Bycatch records of sea turtles obtained through Japanese Observer Program in the IOTC Convention Area

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Abstract

This document overviewed sea turtle bycatch occurred in the IOTC Convention Area obtained through Japanese Observer Program. The fishing areas covered in IOTC and CCSBT from 2010 to 2015 and 1992 and 2015, respectively. In total, 28 and 4 million hooks were observed by on-board observers for shallower-set and deeper-set longlines, respectively. Geographical distribution of bycatch changed not only among set types but also among species. Olive ridley occurred the most frequently in the bycatch data, followed by loggerhead and leatherback. There were no observations of green, hawksbill and flatback turtle in those data. Almost all the loggerheads were by-caught around the South African waters by shallower-sets. No olive ridley was caught in the south of 20^{o} S. Leatherbacks were caught around South African and equatorial waters by both set types. Bycatch rate (per 1,000 hooks) of shallower-sets for leatherback, loggerhead, olive ridley, and unidentified turtle were 0.00009, 0.0003, 0, and 0.0001, respectively. Mean bycatch rate of deeper-sets were 0.001, 0.0003, 0.011, and 0.012 for leatherback, loggerhead, olive ridley, and unidentified turtle, respectively.

Introduction

In the Indian Ocean Tuna Commission (IOTC) Convention Area, there are six sea turtle species, leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), olive ridley (*Lepidochelys olivacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and flatback turtle (*Natator depressus*). The distribution of their nesting sites has relatively been revealed well as the results of the increase of research efforts. On the other hand, it is still unclear about the distributional range in pelagic ocean, especially in the Indian Ocean, where some species spend greater part of their life time. The distributional range of the sea turtle species will be revealed by accumulation of geolocational records by satellite tracking or fishing activities. In addition, some modelling approaches for species distribution, such as Ocean Circulation Modelling or Species Distribution Modelling, are also developed and applied to predict the animal distribution (e.g. González Carman et al. 2016; Putman et al. 2013). However, even though the modelling approaches make substantial progress, accuracy of

estimation will not increase unless the occurrence record of sea turtle is accumulated.

In this paper, we compiled bycatch records of sea turtles to provide the distributional information obtained through the Japanese scientific observer program for pelagic longline fisheries operated in the IOTC Convention Area.

Materials and methods

Observer data including information on operation and sea turtle bycatch number were collected through the Japanese Observer Program for distant water longliners conducted in the IOTC and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) Convention Areas. This study covered the observer data in IOTC and CCSBT from 2010 to 2015 and 1992 and 2015, respectively.

The set-by-set operational data were aggregated by quarter (season) and by 5^{o} x 5 ^{o} degree in latitude and longitude. Quarters 1 to 4 correspond to January-March, April-June, July-September and August-December. We categorized each operation into the following two groups accordance with number of hook per basket: shallower and deeper sets for 6 to 13 and 14 and more, respectively. The shallower and deeper sets, subject to targeted tuna species in general, target southern Bluefin or yellowfin and bigeye, respectively.

The on-board observers recorded interactions of sea turtles. They took pictures of them and measured straight carapace length (SCL) to the nearest millimeter by caliper as far as possible. Bycatch rate was calculated as by number of sea turtle bycatch per 1,000 hooks.

Results

In total, 28 and 4 million hooks were observed by the on-board observers through 11 thousand and 1.7 thousand operations for the shallower-set and deeper-set longlines. The shallower-set operations were mainly distributed in the south of 20^{o} S, whereas the deeper-sets were operated mainly in the north of 20^{o} S (Figure 1). The shallower-sets were mostly operated from Q2 to Q4, meanwhile the deeper-set was mainly operated in Q1, Q3, and Q4.

There were apparent differences in distribution of bycatch not only among set types but also species (Figure 2). Olive ridley was the most frequently occurred in the bycatch data, followed by loggerhead and leatherback. Green, hawksbill and flatback turtles were not observed. All the loggerheads except for one of putative hybrid turtles were caught around the waters off South Africa by shallower-set (Figure 2). No olive ridley was caught in the south of 20^{o} S by shallower-set. Leatherbacks were caught off South Africa and equatorial waters by both set types.

Most of loggerheads were caught in Q2 and Q3, meanwhile leatherbacks were caught in Q1 and Q4 in shallower-set fisheries (Figures 3 and 4). In deeper-sets, olive ridleys, leatherbacks, and unidentified turtles were caught year-round except for Q2 which is low season of fishing (Figures 5–7).

Simple arithmetic averages of bycatch rate of shallower-sets for leatherback, loggerhead, olive ridley, and unidentified turtle were 0.00009, 0.0003, 0, and 0.0001, respectively. Mean bycatch rate of deeper-sets were 0.001, 0.0003, 0.011, and 0.012 for leatherback, loggerhead, olive ridley, and unidentified turtle, respectively.

The mean SCL (size range of SCL and number of individuals were shown in a parenthesis) were 57.1 cm (42–77 cm, n=8), 48.3 cm (31–66 cm, n=48), 79.5 cm (59–120 cm, n=4), 47.3 cm (41–58 cm, n=25) for loggerhead, olive ridley, leatherback, and unidentified species, respectively. The size distributions of each species were shown in Figures 8 and 9.

