. The specimen identified as *Lat. colubrina* (REO-158) is actually distinct from the species in having no more than two prefrontal shields, 19 rows of scales almost throughout the body, uniformly dark supralabial region, and dark body bands distinctly broader than the neighboring much lighter interspaces: In *Lat. colubrina*, prefrontal shields are usually three; dorsal scale rows usually alter between 21 and 25 in most portion of body; supralabial region is light yellow, being prominent against much darker surrounding regions; and dark body bands are distinctly narrower than the neighboring light interspaces (Stejneger, 1907; Smith, 1926; Maki, 1931; Nakamura and Uéno, 1963; McCarthy, 1986; Ota et al., 1985, 1986). All these and most other character states in this specimen (e.g., undivided rostral; lack of a ventromedial keel throughout the body; and formation of complete annulus by each dark body band) strongly suggest its affinity to *Lat. laticaudata* (also see Cogger et al. [1987]). Indeed, Kodakarajima Island of the southern Tokara Island Group is known to have some nesting sites of *Lat. laticaudata* and *Lat. semifasciata* (Ota, 1995; Ota and Okada, 2003). As *Lat. laticaudata*, however, the specimen exhibits an extraordinarily huge body size (1403 ㎜ in total length), because the total length of the species is usually smaller than 1100 ㎜ : in this character, REO-158 resembles *Lat. colubrina*, whose total length reaches close to (and sometimes even exceeds) 1400 ㎜ (e.g., Smith, 1926; Ota et al., 1985). Further detailed studies, those using molecular data in particular, may reveal the presence of cryptic species in *Lat. laticaudata* sensu lato that show prominent divergence from each other in body size, as in the case of *Lat. colubrina* sensu lato (Cogger and Heatwole, 2006; Lane and Shine, 2011).

The KPM specimen originally identified and labeled as *Lap. hardwickii* (=*Lap. curtus*: RE 981-03) is also distinct from the species in reality in having an elongate body (1264 ㎜ in total length), as well as more ventrals (318) that are minute but still discernible from scales in adjacent rows, more subcaudals (44), and dark body bands, each of which, though much narrower ventrally, forms a complete annulus: *Lap. curtus* has a more stout, shorter body (ca 600-110 ㎜), 114-230 ventrals that are almost indiscernible from adjacent body scales, 24-42 subcaudals, and dark body bands, each of which usually extends only to the ventrolateral region on each side of the body (thus failing to form a complete annulus) (Smith, 1926; Gritis and Voris, 1990; Rassmussen et al. 2011). All these and other characters suggest that RE 981-03 actually belongs to *Hydrophis melanocephalus* or *H. cyanocinctus*. Because all attempts to morphologically convincingly discriminate the latter two species from East Asia have failed to the present (Ota et al., 2008), further comparative studies using morphological and molecular data are needed to determine the specific allocation of RE 981-03 with certainty.

Careful examinations of the two sea snake specimens of KPM, as well as the interviews to Dr. Shogi Mishima and surveys of East Asian sea snake specimens in the Japan Snake Institute and several other institutes having natural history collections from Japan (e.g., National

Science Museum Tokyo, Osaka Museum of Natural History, and Okinawa Prefectural Museum), have failed to bring even a single voucher or any other objective evidence to support the occurrence of *Lat. colubrina* in the central Ryukyus including the Amami Group or of *Lap. curtus* in any part of the Japanese territory. We thus tentatively assume that Mishima's (1961, 1965) records of two *Lat. colubrina* and a single *Lap. curtus* from Amamioshima Island were, respectively, derived from error in identification or assignment of worng sampling labels, and from erroneous identification of a specimen which actually represented an Amami population of *Hydrophis ornatus*. Additional vouchers or concrete, supportive evidence of other kinds are definitely needed for recognition of *Lat. colubrina* and *Lap. curtus* as elements of the central Ryukyu and whole Japanese sea snake faunas, respectively.

ACKNOWLEDGMENTS

We thank Dr. Shogi Mishima for responding to each of our queries in good earnest. Without his thoughtful cooperation, nothing could have been progressed on this subject. We are also much indebted to Mr. Hajime Moriguchi for his help in searching for *Lat. colubrina* specimens from Amamioshima Island at the Japan Snake Institute, to Mr. Yasuhiko Shibata for provision of pertinent literature and information regarding the current contact of Dr. Mishima, to the curatorial staff of National Science Museum Tokyo (Dr. Hideki Endo [former] and Dr. Shin-ichiro Kawada), Osaka Museum of Natural History (Mr. Yasuhiko Shibata [former] and Dr. Kiyotaka Hatooka), and Okinawa Prefectural Museum (Mr. Masanao Toyama [former], Mr. Yoshinori Chigira [former], and Mr. Satoshi Tanaka) for permitting us to survey for sea snake specimens in reptile collections in their care, and to Dr. Mamoru Toda and Dr. Gen Masunaga for pertinent, insightful discussion throughout this project. Dr. Masunaga also permitted us to use his color photographs for Fig. 3. Special thanks are due late Dr. Michihisa Toriba for provision of pertinent literature and also for discussion regarding the topics dealt with in this paper. We, however, declare that any error in ideas and conclusions given in this paper, when present, is solely of our own responsibility.

This research was supported in part by grants-in-aid from the Ministry of Education, Culture, Sports, Science, and Technology, Japan (C-18570090 and 21570098)

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