

IDENTIFICATION OF SHARK SPECIES BY SEM OBSERVATION OF DENTICLE OF SHARK FINS

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SUMMARY

The denticles of shark fins were observed by SEM for thirteen pelagic shark species which were frequently caught Japanese longline fishery. The observations we have conducted in the present study revealed that denticles possess species specific characters, which can be useful in the identification of the species of shark fins. The finding was consistent to our previous studies which characterized these three fins according to shape and color.

RÉSUMÉ

Les denticules des ailerons de treize espèces pélagiques de requin fréquemment capturées par les palangriers japonais ont été examinés par SEM. Les observations effectuées dans la présente étude ont révélé que les denticules possèdent des caractéristiques spécifiques de l'espèce qui peuvent s'avérer utiles pour l'identification de l'espèce à laquelle correspondent les ailerons. Les résultats concordaient avec nos études antérieures qui identifiaient ces trois types d'aileron selon la forme et la couleur.

RESUMEN

Se observaron por SEM los dentículos de las aletas trece especies de tiburones pelágicos capturadas frecuentemente por la pesquería de palangre pelágico japonesa. Las observaciones efectuadas en el presente estudio revelaron que los dentículos poseen características específicas de las especies, que pueden ser útiles a la hora de identificar las especies a las que pertenecen las aletas de los tiburones. Este descubrimiento concuerda con nuestros anteriores estudios que caracterizaban estas tres aletas según su forma y color.

KEYWORDS

Fish biology, Identification keys, Shark fin, Pelagic sharks

1. INTRODUCTION

The dorsal, pectoral and caudal fins of sharks captured by longline, drift net and purse seine fisheries are used as raw materials of the expensive shark fin delicacies and these are being traded at high value not only among East Asian countries but worldwide. FAO reported that the worldwide

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shark fin export amounted to almost 3,000 - 6,000 ton while import reached 2,000 - 7,000 ton during the period between 1990 and 1997 (FAO 1999). However, the species of shark fin have not been recorded and trading data are obtained only name of shark fins, dried and salted or unsalted. In Japan, identification of the species of shark fin was difficult because fishermen cut and dry the fin on the fishing boat then sell it directly to shark fin dealers.

In order to establish a method for identifying shark species from fins, we conducted SEM (Scanning electron microscope) observation of denticles (scales of elasmobranchs) sampled from fins of 13 pelagic shark species.

2. MATERIALS AND METHODS

The location of denticles, common and scientific names of the 13 species examined are shown in Table 1. One to two cm-square skin samples were cut off from the center or base of the first dorsal, pectoral and lower lobe of caudal fins, and used for observation of denticles.

The materials were scales that were extracted from frozen or dried fin. These were fixed and maintained ethanol after the ultrasonic washing. Then, dehydrated through a graded series of ethanol, permuted butanol, and freeze dried. Finally, the materials were coated with gold, by ion sputtering, and observed by the SEM Topcon ABT-55.

3. RESULTS

3.1 Salmon shark (*Lamna ditropis*): Plates 1 and 2

The denticles are densely distributed, and slightly overlap each other along the anterior and lateral margins. There are three or five crests on the surface, and symmetric with the central crest. On the lower lobe, a posterior margin of denticle is "W" shape (Plate 1), while relatively smooth at the first dorsal fin (Plate 2). Denticle shape is a diamond or an ellipsoid with longer vertical width than horizontal.

3.2 Shortfin mako (*Isurus oxyrinchus*): Plates 3 and 4

The denticles are densely distributed, and slightly overlap each other along the anterior and lateral margins. Many denticles have three crests and some denticles show protuberant lateral margins. The posterior margin is smoothly "V" shape. The denticles on the dorsal (Plate 3) and pectoral fins are comparatively bigger than those in the caudal fin (Plate 4). Denticles shape is an ellipsoid with longer horizontal width than vertical.