Discussion

In the IOTC Convention Area, Huang et al. (2016) reported incidental catch of sea turtles by Taiwanese longline fisheries. The fishing efforts of Taiwanese large scale longline fisheries in tropical area distributed more north-west than that of our study. Olive ridley was the most frequent species of sea turtle bycatch by the Taiwanese fisheries, in common with our results. The results from the present and previous (Taiwanese) studies indicated that olive ridley showed wide distribution in the tropical Indian Ocean. Green and hawksbill turtles were occurred in the Taiwanese study, whereas there were no bycatch data of these two species in this study. It was inferred that presence/absence of these two species could be derived by the differences in fishing areas among the two fleets, because the Taiwanese longliners tended to operate closer to coastal area than the Japanese ones.

The bycatch rates for all species of Japanese longliners operated in the IOTC Convention Area obtained in this study, especially loggerhead, were much lower than that of the other ocean basin, which were recorded 0.104 in NE Atlantic, 0.02 in SE Atlantic (Petersen et al. 2009), 0.07 in tropical Atlantic and 0.39 to 1.78 in SW Atlantic (Pons et al. 2010). The number of loggerhead nesting population in SW Indian, which is estimated from 300 to 500 nesting females per year (Baldwin et al. 2003), is much lower than that of NW (around 70,000 nests per year; Ehrhart et al. 2003), NE (more than 1,000 nesting females per year; Ehrhart et al. 2003), and SW Atlantic (4,000 nests per year in SW Atlantic; Marcovaldi 2005).

In addition, not so small number of unidentified turtles were included to our data. It is expected to be reduced the unidentified individuals in future to obtain a better knowledge of sea turtles and to be discussed about the features of occurrence in the Indian Ocean.

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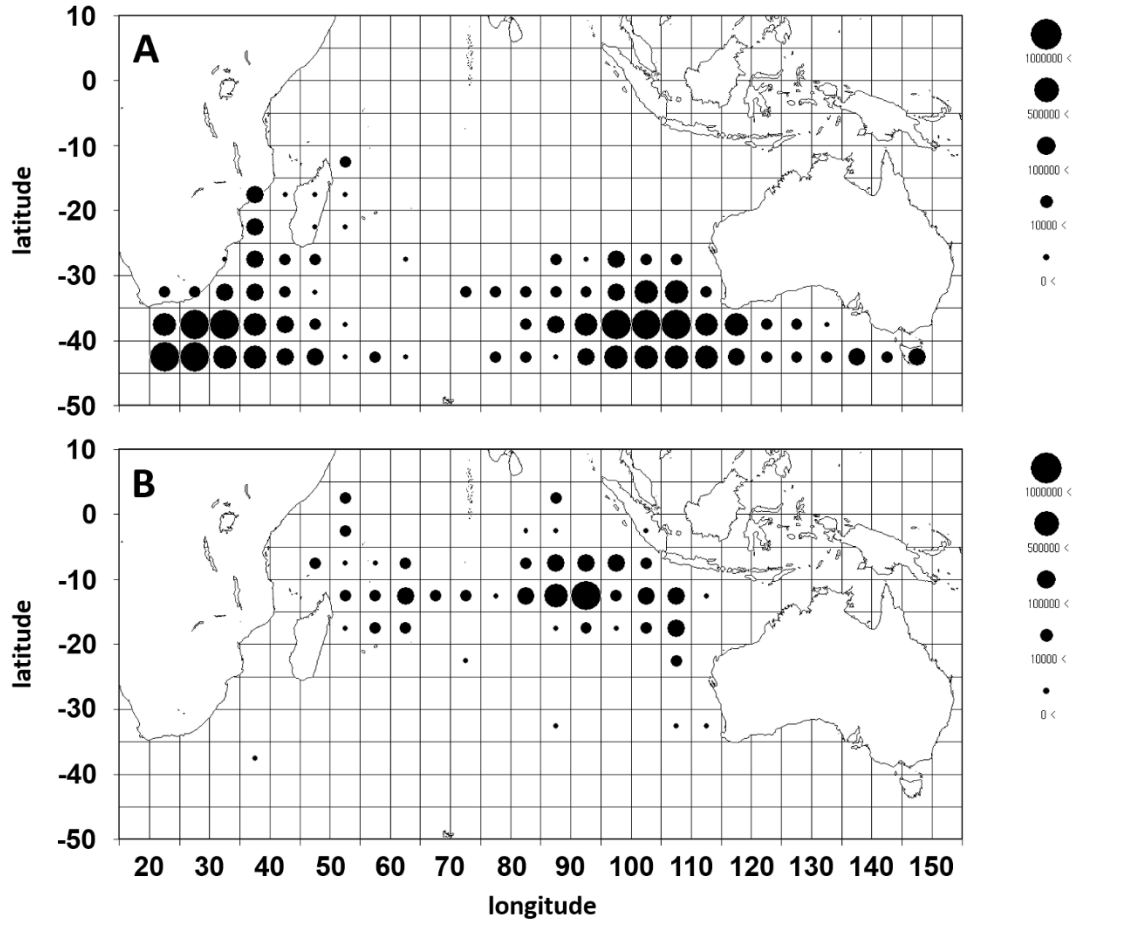

Figure 1. The distributions of fishing operations observed in the IOTC Convention Area, which were covered in IOTC and CCSBT from 2010 to 2015 and 1992 and 2015, respectively. Map A shows the distribution of shallower-set fisheries and map B shows that of deeper-sets. The filled circles mean the number of hooks observed.

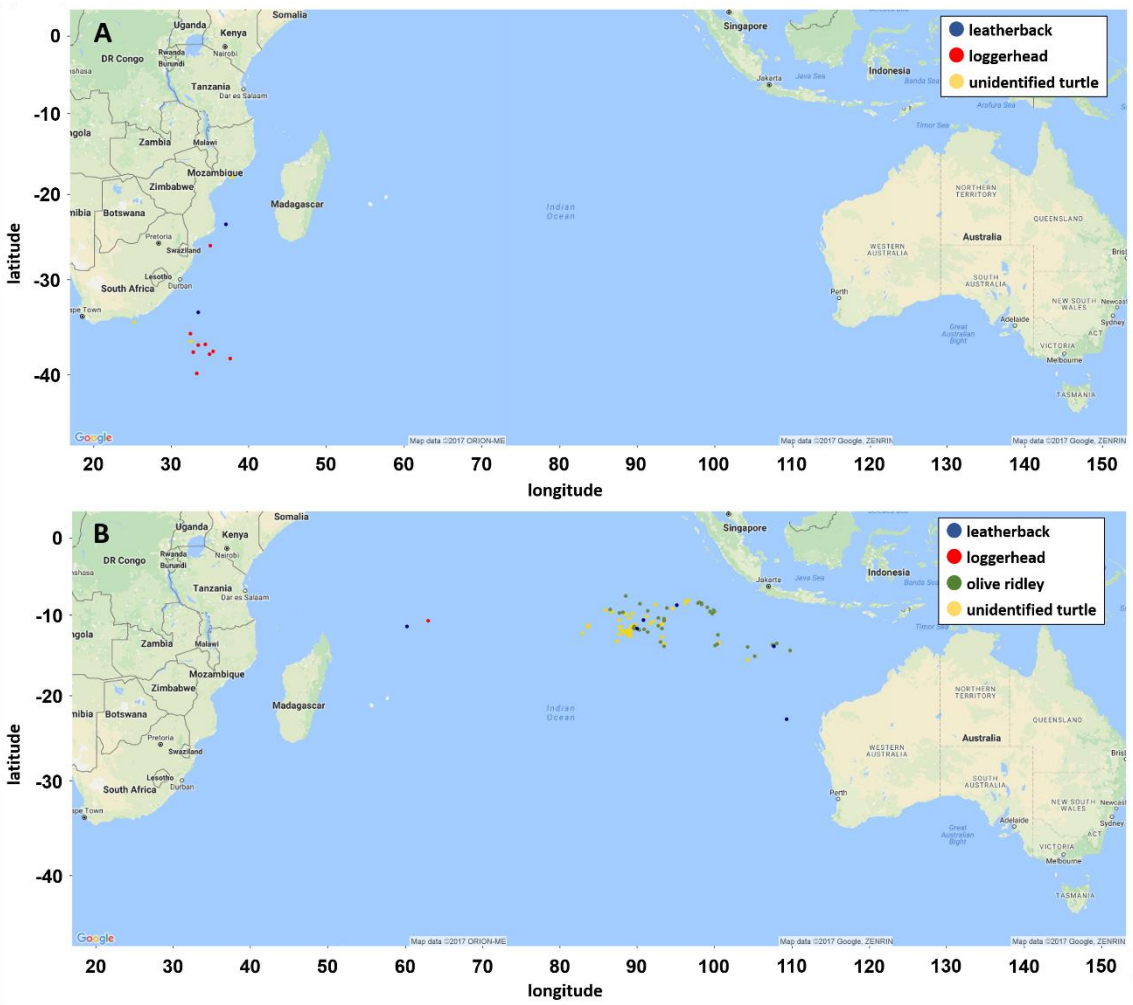

Figure 2. Distribution of bycatch by each sea turtle species for shallower-set (A) and deeper-set (B) fisheries.