3.3 Longfin mako (*Isurus paucus*): Plates 5 and 6

The denticles are densely distributed, and slightly overlap each other along the anterior and lateral margins. Many denticles have three crests but some denticles of the pectoral fin have 5 crests (Plate 5). The posterior margin is slightly "W" shape (Plate 6). The denticle shape is a diamond or an ellipsoid with longer vertical width than horizontal.

3.4 Pelagic thresher (*Alopias pelagicus*): Plates 7 and 8

The denticles are sparsely distributed and with few overlappings. Therefore, each denticles forms a solitary unit. The central crest is distinct and other crests are on both sides. A posterior margin is

apparently "W" shape while only a part of the central crest of anterior margin is projected. The denticle shows longer horizontal width than vertical, resembling a flying bird.

3.5 Bigeye thresher (*Alopias superciliosus*): Plates 9, 10 and 11

The denticles are sparsely distributed and are in arrays (Plate 9 and 10). The denticles of small shark form solitary units, and the central crest is distinct while the other two crests are indistinct (Plate 11). The larger shark has denticles with three distinct crests, and only a part of the the central crest of anterior margin was projected. The denticle is an ellipsoid with longer horizontal width than vertical.

3.6 Thresher shark (*Alopias vulpinus*): Plate 12

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. Therefore five crests and the posterior margin is apparently "W" shape (Plate 12). The denticle is a diamond with slightly longer horizontal width than vertical.

3.7 Silky shark (*Carcharhinus falciformis*): Plate 13

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. There are five or seven crests, and posterior margin is smoothly "V" shape (Plate 13). The denticle is diamond in shape.

3.8 Oceanic whitetip shark (*Carcharhinus longimanus*): Plate 14

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. There are five crests, although some denticles have two more indistinct crests at the outer sides (Plate 14). The relatively smooth posterior margin of denticles is pointed at the central crest. The denticle is an ellipsoid with longer vertical width than horizontal.

3.9 Dusky shark (*Carcharhinus obscurus*): Plates 15 and 16

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. Denticles have five crests but the outer two crests are indistinct (Plate 15). The posterior margin is apparently "W" shape (Plate 16). The denticle is an ellipsoid with longer vertical width than horizontal.

3.10 Blue shark (*Prionace glauca*): Plate 17

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. There are 3 crests but some denticles have two more indistinct crests at the outer sides (Plate 14). The posterior margin is smoothly "V" shape. The denticle is a diamond or an ellipsoid with longer vertical width than horizontal.

3.11 Scalloped hammerhead (*Sphyrna lewini*): Plate 18

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. The denticles have five crests that are apparent from the anterior margin to the posterior margin (Plate 18). The posterior margin is "W" shape. The denticle is diamond in shape.

3.12 Great hammerhead (*Sphyrna mokarran*): Plate 19

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. There are 3 crests but some denticles have two more indistinct crests at the outer sides (Plate 19). The posterior margin is apparently "W" shape. The denticle is a diamond with longer vertical width than horizontal.

3.13 Smooth hammerhead (*Sphyrna zygaena*): Plate 20

The denticles are densely distributed, and overlap each other along the anterior and lateral margins. The three or only one crests are from the center to the posterior margin of denticles (Plate 20). The posterior margin is apparently "W" shape while the anterior margin is a semicircle.

4. DISCUSSION

In this study, we surveyed the crests, posterior margin and shape of the denticles on 13 pelagic sharks that were traded as shark fin mainly in Japan. As a result, the denticles of 13 species are classified into followed seven categories by morphological characters.

(1) Pelagic thresher

The denticles are sparsely distributed.
The posterior margin is apparently "W" shape.
Denticle shows resembling a flying bird.

(2) Bigeye thresher

The denticles are sparsely distributed and are in arrays.
There are 3 crests.
The horizontal length is two times longer than vertical length.
The denticle is an ellipsoid.

(3) Smooth hammerhead

The denticles are densely distributed.
The three crests are from the center to posterior margin.
The posterior margin is apparently "W" shape.