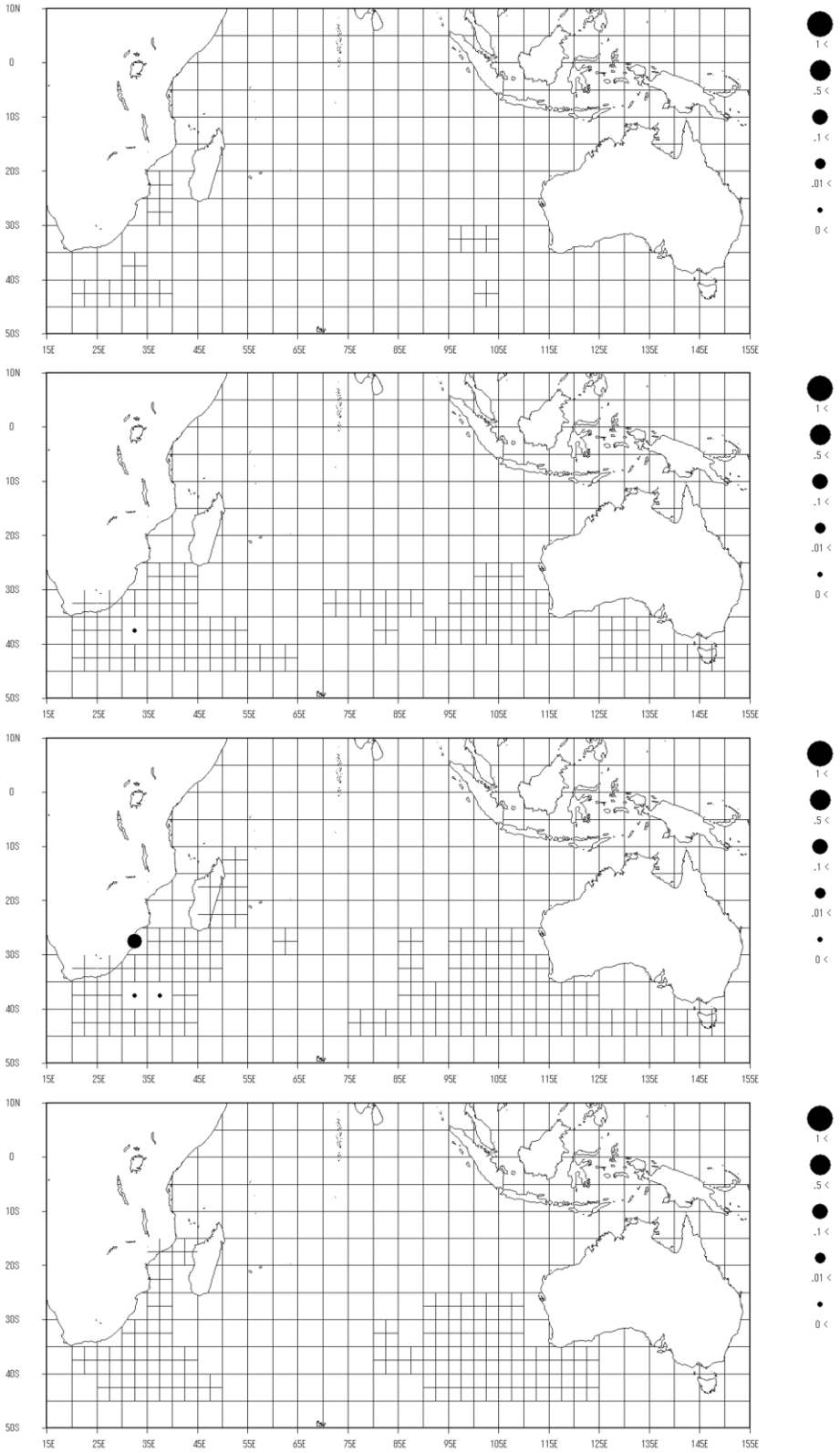

Figure 3. Distributional maps of bycatch rates of loggerhead caught by shallower-sets from Q1 to Q4.