(4) Oceanic whitetip shark

The denticles are densely distributed.
The denticles have five or seven crests.
The relatively smooth posterior margin of denticles is pointed at central crest.
The denticle is an ellipsoid with longer vertical width.

(5) Shortfin mako, Silky shark and Blue shark

The denticles are densely distributed.
The posterior margin is smoothly "V" shape.
The denticles have five or seven crests.
The denticle is a diamond.

(6) Salmon shark, Longfin mako and Dusky shark

The denticles are densely distributed.

The posterior margin is slightly "W" shape.

The denticles have 3 - 7 crests.

The denticle is an ellipsoid with longer vertical width.

(7) Thresher shark, Scalloped hammerhead and Great hammerhead

The denticles are densely distributed.

The posterior margin is apparently "W" shape.

The denticles have 5 - 7 crests.

The denticle is a diamond.

The categories (1) to (4) above-mentioned were constructed by only one species, therefore these species were discriminated easily by observation of denticles. Furthermore, the categories (5), (6) and (7) included various species but it is possible that the each species were identified by detailed survey of denticles (e.g. pattern of surface, whole shape and state of crests).

In bigeye thresher and blue shark, the variation in denticles were not confirmed between small and large sharks. However, variation of denticles due to growth should be investigated about other species.

On the other hand, some size variation of part of fins, first dorsal fin, pectoral fin and lower lobe of caudal fin, are observed. The variation of denticles, due to growth and also to habitats, should be investigated by collecting more specimens.

We have previously reported the identification method for shark fin from its morphological characters (Matunaga *et al.* 1998, Nakano and Kitamura 1999). The observations we have conducted in the present study revealed that denticles possess species specific characters, which can be useful in the identification of the species of shark fins. The finding was consistent to our previous studies which characterized these three fins according to shape and color.

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6. REFERENCES

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Table 1: Species name, scientific name and location of denticles used in this study

Common Name	Scientific Name	Location of denticles
Salmon shark	<i>Lamna ditropis</i>	D, C
Shortfin mako	<i>Isurus oxyrinchus</i>	D, P, C
Longfin mako	<i>Isurus paucus</i>	D, P, C
Pelagic thresher	<i>Alopias pelagicus</i>	D
Bigeye thresher	<i>Alopias superciliosus</i>	D, P, C
Thresher shark	<i>Alopias vulpinus</i>	D
Silky shark	<i>Carcharhinus falciformis</i>	D, P, C
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	C
Dusky shark	<i>Carcharhinus obscurus</i>	D, P, C
Blue shark	<i>Prionace glauca</i>	D, P, C
Scalloped hammerhead	<i>Sphyrna lewini</i>	D, P, C
Great hammerhead	<i>Sphyrna mokarran</i>	D
Smooth hammerhead	<i>Sphyrna zygaena</i>	D

* D: first dorsal fin, P: pectoral fin, C: lower lobe of caudal fin

Plate 1 to 20: The photograph of denticles by SEM

1: Salmon shark, dorsal fin; 2: Salmon shark, caudal fin; 3: Shortfin mako, dorsal fin; 4: Shortfin mako, caudal fin; 5: Longfin mako, pectoral fin; 6: Longfin mako, caudal fin; 7: Pelagic thresher, dorsal fin; 8: Pelagic thresher, caudal fin; 9: Bigeye thresher, pectoral fin; 10: Bigeye thresher, dorsal fin; 11: Bigeye thresher (small shark), pectoral fin; 12: Thresher shark, dorsal fin; 13: Silky shark, dorsal fin; 14: Oceanic whitetip shark, caudal fin; 15: Dusky shark, dorsal fin; 16: Dusky shark, pectoral fin; 17: Blue shark, caudal fin; 18: Scalloped hammerhead, dorsal fin; 19: Great hammerhead, dorsal fin; 20: Smooth hammerhead, dorsal fin

(The bar scale indicate 200 μ m.)