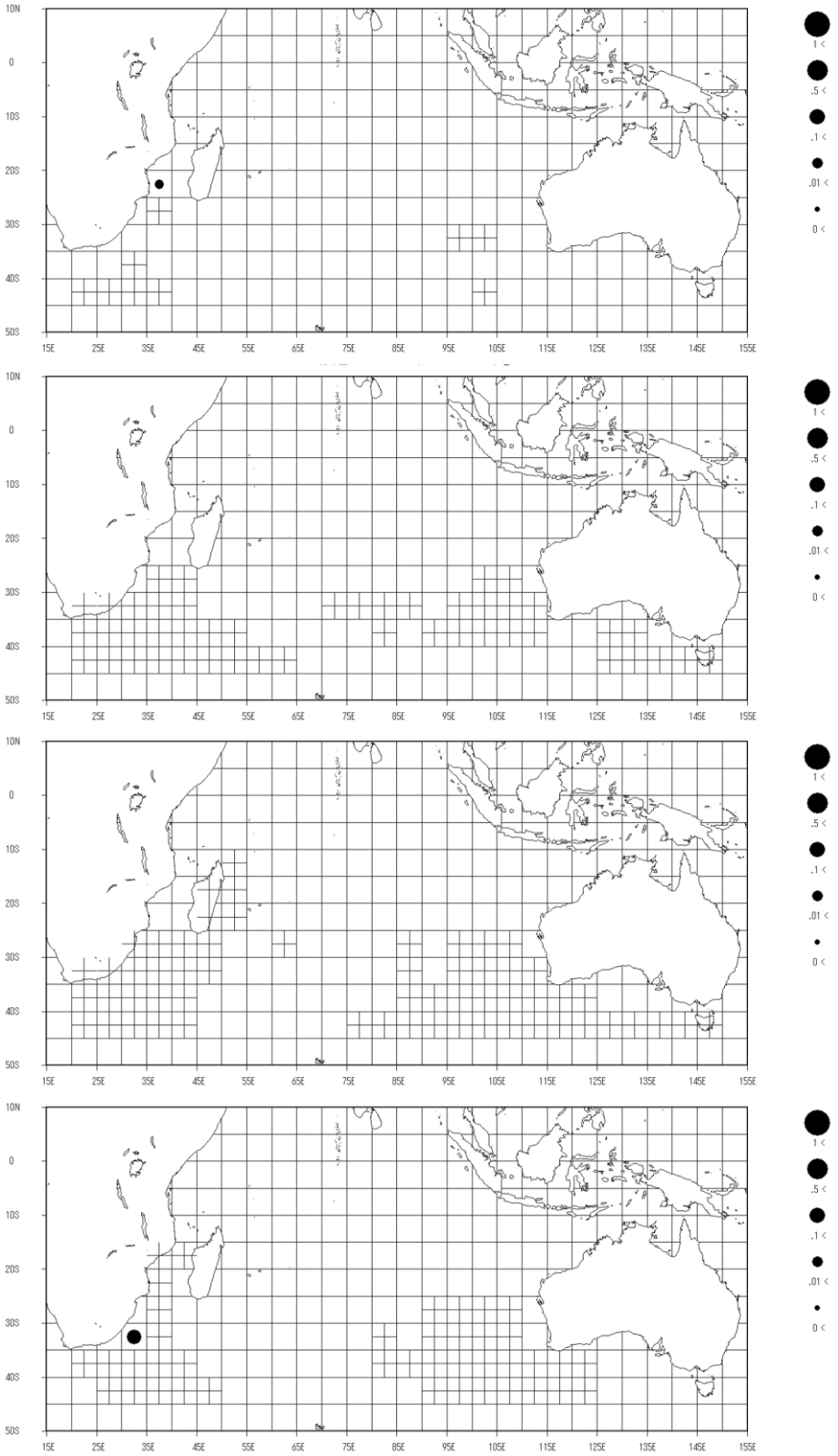

Figure 4. Distributional maps of bycatch rates of leatherback caught by shallower-sets from Q1 to Q4.

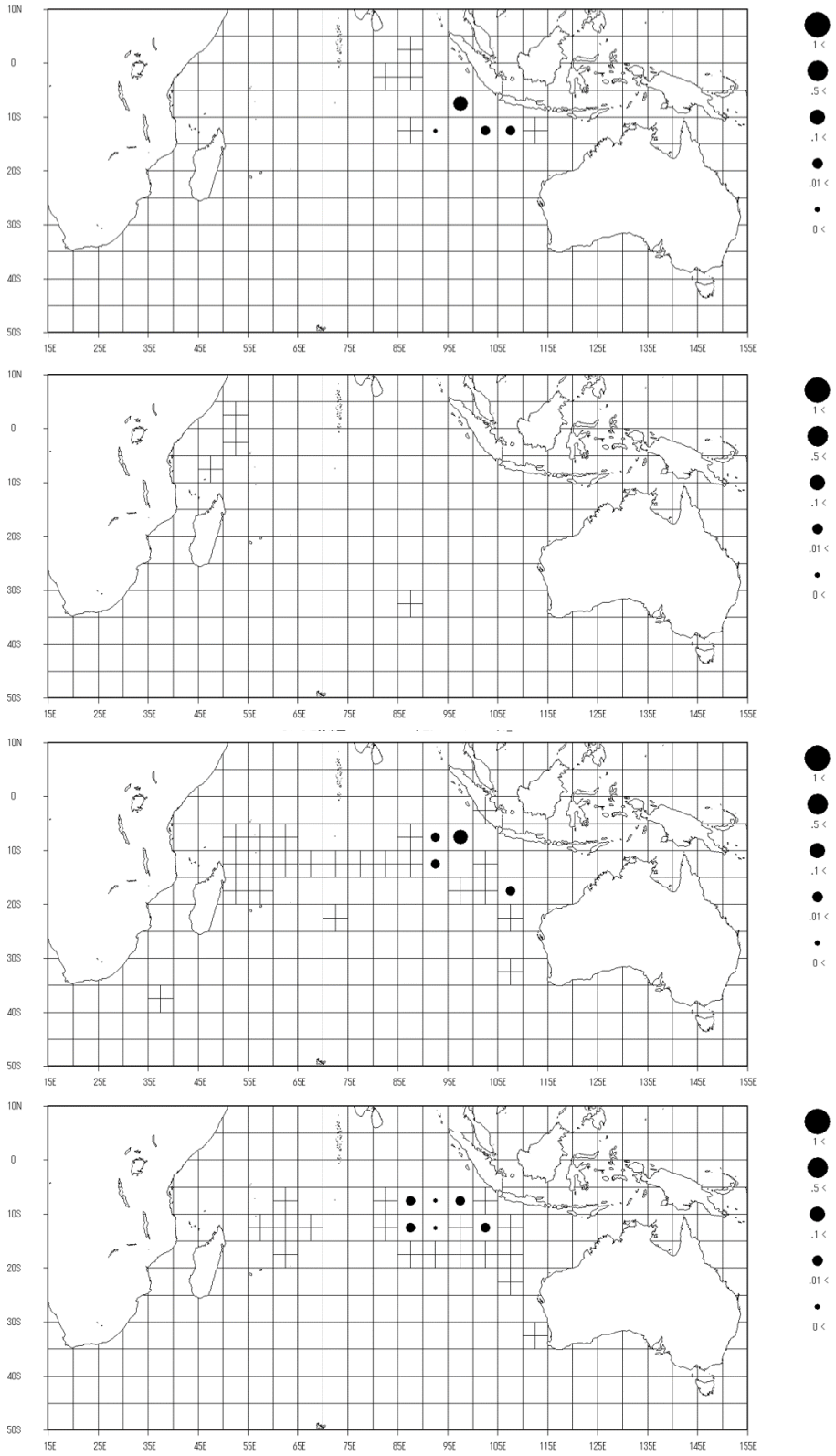

Figure 5. Distributional maps of bycatch rates of olive ridley caught by deeper-sets from Q1 to Q4.

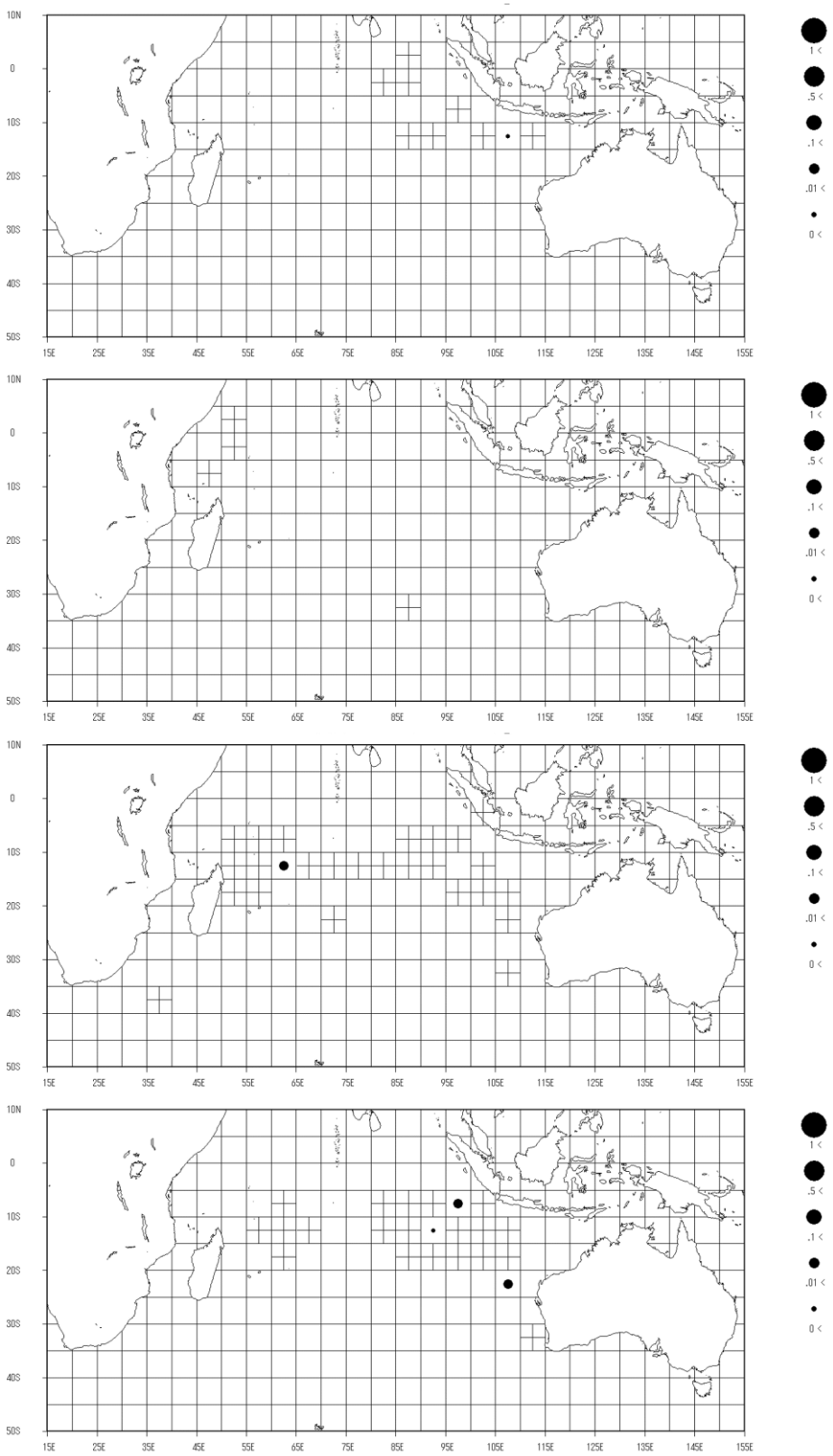

Figure 6. Distributional maps of bycatch rates of leatherback caught by deeper-sets from Q1 to Q4.

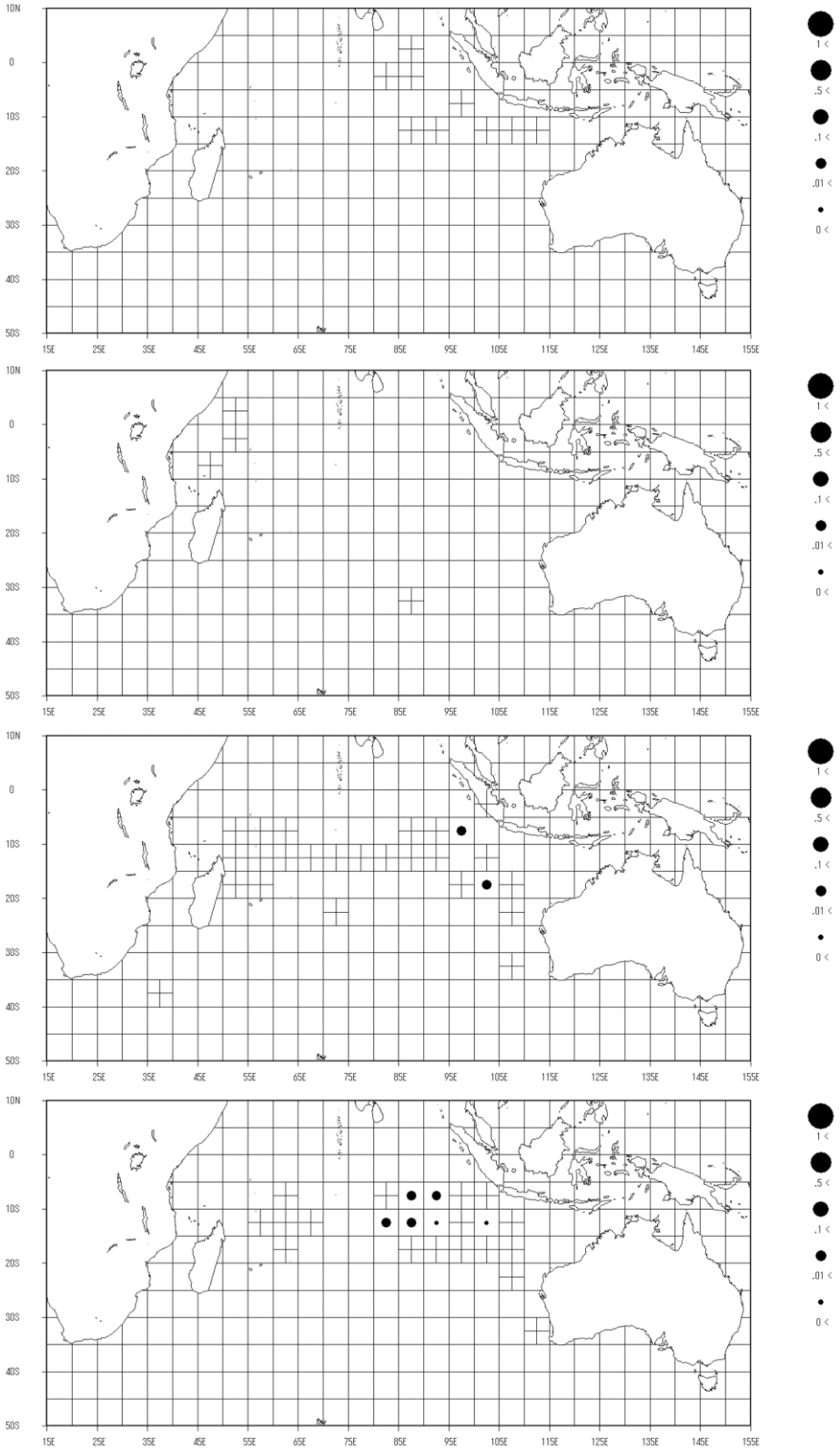

Figure 7. Distributional maps of bycatch rates of unidentified turtle caught by deeper-sets from Q1 to Q4.

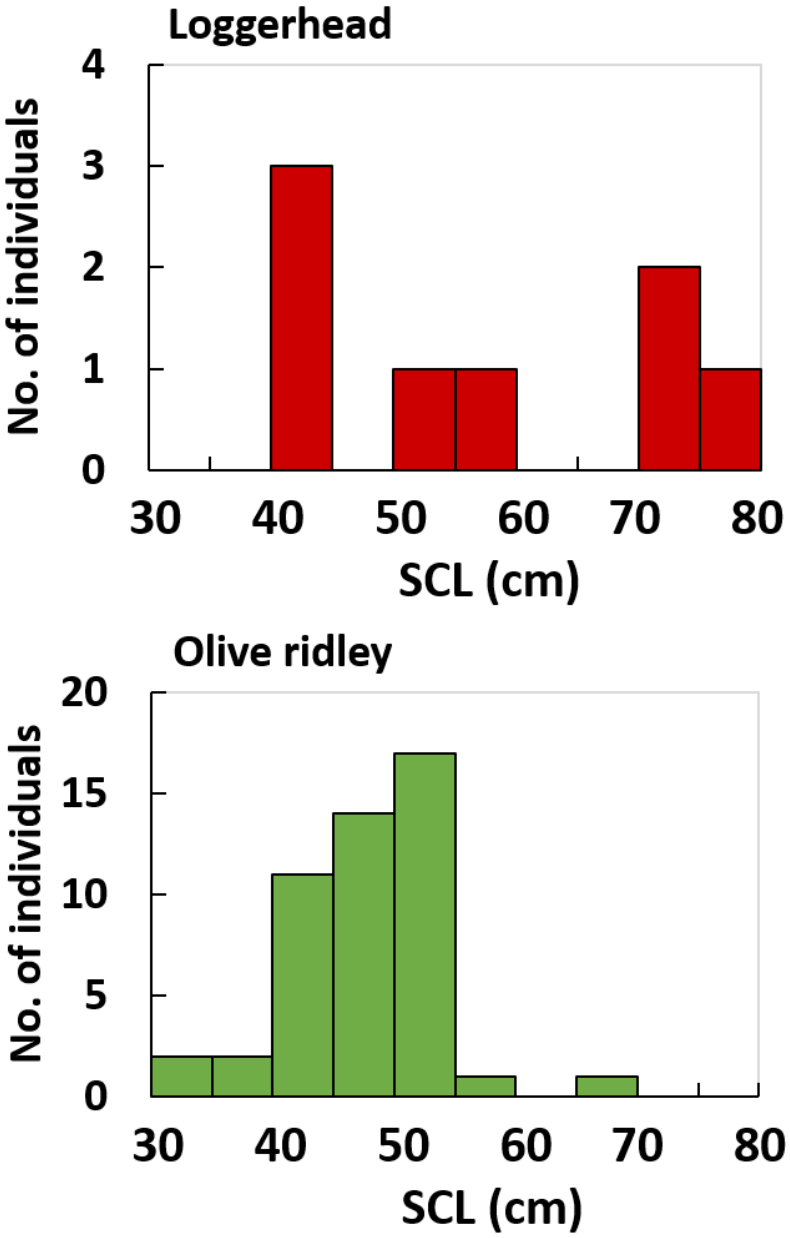

Figure 8. The size of SCL distribution of loggerhead and olive ridley.

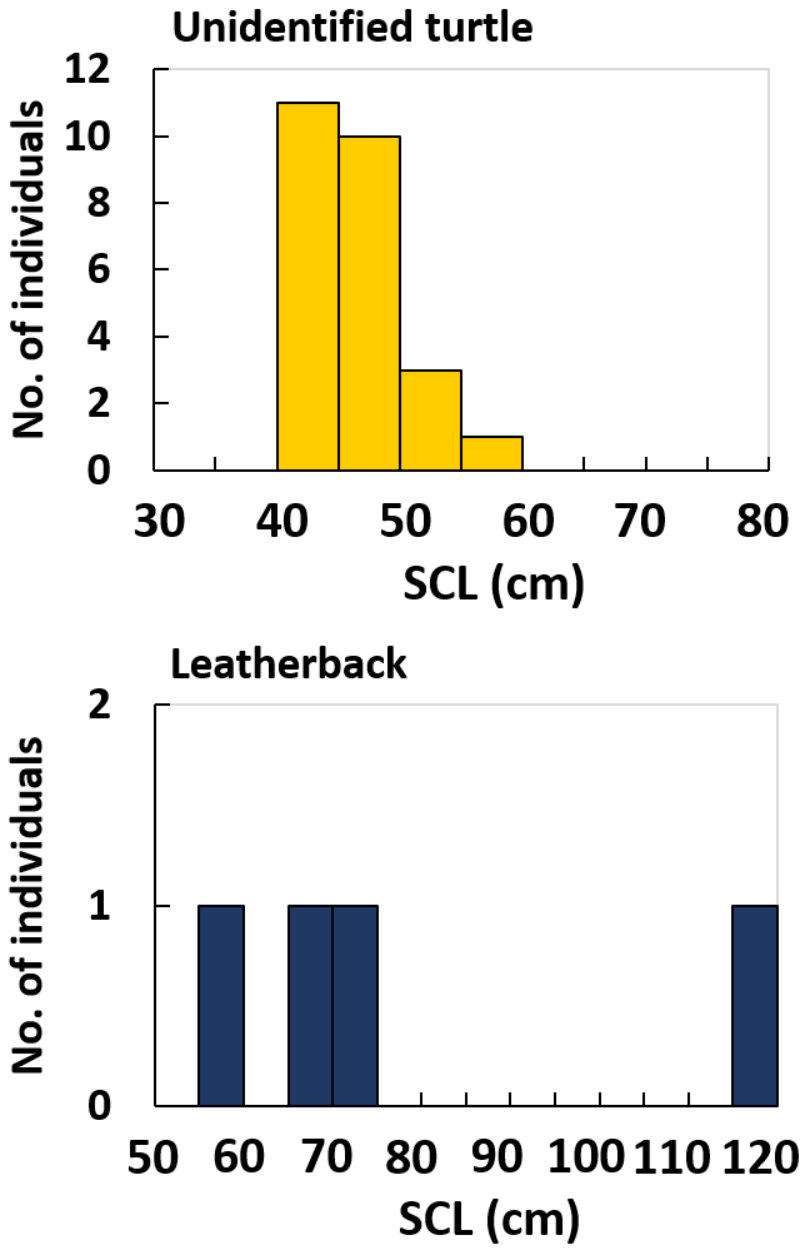

Figure 9. The size of SCL distribution of unidentified turtle and leatherback.